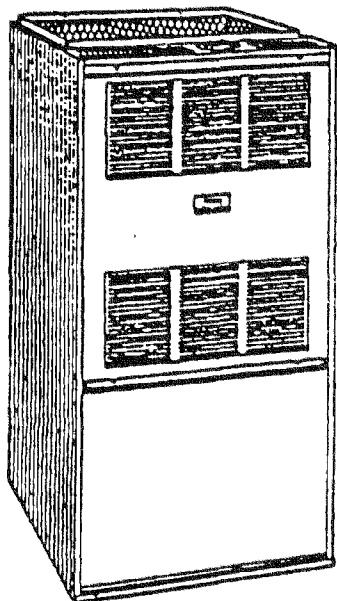


Amana



**GUI, GBI,
GCI, GSI,
MODEL
GAS FURNACES**

SERVICE INSTRUCTIONS

AMANA REFRIGERATION, INC., AMANA, IOWA 52204

**MANUFACTURING NUMBERS
COVERED IN THIS MANUAL**

SEE MODEL AND MANUFACTURING NUMBERS ON PAGE 3.

Amana
A Raytheon Company

INDEX

Important Safety Information	3
Product Identification	4 - 9
Furnace Specifications	10 - 16
Blower Performance Specifications	17 - 20
Combustion and Ventilation air	21 - 23
Venting	24 - 63
Horizontal Venting	64 - 69
Product Design	70 - 74
System Operation	75 - 79
Polarization and Phasing	80
Scheduled Maintenance	81 - 82
Servicing	83 - 97
Wiring Diagrams	98 - 111
Schematics	112 - 114

This manual, RA662001, replaces R0204614.
Rev. 1 added "X" model, low NOX furnaces.

IMPORTANT INFORMATION

Great pride and workmanship go into every 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 service technician who is familiar with the safety procedures required in the repair and who is equipped with the proper tools and testing instruments.

WARNING

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

CAUTION

IF YOU PERFORM SERVICE ON YOUR OWN 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, Caloric/Modern Maid 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.
AMANA, IOWA 52204

OR 1-319-622-5511
CALL and ask for the
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.



PRODUCT IDENTIFICATION

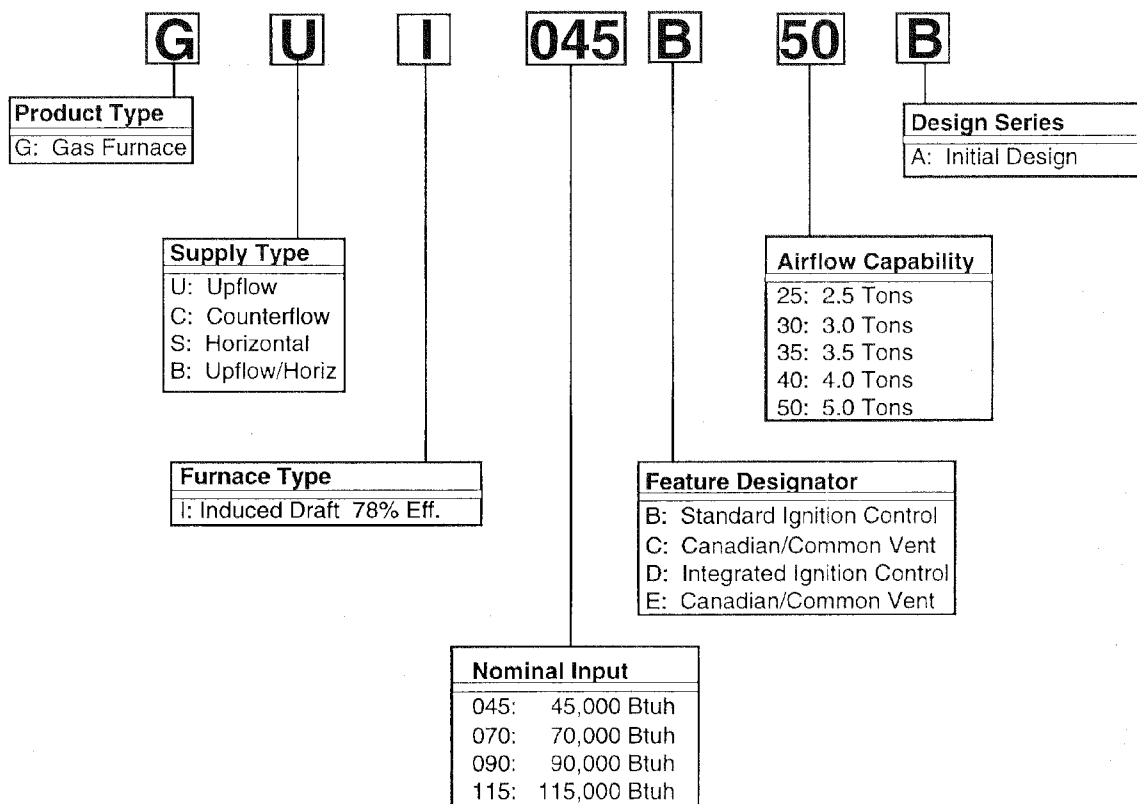
The model and manufacturing number are used for positive identification of component parts used in manufacturing. At which time engineering and manufacturing changes take place where interchangeability of components are affected, the manufacturing number will change.

It is very important to use the model and manufacturing numbers at all times when requesting service or parts information.

MODEL	M/N	MODEL	M/N	MODEL	M/N
GUI045B25A	P9898101F	GUI045C25A	P9898110F	GUI045D25A	P1159801F
GUI070B30A	P9898102F	GUI070C30A	P9898111F	GUI070D30A	P1159802F
GUI070B40A	P9898103F	GUI070C40A	P9898112F	GUI070D40A	P1159803F
GUI090B30A	P9898104F	GUI090C30A	P9898113F	GUI090D30A	P1159804F
GUI090B50A	P9898105F	GUI090C50A	P9898114F	GUI090D50A	P1159805F
GUI115B35A	P9898106F	GUI115C35A	P9898115F	GUI115D35A	P1159806F
GUI115B50A	P9898107F	GUI115C50A	P9898116F	GUI115D50A	P1159807F
GUI140B35A	P9898108F	GUI140C35A	P9898117F	GUI140D35A	P1159808F
GUI140B50A	P9898109F	GUI140C50A	P9898118F	GUI140D50A	P1159809F
GUI045B25B	P1106301F	GUI045C25B	P1106401F	GUI045E25A	P1159901F
GUI070B30B	P1106302F	GUI070C30B	P1106402F	GUI070E30A	P1159902F
GUI070B40B	P1106303F	GUI070C40B	P1106403F	GUI070E40A	P1159903F
GUI090B30B	P1106304F	GUI090C30B	P1106404F	GUI090E30A	P1159904F
GUI090B50B	P1106305F	GUI090C50B	P1106405F	GUI115E35A	P1159906F
GUI115B35B	P1106306F	GUI115C35B	P1106406F	GUI140E35A	P1159908F
GUI115B50B	P1106307F	GUI115C50B	P1106407F	GUI140E50A	P1159909F
GUI140B35B	P1106308F	GUI140C35B	P1106408F		
GUI140B50B	P1106309F	GUI140C50B	P1106409F	GUI045E25A	P1159910F
				GUI070E30A	P1159911F
GUI045B25B	P1158601F	GUI045C25B	P1158701F	GUI070E40A	P1159912F
GUI070B30B	P1158602F	GUI070C30B	P1158702F	GUI090E30A	P1159913F
GUI070B40B	P1158603F	GUI070C40B	P1158703F	GUI115E35A	P1159914F
GUI090B30B	P1158604F	GUI090C30B	P1158704F	GUI140E35A	P1159915F
GUI090B50B	P1158605F	GUI090C50B	P1158705F	GUI140E50A	P1159916F
GUI115B35B	P1158606F	GUI115C35B	P1158706F		
GUI115B50B	P1158607F	GUI115C50B	P1158707F	GUI045X25A	P1174501F
GUI140B35B	P1158608F	GUI140C35B	P1158708F	GUI070X30A	P1174502F
GUI140B50B	P1158609F	GUI140C50B	P1158709F	GUI070X40A	P1174503F
				GUI090X30A	P1174504F
GSi045B25A	P9898301F			GUI090X50A	P1174505F
GSi070B30A	P9898302F			GUI115X35A	P1174506F
GSi070B40A	P9898303F			GUI115X50A	P1174507F
GSi090B30A	P9898304F			GUI140X35A	P1174508F
GSi090B50A	P9898305F			GUI140X50A	P1174509F
GSi115B35A	P9898306F				
GSi115B50A	P9898307F				
GSi140B50A	P9898308F				
GSi045B25B	P1106701F	GSi045D25A	P1160001F	GBi045A25A	P1176901F
GSi070B30B	P1106702F	GSi070D35A	P1160002F	GBi070A30A	P1176902F
GSi070B40B	P1106703F	GSi090D30A	P1160004F	GBi070A40A	P1176903F
GSi090B30B	P1106704F	GSi090D50A	P1160005F	GBi090A30A	P1176904F
GSi090B50B	P1106705F	GSi115D35A	P1160006F	GBi090A50A	P1176905F
GSi115B35B	P1106706F	GSi115D50A	P1160007F	GBi115A35A	P1176906F
GSi115B50B	P1106707F	GSi140D50A	P1160008F	GBi115A50A	P1176907F
GSi140B50B	P1106708F	GSi070D30A	P1160009F	GBi140A50A	P1176908F
		GSi070D40A	P1160010F		

PRODUCT IDENTIFICATION

GCI045B25A	P9898201F	GCI045C25A	P9898209F	GCI045D25A	P1155301F
GCI070B30A	P9898202F	GCI070C30A	P9898210F	GCI070D35A	P1155302F
GCI070B40A	P9898203F	GCI070C40A	P9898211F	GCI090D30A	P1155304F
GCI090B30A	P9898204F	GCI090C30A	P9898212F	GCI090D50A	P1155305F
GCI090B50A	P9898205F	GCI090C50A	P9898213F	GCI115D35A	P1155306F
GCI115B35A	P9898206F	GCI115C35A	P9898214F	GCI115D50A	P1155307F
GCI115B50A	P9898207F	GCI115C50A	P9898215F	GCI140D50A	P1155308F
GCI140B50A	P9898208F	GCI140C50A	P9898216F		
				GCI045X25A	P1155309F
GCI040B25B	P1106501F	GCI045C25B	P1106601F	GCI070X35A	P1155310F
GCI070B30B	P1106502F	GCI070C30B	P1106602F	GCI090X30A	P1155311F
GCI070B40B	P1106503F	GCI070C40B	P1106603F	GCI090X50A	P1155312F
GCI090B30B	P1106504F	GCI090C30B	P1106604F	GCI115X35A	P1155313F
GCI090B50B	P1106505F	GCI090C50B	P1106605F	GCI115X50A	P1155314F
GCI115B35B	P1106506F	GCI115C35B	P1106606F	GCI140X50A	P1155315A
GCI115B50B	P1106507F	GCI115C50B	P1106607F		
GCI140B50B	P1106508F	GCI140C50B	P1106608F		



PRODUCT IDENTIFICATION

FOR YOUR SAFETY READ BEFORE OPERATING.



WARNING

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 a 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 to 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 the gas company.
- If you cannot reach the gas company, call the fire department.

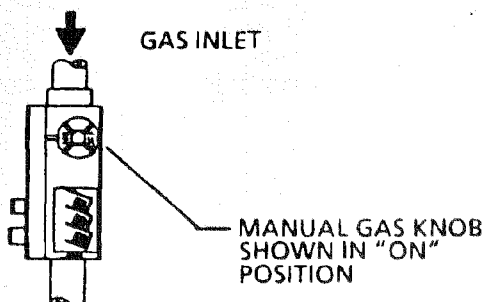
- C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

- 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 page.
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.

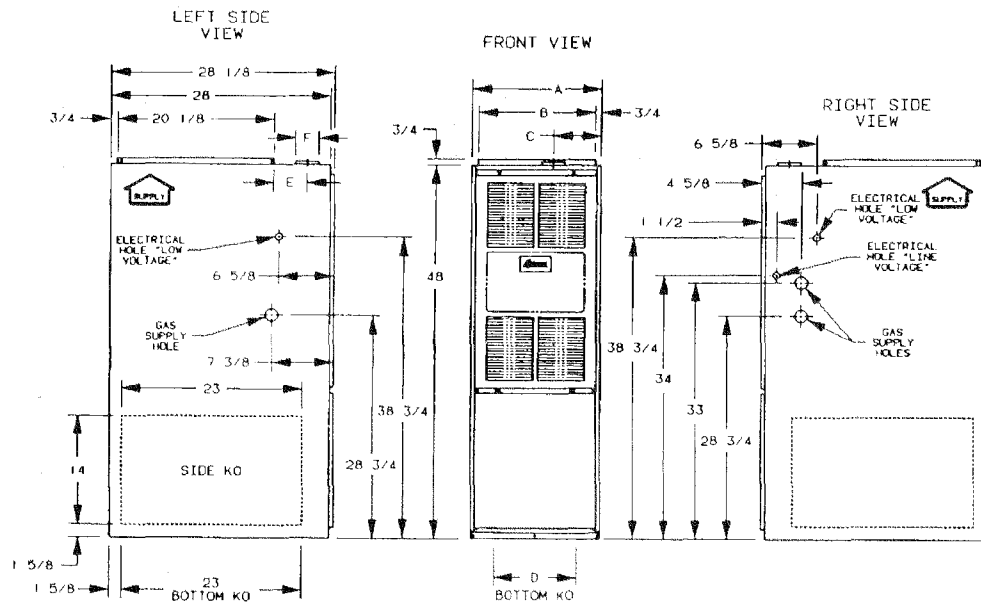


6. Wait five (5) minutes to clear out any gas. If you then smell gas, **STOP!** Follow "B" in the safety information above on this label. If you don't smell gas, go to the next step.
7. Turn gas control knob counterclockwise  to "ON".
8. Replace control access panel.
9. Turn on all electric power to 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.

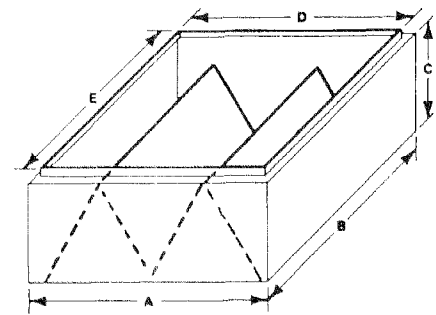
TO TURN OFF APPLIANCE

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.

PRODUCT IDENTIFICATION



UPFLOW FURNACE DIMENSIONS						
	A	B	C	D	E	F
GUI045	16 1/2	15	6 1/8	10 1/2	2 5/16	3
GUI070	20 1/2	15	6 1/8	10 1/2	2 5/16	3
GUI090	24 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 Filter Cabinet

CLEARANCES TO COMBUSTIBLE SURFACES GUI & GCI MODEL FURNACES

	UPFLOW	COUNTERFLOW
FRONT	6	6
LEFT SIDE	1	1
RIGHT SIDE	2**	6*
REAR	0	0
TOP	1	0
FLUE	6	6*
FLOOR	C	NC***

C = COMBUSTIBLE FLOOR (WOOD ONLY)

NC = NON-COMBUSTIBLE FLOOR

* = MAY BE COMBUSTIBLE (WOOD ONLY) WITH SPECIAL SUBBASE

** = 2" CLEARANCE FOR GUI045 & GUI070 ONLY (MAY BE 1" WHEN TYPE B VENT IS USED.) ALL OTHERS MAY BE 1".

*** = MAY BE COMBUSTIBLE (WOOD ONLY) WITH SPECIAL SUBBASE NO. CFSB16,20, OR 24

COUNTERFLOW FILTER CABINET						
FILTER KIT	USED ON MODEL	A	B	C	D	E
CFC16	GCI045, 070	15 1/8	20 1/2	9 1/2	13 5/8	18 5/16
CFC20	GCI090x30	19 1/8	20 1/2	9 1/2	17 5/8	18 5/16
CFC24	GCI115, 140	23 1/8	20 1/2	9 1/2	21 5/8	18 5/16
CFC20D	GCI090x50	19 1/8	20 1/2	9 1/2	17 5/8	18 5/16

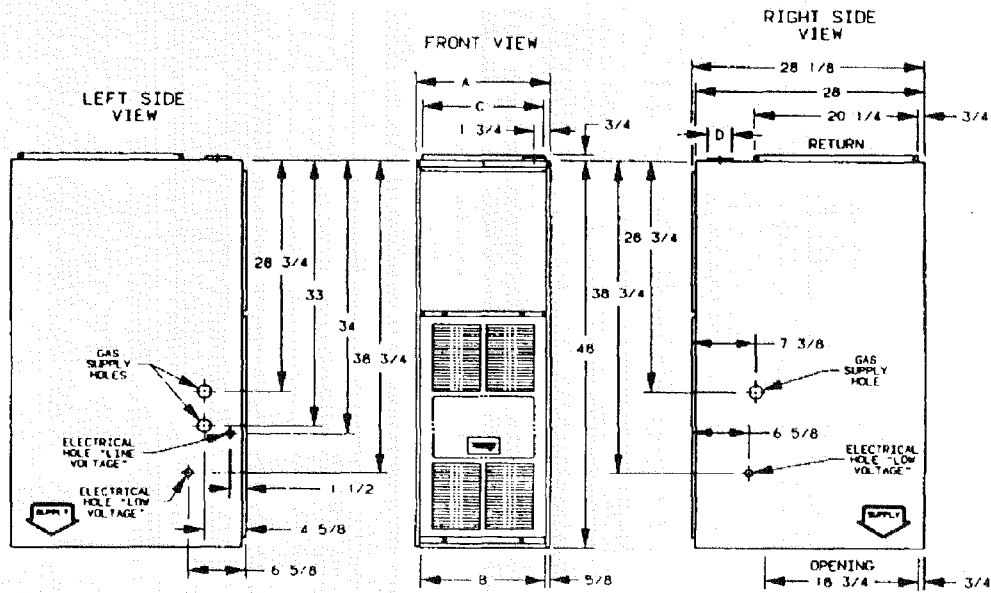
ACCESSIBILITY CLEARANCES (MINIMUM)

36" at front is required for servicing or cleaning.

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

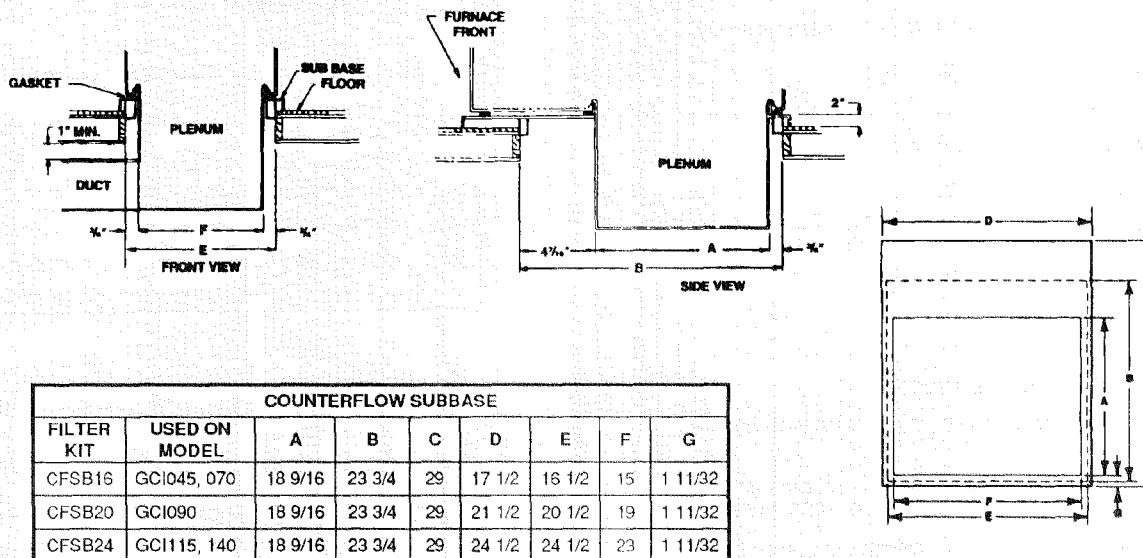
All dimensions given in inches.

PRODUCT IDENTIFICATION

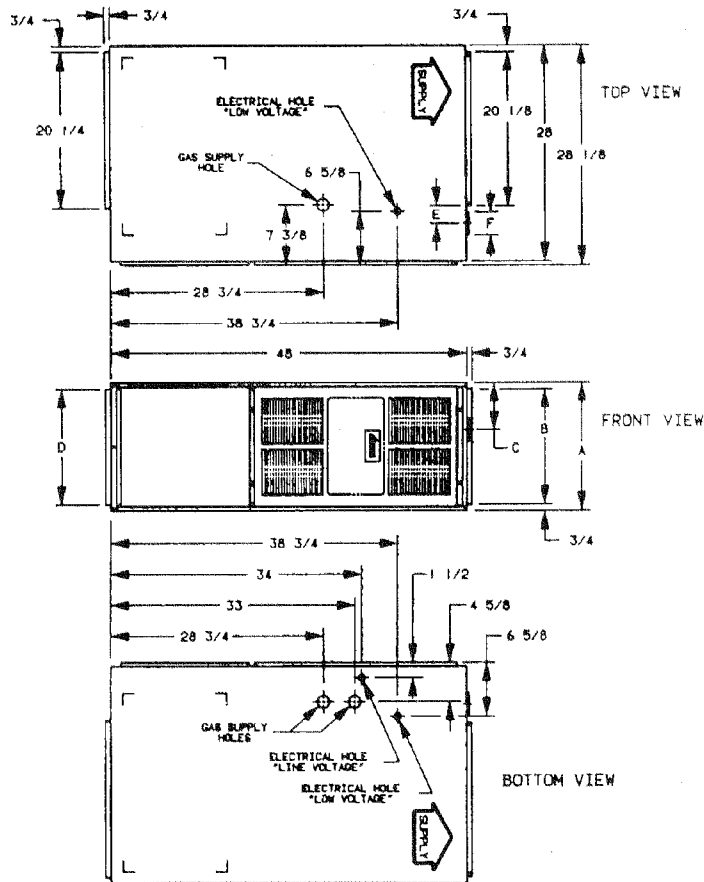


COUNTERFLOW FURNACE DIMENSIONS				
	A	B	C	D
GCI045	16 1/2	15 1/4	14 15/16	3
GCI070	16 1/2	15 1/4	14 15/16	3
GCI090	20 1/2	19 1/4	18 15/16	3
GCI115	24 1/2	23 1/4	22 15/16	4*
GCI140	24 1/2	23 1/4	22 15/16	4*

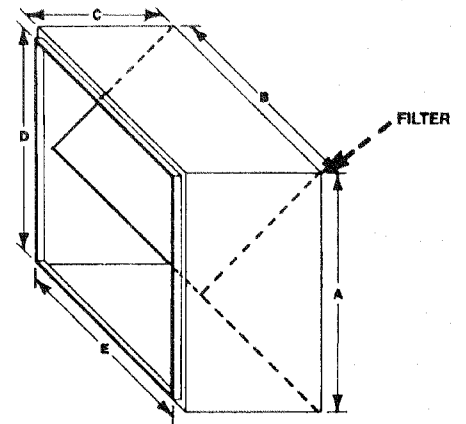
* Requires 3" - 4" adapter supplied with furnace



PRODUCT IDENTIFICATION



HORIZONTAL FURNACE DIMENSIONS						
	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
GSI090	20 1/2	19	8 1/8	18 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 Filter Cabinet

CLEARANCES TO COMBUSTIBLE SURFACES GSI MODEL FURNACES			
	HORIZONTAL LEFT	HORIZONTAL RIGHT	UPFLOW
FRONT	Alcove	Alcove	Alcove
RIGHT	6	12	2**
LEFT	12	6	1
REAR	0	0	0
TOP	6	6	0
FLUE	6*	6*	6*
FLOOR	C	C	C

C = COMBUSTIBLE FLOOR (WOOD ONLY)

* = MAY BE 1" WHEN TYPE B VENT IS USED.

** = 2" CLEARANCE FOR GSI045x25A, GSI070x35A ONLY (MAY BE 1" WHEN TYPE B IS USED.) ALL OTHERS MAY BE 1".

HORIZONTAL FILTER CABINET						
FILTER KIT	USED ON MODEL	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
HFC24	GSI115, 140	23 1/8	20 3/8	13 1/4	21 5/8	18 15/16

FURNACE SPECIFICATIONS

MODEL	GBI045A 25A	GBI070A 30A	GBI070A 40A	GBI090A 30A	GBI090A 50A	GBI115A 35A	GBI115A 50A	GBI140A 50A
BTUH INPUT (U.S.)	45,000	70,000	70,000	90,000	90,000	115,000	115,000	140,000
OUTPUT (U.S.)	36,000	56,000	56,000	71,000	71,000	92,000	92,000	111,000
INPUT (CAN)	45,000	70,000	70,000	90,000	90,000	115,000	115,000	140,000
OUTPUT (CAN)	36,000	55,300	55,300	70,200	70,200	90,850	90,850	111,300
HIGH ALT. INPUT (CAN)	40,500	63,000	63,000	71,000	71,000	103,500	103,500	126,000
OUTPUT (CAN)	32,400	49,770	49,770	63,180	63,180	81,760	81,760	100,170
RATED EXT. STATIC (wc)	.10 - .50	.12 - .50	.12 - .50	.15 - .50	.15 - .50	.20 - .50	.20 - .50	.20 - .50
TEMPERATURE RISE °F	25 - 55	30 - 60	30 - 60	35 - 65	35 - 65	35 - 65	35 - 65	40 - 70
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
BLOWER HORSEPOWER	1/4	1/3	1/2	1/3	3/4	1/2	3/4	3/4
BLOWER SPEEDS	3	4	4	4	4	4	3	4
FULL LOAD AMPS	10.1	13.6	15.6	13.6	17.7	15.6	17.2	17.2
TRANSFORMER (VA)	40	40	40	40	40	40	40	40
HEAT ANTICIPATOR	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
LIMIT SETTING °F	220	240	260	190	210	210	200	210
AUXILIARY LIMIT °F	160	160	160	160	160	160	160	160
FAN DELAY ON	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.
OFF HEATING	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.
OFF COOLING	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.
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
FILTER TYPE	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
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
NUMBER OF FILTERS	1	1	2	1	2	1	2	2
NET WEIGHT lbs.	145	161	161	178	178	196	196	206

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 manufactures method of 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 output.
4. Maximum full load amps include 5 amps drawn by the ignitor during preheat cycle.

FURNACE SPECIFICATIONS

MODEL	GUI045B /C25A/B	GUI070B /C30A/B	GUI070B /C40A/B	GUI090B /C30A/B	GUI090B /C50A/B	GUI115B /C35A/B	GUI115B /C50A/B	GUI140B /C35A/B	GUI140B /C50A/B
BTUH INPUT (U.S.)	45,000	70,000	70,000	90,000	90,000	115,000	115,000	140,000	140,000
OUTPUT (U.S.)	36,000	55,000	55,000	71,000	71,000	91,000	90,000	110,000	111,000
INPUT (CAN)	45,000	70,000	70,000	90,000	90,000	115,000	115,000	140,000	140,000
OUTPUT (CAN)	36,000	55,300	55,300	70,200	70,200	90,850	90,850	111,300	111,300
HIGH ALT. INPUT (CAN)	40,500	63,000	63,000	71,000	81,000	103,500	103,500	126,000	126,000
OUTPUT (CAN)	32,400	49,770	49,770	63,180	63,180	81,760	81,760	100,170	100,170
RATED EXT. STATIC (wc)	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5
TEMPERATURE RISE °F	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
HEAT ANTICIPATOR	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
LIMIT SETTING °F	230	200	200	200	200	200	200	200	200
AUXILIARY LIMIT °F	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VENT SAFETY SW. (CAN.)	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 TYPE	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
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 lbs.	137	148	148	160	160	178	178	188	188

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 manufactures method of 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 output.
4. Maximum full load amps include 5 amps drawn by the ignitor during preheat cycle.

FURNACE SPECIFICATIONS

MODEL	GUI045 D/E/X25A	GUI070 D/E/X30A	GUI070 D/E/X40A	GUI090 D/E/X30A	GUI090 D/X50A	GUI115 D/E/X35A	GUI115 D/X50A	GUI140 D/E/X35A	GUI140 D/E/X50A
BTUH INPUT (U.S.)	45,000	70,000	70,000	90,000	90,000	115,000	115,000	140,000	140,000
OUTPUT (U.S.)	36,000	56,000	56,000	71,000	71,000	92,000	92,000	111,000	111,000
INPUT (CAN)	45,000	70,000	70,000	90,000	90,000	115,000	115,000	140,000	140,000
OUTPUT (CAN)	36,000	55,300	55,300	70,200	70,200	90,850	90,850	111,300	111,300
HIGH ALT. INPUT (CAN)	40,500	63,000	63,000	71,000	71,000	103,500	103,500	126,000	126,000
OUTPUT (CAN)	32,400	49,770	49,770	63,180	63,180	81,760	81,760	100,170	100,170
RATED EXT. STATIC (wc)	.10 - .50	.12 - .50	.12 - .50	.15 - .50	.15 - .50	.20 - .50	.20 - .50	.20 - .50	.20 - .50
TEMPERATURE RISE °F	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	1/4	1/3	1/2	1/3	3/4	1/2	3/4	1/2	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
HEAT ANTICIPATOR	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
LIMIT SETTING °F	270	240	250	200	220	230	240	220	220
AUXILIARY LIMIT °F	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FAN DELAY ON	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.
OFF HEATING	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.
OFF COOLING	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.
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 TYPE	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
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 lbs.	132	148	148	160	160	178	178	188	188

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 manufactures method of 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 output.
4. Maximum full load amps include 5 amps drawn by the ignitor during preheat cycle.

FURNACE SPECIFICATIONS

MODELS	GCI045B/ C25A/B	GCI070B/ C30A/B	GCI070B/ C40A/B	GCI090B/ C30A/B	GCI090B/ C50A/B	GCI115B/ C35A/B	GCI115B/ C50A/B	GCI140B/ C50A/B
BTUH INPUT (U.S.)	45,000	70,000	70,000	90,000	90,000	115,000	115,000	140,000
OUTPUT (U.S.)	36,000	56,000	56,000	72,000	72,000	92,000	92,000	112,000
INPUT (CAN)	45,000	70,000	70,000	90,000	90,000	115,000	115,000	140,000
OUTPUT (CAN)	37,350	58,100	58,100	74,700	74,700	95,450	95,450	116,200
HIGH ALT. INPUT (CAN)	40,500	63,000	63,000	81,000	81,000	103,500	103,500	126,000
OUTPUT (CAN)	33,610	52,290	52,290	67,230	67,230	85,900	85,900	104,580
RATED EXT. STATIC (wc)	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5
TEMPERATURE RISE °F	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
HEAT ANTICIPATOR	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
LIMIT SETTING °F	250	200	200	180	250	200	200	200
AUXILIARY LIMIT °F	160	160	140	160	140	160	140	140
VENT SAFETY SW. (Can.) °F	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
FILTER TYPE	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
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
NUMBER OF FILTERS								
NET WEIGHT lbs.	131	147	147	159	159	177	177	206

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 manufactures method of 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 output.
4. Maximum full load amps include 5 amps drawn by the ignitor during preheat cycle.

FURNACE SPECIFICATIONS

MODEL	GCI045 D25A	GCI070 D35A	GCI090 D30A	GCI090 D50A	GCI115 D35A	GCI115 D50A	GCI140 D50A
BTUH INPUT (U.S.)	45,000	70,000	90,000	90,000	115,000	115,000	140,000
OUTPUT (U.S.)	37,000	56,000	73,000	73,000	92,000	92,000	113,000
INPUT (CAN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OUTPUT (CAN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HIGH ALT. INPUT (CAN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OUTPUT (CAN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RATED EXT. STATIC (wc)	.10 - .50	.12 - .50	.15 - .50	.15 - .50	.20 - .50	.20 - .50	.20 - .50
TEMPERATURE RISE °F	25 - 55	35 - 65	45 - 75	35 - 65	40 - 70	45 - 75	45 - 75
BLOWER WHEEL (D" x W")	9 X 8	10 X 7	10 X 8	11 X 8	10 X 10	11 X 8	11 X 8
BLOWER HORSEPOWER	1/4	1/2	1/3	3/4	1/2	3/4	3/4
BLOWER SPEEDS	3	4	4	4	4	4	4
FULL LOAD AMPS	4.2	7.6	7.9	11.5	9.5	11.5	11.5
TRANSFORMER (VA)	40	40	40	40	40	40	40
HEAT ANTICIPATOR	0.7	0.7	0.7	0.7	0.7	0.7	0.7
LIMIT SETTING °F	250	220	210	200	230	190	170
AUXILIARY LIMIT °F	160	160	160	160	160	160	160
FAN DELAY ON	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.
OFF HEATING	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.
OFF COOLING	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.
GAS SUPPLY PRESS (Nat/LP)	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"
ORIFICE SIZE (Nat/LP)	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54	#43 / #54
NUMBER OF BURNERS	2	3	4	4	5	5	6
FILTER TYPE	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
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
NUMBER OF FILTERS	2	2	2	2	2	2	2
NET WEIGHT lbs.	131	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 manufactures method of 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 output.
4. Maximum full load amps include 5 amps drawn by the ignitor during preheat cycle.

FURNACE SPECIFICATIONS

MODELS	GS1045B 25A/B	GS1070B 30A/B	GS1070B 40A/B	GS1090B 30A/B	GS1090B 50A/B	GS1115B 35A/B	GS1115B 50A/B	GS1140B 50A/B
BTUH INPUT (U.S.)	45,000	70,000	70,000	90,000	90,000	115,000	115,000	140,000
OUTPUT (U.S.)	37,000	55,000	55,000	72,000	71,000	92,000	91,000	111,000
INPUT (CAN)	-	-	-	-	-	-	-	-
OUTPUT (CAN)	-	-	-	-	-	-	-	-
HIGH ALT. INPUT (CAN)	-	-	-	-	-	-	-	-
OUTPUT (CAN)	-	-	-	-	-	-	-	-
RATED EXT. STATIC (wc)	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5	.2 - .5
TEMPERATURE RISE °F	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
HEAT ANTICIPATOR	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
LIMIT SETTING °F	230	200	200	180	230	200	250	200
AUXILIARY LIMIT °F	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
FILTER TYPE	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
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
NUMBER OF FILTERS	-	-	-	-	-	-	-	-
NET WEIGHT lbs.	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 manufactures method of 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 output.
4. Maximum full load amps include 5 amps drawn by the ignitor during preheat cycle.

FURNACE SPECIFICATIONS

MODEL	GS1045 D25A	GS1070 D30A	GS1070 D35A	GS1070 D40A	GS1090 D30A	GS1090 D50A	GS1115 D35A	GS1115 D50A	GS1140 D50A
BTUH INPUT (U.S.)	45,000	70,000	70,000	70,000	90,000	90,000	115,000	115,000	140,000
OUTPUT (U.S.)	36,000	56,000	56,000	55,000	72,000	72,000	92,000	92,000	112,000
INPUT (CAN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OUTPUT (CAN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HIGH ALT. INPUT (CAN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OUTPUT (CAN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RATED EXT. STATIC (wc)	.10 - .50	.12 - .50	.12 - .50	.12 - .50	.15 - .50	.15 - .50	.20 - .50	.20 - .50	.20 - .50
TEMPERATURE RISE °F	35 - 65	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	10 X 7	11 X 8	10 X 8	11 X 8	10 X 10	11 X 8	11 X 8
BLOWER HORSEPOWER	1/4	1/3	1/2	1/2	1/3	3/4	1/2	3/4	3/4
BLOWER SPEEDS	3	4	4	3	4	4	4	4	4
FULL LOAD AMPS	4.2	7.9	7.6	10.2	7.9	11.5	9.5	11.5	11.5
TRANSFORMER (VA)	40	40	40	40	40	40	40	40	40
HEAT ANTICIPATOR	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
LIMIT SETTING °F	260	210	240	200	200	200	220	180	170
AUXILIARY LIMIT °F	160	160	160	160	160	160	160	160	160
FAN DELAY ON	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.	30 secs.
OFF HEATING	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.	90 secs.
OFF COOLING	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.	45 secs.
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	3	4	4	5	5	6
FILTER TYPE	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
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	1	1	1	2	1	2	2
NET WEIGHT lbs.	132	147	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 manufactures method of 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 output.
4. Maximum full load amps include 5 amps drawn by the ignitor during preheat cycle.

BLOWER PERFORMANCE SPECIFICATIONS

MODEL	MOTOR SPEED	External Static Pressure, Inches Water Column													
		0.2		0.3		0.4		0.5		0.6		0.7		0.8	
		CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise	CFM	Rise
GUI045x25x GBI045A25A	LO	690	49	675	50	660	51	640	53	590	57	530	64	450	-
	MED	965	35	950	36	915	37	875	39	820	41	760	44	675	50
	HI	1240	27	1170	29	1100	31	1050	32	950	36	870	39	780	43
GUI070x30x GBI070A30A	LO	725	-	720	-	700	-	675	-	580	-	515	-	420	-
	M-LO	935	56	920	57	900	58	865	-	820	-	770	-	690	-
	MED	1190	44	1150	46	1115	47	1065	49	1010	52	945	56	860	-
GUI070x40x GBI070A40A	LO	1470	36	1410	37	1345	39	1275	41	1200	44	1110	47	1000	53
	M-LO	1135	46	1135	46	1130	46	1125	47	1095	48	1070	49	1035	51
	MED	1340	39	1335	39	1325	40	1300	40	1270	41	1235	43	1180	44
GUI090x30x GBI090A30A	LO	1570	33	1560	34	1525	34	1485	35	1450	36	1400	38	1330	39
	M-LO	1895	-	1835	-	1775	-	1700	31	1630	32	1550	34	1450	36
	MED	850	-	830	-	800	-	775	-	730	-	680	-	610	-
GUI090x50x GBI090A50A	LO	910	73	900	74	870	-	840	-	800	-	750	-	690	-
	M-LO	1120	60	1080	62	1050	63	1010	66	960	67	900	72	820	-
	MED	1395	48	1335	50	1275	52	1220	55	1150	56	1065	61	970	67
GUI115x35x GBI115A35A	LO	995	-	1005	-	995	-	985	-	945	-	900	-	820	-
	M-LO	1300	52	1275	53	1235	55	1185	57	1125	60	1050	64	965	-
	MED	1460	46	1415	48	1355	50	1290	52	1220	55	1135	59	1045	-
GUI115x50x GBI115A50A	LO	1560	43	1495	45	1430	47	1365	49	1280	53	1200	56	1100	61
	M-LO	1230	55	1220	55	1210	56	1200	56	1170	58	1135	59	1090	62
	MED	1530	44	1525	44	1520	44	1515	45	1485	45	1455	46	1410	48
GUI140x35x GBI140A35A	LO	1770	38	1770	38	1755	38	1725	39	1700	40	1660	41	1600	42
	M-LO	2330	-	2280	-	2220	-	2125	-	2055	-	1965	-	1850	36
	MED	1180	-	1175	-	1150	-	1125	-	1090	-	1050	-	995	-
GUI140x50x GBI140A50A	LO	1410	61	1400	62	1375	63	1350	64	1310	-	1265	-	1200	-
	M-LO	1655	52	1645	52	1620	53	1575	55	1480	58	1410	61	1310	-
	MED	2000	43	1950	44	1875	46	1800	48	1725	50	1630	53	1520	57
GUI140x50x GBI140A50A	LO	1530	56	1520	57	1500	58	1475	58	1430	60	1370	63	1280	-
	M-LO	1730	50	1720	50	1700	51	1675	51	1620	53	1560	55	1470	59
	MED	2375	36	2275	38	2200	39	2125	41	2030	42	1920	45	1760	49
GUI140x50x GBI140A50A	LO	1160	-	1150	-	1135	-	1124	-	1090	-	1040	-	980	-
	M-LO	1330	-	1315	-	1295	-	1275	-	1230	-	1175	-	1100	-
	MED	1585	65	1560	66	1525	68	1475	70	1425	71	1340	-	1230	-
GUI140x50x GBI140A50A	LO	1930	54	1875	55	1835	57	1750	59	1680	60	1600	63	1480	68
	M-LO	1490	70	1470	71	1450	72	1425	73	1380	73	1330	-	1260	-
	MED	1660	62	1650	63	1635	63	1625	64	1590	64	1550	65	1490	68
GUI140x50x GBI140A50A	LO	2290	-	2230	47	2130	49	2050	51	1960	52	1850	55	1700	59
	M-LO	1475	-	1460	-	1440	-	1390	-	1335	-	1260	-	1160	-
	MED	1710	61	1675	63	1635	64	1580	66	1515	69	1420	-	1310	-
GUI140x50x GBI140A50A	LO	1930	54	1880	56	1815	58	1750	60	1665	63	1560	67	1450	-
	M-LO	2290	46	2225	47	2120	50	2000	53	1890	56	1790	59	1660	63
	MED	1475	-	1460	-	1440	-	1390	-	1335	-	1260	-	1160	-

1. CFMin chart is with filter(s) as shipped with furnace. If furnace is shipped with two side air return filters, this chart assumes both filters are installed.
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 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	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
GCI045x25x	LO	730	46	730	46	700	48	675	49	610	53	535	-	390	-
	MED	915	36	900	37	870	38	825	40	760	43	680	48	500	-
	HI	1220	27	1160	27	1090	31	1015	33	930	36	825	39	680	48
GCI070B/C30x	LO	740	-	730	-	700	-	675	-	610	-	540	-	430	-
	M-LO	970	53	950	55	920	56	890	58	840	59	770	-	670	-
	MED	1265	41	1220	43	1175	55	1125	46	1050	47	970	51	835	60
	HI	1530	-	1465	-	1400	37	1330	39	1240	40	1155	43	1030	48
GCI070D/X35x	LO	860	61	850	62	840	62	830	63	820	64	810	-	800	-
	M-LO	1060	49	1050	50	1040	50	1030	51	1020	51	1010	52	1000	52
	MED	1360	38	1350	39	1325	39	1275	41	1225	43	1200	44	1175	45
	HI	1660	-	1610	-	1550	-	1490	-	1430	37	1360	38	1275	41
GCI070B/C40	LO	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
GCI090x30x	LO	740	-	730	-	700	-	675	-	620	-	860	-	460	-
	M-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
GCI090B/C50x	LO	1525	44	1475	45	1400	48	1350	49	1270	51	1180	55	1035	63
	M-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
GCI090D/X50x	LO	1220	56	1190	57	1170	58	1160	59	1115	61	1100	62	1055	-
	M-LO	1425	48	1415	48	1390	49	1370	50	1345	51	1315	52	1265	54
	MED	1650	41	1635	42	1630	42	1600	43	1570	44	1540	44	1485	46
	HI	2260	-	2230	-	2140	-	2085	-	1980	-	1935	-	1850	37
GCI115x35x	LO	1060	-	1050	-	1040	-	1000	-	955	-	890	-	790	-
	M-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
GCI115B/C50x	LO	1380	62	1360	63	1335	64	1300	66	1250	67	1180	71	1080	-
	M-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
GCI115D/X50x	LO	1240	71	1230	71	1190	74	1170	-	1135	-	1110	-	1055	-
	M-LO	1470	60	1435	61	1415	62	1380	64	1345	65	1310	67	1250	70
	MED	1700	52	1670	53	1655	53	1630	54	1565	56	1520	58	1470	60
	HI	2280	-	2240	-	2175	-	2095	-	2025	-	1925	46	1835	48
GCI140B/C50x	LO	1315	-	1280	-	1240	-	1200	-	1140	-	1060	-	950	-
	M-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
GCI140D/X50x	LO	1250	-	1245	-	1235	-	1225	-	1200	-	1170	-	1125	-
	M-LO	1465	72	1460	73	1450	73	1430	74	1410	-	1370	-	1325	-
	MED	1690	63	1675	63	1655	64	1640	65	1605	66	1560	68	1525	70
	HI	2180	49	2125	50	2060	52	2030	52	1980	54	1920	55	1860	57

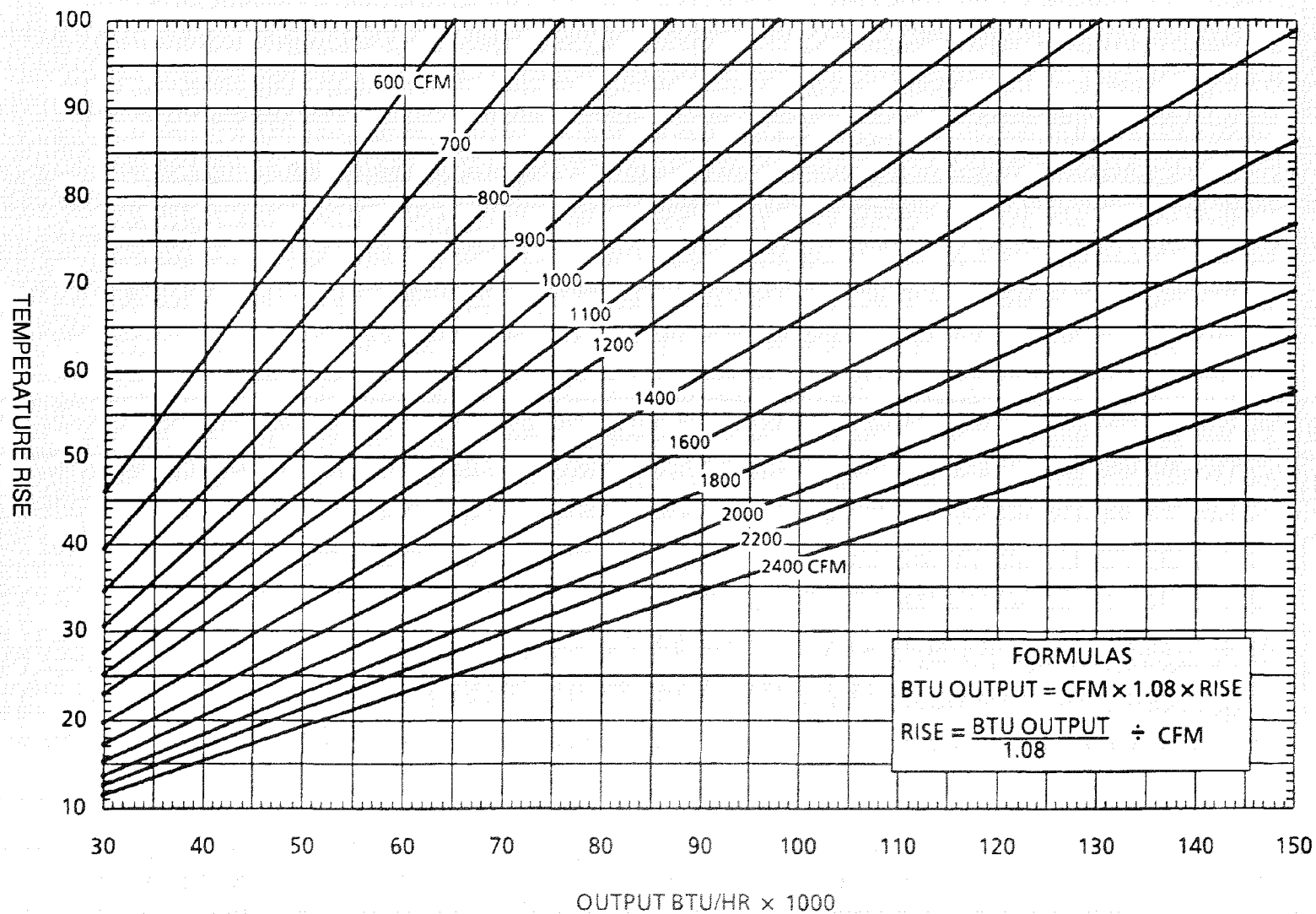
1. CFM in chart is with filter(s) as shipped with furnace. If furnace is shipped with two side air return filters, this chart assumes both filters are installed.
2. INSTALLATION IS TO BE ADJUSTED TO OBTAIN TEMPERATURE RISE WITHIN THE RANGE SPECIFIED ON THE RATING PLATE.
3. The chart is for information only. For satisfactory operation, external static pressure 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	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
GSI045x25x	LO	730	46	730	46	700	48	675	49	610	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
GSI070B30x	LO	740	-	730	-	700	-	675	-	610	-	540	-	430	-
	M-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	58
GSI070D30x	LO	1530	-	1465	-	1400	37	1330	39	1240	40	1155	43	1030	48
	M-LO	620	-	610	-	590	-	570	-	520	-	460	-	390	-
	MED	890	58	880	59	850	61	720	92	770	-	720	-	630	-
GSI070D35x	LO	1240	42	1200	43	1160	45	1120	46	1060	49	990	52	900	58
	M-LO	1580	33	1520	-	1450	36	1360	38	1290	40	1220	43	1120	46
	MED	830	61	825	62	820	62	815	62	800	64	780	-	775	-
GSI070D40x	LO	1085	47	1080	47	1070	47	1060	48	1050	48	1030	49	990	51
	M-LO	1365	37	1360	37	1320	38	1290	39	1250	41	1185	43	1130	45
	MED	1620	-	1565	-	1515	-	1450	-	1380	37	1320	38	1240	41
GSI070B40x	LO	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
GSI070D40x	LO	1170	44	1160	45	1130	46	1100	47	1060	49	1000	52	910	57
	M-LO	1570	33	1520	-	1460	-	1380	38	1300	40	1230	42	1110	47
	MED	1560	32	1670	-	1610	-	1520	-	1440	36	1360	38	1240	42
GSI090x30x	LO	740	-	730	-	700	-	675	-	620	-	560	-	460	-
	M-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	-
GSI090B50x	LO	1420	47	1350	49	1285	52	1225	54	1140	57	1040	63	900	72
	M-LO	1525	44	1475	45	1400	48	1350	49	1270	51	1180	55	1035	63
	MED	1745	38	1690	39	1625	41	1565	43	1490	44	1400	46	1270	51
GSI090D50x	LO	1955	-	1900	-	1820	37	1760	38	1680	39	1580	41	1430	45
	M-LO	2210	-	2150	-	2070	-	2000	-	1910	-	1810	36	1650	39
	MED	1290	52	1280	52	1255	54	1235	55	1200	56	1150	59	1100	62
GSI115x35x	LO	1500	45	1490	45	1460	46	1435	47	1400	48	1345	50	1285	53
	M-LO	1760	38	1725	39	1690	40	1645	41	1580	43	1515	45	1440	47
	MED	2165	-	2110	-	2040	-	1960	-	1885	36	1800	38	1730	39
GSI115B50x	LO	1060	-	1050	-	1040	-	1000	-	955	-	880	-	790	-
	M-LO	1260	68	1250	68	1220	-	1200	-	1145	-	1080	-	990	-
	MED	1580	54	1560	55	1510	56	1460	58	1395	60	1300	64	1150	-
GSI115D50x	LO	1920	44	1835	46	1760	48	1670	51	1570	53	1460	57	1320	63
	M-LO	1380	62	1360	63	1335	64	1300	66	1250	67	1180	71	1080	-
	MED	1610	53	1570	54	1540	55	1490	57	1425	59	1340	63	1200	70
GSI140B50x	LO	1890	-	1860	46	1800	47	1750	49	1680	50	1600	52	1480	57
	M-LO	2260	-	2200	-	2125	-	2050	-	1950	-	1850	-	1710	49
	MED	1325	65	1300	67	1280	68	1250	69	1230	71	1195	73	1150	-
GSI140D50A	LO	1560	56	1525	57	1500	58	1470	59	1425	61	1360	64	1300	67
	M-LO	1800	48	1775	49	1745	50	1700	51	1650	53	1580	55	1520	57
	MED	2285	-	2220	-	2150	-	2080	-	2000	-	1920	-	1835	47
GSI140B50x	LO	1315	-	1280	-	1240	-	1200	-	1140	-	1060	-	950	-
	M-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	-
GSI140D50A	LO	2340	-	2265	46	2200	47	2100	49	1995	51	1860	55	1620	63
	M-LO	1290	-	1270	-	1260	-	1235	-	1190	-	1150	-	1090	-
	MED	1510	69	1500	70	1460	70	1445	73	1415	74	1360	-	1300	-
GSI140D50A	LO	1780	59	1760	60	1725	61	1680	62	1630	64	1560	67	1485	71
	M-LO	2315	-	2240	47	2170	48	2100	50	2020	52	1940	54	1850	57
	MED	1290	-	1270	-	1260	-	1235	-	1190	-	1150	-	1090	-

1. CFM in chart is with filter(s) as shipped with furnace. If furnace is shipped with two side air return filters, this chart assumes both filters are installed.
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 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.

BTU OUTPUT vs TEMPERATURE RISE CHART



BLOWER PERFORMANCE SPECIFICATIONS

COMBUSTION AND VENTILATION AIR

WARNING

PROPERTY DAMAGE, BODILY INJURY, OR DEATH MAY OCCUR IF THE FURNACE AND ANY OTHER FUEL-BURNING APPLIANCES ARE NOT PROVIDED WITH ENOUGH FRESH AIR FOR PROPER COMBUSTION AND VENTILATION OF FLUE GASES. MOST HOMES REQUIRE OUTSIDE AIR TO BE SUPPLIED INTO THE FURNACE AREA.

Improved construction and additional insulation in homes has reduced the heat loss and made these homes much tighter around doors and windows so that air infiltration is minimal. This creates a problem to supply combustion and ventilation air for gas fired or other fuel burning appliances. Any use of appliances that pull air out of the house (clothes dryers, exhaust fans, fireplaces, etc.) increases this problem and appliances could be starving for air.

In addition, these energy saving measures mean that your home will retain more water vapor and have a higher relative humidity. High humidity, especially during cold weather, may be damaging to buildings because condensation forms on windows and inside walls.

AIR REQUIREMENTS

Most homes will require that outside air be supplied to the furnace area by means of ventilation grilles or ducts connecting directly to the outdoors or spaces open to the outdoors such as attics or crawl spaces. The following information on air for combustion and ventilation is reproduced from the National Fuel Gas Code NFPA54/ANSI Z223.1 Section 5.3 or Canadian Installation Code and CANI-B149.2.

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 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 applied for ventilation, including all air required for comfort and proper working conditions for personnel.

(e) 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 appliance of one of the methods covered in 5.3.3 and 5.3.4.

(f) 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.

5.3.2 Equipment Located in Unconfined Spaces:

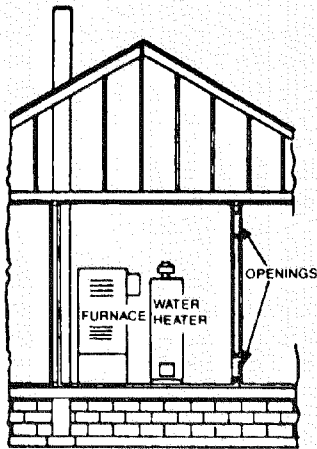
In unconfined spaces (see definition below) in buildings, infiltration may be adequate to provide air for combustion, ventilation and dilution of flue gases. However, in buildings of tight construction (for example, weather stripping, heavily insulated, caulked, vapor barrier, etc.), additional air may 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 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.)

COMBUSTION AND VENTILATION AIR

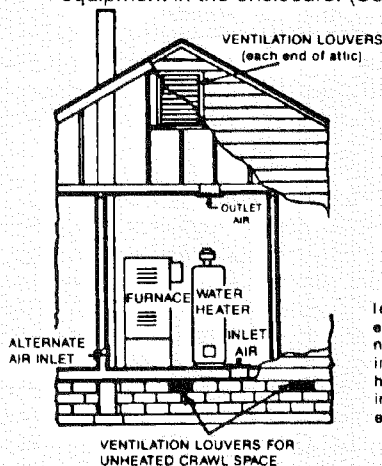


Note: Each opening shall have a free area of not less than one square inch per 1,000 Btu per hour of the total input rating of all equipment in the enclosure, but not less than 100 square inches.

Fig. 1. Equipment Located in Confined Spaces; All Air from inside the Building. See 5.3.3-a.

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

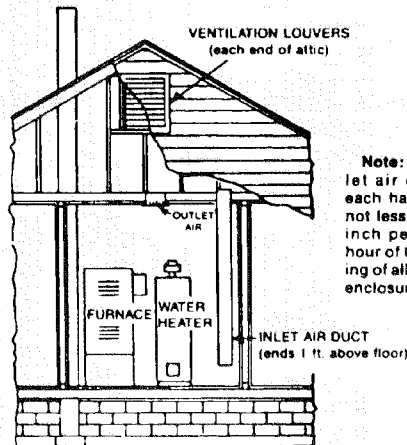
1. When directly communicating with the outdoors, each opening shall have a minimum free area of 1 square inch per 4,000 Btu per hour of total input rating of all equipment in the enclosure. (See Figure 2.)



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 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-b.

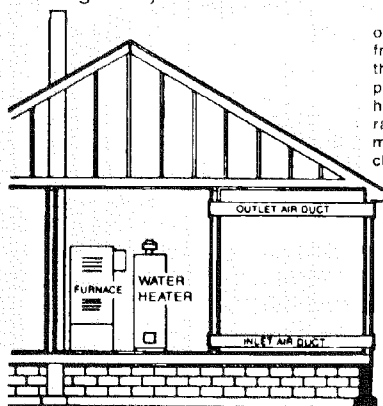
2. When communicating with the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4,000 Btu per hour of total input rating of all equipment in the enclosure. (See Figure 3.)



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.

Fig. 3. Equipment Located in Confined Spaces; All Air from Outdoors Through Ventilated Attic. See 5.3.3-b.

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.)



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.

Fig. 4. Equipment Located in Confined Spaces; All Air from Outdoors. See 5.3.3-b.

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.

5.3.4 Specially Engineered Installations:

The requirement 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.

COMBUSTION AND VENTILATION AIR

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.

VENTING

IMPORTANT NOTE TO THE INSTALLER

Before installing this unit please read this manual to familiarize yourself on the specific items which must be adhered to, such as vent materials, vent sizing, venting system layout, etc. Affix this manual, the Installation Instructions, and the User's Informational Manual adjacent to the furnace.

CAUTION

TO AVOID THE POSSIBILITIES OF PROPERTY DAMAGE, ILLNESS, OR DEATH; BE SURE TO FOLLOW THESE INSTALLATION INSTRUCTIONS. THROUGHOUT THESE INSTRUCTIONS, THE WORDS "MUST" AND "SHALL" REFER TO ITEMS WHICH MUST BE FOLLOWED FOR PROPER OPERATION. THE WORDS "MAY", "CAN" AND "SHOULD" REFER TO ITEMS WHICH MAY NOT BE REQUIRED FOR PROPER OPERATION, UNDER CERTAIN CONDITIONS

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 THIS MANUAL. 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.

IMPORTANT NOTE TO THE OWNER

It is important that you fill out the owner's registration card and mail it today. When filling in the registration card, be sure to include the model, manufacturing and serial numbers plus the installation date.

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

Keep this literature in a safe place for future reference.

This manual contains information on venting of Air Command 80 furnaces. For additional information on installation, operation, and maintenance of the furnace, consult the Installation Manual and User's Informational Manual which are shipped with the furnace.

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.

- 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.
- 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.
- 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.

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

VENTING

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 a 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., gauge 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.

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.

VENTING

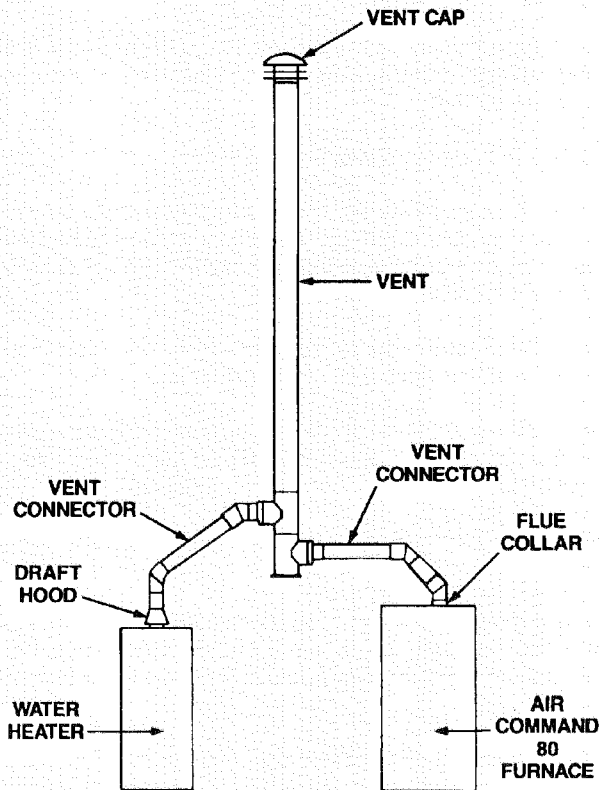


Fig. 1: Location of Definitions

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

GUI045E25
GUI070E30
GUI070E40
GUI090E30
GUI090E50
GUI115E35
GUI115E50
GUI140E35
GUI140E50

Note: Only current production models which include a vent safety switch are listed above.

WARNING

PERSONAL INJURY HAZARD
FAILURE TO IDENTIFY THE CAUSE OF THE VENT SAFETY SWITCH OPENING CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH FROM ASPHYXIATION.

DO NOT BY-PASS THIS SWITCH.

These furnaces include a thermally activated, manual reset vent safety 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 a qualified servicer.

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 GAMA venting tables for this example.

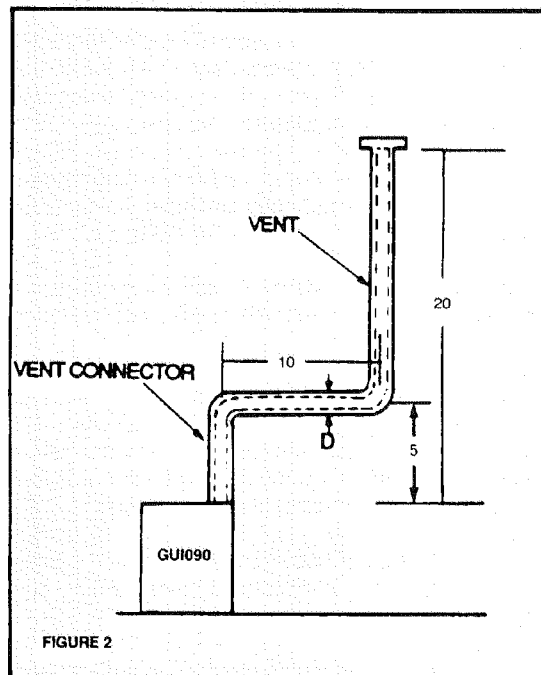


FIGURE 2

VENTING

When installing a GUI090 in a typical installation, the installer may prefer to use 3" single wall metal vent connector and type B vent. By following the left hand column of table 2 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).

Height Lateral		3"			4"		
		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	NR	NR	NR	NR	NR	NR
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

Table 2

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).
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.

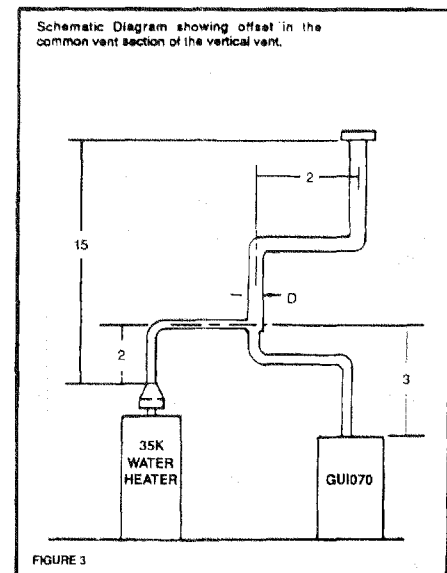
A 3" to 4" adapter will be required at the furnace flue collar.

Height Lateral		3"			4"		
		Appl					
		FAN		NAT	FAN		NAT
H (ft)	L (ft)	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

Table 1

Example 2

In this example, the application calls for a GUI070 installed with a 35,000 BTUH water heater. See figure 3 below.



VENTING

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.

Vent Height H (ft)	Connector Rise R (ft)	3"			4"		
		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

Table 4

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 63,000 BTUH.

Please note that the horizontal vent connector length should not exceed 6 feet (1½ feet per inch of connector diameter). See note 4 in the 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.

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

Table 3

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. $159 \text{ MBh} \times .80 = 127$ 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)	Fan Capacity					
	4"			5"		
	Combi					
	FAN	FAN	NAT	FAN	FAN	NAT
	FAN	NAT	NAT	FAN	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, we will confirm that the common vent is not too big for the furnace. Rule 19B in the Appendix specifies that the common vent's flow area shall not be more than 7 times the flow area of the "smallest listed appliance categorized vent area, flue collar area, or draft hood outlet area." The furnace has a 3" vent collar, with a flow area of $(3.14 \times (3/2)^2) = 7.1 \text{ in}^2$. Thus, flow areas as large as $7.1 \times 7 = 49.5 \text{ in}^2$ could be acceptable. Table 9 in the Appendix shows that a 5" vent has an equivalent area of 19.6 in^2 . 19.6 is less than 49.5 , so this 5" common vent will be acceptable.

VENTING

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 to 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.

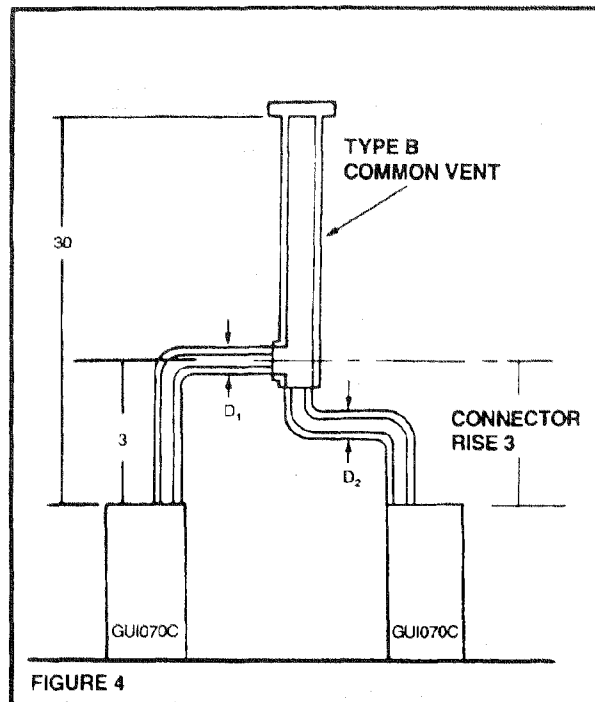
RULE 19A, 19B SUMMARY

Smallest Draft Hood or Flue Collar in system	Largest Allowable Round Vent	Largest Allowable Masonry Liner
3 inch Diameter	7 inch Diameter	Nominal 8 x 8
4 inch Diameter	10 inch Diameter	Nominal 12 x 12

This table shows the largest allowable vents or masonry liners that are allowed under any conditions. Under some conditions, the "largest allowable" sizes listed above could be unacceptable. See the Rules and Tables for details.

Example 3

This example has a large house requiring two GUI070C furnaces common vented. See the figure below. Please note that the furnaces having a vent safety 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 ratings falls between the FAN minimum and the 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.

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	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
30	1	47	60	31	77	110	57
	2	50	62	37	81	115	67
	3	54	64	42	85	119	76

Table 4

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.

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
20	1	21	54	31	33	99	56
	2	22	57	37	34	105	66
	3	23	60	42	35	110	74
30	1	20	62	33	31	113	59
	2	21	64	39	33	118	70
	3	22	66	44	34	123	79

Table 3

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

VENTING

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.

Common Vent Capacity				
Vent Height H (ft)	4"			
	FAN + FAN	FAN NAT	NAT + NAT	
6	92	81	63	
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 be reused?

Rule 19 in the Appendix answers this question. It specifies that the vent flow area shall not exceed 7 times the flow area of the smallest "listed appliance categorized vent area, flue collar area, or draft hood outlet area."

A GUI070 has a 3 inch diameter flue collar, and a flow area of $(3.14 \times 1.5/2)^2 = 7.1 \text{ in}^2$. $7.1 \times 7 = 49.5 \text{ in}^2$, so any vent with a flow area of 49.5 in^2 or smaller would be acceptable.

Table 9 in the Appendix shows the flow areas for various vent sizes:

- 4 inch diameter = 12.2 square inches
- 5 inch diameter = 19.6 square inches
- 6 inch diameter = 28.3 square inches
- 7 inch diameter = 38.3 square inches
- 8 inch diameter = 50.3 square inches

Thus, the 4 inch diameter vent which would be used for a new installation will be acceptable. Vents of 5 inch, 6 inch or 7 inch diameter would also be acceptable. Any vent of 8 inches or more in diameter would be too big.

In summary, 4" Type B vent connectors must be used to run from each GUI070 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", 6", or 7" in nominal diameter. If this is a new construction installation, a 4 inch diameter Type B common vent is the best choice*, assuming there are no vertical offsets in the common vent. If this is a replacement job, an existing 5 inch, 6, inch or 7 inch diameter Type B vent would be acceptable.

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

EXAMPLE 4

In this example a GSI070 furnace is being installed into the crawlspace of a home with a 15 foot high 8" x 8" tile lined masonry chimney. The furnace will be located 5 feet from the masonry chimney, and there are no other appliances being vented into the chimney. See Figure 5.

Because no source of dilution air is present, note 21 from the Appendix requires that the chimney be relined with either Type B vent or a listed single wall metal lining system. For this example, a flexible metal liner will be used. It must be sized per Note 22 in the Appendix.

Note 16 from the Appendix requires that a vent connector located in a crawlspace to type B or equivalent, so Table 1 will be used to size the vent connector and flexible liner.

From Table 1, the maximum capacity for 3" is 65,000 — $(0.2 \times 65,000) = 13,000$. This is less than 70,000. Therefore, 3" is too small and 4" will be checked. $130,000 - (0.2 \times 130,000) = 104,000$. 70,000 is between 30,000 and 104,000, therefore 4" will be used.

Height H (ft)		Lateral L (ft)	3"						4"						
			App												
			FAN		NAT		FAN		NAT		FAN		NAT		
			Min	Max	Max		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							

Table 1

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

In summary, a 4 inch Type B vent connector will be attached to a 4 inch flexible aluminum liner. A three to four inch adapter will be required at the flue collar of the furnace.

VENTING

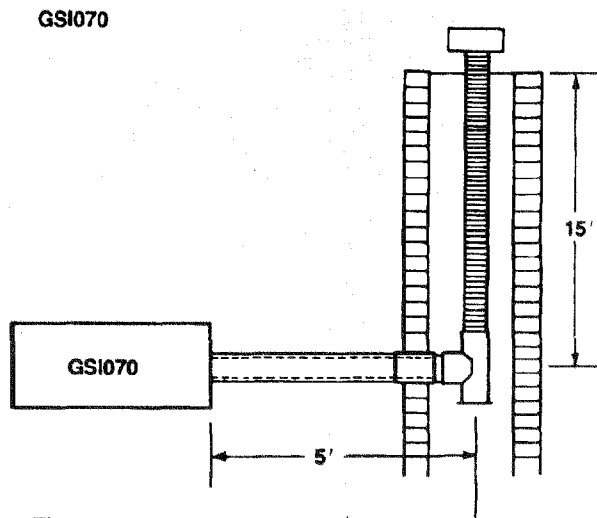


Figure 5

Example 5

In this example, the application calls for a GUI090 furnace installed with a 35,000 BTUH water heater. The units are to be vented into a 8" x 8" tile lined masonry chimney in the interior of the building, as shown in Figure 6.

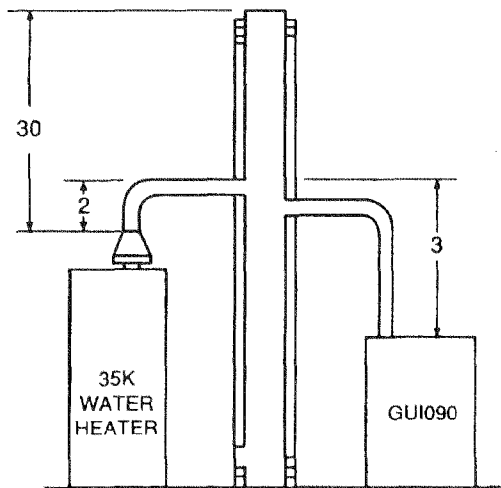


Figure 6

Table 8 is used to size common venting installations involving single wall connector into masonry chimneys for the water heater. Read down to the vent height of 30 feet and across the 2 foot connector rise to the NAT Max column. This value must be greater than the input of the water heater. A 3" connector cannot be used (35,000 is more than 31,000) but a 4" connector is acceptable (35,000 is less than 54,000). Note that the horizontal run of the connector should not exceed 6 feet (1½ Ft. per inch of connector diameter). See Note 4.

Vent Connector Capacity

Vent Height H (ft)	Connector Rise R (ft)	3"		4"	
		FAN		FAN	
		Min	Max	Min	Max
6	1	NR	NR	21	NR
	2	NR	NR	28	NR
	3	NR	NR	34	NR
15	1	NR	NR	23	NR
	2	NR	NR	30	92
	3	NR	NR	34	96
30	1	NR	NR	24	86
	2	NR	NR	31	94
	3	NR	NR	35	95

Table 8

For the furnace vent connector, Table 8 can also be used to check single wall connector performance. Read down the vent height column to 30 feet and then across the 3 foot connector rise row. A 3" connector is not recommended and a 90,000 BTUH furnace is too small when compared to the 4" connector FAN Min of 95,000 BTUH. Therefore, Table 7 must be used to size a Type B double wall vent connector. In this table a 3" connector is too small (90,000 is more than 64,000). A 4" connector is acceptable because the furnace input (90,000) is less than the FAN Max of 131,000 and it is greater than the fan min of 57,000 BTUH.

Vent Connector Capacity

Vent Height H (ft)	Connector Rise R (ft)	3"		4"	
		FAN		FAN	
		Min	Max	Min	Max
6	1	24	NR	21	39
	2	26	43	28	41
	3	27	49	34	42
15	1	24	48	23	38
	2	25	55	31	39
	3	26	59	35	41
30	1	24	54	25	37
	2	25	60	32	38
	3	26	64	36	40

Table 7

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

Next, the capacity of the masonry chimney must be checked. From Table 9, the equivalent area for a nominal liner size of 8" x 8" is 42.7 sq. in. Using the bottom of Table 8, for a vent height of 30 feet and a FAN + NAT capacity of 125,000 we find that a minimum internal chimney area of 28 square inches is required, so 42.7 square inches is large enough. As before, the maximum area for a 3" flue collar furnace (such as the GUI090)

VENTING

is 49.5 square inches. (NOTE 19) Therefore, an 8x8 tile liner (42.7 square inches) is acceptable. An 8x12 tile liner (63.6 square inches) would have been too big.

Common Vent Capacity

Vent Height H (ft)	Minimum Intake								
	12			19			28		
	Combined Appliance In								
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	NR	73	25	NR	118	45	NR	176	71
8	NR	79	28	NR	128	52	NR	190	81
10	NR	83	31	NR	136	56	NR	205	89
15	NR	88	36	NR	149	66	NR	230	108
20	NR	90	40	NR	157	74	NR	247	120
30	NR	NR	NR	NR	NR	NR	NR	266	135
50	NR	NR	NR	NR	NR	NR	NR	NR	NR

WARNING

POSSIBILITY OF PROPERTY DAMAGE, PERSONAL INJURY, OR DEATH — DAMAGING CONDENSATION CAN OCCUR INSIDE MASONRY CHIMNEYS WHEN A SINGLE FAN ASSISTED CATEGORY I APPLIANCE (80% AFUE FURNACE) IS VENTED WITHOUT ADEQUATE DILUTION AIR. 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 OR TYPE B METAL VENT.

ALL INSTALLATIONS USING MASONRY CHIMNEYS MUST BE SIZED IN ACCORDANCE WITH THE APPROPRIATE 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 EXTREMELY COLD CONDITIONS, LONG VENT CONNECTORS, 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 METAL VENT.

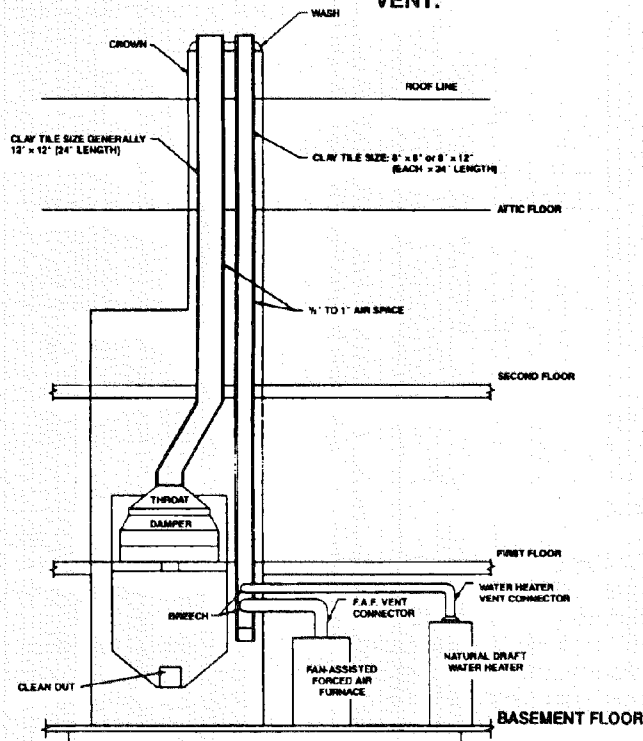


Figure 7: Typical Multiple Flue Clay Tile Chimney

32 Rev. 1

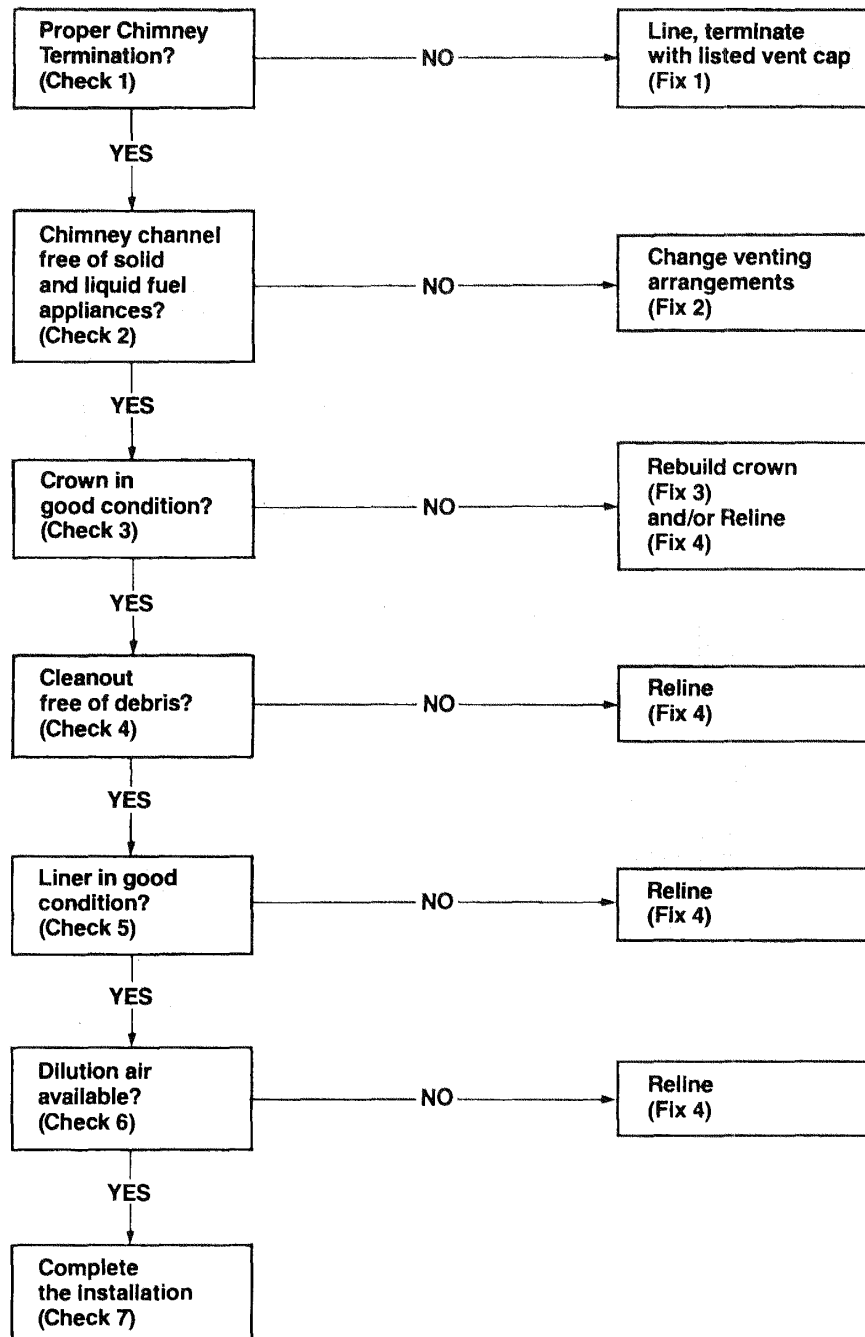
VENTING

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.

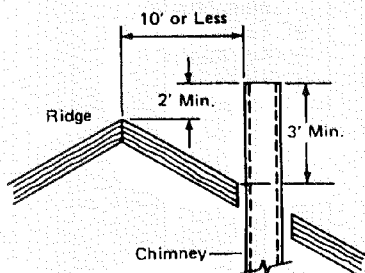
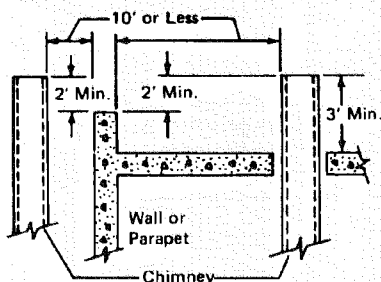
This inspection is based upon a draft topical report, "Masonry Chimney Inspection and Relining", issued by the Gas Research Institute. While not yet finalized, we believe this report represents the best information of this subject which is currently available.



VENTING

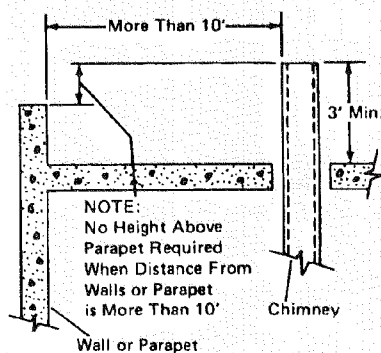
Check 1 — Proper chimney termination. A masonry chimney used as a vent for gas fired equipment must extend at least three feet above the highest point where it passes through the roof. It must extend at least two feet higher than any portion of a building within a horizontal distance of 10 feet. In addition,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

Figure 8 Typical Termination Locations for Chimneys



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

Figure 8 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 (liquefied 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.)

VENTING

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 front section 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 in Appendix A. If the liner is too small or too large, then the chimney must be relined (Fix 4).

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 or 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, and the liner is an acceptable size as determined by the tables in the Appendix, then 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:

- Extremely cold weather
- long vent connectors
- Masonry chimneys with no air gap between the liner and the bricks. (In practice, this can be difficult to detect.)
- Exterior chimneys (The tables in the Appendix assume interior chimneys.)

If, in judgment of the local gas utility, installer, and/or local codes; one or more of the above factors is likely to present a problem, the chimney must be relined (Fix 4).

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

VENTING

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 other portions 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 instructions are followed.

Alternatively, under some conditions an Air Command 90 or 95 could be installed rather than an Air Command 80. The Command 90 or 95 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. Once such standard which may be references 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 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 should then be topped with a listed vent cap. 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 Appendix A 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".

For sizing of flexible liners, see Note 22 and the tables in the Appendix.

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.

Some manufacturers of flexible liners offer an insulation sleeve designed to be added to the liner before it is installed in the chimney. (Poured insulation, either vermiculite or other materials, is longer recommended.) 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 in none of those three conditions exist which require additional liner insulation, the installer may wish to consider it if:

VENTING

- 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.

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.

- Seal any unused openings in the common venting system.
- 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.
- 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.
- Follow the lighting instructions. Place the appliance being inspected in operation. Adjust thermostat so appliance will operate continuously.
- 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.
- 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.
- If improper venting is observed during any of the above test, the common venting system must be corrected and in accordance with the latest edition of the National Fuel Gas Code, ANSI Z223.1.

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

B. Troubleshooting Procedure

If the venting system(s) of the AC80 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 circulating air mixture entering the furnace. Entering air (return air plus outdoor air, if any) which is less than 55°F 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.
- Re-examine the venting system layout, simplifying it where practical. For example, could two 45s replace two 90s in a horizontal offset?
- 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.

VENTING

VENTING TABLES CATEGORY I CENTRAL FURNACES



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VENTING

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, industry wide venting tables now exist for fan-assisted combustion system central furnaces. Venting tables for these types of appliances are not contained in the National Fuel Gas Code (NFPA 54/ANSI Z223.1-1988).

All requirements contained in this booklet apply to both Category I drafthood 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 drafthood 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 in both metal and masonry chimneys.

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.

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VENTING

VENTING REQUIREMENTS FOR CATEGORY I APPLIANCES

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 or masonry chimneys. Tables are also included covering similar venting material combinations when applied to common venting arrangements of two or more 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 or more fan-assisted appliances attached to the common vent.

"FAN+NAT"

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

"NAT+NAT"

refers to the maximum combined input rating of two or more 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.

DraftHood

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.

Categorized
Vent Diameter

The minimum vent diameter permissible for Category I appliances to maintain a nonpositive vent static pressure when tested in accordance with nationally recognized standards.

VENTING

1.1. 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) The venting tables included in this instruction apply to vents and chimneys internal to the structure below the roof line. Exterior chimneys or vents not enclosed by the structure or a chase below the roof line may experience continuous condensation depending on locality. Consult local gas utility, appliance manufacturer and/or local codes. A chimney with one or more sides exposed to the outside of the structure is considered to be an exterior chimney. A Type B or listed chimney lining system passing through an unused masonry chimney flue is not considered to be exposed to the outdoors

2) If the vent or connector 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 FT.
- b) Vents or connectors for appliance draft hood outlets or flue collars 12 inches in diameter or smaller are not reduced more than one table size (e.g. 12 inches to 10 inches is a one size reduction).
- c) Vents or connectors for appliance draft hood or flue collars above 12 inches in diameter are not reduced more than two table 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% ($0.90 \times$ maximum capacity).
- e) The draft hood outlet is greater than 4 inches in diameter. Do not connect a 3 inch diameter vent or connector to a 4 inch diameter draft hood outlet. This provision does not apply to fan-assisted appliances.

3) 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, 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 ($0.90 \times$ maximum listed capacity).

* Two 45° elbows are equivalent to one 90° elbow.

4) The common venting Tables 3, 4, 7, & 8 were generated using a maximum horizontal vent connector length of 1 1/2 feet (18 inches) for each inch of connector diameter as follows:

CONNECTOR DIAMETER (INCHES)	MAXIMUM HORIZONTAL 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. Connectors with longer horizontal lengths than those listed above are possible under the following conditions:

- a. The maximum capacity (Fan Max. or Nat Max.) of the vent connector shall be reduced 10% for each additional multiple of the length listed above. For example, the maximum length listed above for a 4 inch connector is 6 feet. With a connector length greater than 6 feet but not exceeding 12 feet, the maximum capacity must be reduced by 10% ($0.90 \times$ maximum vent connector capacity). With a connector length greater than 12 feet but not exceeding 18 feet, the maximum capacity must be reduced by 20% ($0.80 \times$ maximum vent capacity).

VENTING

- b. The minimum capacity (Fan Min.) shall be determined by referring to the corresponding single appliance table (Tables 1 and 2). In this case, for each appliance the entire vent connector and common vent from the appliance to the vent termination would be treated as a single appliance vent, as if the other appliances were not present.

- 5) 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%, the equivalent of 1 (one) 90° elbow (0.90 x maximum common vent capacity). See Figure 7: The horizontal length of the common vent connect or manifold (L) should not exceed 1-1/2 feet (18 inches) for each inch of common vent connector manifold diameter.
- 6) 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%, the equivalent of 2 (two) 90° elbows (0.80 x maximum common vent capacity). The horizontal length of the offset shall not exceed 1 1/2 feet for each inch of common vent diameter.
- 7) 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.
- 8) 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 vent manufacturer's instructions.

VENT 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. (SEE FIGURE 1)

VENT CAPS LARGER THAN 12"

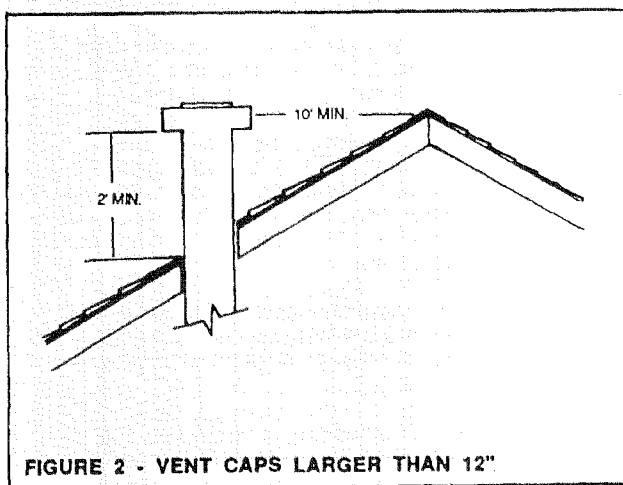
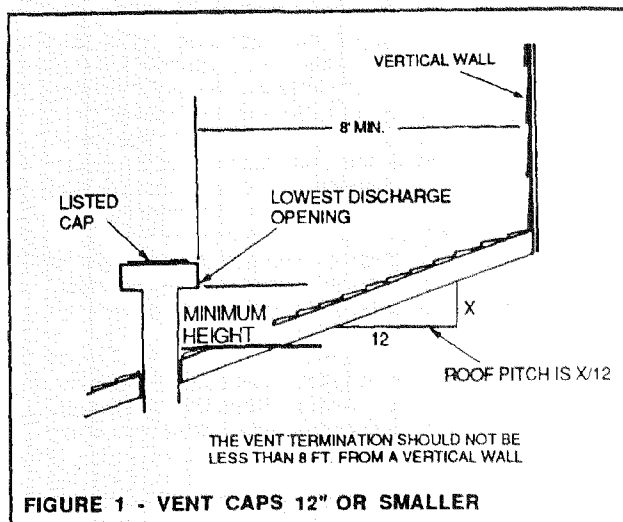
Listed vent caps larger than 12" must be located at least 2 feet above the highest point and at least 2 feet higher than any portion of a building within a horizontal distance of 10 Feet. (SEE FIGURE 2)

- 9) Use sea level input rating when determining maximum capacity for high altitude installation. Use actual input rating for determining minimum capacity for high altitude installation.

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



VENTING

- 10) No portion of the venting system can extend into, or pass through any circulating air duct or plenum.
- 11) 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 (Z223.1)
- 12) 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.
- 13) A Category I appliance must never be connected to a chimney that is servicing a solid fuel appliance. If a fireplace chimney flue is used to vent this appliance, the fireplace opening must be permanently sealed.
- 14) 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.
- 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 single wall metal vent connector shall be readily accessible for inspection, cleaning, and replacement.
- 18) For appliances with more than one input rate, the minimum vent or connector (Fan Min) capacity determined from the tables shall be less than the lowest appliance input rating and the maximum vent or connector (Fan or Nat Max.) capacity determined from the tables shall be greater than the highest appliance input rating.

19) For single appliance vents:

- a) If the vertical vent or tile lined chimney has a larger diameter or flow area than the vent connector, use the vertical vent diameter to determine the minimum vent capacity and the vent connector diameter to determine the maximum vent capacity. The flow area of the vertical vent, however, shall not exceed 7 times the flow area of the listed appliance categorized vent area, draft hood outlet area or flue collar area unless designed in accordance with approved engineering methods. See Table 9 for calculated areas.

b) For multiple appliance vents:

The flow area of the largest section of vertical vent or chimney shall not exceed 7 times the smallest listed appliance categorized vent area, flue collar area, or draft hood outlet area unless designed in accordance with approved engineering methods. See Table for calculated areas.

$$\text{Maximum vent or tile lined chimney flow area} = \frac{\pi(D^2)}{4} \times 7$$

* Draft hood outlet diameter, flue collar diameter, or listed appliance categorized vent diameter.

- c) In no case, shall the vent connector be upsized more than 2 consecutive table size diameters over the size of the draft hood outlet, flue collar outlet, or listed appliance categorized vent. Example: An appliance with a 4 inch diameter flue outlet collar or draft hood outlet cannot be vented with a connector diameter larger than 6 inches.

- 20) Masonry chimneys used to vent Category I central furnaces must be either tile-lined or lined with a listed metal lining system or dedicated gas vent. Unlined masonry chimneys are prohibited. (See Note 1).

- 21) A fan assisted furnace may be common vented into an existing masonry chimney provided:

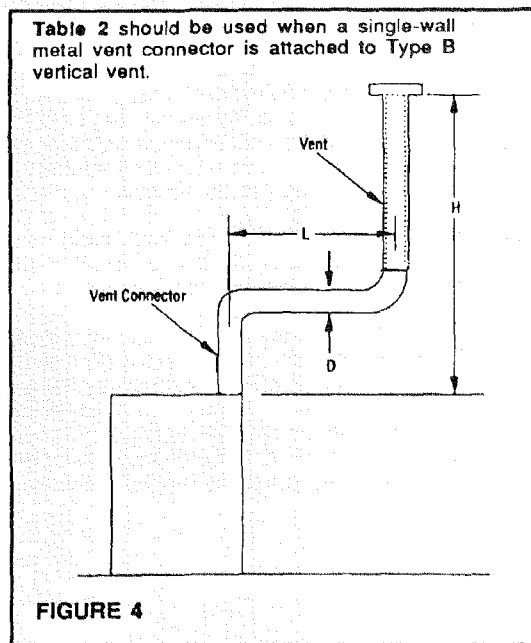
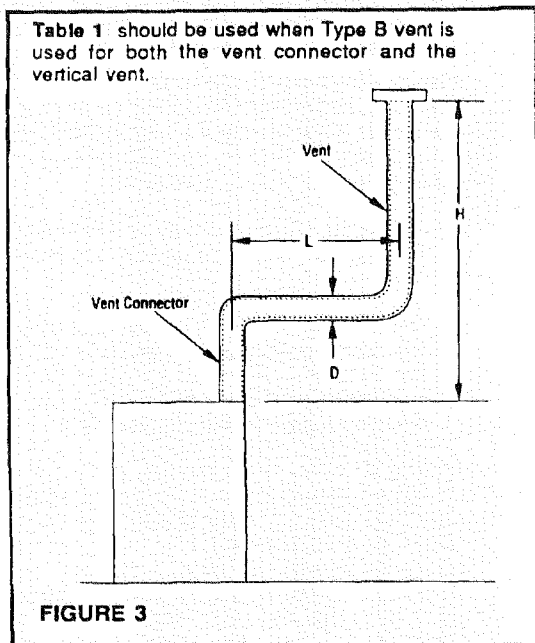
- a. The chimney is currently serving at least one draft hood equipped appliance.
- b. The vent connectors and chimney are sized in accordance with Tables 7 & 8.

SINGLE APPLIANCE VENTING OF A FAN ASSISTED FURNACE INTO A TILE LINED, MASONRY CHIMNEY IS PROHIBITED. THE CHIMNEY MUST FIRST BE LINED WITH EITHER TYPE B VENT SIZED IN ACCORDANCE WITH TABLES 1 OR 2 OR A LISTED, SINGLE WALL, METAL LINING SYSTEM, SIZED IN ACCORDANCE WITH NOTE 22.

VENTING

- 22) Listed, corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Tables 1 or 2 for dedicated venting and Tables 3 or 4 for common venting with the maximum capacity reduced by 0.20% (0.80 x maximum capacity) and the minimum capacity as shown in the applicable table. Corrugated metal vent systems installed with bends or offsets require additional reduction of the vent maximum capacity (See Note 6).
- 23) 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. Connector rise "R" is measured from the draft hood outlet or flue collar to the level where the vent gas streams come together. (Not applicable to multi-story).
- 24) For multi-story installations, available total height for each segment of the system "H" is the vertical distance between the highest draft hood outlet or flue collar entering that segment and the centerline of the next higher interconnection tee (See Figure 13).
- 25) The size of the lowest connector and of the vertical vent leading to the lowest interconnection of a multi-story system must be in accordance with Table 1 OR 2, for available total height "H" up to the lowest interconnection (See Figure 14).
- 26) Common vents in multi-story systems shall be type B when used in multi-story systems and have no offsets.
- 27) Numbers followed by an asterisk (*) in Table 6, indicate the possibility of continuous condensation, depending on locality. Consult appliance manufacturer, local serving gas supplier, and/or authority having jurisdiction.
- 28) In a single run of vent or vent connector, more than one diameter and type of pipe are permitted to be used, provided that all the size are permitted by the tables.
- 29) If the desired vent height and connector rise and/or lateral are between the table entries, linear interpolation is permitted for calculation of the permissible appliance input ratings. Extrapolation beyond the table entries is not recommended. (See Example 7)
- 30) All combinations of pipe sizes, single-wall, and double-wall metal pipe are allowed within any connector run(s) or within the common vent provided ALL of the appropriate tables permit ALL of the desired sizes and types of pipe, as if they were used for the entire length of the subject connector or vent. If single-wall and Type B double-wall metal pipe are used for vent connectors, the common vent must be sized using Table 4.
- 31) Locate draft hood outlet or flue collar of smallest input appliance closest to or under common vent.
- 32) When vent table permits more than one diameter of pipe to be used for a connector or vent, the smallest permitted diameter should be preferred.

TYPICAL VENTING APPLICATIONS



VENTING

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

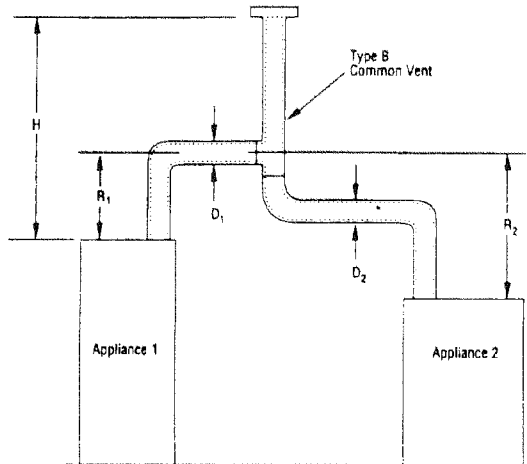


FIGURE 5

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

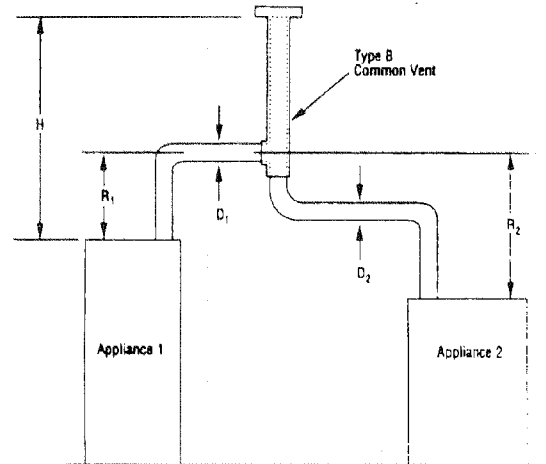


FIGURE 6

Schematic Diagram showing a typical manifolded common vent section "L" of the vent connector. (See Note 5)

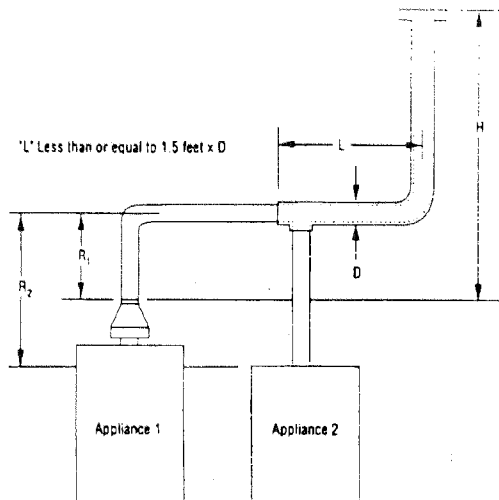


FIGURE 7

Schematic Diagram showing offset in the common vent section of the vertical vent. (See Note 6)

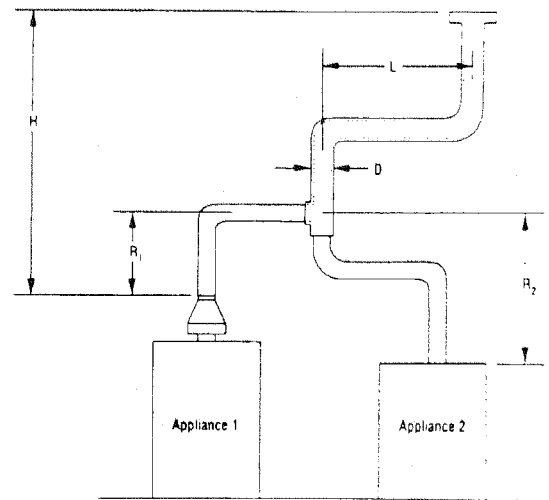


FIGURE 8

VENTING

Table 5 shall be used when a Type B, double-wall vent connector is attached to a tile lined masonry chimney.

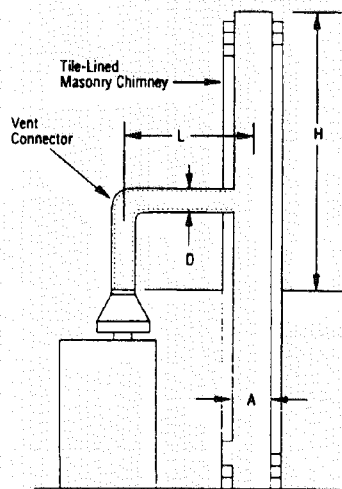


FIGURE 9

Table 6 shall be used when a single-wall metal vent connector is attached to a tile lined masonry chimney.

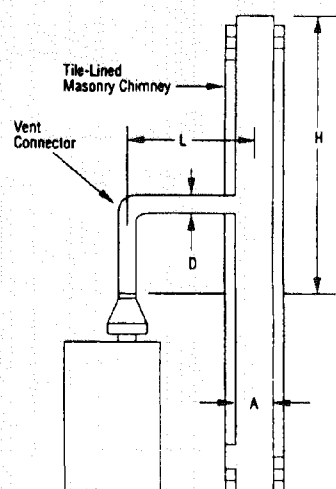


FIGURE 10

Table 7 shall be used when Type B double wall vent connectors are attached to a tile lined masonry chimney.

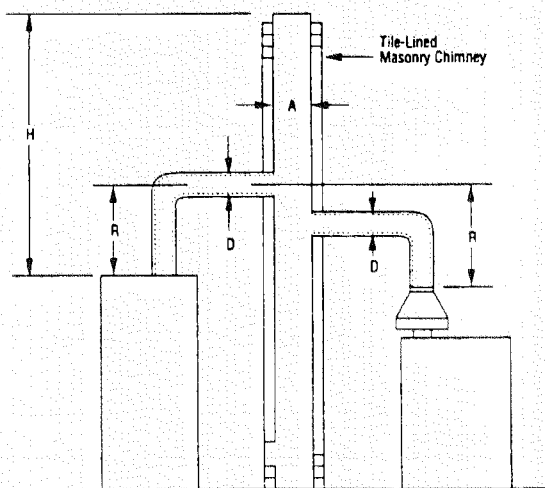


FIGURE 11

Table 8 shall be used when single-wall metal vent connectors are attached to a tile lined masonry chimney.

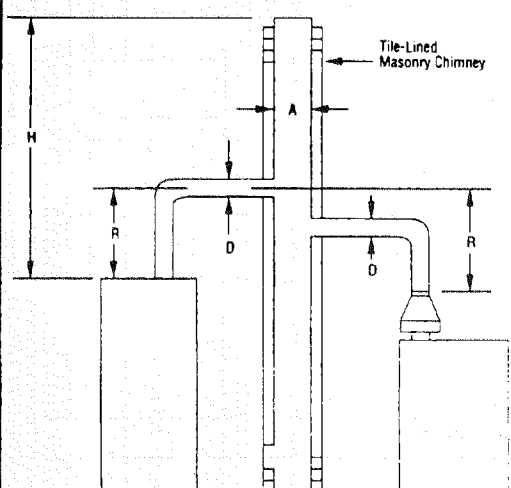


FIGURE 12

VENTING

VENT TABLES

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

TABLE 1

Height H (ft)		Vent and Connector Diameter - D (inches)																				
		3"			4"			5"			6"			7"			8"			9"		
		Appliance Input Rating in Thousands of Btu Per Hour																				
Lateral L (ft)	FAN Min	FAN Max	NAT Max	FAN Min	FAN Max	NAT Max	FAN Min	FAN Max	NAT Max	FAN Min	FAN Max	NAT Max	FAN Min	FAN Max	NAT Max	FAN Min	FAN Max	NAT Max	FAN Min	FAN Max	NAT 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
20	15	35	53	37	48	112	76	61	195	128	76	301	198	98	429	275	115	580	373	134	755	491
	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
30	10	28	64	44	38	133	89	50	229	150	62	351	228	81	499	321	95	675	443	112	877	576
	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	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
100	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
	50	NR	NR	NR	69	131	NR	84	250	NR	99	410	259	123	605	376	141	844	522	161	1125	670
200	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
300	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

VENTING

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 (Inches)																															
				10"		12"		14"		16"		18"		20"		22"		24"																	
				FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT				
Min			Max			Min			Max			Min			Max			Min			Max			Min			Max			Min			Max		
Appliance Input Rating in Thousands of Btu Per Hour																																			
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										
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											
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											
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											
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										
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											
5	115	758	503	154	1110	733	199	1528	1010	251	2013	1330	311	2563	1685	398	3180	2090	476	3863	2545	562	4612	3040											
8	137	746	490	180	1097	720	231	1514	1000	289	2000	1320	354	2552	1670	450	3163	2070	537	3850	2530	630	4602	3030											
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										
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											
5	112	839	547	149	1229	829	192	1696	1105	243	2238	1461	300	2849	1871	382	3536	2318	458	4301	2818	540	5132	3371											
10	142	817	525	187	1204	795	238	1669	1080	298	2209	1430	364	2818	1840	459	3504	2280	546	4268	2780	641	5099	3340											
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										
2	63	1019	675	86	1495	985	114	2062	1350	147	2719	1770	186	3467	2260	239	4304	2800	290	5232	3410	346	6251	4080											
5	105	1003	660	140	1476	967	182	2041	1327	229	2696	1748	283	3442	2235	355	4278	2777	426	5204	3385	501	6222	4057											
10	135	977	635	177	1446	936	227	2009	1289	283	2659	1712	346	3402	2193	432	4234	2739	510	5159	3343	599	6175	4019											
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											
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										
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											
5	101	1133	738	135	1674	1079	174	2320	1498	219	3071	1978	270	3926	2544	337	4885	3174	403	5950	3880	475	7119	4662											
10	130	1105	710	172	1641	1045	220	2282	1460	273	3029	1940	334	3880	2500	413	4835	3130	489	5896	3830	573	7063	4600											
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											
20	167	1052	665	217	1578	990	273	2210	1390	335	2948	1880	404	3791	2430	495	4737	3050	585	5792	3760	689	6953	4550											
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										
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											
5	96	1332	851	127	1981	1289	164	2759	1775	206	3666	2350	252	4701	3020	312	5863	3783	373	7155	4622	439	8574	5552											
10	125	1301	829	164	1944	1254	209	2716	1733	259	3617	2300	316	4647	2970	386	5803	3739	456	7090	4574	535	8505	5471											
15	143	1272	807	187	1908	1220	237	2674	1692	292	3570	2250	354	4594	2920	431	5744	3695	507	7026	4527	590	8437	5319											
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											
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											
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										
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											
5	90	1600	996	118	2406	1495	151	3380	2102	191	4520	2813	234	5826	3639	283	7295	4597	336	8933	5654	394	10737	6818											
10	118	1567	972	154	2366	1466	196	3332	2064	243	4464	2767	295	5763	3585	355	7224	4542	419	8855	5585	491	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											
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											
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											
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										
2	30	1975	1190	44	3027	1820	72	4313	2550	95	5834	3500	120	7591	4600	138	9577	5800	169	11803	7200	204	14264	8800											
5	82	1955	1159	107	3002	1803	136	4282	2531	172	5797	3475	208	7548	4566	245	9528	5769	293	11748	7162	341	14204	8756											
10	108	1923	1142	142	2961	1775	180	4231	2500	223	5737	3434	268	7478	4509	318	9447	5717	374	11658	7100	436	14105	8683											
15	126	1892	1124	163	2920	1747	206	4182	2469	252	5678	3392	304	7409	4451	358	9367	5665	418	11569	7037	487	14007	8610											
20	141	1861	1107	181	2880	1719	226	4133	2438	277	5619	3351	330	7341	4394	387	9289	5613	452	11482	6975	523	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											
50	241	1688	1000	292	2657	1550	350	3856	2250	415	5289	3100	486	6956	4050	572	8841	5300	659	10979	6600	752	13354	8100											

VENTING

VENT TABLES

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

TABLE 2

Height H (ft)		Lateral L (ft)		Vent and Connector Diameter - D (Inches)												Appliance Input Rating In Thousands of Btu Per Hour																				
				3"	4"	5"	6"	7"	8"	9"	10"	12"																								
				Appliance Input Rating In Thousands of Btu Per Hour																																
				FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT			FAN		
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	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	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							
	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							
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							
	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							
50	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							
	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							
100	0		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							
	2		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							
	5		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							
	10		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
200	0		NR	NR	NR	49	214	NR	69	403	NR	100	659	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							
	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							
500	0		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							
	2		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							
	5		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							
	10		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

VENTING

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 (inches)																								
				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	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	411			
	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	494			
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 (inches)																				
	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	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

VENTING

VENT TABLES

TABLE 3 (cont'd)

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

Vent Connector Capacity

Vent Height H (ft)		Connector Rise R (ft)		Vent Connector Diameter - D (Inches)																											
				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		
		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	2	174	764	496	223	1046	653	281	1371	853	346	1772	1080	NA	NA	NA	NA	NA	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	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	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	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	662	3957	2590	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	669	4373	3130	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	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	686	4175	2710	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	694	4593	3270	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	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	734	4631	2960	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	743	5035	3600	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	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	772	5005	3130	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	785	5392	3790	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	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	847	5606	3410	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	860	5961	4150	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	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	851	6633	3790	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	867	6943	4620	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	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	769	8650	3950	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	786	8892	4810	786	8892	4810			

Common Vent Capacity

Vent Height H (ft)	Common Vent Diameter - D (Inches)																				
	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

VENTING

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 (inches)																																																	
				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										
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 (inches)																							
	4"			5"			6"			7"			8"			9"			10"					
	Combined Appliance Input Rating in Thousands of Btu Per Hour																							
	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT
	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+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	395	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			

VENT TABLES

Capacity of Masonry Chimney with Type B Double-Wall Vent Connectors
Serving a Single Category I Appliance

TABLE 5

Height H (ft)		Lateral L (ft)		Connector Diameter - D (Inches) To be used with chimney areas within the size limits at bottom																														
				3"			4"			5"			6"			7"			8"			9"			10"			12"						
				Appliance Input Rating 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	Min	Max	Max	Min	Max	Max
6	2	NR	NR	28	NR	NR	52	NR	NR	86	NR	NR	130	NR	NR	180	NR	NR	247	NR	NR	320	NR	NR	401	NR	NR	581	NR	NR	724	NR	NR	896
	5	NR	NR	25*	NR	NR	49	NR	NR	82	NR	NR	117	NR	NR	165	NR	NR	231	NR	NR	298	NR	NR	376	NR	NR	561	NR	NR	712	NR	NR	888
10	2	NR	NR	31	NR	NR	61	NR	NR	103	NR	NR	162	NR	NR	221	NR	NR	298	NR	NR	388	NR	NR	491	NR	NR	724	NR	NR	912	NR	NR	1152
	5	NR	NR	28*	NR	NR	57	NR	NR	96	NR	NR	148	NR	NR	204	NR	NR	277	NR	NR	365	NR	NR	466	NR	NR	712	NR	NR	900	NR	NR	1128
	10	NR	NR	25*	NR	NR	50*	NR	NR	87	NR	NR	139	NR	NR	181	NR	NR	263	NR	NR	347	NR	NR	444	NR	NR	668	NR	NR	856	NR	NR	1088
15	2	NR	NR	35*	NR	NR	67	NR	NR	114	NR	NR	179	NR	NR	250	NR	NR	336	NR	NR	441	NR	NR	562	NR	NR	841	NR	NR	1088	NR	NR	1392
	5	NR	NR	33*	NR	NR	62	NR	NR	107	NR	NR	164	NR	NR	231	NR	NR	313	NR	NR	416	NR	NR	533	NR	NR	828	NR	NR	1056	NR	NR	1376
	10	NR	NR	28*	NR	NR	55*	NR	NR	97	NR	NR	153	NR	NR	216	NR	NR	296	NR	NR	394	NR	NR	567	NR	NR	777	NR	NR	1008	NR	NR	1320
	15	NR	NR	NR	NR	NR	48*	NR	NR	89*	NR	NR	141	NR	NR	201	NR	NR	281	NR	NR	375	NR	NR	485	NR	NR	742	NR	NR	960	NR	NR	1248
20	2	NR	NR	38*	NR	NR	74	NR	NR	124	NR	NR	201	NR	NR	274	NR	NR	375	NR	NR	491	NR	NR	627	NR	NR	953	NR	NR	1232	NR	NR	1584
	5	NR	NR	36*	NR	NR	68*	NR	NR	116	NR	NR	184	NR	NR	254	NR	NR	350	NR	NR	463	NR	NR	597	NR	NR	933	NR	NR	1216	NR	NR	1560
	10	NR	NR	NR	NR	NR	60*	NR	NR	107*	NR	NR	172	NR	NR	237	NR	NR	332	NR	NR	440	NR	NR	566	NR	NR	879	NR	NR	1128	NR	NR	1472
	15	NR	NR	NR	NR	NR	NR	NR	NR	97*	NR	NR	159	NR	NR	220	NR	NR	314	NR	NR	418	NR	NR	541	NR	NR	840	NR	NR	1080	NR	NR	1440
	20	NR	NR	NR	NR	NR	NR	NR	NR	83*	NR	NR	148*	NR	NR	206	NR	NR	296	NR	NR	397	NR	NR	513	NR	NR	807	NR	NR	1040	NR	NR	1360
30	2	NR	NR	41*	NR	NR	82*	NR	NR	137	NR	NR	216	NR	NR	303	NR	NR	421	NR	NR	558	NR	NR	717	NR	NR	1112	NR	NR	1440	NR	NR	1872
	5	NR	NR	NR	NR	NR	76*	NR	NR	128*	NR	NR	198	NR	NR	281	NR	NR	393	NR	NR	526	NR	NR	683	NR	NR	1094	NR	NR	1408	NR	NR	1824
	10	NR	NR	NR	NR	NR	67*	NR	NR	115*	NR	NR	184*	NR	NR	263	NR	NR	373	NR	NR	500	NR	NR	648	NR	NR	1025	NR	NR	1320	NR	NR	1712
	15	NR	NR	NR	NR	NR	NR	NR	NR	107*	NR	NR	171*	NR	NR	243*	NR	NR	353	NR	NR	476	NR	NR	621	NR	NR	981	NR	NR	1272	NR	NR	1656
	20	NR	NR	NR	NR	NR	NR	NR	NR	91*	NR	NR	159*	NR	NR	227*	NR	NR	332	NR	NR	450	NR	NR	592	NR	NR	940	NR	NR	1216	NR	NR	1584
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	188*	NR	NR	288*	NR	NR	416	NR	NR	555	NR	NR	877	NR	NR	1136	NR	NR	1488
50	2	NR	NR	NR	NR	NR	92*	NR	NR	161*	NR	NR	251*	NR	NR	351*	NR	NR	477	NR	NR	633	NR	NR	812	NR	NR	1243	NR	NR	1600	NR	NR	2080
	5	NR	NR	NR	NR	NR	NR	NR	NR	151*	NR	NR	230*	NR	NR	323*	NR	NR	445	NR	NR	596	NR	NR	774	NR	NR	1225	NR	NR	1584	NR	NR	2016
	10	NR	NR	NR	NR	NR	NR	NR	NR	138*	NR	NR	215*	NR	NR	304*	NR	NR	424*	NR	NR	567	NR	NR	733	NR	NR	1147	NR	NR	1488	NR	NR	1920
	15	NR	NR	NR	NR	NR	NR	NR	NR	127*	NR	NR	199*	NR	NR	282*	NR	NR	400*	NR	NR	539*	NR	NR	702	NR	NR	1099	NR	NR	1440	NR	NR	1840
	20	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	185*	NR	NR	264*	NR	NR	376*	NR	NR	511*	NR	NR	669*	NR	NR	1050	NR	NR	1392	NR	NR	1776
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	327*	NR	NR	468*	NR	NR	623*	NR	NR	984	NR	NR	1296	NR	NR	1680
Minimum Internal Area of Chimney Square Inches		12			19			28			38			50			63			78			95			132								
Maximum Internal Area of Chimney Square Inches		49			88			137			198			269			352			445			550			792								

VENTING

VENT TABLES

Capacity of Masonry Chimney with Single-Wall Vent Connectors
Serving a Single Category I Appliance

TABLE 6

Height H (ft)		Lateral L (ft)		Connector Diameter - D (Inches) To be used with chimney areas within the size limits at bottom																																							
				3"		4"		5"		6"		7"		8"		9"		10"		12"																							
				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	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max						
6	2	NR	NR	28	NR	NR	52	NR	NR	86	NR	NR	130	NR	NR	180	NR	NR	247	NR	NR	319	NR	NR	400	NR	NR	580															
	5	NR	NR	25*	NR	NR	48	NR	NR	81	NR	NR	116	NR	NR	164	NR	NR	230	NR	NR	297	NR	NR	375	NR	NR	560															
10	2	NR	NR	31	NR	NR	61	NR	NR	102	NR	NR	161	NR	NR	220	NR	NR	297	NR	NR	387	NR	NR	490	NR	NR	722															
	5	NR	NR	28*	NR	NR	56	NR	NR	95	NR	NR	147	NR	NR	203	NR	NR	276	NR	NR	364	NR	NR	463	NR	NR	710															
	10	NR	NR	24*	NR	NR	49*	NR	NR	86	NR	NR	137	NR	NR	189	NR	NR	261	NR	NR	345	NR	NR	441	NR	NR	665															
15	2	NR	NR	35*	NR	NR	67	NR	NR	113	NR	NR	178	NR	NR	249	NR	NR	335	NR	NR	440	NR	NR	560	NR	NR	840															
	5	NR	NR	32*	NR	NR	61	NR	NR	106	NR	NR	163	NR	NR	230	NR	NR	312	NR	NR	414	NR	NR	531	NR	NR	825															
	10	NR	NR	27*	NR	NR	54*	NR	NR	96	NR	NR	151	NR	NR	214	NR	NR	294	NR	NR	392	NR	NR	504	NR	NR	774															
	15	NR	NR	NR	NR	NR	46*	NR	NR	87*	NR	NR	138	NR	NR	198	NR	NR	278	NR	NR	372	NR	NR	481	NR	NR	738															
20	2	NR	NR	38*	NR	NR	73	NR	NR	123	NR	NR	200	NR	NR	273	NR	NR	374	NR	NR	490	NR	NR	625	NR	NR	950															
	5	NR	NR	35*	NR	NR	67*	NR	NR	115	NR	NR	183	NR	NR	252	NR	NR	348	NR	NR	461	NR	NR	594	NR	NR	930															
	10	NR	NR	NR	NR	NR	59*	NR	NR	105*	NR	NR	170	NR	NR	235	NR	NR	330	NR	NR	437	NR	NR	562	NR	NR	875															
	15	NR	NR	NR	NR	NR	NR	NR	NR	95*	NR	NR	156	NR	NR	217	NR	NR	311	NR	NR	414	NR	NR	536	NR	NR	835															
	20	NR	NR	NR	NR	NR	NR	NR	NR	80*	NR	NR	144*	NR	NR	202	NR	NR	292	NR	NR	392	NR	NR	510	NR	NR	800															
30	2	NR	NR	41*	NR	NR	81*	NR	NR	136	NR	NR	215	NR	NR	302	NR	NR	420	NR	NR	556	NR	NR	715	NR	NR	1110															
	5	NR	NR	NR	NR	NR	75*	NR	NR	127*	NR	NR	196	NR	NR	279	NR	NR	391	NR	NR	524	NR	NR	680	NR	NR	1090															
	10	NR	NR	NR	NR	NR	66*	NR	NR	113*	NR	NR	182*	NR	NR	260	NR	NR	370	NR	NR	496	NR	NR	644	NR	NR	1020															
	15	NR	NR	NR	NR	NR	NR	NR	NR	105*	NR	NR	168*	NR	NR	240*	NR	NR	349	NR	NR	471	NR	NR	615	NR	NR	975															
	20	NR	NR	NR	NR	NR	NR	NR	NR	88*	NR	NR	155*	NR	NR	223*	NR	NR	327	NR	NR	443	NR	NR	585	NR	NR	932															
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	182*	NR	NR	281*	NR	NR	408	NR	NR	544	NR	NR	865															
50	2	NR	NR	NR	NR	NR	91*	NR	NR	160*	NR	NR	250*	NR	NR	350*	NR	NR	475	NR	NR	631	NR	NR	810	NR	NR	1240															
	5	NR	NR	NR	NR	NR	NR	NR	NR	149*	NR	NR	228*	NR	NR	321*	NR	NR	442	NR	NR	593	NR	NR	770	NR	NR	1220															
	10	NR	NR	NR	NR	NR	NR	NR	NR	136*	NR	NR	212*	NR	NR	301*	NR	NR	420*	NR	NR	562	NR	NR	728	NR	NR	1140															
	15	NR	NR	NR	NR	NR	NR	NR	NR	124*	NR	NR	195*	NR	NR	278*	NR	NR	395*	NR	NR	533*	NR	NR	695	NR	NR	1090															
	20	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	180*	NR	NR	258*	NR	NR	370*	NR	NR	504*	NR	NR	660*	NR	NR	1040															
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	318*	NR	NR	458*	NR	NR	610*	NR	NR	970																	
Minimum Internal Area of Chimney Square Inches		12		19		28		38		50		63		78		95		132																									
Maximum Internal Area of Chimney Square Inches		49		88		137		198		269		352		445		550		792																									

* SEE NOTE 27

VENTING

VENTING

VENT TABLES

Capacity of Masonry Chimney with Type B Double-Wall Connectors
Serving two or more Category I Appliances

TABLE 7

Vent Connector Capacity

Vent Height H (ft)		Connector Rise R (ft)		Vent Connector Diameter - D (Inches)																							
				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	24	NR	21	39	62	40	52	106	67	65	194	101	87	274	141	104	370	201	124	479	253	145	599	319		
	2	26	43	28	41	79	52	53	133	85	67	230	124	89	324	173	107	436	232	127	562	330	148	694	378		
	3	27	49	34	42	92	61	55	155	97	69	262	143	91	369	203	109	491	270	129	633	349	151	795	439		
15	1	24	48	23	38	93	44	54	154	74	72	277	114	100	384	174	125	511	229	153	658	297	184	824	375		
	2	25	55	31	39	105	55	56	174	89	74	299	134	103	419	192	128	558	260	156	718	339	187	900	432		
	3	26	59	35	41	115	64	57	189	102	76	319	153	105	448	215	131	597	292	159	760	382	190	960	486		
30	1	24	54	25	37	111	48	52	192	82	69	357	127	96	504	187	119	680	255	145	883	337	175	1115	432		
	2	25	60	32	38	122	58	54	208	95	72	376	145	99	531	209	122	715	287	149	928	378	179	1171	484		
	3	26	64	36	40	131	66	56	221	107	74	392	163	101	554	233	125	746	317	152	968	418	182	1220	535		
50	1	23	52	26	36	116	49	51	209	82	67	405	133	92	582	198	115	798	271	140	1049	362	168	1334	462		
	2	24	59	31	37	127	58	53	225	96	70	421	152	95	604	222	118	827	304	143	1085	400	172	1379	510		
	3	26	64	37	39	135	66	55	237	108	72	435	170	98	624	247	121	854	334	147	1118	439	176	1421	558		

Common Vent Capacity

Vent Height H (ft)	Minimum Internal Area of Chimney, Square Inches																							
	12			19			28			38			50			63			78			113		
	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	NR	74	25	NR	119	46	NR	178	71	NR	257	103	NR	351	143	NR	458	188	NR	582	246	NR	853	NR
8	NR	80	28	NR	130	53	NR	193	82	NR	279	119	NR	384	163	NR	501	218	NR	636	278	NR	937	408
10	NR	84	31	NR	138	56	NR	207	90	NR	299	131	NR	409	177	NR	538	236	NR	686	302	NR	1010	454
15	NR	90	36	NR	152	67	NR	233	106	NR	334	152	NR	467	212	NR	611	283	NR	781	365	NR	1156	546
20	NR	92	41	NR	159	75	NR	250	122	NR	368	172	NR	508	243	NR	668	325	NR	858	419	NR	1286	648
30	NR	NR	NR	NR	NR	NR	NR	270	137	NR	404	198	NR	564	278	NR	747	381	NR	969	496	NR	1473	749
50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	620	328	NR	831	461	NR	1089	606	NR	1692	922

VENTING

VENT TABLES

Capacity of Masonry Chimney with Single-Wall Connectors
Serving two or more Category I Appliances

TABLE 8

Vent Connector Capacity

Vent Height H (ft)		Connector Rise R (ft)		Vent Connector Diameter - D (Inches)																					
				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	Min	Max	Max					
6	1	NR	NR	21	NR	NR	39	NR	NR	66	179	191	100	231	271	140	292	366	200	362	474	252	499	594	283
	2	NR	NR	28	NR	NR	52	NR	NR	84	186	227	123	239	321	172	301	432	231	373	557	299	509	696	331
	3	NR	NR	34	NR	NR	61	134	153	97	193	258	142	247	365	202	309	491	269	381	634	344	519	793	375
15	1	NR	NR	23	NR	NR	43	129	151	73	199	271	112	268	376	171	349	502	225	445	646	291	623	808	360
	2	NR	NR	30	92	103	54	135	170	88	207	295	132	277	411	189	359	548	256	456	706	334	634	884	402
	3	NR	NR	34	96	112	63	141	185	101	215	315	151	286	439	213	368	586	289	466	755	378	646	945	437
30	1	NR	NR	24	86	108	47	126	187	80	193	347	124	259	492	183	338	665	250	430	864	330	600	1089	455
	2	NR	NR	31	91	119	57	132	203	93	201	366	142	269	518	205	348	699	282	442	908	372	613	1145	490
	3	NR	NR	35	95	127	65	138	216	105	209	381	160	277	540	229	358	729	312	452	946	412	626	1193	521
50	1	NR	NR	25	85	113	48	124	204	80	188	392	130	252	567	194	328	778	265	417	1022	355	582	1302	537
	2	NR	NR	31	89	123	57	130	218	94	196	408	149	262	588	218	339	806	294	429	1058	393	596	1346	567
	3	NR	NR	35	94	131	65	136	231	106	205	422	167	271	607	243	349	831	328	440	1090	431	610	1386	595

Common Vent Capacity

Vent Height H (ft)	Minimum Internal Area of Chimney, Square Inches																							
	12			19			28			38			50			63			78			113		
	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	NR	73	25	NR	118	45	NR	176	71	NR	255	102	NR	348	142	NR	455	187	NR	579	245	NR	846	NR
8	NR	79	28	NR	128	52	NR	190	81	NR	276	118	NR	380	162	NR	497	217	NR	633	277	NR	928	405
10	NR	83	31	NR	136	56	NR	205	89	NR	295	129	NR	405	175	NR	532	234	NR	680	300	NR	1000	450
15	NR	88	36	NR	149	66	NR	230	105	NR	335	150	NR	460	210	NR	602	280	NR	772	360	NR	1139	540
20	NR	90	40	NR	157	74	NR	247	120	NR	362	170	NR	503	240	NR	661	321	NR	849	415	NR	1264	640
30	NR	NR	NR	NR	NR	NR	NR	266	135	NR	398	193	NR	558	275	NR	739	377	NR	957	490	NR	1447	740
50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	612	325	NR	821	456	NR	1076	600	NR	1672	910

VENTING

TABLE 9

**MASONRY CHIMNEY LINER DIMENSIONS
WITH CIRCULAR EQUIVALENTS**

NOMINAL LINER SIZE INCHES	INSIDE DIMENSIONS IN LINER INCHES	INSIDE DIA. OR EQUIVALENT DIA. INCHES	EQUIVALENT AREA SQ. INCHES
4 x 8	2 1/2 x 6 1/2	4	12.2
		5	19.6
		6	28.3
		7	38.3
8 x 8	6 3/4 x 6 3/4	7.4	42.7
		8	50.3
8 x 12	6 1/2 x 10 1/2	9	63.6
		10	78.5
12 x 12	9 3/4 x 9 3/4	10.4	83.3
		11	95
12 x 16	9 1/2 x 13 1/2	11.8	107.5
		12	113
		14	153.9
16 x 16	13 1/4 x 13 1/4	14.5	162.9
		15	176.7
16 x 20	13 x 17	16.2	206.1
		18	254.4
20 x 20	16 3/4 x 16 3/4	18.2	260.2
		20	314.1
20 x 24	16 1/2 x 20 1/2	20.1	314.2
		22	380.1
24 x 24	20 1/4 x 20 1/4	22.1	380.1
		24	452.3
24 x 28	20 1/2 x 24 1/4	24.1	456.2
28 x 28	24 1/4 x 24 1/4	26.4	543.3
		27	572.5
30 x 30	25 1/2 x 25 1/2	27.9	607
		30	706.8
30 x 36	25 1/2 x 31 1/2	30.9	749.9
		33	855.3
36 x 36	31 1/2 x 31 1/2	34.4	929.4
		36	1017.9

When liner sizes differ dimensionally from those shown in Table 9 equivalent diameters may be determined from published tables for square and rectangular ducts of equivalent carrying capacity or by other engineering methods.

VENTING

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

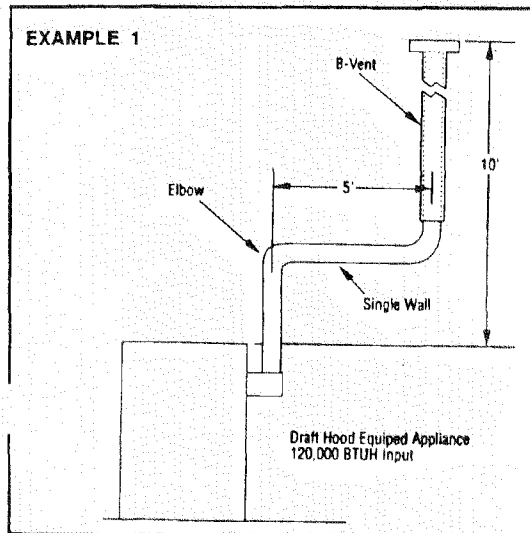
Table 2 should be used to solve this problem because single-wall metal vent connectors are being used with a Type B vent. Refer to Figure 4 of Typical Applications.

- 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.
- 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 3). 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

$186,000 \times .90 = 167,000$; This is greater than the required 120,000, therefore use a 6" Vent and connector when three elbows are used.



Example 2: Single Fan-Assisted Appliance

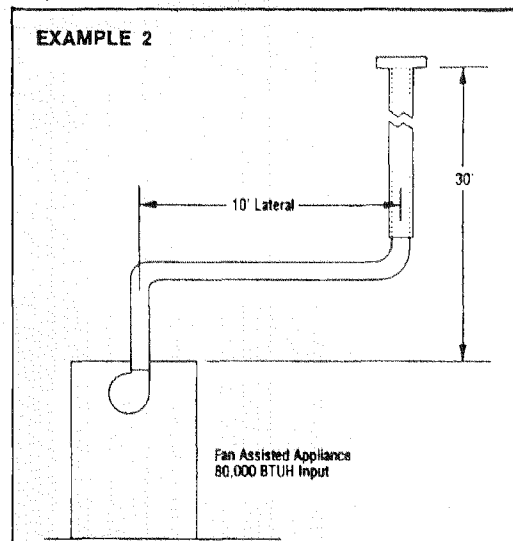
Suppose an installer has an 80,000 Btu/hr input fan-assisted appliance that must be installed using 10 feet of lateral connector attached to a 30-Ft high Type B vent. Two 90° elbows are needed for the installation. Can a single-wall metal vent connector be used for this application?

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.



VENTING

EXAMPLES USING COMMON VENTING TABLES

Example 3: Common Venting Two Draft-Hood Appliances

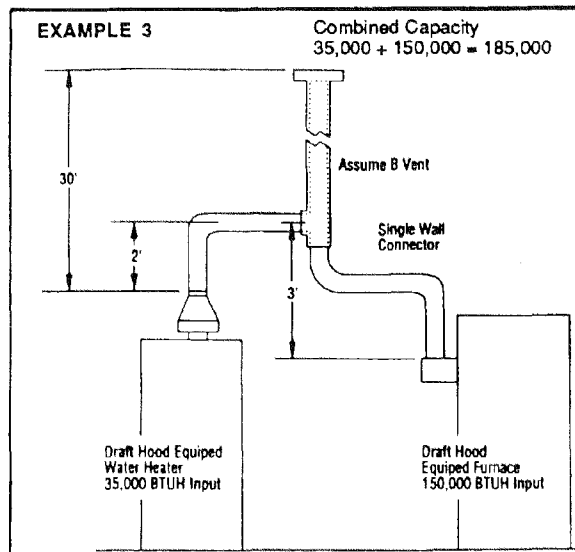
Suppose a 35,000 Btu/hr water heater is to be common vented with a 150,000 Btu/hr furnace using a common vent with a total height of 30 feet. The connector rise is 2 feet for the water heater and 3 feet for the furnace. Assume single-wall metal connectors will be used with Type B vent. What size connectors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

Solution - (Table 4 applies 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.



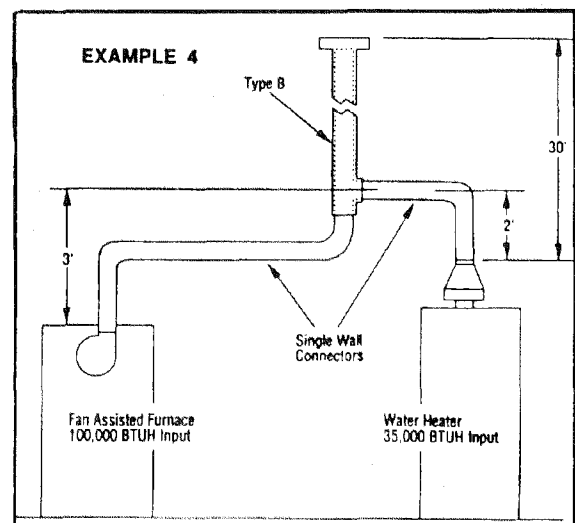
Example 4: Common Venting a Draft Hood Water Heater with a Fan-Assisted Furnace

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 30 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.



VENTING

EXAMPLES USING COMMON VENTING TABLES

Example 4: (cont'd)

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 135,000 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.

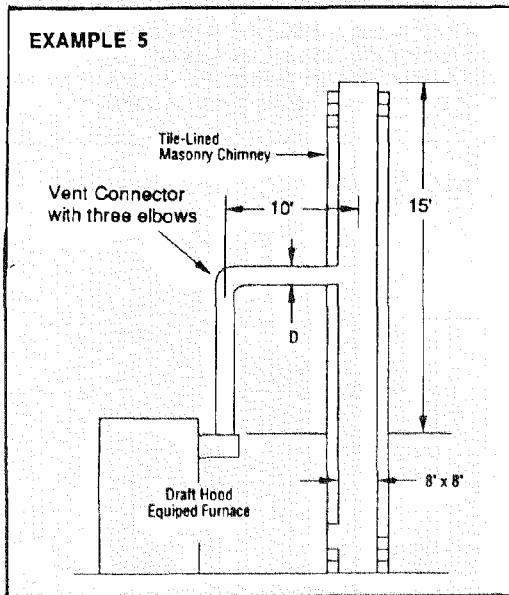
Summary. In this example, the installer may use a 3 inch diameter, single-wall metal vent connector for the water heater and a 4 inch diameter, single-wall metal vent connector for the furnace. The common vent should be a 5 inch diameter Type B vent.

Example 5: Single Draft Hood Equipped Furnace Vented into A Masonry Chimney

A 135,000 Btu/hr draft hood equipped furnace is to be vented into a 15' high tile lined masonry chimney. The chimney is not exposed to the outside except above the roof line. The furnace has a 6" diameter draft hood outlet and requires a 10' lateral vent connector with 3 elbows. The chimney is constructed using a 8" x 8" liner. What size single wall vent connector is required?

Solution:

Table 6 should be used. Refer to the figure for Example 5.



To determine the required vent connector diameter, read down the height column in Table 6 until 15' is found. Find the row for a 10' long lateral. The table shows that a 6" diameter connector will allow a maximum capacity of 151,000 Btu/hr for "Nat Max." (draft-hood equipped) furnace. Because 3 elbows are required, however, the maximum capacity must be reduced by 10% (See Note 3). Allowing for the additional elbow the corrected maximum capacity is 135,900 Btu/hr. A 6" diameter connector is large enough and should be used. The internal area of the chimney is 8" x 8" = 64 sq. in. and is within the acceptable range (38 sq. in. to 198 sq. in.) for a 6" vent connector as shown in Table 6.

Example 6: Common venting into a Masonry Chimney

In this case, a 35,000 Btu/hr input 4 inch diameter outlet draft hood-equipped water heater with 2 feet of connector rise and 4 feet of horizontal length is to be common vented with a 100,000 Btu/hr fan-assisted furnace with a 4 inch diameter flue collar, 3 feet of connector rise and 6 feet of horizontal length. The common vent is an 8 x 12 tile lined chimney that is 30 feet tall. What are the recommended vent diameters for each connector? Is this an acceptable installation?

Solution

Table 8 is used to size common venting installations involving single wall connectors into masonry chimneys.

Water Heater Vent Connector Diameter. Using Table 8, 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 of only 31,000 Btu/hr while a 4 inch vent connector has a maximum input of 57,000 Btu/hr. A 4 inch vent connector must therefore be used.

Furnace Vent Connector Diameter. Using Table 8 Vent Connector Capacity, read down the Total Vent Height "H" column to 30 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 127,000 Btu/hr and a minimum input rating of 95,000 Btu/hr. The 100,000 Btu/hr furnace in this example falls within this range, so a 4 inch connector is adequate.

VENTING

EXAMPLE 6: (cont'd)

Masonry Chimney. From Table 9, the Equivalent Area for a Nominal Liner size of 8 inches x 12 inches is 63.6 square inches. Using Table 8, Common Vent Capacity, read down the "Fan + Nat" column under the Minimum internal Area of Chimney value of 63 to the row for 30-ft height, to find a capacity value of 739,000 Btu/hr. The combined input rating of the furnace and water heater 135,000 Btu/hr, is less than the Table value, so this is an acceptable installation.

Note 19 requires the common vent area to be no greater than seven times the flow area of the smallest appliance outlet area. Both appliances in this installation use 4 inch diameter outlets. From Table 9, the Equivalent Area for an Inside Diameter of 4 inches is 12.2 square inches. Seven times 12.2 is 85.4, which is greater than 63.6, so this configuration is acceptable.

Note 1 specifies that the Table values are for vents or chimneys which are not exposed to the outdoors below the roofline. If the masonry chimney in this case were exposed below the roofline, then the appliance manufacturer, local gas utility, and/or authority having jurisdiction must be consulted.

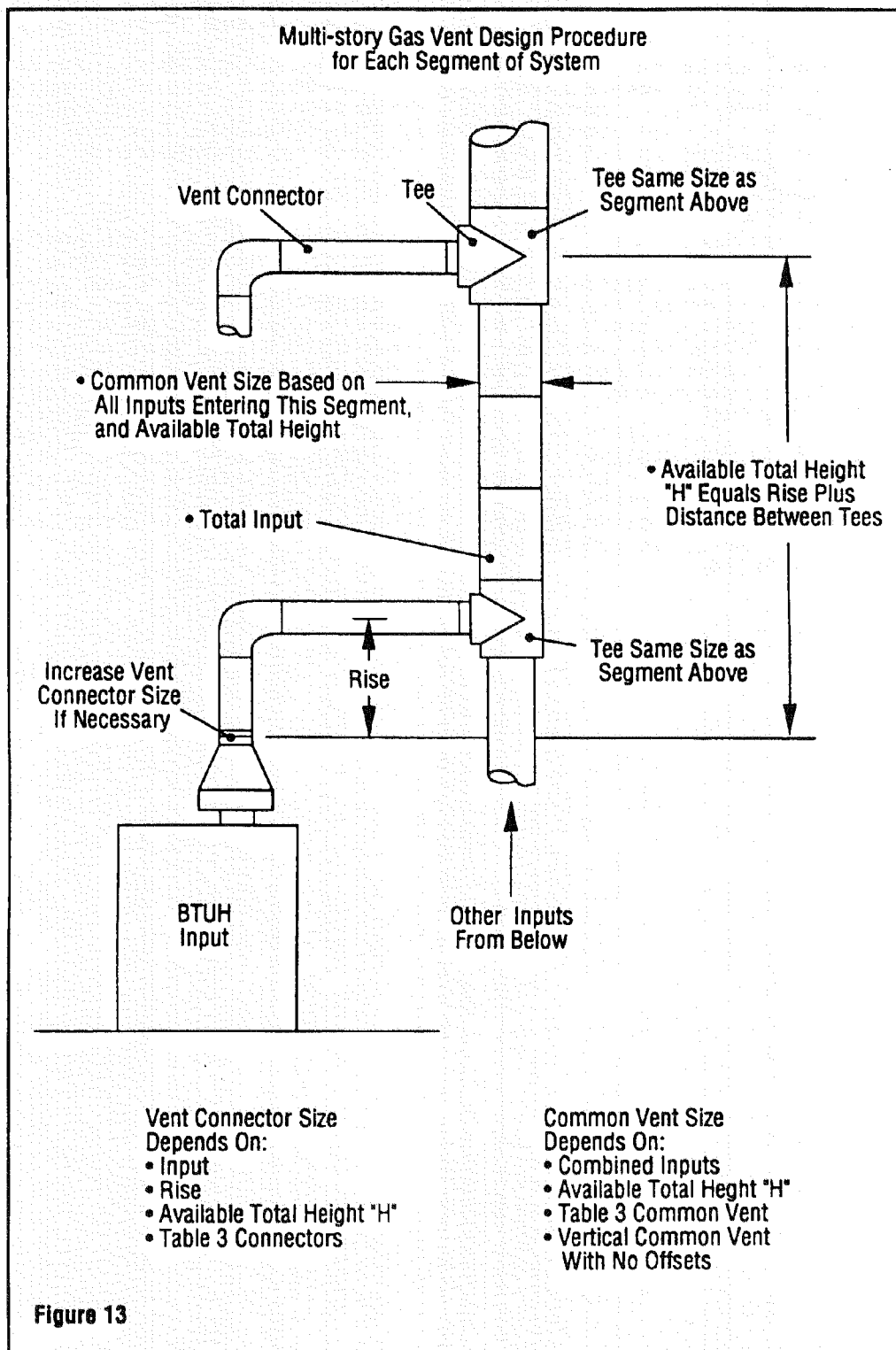
Example 7: Interpolating Between Table Values

An installer has an 80,000 Btu/hr input appliance with a 4 inch diameter draft hood outlet that needs to be vented into a 12-ft high Type B vent. The vent connector has a 5 ft lateral length and is also Type B. Can this appliance be vented using a 4 inch diameter vent?

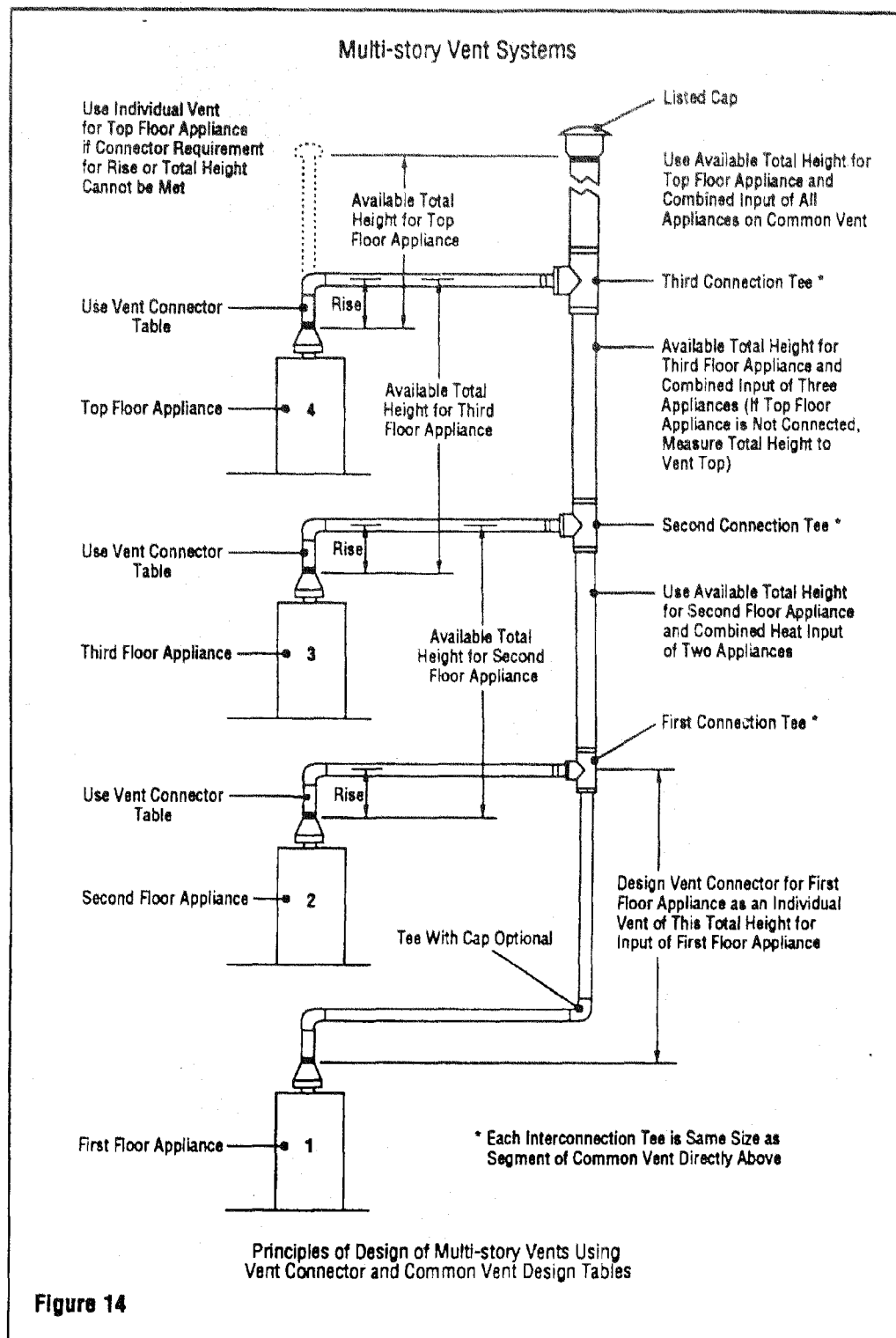
Solution

Table 1 is used in the case of an all Type B vent system. However, since there is no entry in Table 1 for height of 12 feet, interpolation must be used. Read down the 4 inch diameter "NAT Max" column to the row associated with 10 ft. height and 5 ft. lateral to find the capacity value of 77,000 Btu/hr. Go down further to the 15 ft. height, 5 ft. lateral row to find the capacity value of 87,000 Btu/hr. The difference between the 15 ft. height capacity value and the 10 ft. height capacity value is 10,000 Btu/hr. The capacity for a vent system with a 12 ft. height is equal to the capacity for a 10 ft. height plus $2/5$ of the difference between the 10 ft. and 15 ft. height values, or $77,000 + 2/5 \times 10,000 = 81,000$ Btu/hr. Therefore, a 4 inch diameter vent may be used in the installation.

VENTING



VENTING



HORIZONTAL VENTING

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 a horizontal furnace is shown in Figure 1, while

the upflow furnace's horizontal 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.

⚠ WARNING

TO AVOID THE POSSIBILITIES OF PERSONAL INJURY OR DEATH THIS SYSTEM IS ONLY TO BE USED WITH **ONE FURNACE**. COMMON VENTING WITH OTHER APPLIANCES IS NOT ALLOWED.

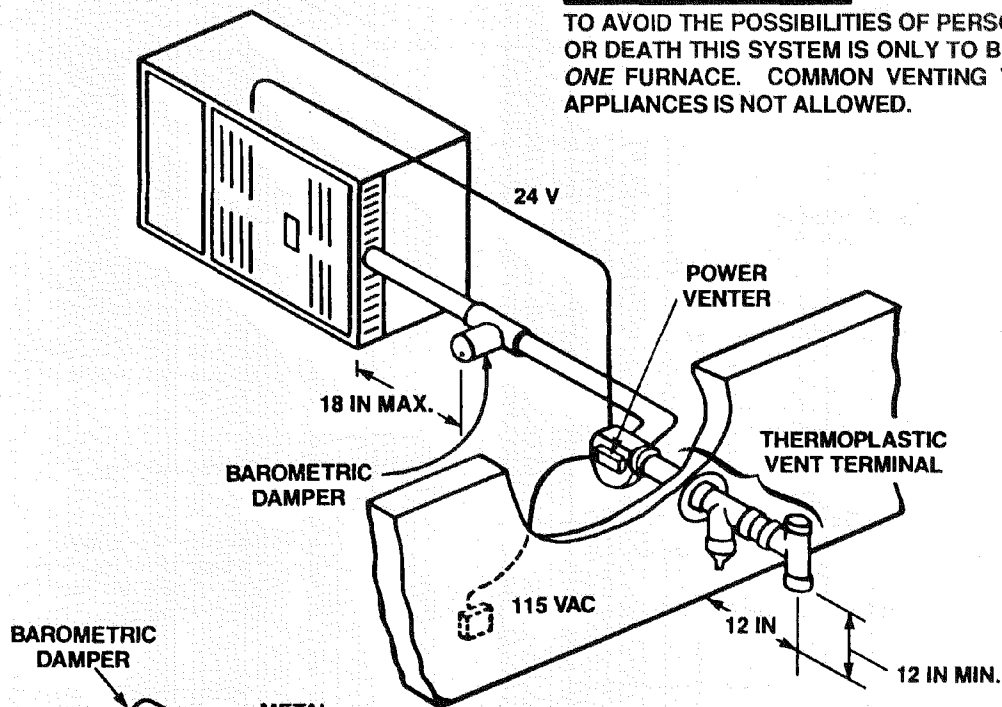


Figure 1. Horizontal Vent System for GSI Furnace

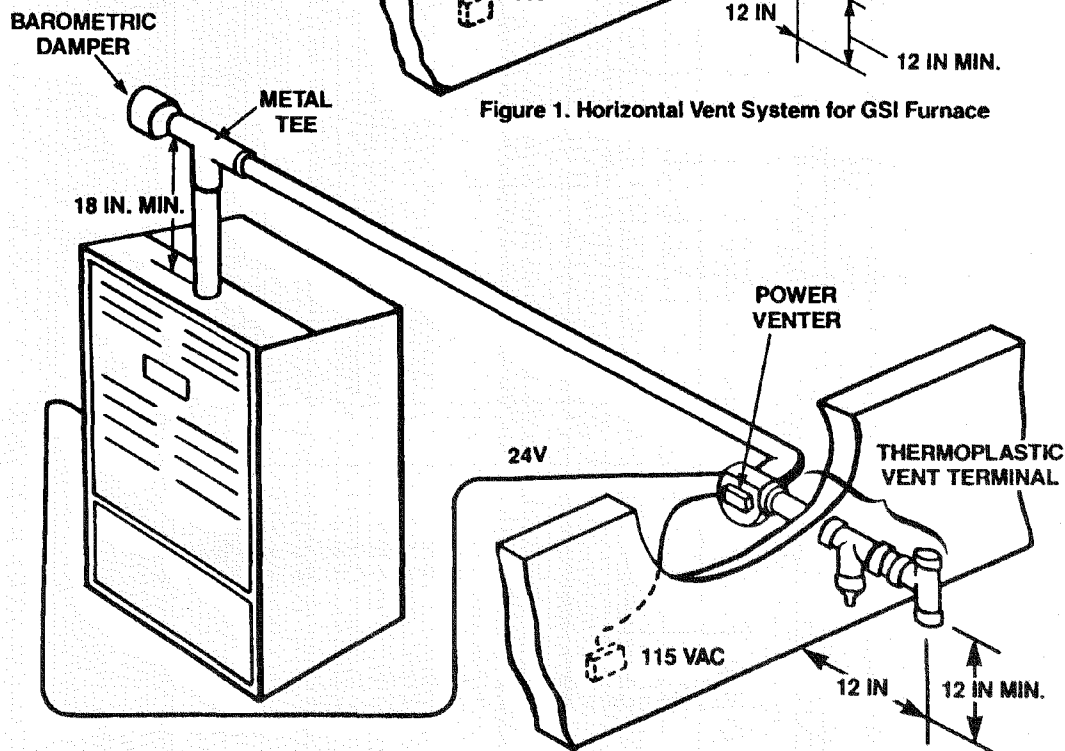


Figure 2. Horizontal Vent System for GUI/GHI Furnaces

HORIZONTAL VENTING

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 American 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 Pipe 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 4 for details.

AR = As required.

Vent Pipe Selection and 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 inlet located within 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 terminal 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.

HORIZONTAL VENTING

- 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.

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

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.

- Enter Table I 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 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 I, the maximum allowable length is 80 equivalent feet of 4" pipe, so 40.0 equivalent feet is acceptable.

TABLE I 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)

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

In Single wall metal pipe is to be used, the following requirements must be met:

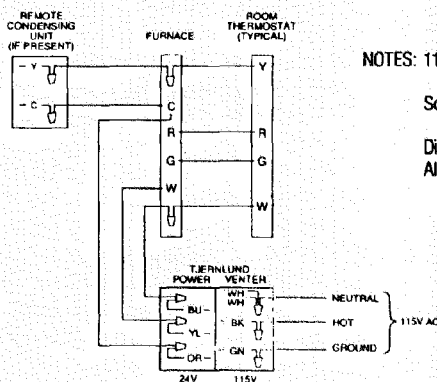
- The single-wall pipe must be located entirely in a space which will be heated to 60°F or higher.
- The single-wall pipe must have a straight length of 30 feet or less, an equivalent length of 80 feet or less as calculated above, and a diameter as shown in Table I.
- The single-wall pipe must not pass 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 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 I.
- The Type B vent must have 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

- 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.
- Mount the power venter according to the manufacturer's instructions.



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

Figure 3. Power Venter Wiring



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	1N/TAN
GN/GREEN	WH/WHITE

HORIZONTAL VENTING

3. Install the metal flue pipe and the single-acting barometric damper as shown in Figure 1 for horizontal furnaces or Figure 2 for upflow furnaces. The damper must connect to a horizontal tee off the flue pipe no more than 18 inches from the furnace outlet (horizontal furnaces), or at least 18 inches above the furnace outlet (upflow furnaces). Consult local building codes and manufacturers' instructions for proper installation procedures.

Installer may need to supply a transition piece from the larger diameter barometric damper to the smaller diameter tee.

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 operations 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. The furnace combustion relay is ener-

gized, and 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 24V 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 timer 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.

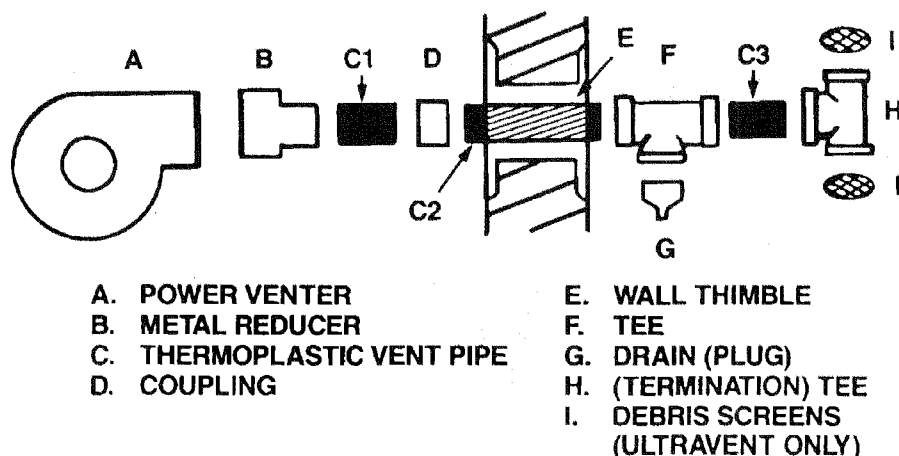


Figure 4. Vent Terminal Assembly

HORIZONTAL VENTING

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.

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

Vent Terminal Assembly



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

Assemble the vent terminal as shown in Figure 4, 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 so that the centerline 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).
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 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 vent 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 fireplace 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.



PERSONAL INJURY HAZARD. 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 the **WHEN AN EXISTING FURNACE...** section below.
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.

HORIZONTAL VENTING

WARNING

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.

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 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.

Power Venting System Maintenance (Qualified servicer only)

WARNING

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 outline 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 User's Informational manuals.

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

PRODUCT DESIGN

GAS SUPPLY AND PIPING

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

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

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

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

HIGH ALTITUDE DERATE (United States Installations Only)

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

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

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

High altitude kits can be purchased depending upon the altitude.

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

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

CAUTION

TO AVOID POSSIBLE UNSATISFACTORY OPERATION OR EQUIPMENT DAMAGE DUE TO UNDERFIRING OF EQUIPMENT, DO NOT UNDERSIZE THE NATURAL GAS PIPING FROM THE METER TO THE FURNACE. WHEN SIZING A TRUNK LINE PER THE TABLES, INCLUDE ALL APPLIANCES ON THAT LINE THAT COULD BE OPERATED SIMULTANEOUSLY.

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

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

LENGTH OF PIPE IN FEET	NOMINAL BLACK PIPE SIZE				
	1/2"	3/4"	1"	1 1/4"	1 1/2"
10	132	278	520	1050	1600
20	92	190	350	730	1100
30	73	152	285	590	980
40	63	130	245	500	760
50	56	115	215	440	670
60	50	105	195	400	610
70	46	96	180	370	560
80	43	90	170	350	530
90	40	84	160	320	490
100	38	79	150	305	460

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

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

CONNECTING THE GAS PIPING - NATURAL GAS

Refer to Installation Instructions for the general layout of the furnace. The following rules apply:

1. Use black iron or steel pipe and fittings for the building piping.
2. Use pipe joint compound on male threads only. Pipe joint compound must be resistant to the action of the fuel used.
3. Use ground joint unions. (Inside or outside of furnace.)
4. Install a drip leg to trap dirt and moisture before it can enter the gas valve. The drip leg must be a minimum of three inches long.
5. Use two pipe wrenches when making connection to the gas valve to keep it from turning.
6. Install a manual shutoff valve. This shutoff valve should be conveniently located within six (6) feet of the unit, and between the meter and unit.

PRODUCT DESIGN

7. Tighten all joints securely.
8. The furnace shall be connected to the building piping by one of the following.
 - a. Rigid metallic pipe and fittings.
 - b. Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
 - c. Listed gas appliance connectors used in accordance with the terms of their listing that are completely in the same room as the equipment.
 - d. In "b" and "c" above, the connector or tubing shall be installed so as to be protected against physical and thermal damage. Aluminum-alloy tubing and connectors shall be coated to protect against external corrosion where they are in contact with masonry, plaster, or insulation or are subject to repeated wettings by such liquids as water (except rain water), detergents, or sewage.

CHECKING THE GAS PIPING



TO AVOID THE POSSIBILITY OF PROPERTY DAMAGE, PERSONAL INJURY OR FIRE, THE FOLLOWING INSTRUCTIONS MUST BE PERFORMED REGARDING GAS CONNECTIONS AND PRESSURE TESTING.

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

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

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

TANKS AND PIPING - PROPANE UNITS



**PERSONAL INJURY HAZARD
IRON OXIDE (RUST) CAN REDUCE THE LEVEL OF ODORANT IN PROPANE GAS. A GAS DETECTING DEVICE IS THE ONLY RELIABLE METHOD TO DETECT A PROPANE GAS LEAK. CONTACT YOUR LOCAL PROPANE SUPPLIER ABOUT INSTALLING A GAS DETECTING WARNING DEVICE TO ALERT YOU IN THE EVENT THAT A GAS LEAK SHOULD DEVELOP.**

FAILURE TO DETECT A PROPANE GAS LEAK COULD RESULT IN AN EXPLOSION OR FIRE WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH.

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

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

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

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

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

Refer to Figure 13 for typical propane gas installations.

PRODUCT DESIGN

TYPICAL PROPANE PIPING

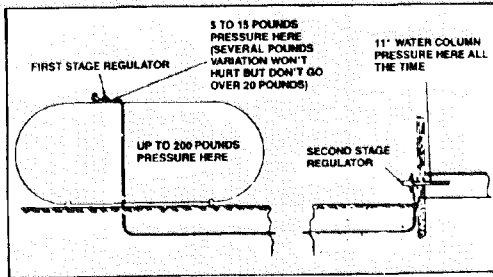


Figure 13

WARNING

IF YOUR PROPANE GAS FURNACE IS INSTALLED IN A BASEMENT, AN EXCAVATED AREA OR A CONFINED SPACE, WE STRONGLY RECOMMEND THAT YOU CONTACT YOUR PROPANE SUPPLIER ABOUT INSTALLING A WARNING DEVICE THAT WOULD ALERT YOU TO A GAS LEAK.

- ... Propane gas is heavier than air and any leaking gas can settle in any low areas or confined spaces.
- ... Propane gas odorant may fade, making the gas undetectable except with a warning device.

An undetected gas leak would create a danger of explosion or fire. If you suspect the presence of gas, follow the instructions on Page 6. Failure to do so could result in **SERIOUS PERSONAL INJURY OR DEATH.**

PROPANE PIPING CHART

Sizing Between First and Second Stage Regulator

Maximum Propane Capacities listed are based on 2 PSIG Pressure Drop at 10 PSIG Setting. Capacities in 1000 BTU/HR

PIPE OR TUBING LENGTH, FEET	TUBING SIZE, O.D., TYPE L						NOMINAL PIPE SIZE, SCH 40	
	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"	1 1/2"
10	730	1700	3200	5300	8300	3200	7500	
20	500	1100	2200	3700	5800	2200	4200	
30	400	920	2000	2900	4700	1800	4000	
40	370	850	1700	2700	4100	1600	3700	
50	330	770	1500	2400	3700	1500	3400	
60	300	700	1300	2200	3300	1300	3100	
80	260	610	1200	1900	2900	1200	2600	
100	220	540	1000	1700	2600	1000	2300	
125	200	490	900	1400	2300	900	2100	
150	190	430	830	1300	2100	830	1900	
175	170	400	780	1200	1900	770	1700	
200	160	380	730	1100	1800	720	1500	

To Convert to Capacities at 15 PSIG Settings -- Multiply by 1.130

To Convert to Capacities at 5 PSIG Settings -- Multiply by 0.879

Sizing Between Single or Second Stage Regulator and Appliance

Maximum Propane Capacities listed are based on 1/2" W.C. Pressure

Drop at 11" W.C. Setting. Capacities in 1000 BTU/HR

PIPE OR TUBING LENGTH, FEET	TUBING SIZE, O.D., TYPE L								NOMINAL PIPE SIZE, SCH 40		
	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	1 1/4"	1 1/2"	1 3/4"	2"
10	39	92	199	329	501	935	275	567	1071	2205	3307
20	26	62	131	216	346	630	189	393	732	1496	2299
30	21	50	107	181	277	500	152	315	590	1212	1858
40	19	41	90	145	233	427	129	267	504	1039	1559
50	18	37	79	131	198	376	114	237	448	913	1417
60	16	35	72	121	187	340	103	217	409	834	1275
80	13	29	62	104	155	289	89	185	346	724	1086
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

PROPANE TANK SIZING (MINIMUM)

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

* AVERAGE RATE/HOUR WITHDRAWAL IN 8 HOUR PERIOD

PRODUCT DESIGN

ELECTRICAL WIRING



TO AVOID THE RISK OF ELECTRICAL SHOCK, WIRING TO THE UNIT MUST BE PROPERLY POLARIZED AND GROUNDED.



TO AVOID ELECTRICAL SHOCK, INJURY OR DEATH, DISCONNECT ELECTRICAL POWER BEFORE CHANGING ANY 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.

LINE VOLTAGE WIRING

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 local codes or, in their absence, with the latest edition of the National Electrical Code, ANSI/NFPA No. 70, or in Canada, Canadian Electrical Code, C22.1, Part 1. A fused disconnect must be provided and sized in accordance with the unit minimum circuit ampacity.

LINE VOLTAGE CONNECTION OF OPTIONAL HUMIDIFIER AND ELECTRONIC AIR CLEANER

Units using the WR50A50 ignition control, Amana Part Number 10207702, will have accessory terminals on the ignition control for connection of field supplied humidifiers and/or electronic air cleaners.

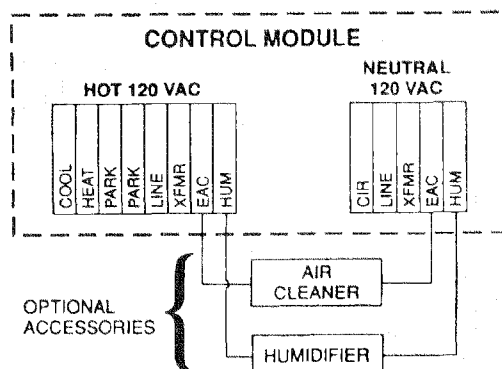
Accessory Load Specifications:

Air Cleaner: 1.0 Amp max at 120 VAC

Humidifier: 1.0 Amp max. at 120 VAC

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

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



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

CIRCULATING AIR AND FILTERS

DUCTWORK - AIR FLOW

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

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

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

Upflow furnace models with 3, or 3 1/2 ton blowers are shipped with one filter, intended for the return air duct to be attached to either side of the furnace cabinet. If the return air duct is to be attached to the bottom of the furnace cabinet, the filter that was supplied with the furnace may not be of the proper size. Refer to the chart below for filter sizes when using bottom return.

Upflow furnace models with 4 or 5 ton blowers are shipped with two filters. If the furnaces are to be operated at high speed, then two return air connections must be made. These may be made on both sides of the furnace cabinet, or on one side and the bottom. If one of the returns is connected to the

PRODUCT DESIGN

bottom, refer to the chart above for proper filter size. If the furnaces are operated at high speed, failure to have two return air connections could result in insufficient airflow for air conditioning requirements and excessive air velocity through the filter. If these furnaces will not be run on high speed, one return air connection will be adequate.

Bottom Return Filter Sizes

Furnace Model	Upflow Furnaces	
	Permanent	Disposable
GUI045x25x	1-14x25x1	2-16x20x1
GUI070x30,40x	1-14x25x1	2-16x20x1
GUI090x35,50x	1-16x25x1	2-16x20x1
GUI115x35,50x	1-20x25x1	2-20x20x1
GUI140x35,50x	1-20x25x1	2-20x20x1

Horizontal or Upflow/Horizontal Furnaces

Furnace Model	Permanent	Disposable
G(B/S)I045x25x	1-16x20x1	1-20x25x1
G(B/S)I070x30x	1-16x20x1	2-16x20x1
G(B/S)I070x40x	1-20x25x1	2-20x20x1
G(B/S)I090x30x	1-16x20x1	2-16x20x1
G(B/S)I090x50x	2-16x20x1	2-20x25x1
G(B/S)I115x35x	1-20x25x1	2-20x20x1
G(B/S)I115x50x	2-16x20x1	2-20x25x1
G(B/S)I140x50x	2-16x20x1	2-20x25x1

Counterflow Furnaces

Furnace Model	Permanent	Disposable
GCI045x25x	1-16x20x1	1-20x25x1
GCI070x30x	1-16x25x1 or 1-20x20x1	2-16x20x1
GCI070x40x	1-20x25x1	2-20x20x1
GCI090x30x	1-16x25x1 or 1-20x20x1	2-16x20x1
GCI090x50x	2-16x20x1 or 1-25x25x1	2-20x25x1
GCI115x35x	1-20x25x1	2-20x20x1
GCI115x50x	2-16x20x1 or 1-25x25x1	2-20x25x1
GCI140x50x	2-16x20x1 or 1-25x25x1	2-20x25x1



Figure 14

Counterflow furnaces may have the filters installed in the return air plenum above the furnace. For proper filter performance the sides of the plenum must be at least as tall as dimension "A" shown in figure 14.

Recommended filter size and type is provided in the following chart. Later Model GCC furnaces are shipped with filters as shown.

NOTE: For easier filter inspection and replacement, the installer may wish to consider providing a removable panel in the front of the return air plenum.

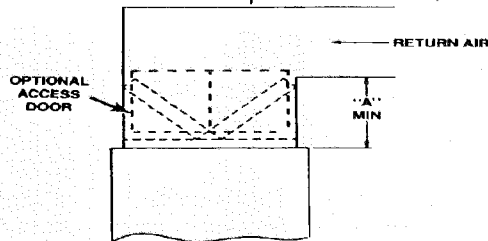


Figure 15

FURNACE MODEL	DIMENSION "A"	FILTER (QTY.), SIZE, TYPE
GCI045x25x	9	2-12x20x1 DISPOSABLE
GCI070x35x	7 1/2	2-10x20x1 PERMANENT
GCI090x30x	10 1/2	2-14x20x1 DISPOSABLE
GCI090x50x	11 1/4	2-15x20x1 PERMANENT
GCI115x35x	11 1/4	2-15x20x1 PERMANENT
GCI115x50x	11 1/4	2-15x20x1 PERMANENT
GCI140x50x	11 1/4	2-15x20x1 PERMANENT

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

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

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

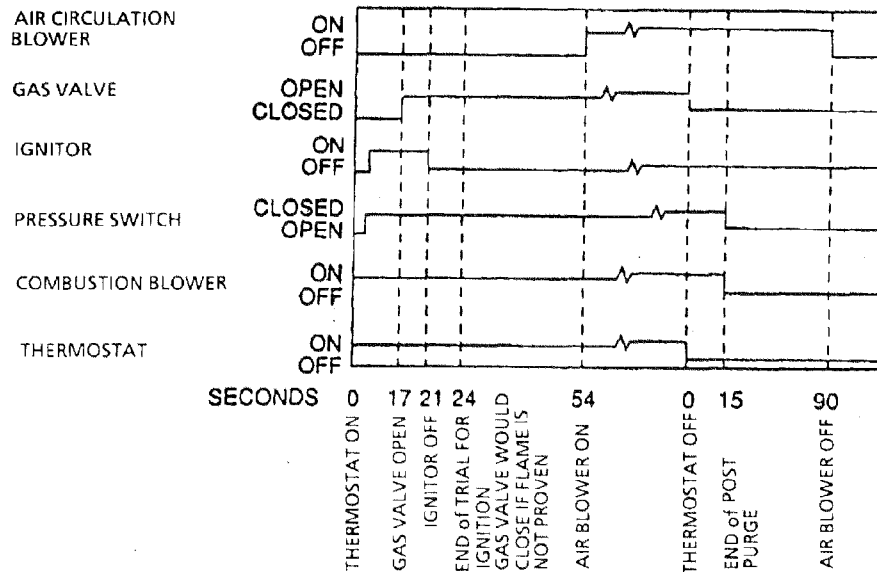
When the furnace is heating, the temperature of the return air entering the furnace must be between 55°F. and 100°F.

SYSTEM OPERATION

SEQUENCE OF OPERATION (Models with White Rodgers 50A50 Control) NORMAL SEQUENCE

1. Thermostat calls for heat.
2. The combustion blower is energized, and the pressure switch contacts close.
3. The ignitor is energized and is allowed to preheat for 17 seconds.
4. The gas valve is energized, delivering gas to the burners and starting combustion.
5. The control checks for a signal from the flame sensor within seven seconds after the gas valve is energized. Gas will continue to flow only if a signal is present.
6. The control waits 30 seconds and turns on the air circulation blower to the speed that was selected for heating operation. At this time the optional humidifier and electronic air cleaner are also energized.
7. The thermostat is satisfied and opens.
8. The control de-energizes the gas valve.
9. After a 15 second delay, the combustion blower and optional humidifier are de-energized.
10. After another 75 second delay, the combustion blower and optional electronic air cleaner are de-energized.

TIMING CHART FOR NORMAL WHITE - RODGERS 50A50 OPERATION



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

SYSTEM OPERATION

ABNORMAL OPERATION

1. Internal Control Failure with White-Rodgers Control
If the control determines it has an internal fault, it enters a locked-out state, and the diagnostic light will **light continuously with no flashes**. The control should be replaced.
2. System Lockout
If a flame is not sensed during the first seven (7) seconds after the gas valve is energized, the control turns off the gas. There will then be a 60 second delay while the combustion blower is energized to purge the heat exchanger. The ignitor will next be energized and preheated for 27 seconds. The gas valve will then be energized. If flame is not sensed in seven (7) seconds the gas valve will be de-energized and another purge will occur. The control will cycle the gas valve a total of three (3) times before it determines it cannot establish measurable combustion and enters a locked out state. If flame is sensed but lost after ten (10) seconds, the control will recycle this series of three tries four (4) more times before locking out. The diagnostic light will indicate this condition with **one short flash** followed by a longer pause. The control can be reset and brought out of lockout mode by turning the thermostat off and then back on.
3. Pressure Switch Stuck Closed
If the control senses the pressure switch is closed when the vent blower is off, it waits until the fault is corrected. The light code for this problem is **two short flashes** followed by a longer pause. The probable cause is a faulty pressure switch or wiring.
4. Pressure Switch Stuck Open
If, after the vent blower is energized, the pressure switch does not close, the control will keep the blower and wait for the switch to close. The diagnostic light code for the problem is **three short flashes** followed by a pause. The probable causes are either disconnected hose to the pressure switch, faulty pressure switch or wiring, or restricted air intake or flue piping.
5. Open Limit Control
If the limit control opens, the air circulation and vent blower will be turned on until the limit closes. The diagnostic light code for this is **four short flashes** followed by a pause. The probable cause is either low conditioned air flow due to dirty filter or resistance in duct work, faulty limit, faulty blower, or blower speed set to low.

6. Missing Jumper Wire
If the jumper between R01 and R02 is not present, the air circulation blower and vent blower will be energized all the time. The diagnostic light code for this is **five flashes** followed by a pause. The probable cause is a missing jumper.
7. Flame Sensed with No Call for Heat
If the control senses a flame when the gas valve is de-energized, it will run the air circulation blower and the vent blower continuously. The diagnostic light code for this is **continuous light flashing**. Probable cause is miswiring.

SEQUENCE OF OPERATION

(Models with White Rodgers 50A47 Control)

NORMAL SEQUENCE OF OPERATION

1. Thermostat calls for heat. The combustion blower is immediately energized.
2. The pressure switch contacts transfer.
3. The ignitor is energized and is allowed to preheat for 34 seconds.
4. The gas valve is energized, delivering gas to the burners and starting combustion.
5. Four seconds after the gas valve is energized the ignitor is de-energized. Seven seconds after the gas valve is energized, the control checks the signal from the flame sensor. Gas flow will continue only if a proper signal is present.
6. The unit will continue to fire while the helical fan control heats up. The fan control will start the main circulating air blower approximately 75 seconds after the gas valve opens (this time may vary depending upon the control setting).
7. The furnace will deliver heat to the conditioned space until the thermostat is satisfied.
8. The gas valve will be de-energized when the thermostat opens.
9. There is a 90 second delay (approximate) before the main air blower and the combustion blower stop. This allows any additional heat in the heat exchanger to be transferred to the conditioned space and to purge combustion products for the heat exchanger and vent system.

SYSTEM OPERATION

SELF DIAGNOSTIC IGNITION CONTROL

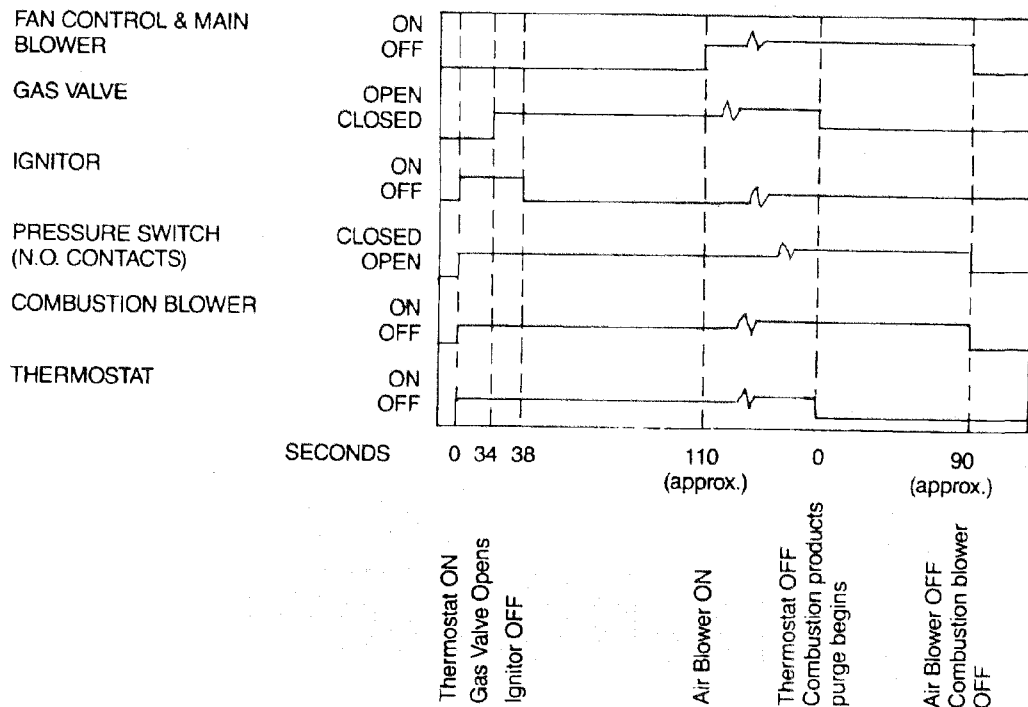
In this furnace, there may be a red indicator light located on the ignition control board near the MV terminal. This light is designed to help the servicer diagnose potential service problems with either the furnace or the ignition control itself. If the furnace is malfunctioning, and the red light is on continuously, the ignition control is faulty. If the red light is flashing, the furnace is probably in a lockout condition. If the indicator light is not on and the furnace does not operate properly, then the problem likely exists elsewhere in the furnace and not in the ignition control board.

RESET AFTER CONTROL LOCK-OUT

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

IMPORTANT: If the furnace frequently has to be reset, it means that a problem exists that should be corrected.

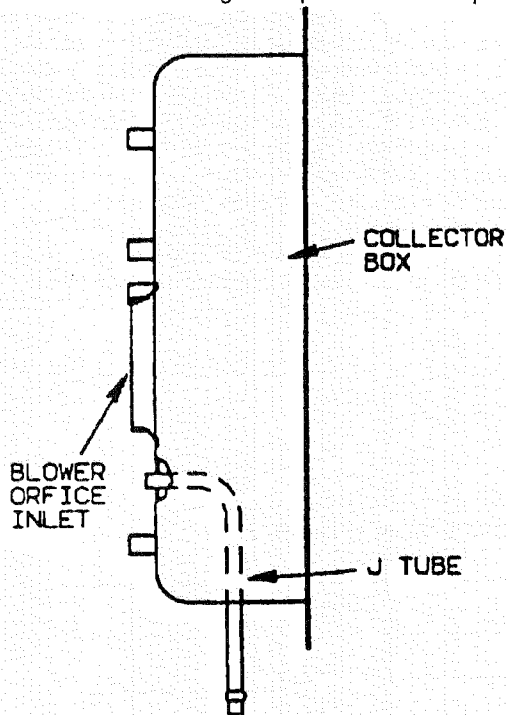
TIMING CHART FOR NORMAL WHITE - RODGERS 50E47 OPERATION



SYSTEM OPERATION

HEATING CYCLE

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.



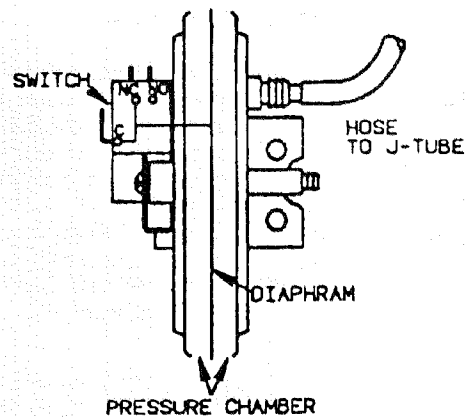
NOTE: J-tube must protrude 1/8" for proper negative reading to be obtained.

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.

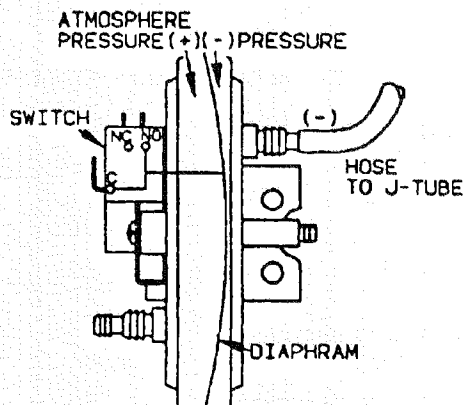
The J-tube has a predetermined orifice size for reading static pressures. The induced draft blower motor assembly is mounted to the collector box so the blower orifice inlet is the inlet to the blower wheel. When the motor is in operation, a negative pressure will be created on the J-tube, collector 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. Canadian Models also require a temperature activated vent safety switch.

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



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.



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 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).

SYSTEM OPERATION

OPERATING INSTRUCTIONS

1. Close the manual gas valve external to the furnace.
2. Turn off the electrical power supply to the furnace.
3. Set room thermostat to lowest possible setting.
4. Remove the door on the front of the furnace.
5. This furnace is equipped with an ignition device which automatically lights the burner. Do not try to light burner by hand.
6. Turn the gas control valve clockwise  to the "Off" position for either the White Rodgers 36-E gas valve (Figure 11B) or the Honeywell VR-8205 gas valve (Figure 11A). For the Robertshaw 7200 gas valve, push in and slide the lever to the "Off" position (Figure 11C). Do not force.
7. Wait five (5) minutes to clear out any gas, then smell for gas, including near the floor.
8. If you smell gas following the five (5) minute waiting period in Step 7, follow the instructions on Page 5. If you do not smell gas, then turn the gas control knob counterclockwise  to the "On" position for either the White Rodgers 36-E gas valve (Figure 11B) or the Honeywell VR-8205 gas valve (Figure 11A). For the Robertshaw 7200 gas valve, push in and slide the lever to the "On" position (Figure 11C). Do not force.

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

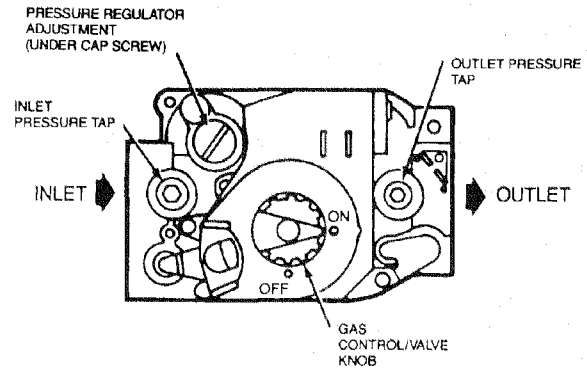


**FIG. 11A — HONEYWELL
MODEL: VR-8205**

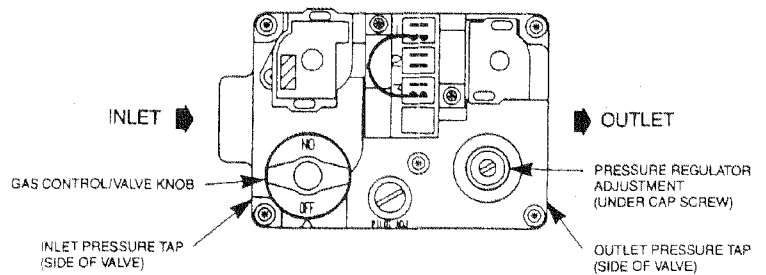


**FIG. 11B — WHITE RODGERS
MODEL: 36E36 TYPE 230**

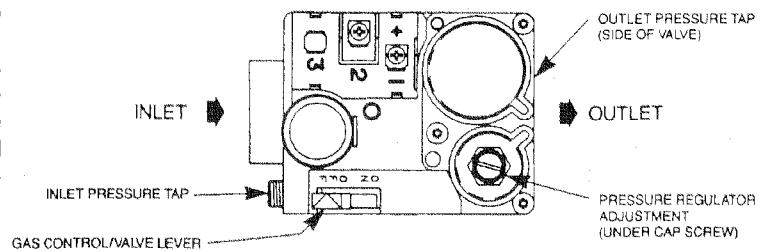


**FIG. 11C — ROBERTSHAW (GRAYSON)
MODEL: 7200**

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



WARNING

WARNING VOLTAGE IS PRESENT USE EXTREME CAUTION

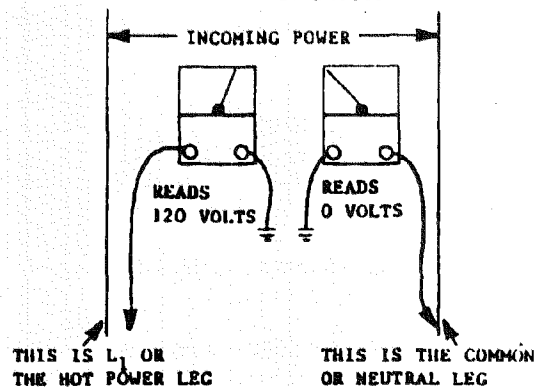


Figure 20

These then should be wired to the furnace accordingly.

CHECKING FOR PHASING - PRIMARY TO SECONDARY OF UNMARKED TRANSFORMERS*

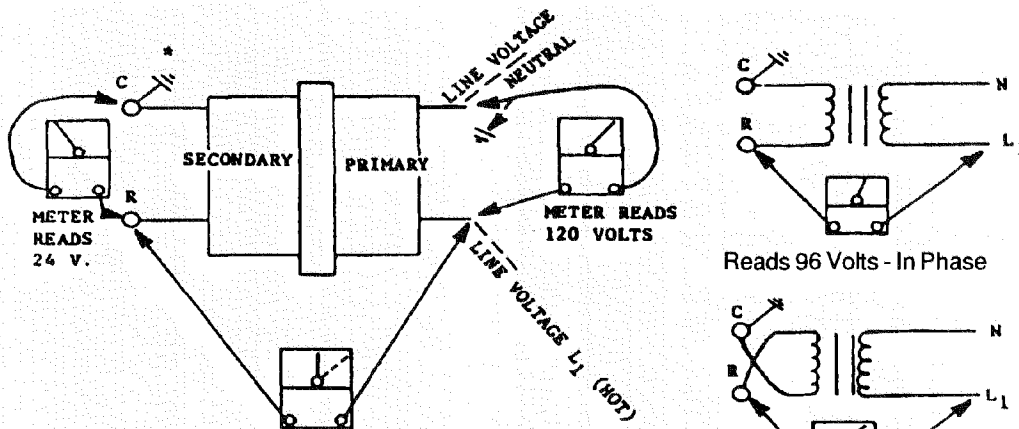


Figure 21

If meter reads approx. 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.

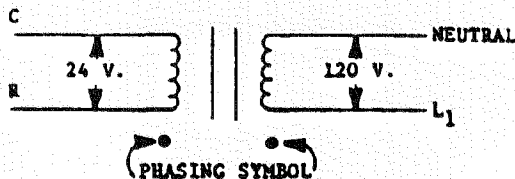


Figure 22

Some transformers will display phasing symbols as shown in figure 22 to assist in determining proper transformer phasing.

Checking for polarization and phasing should become a habit in servicing. Let's start now.

MAINTENANCE

WARNING

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

CAUTION

IF YOU MUST HANDLE THE IGNITOR, HANDLE WITH CARE. TOUCHING THE IGNITOR BODY WITH BARE FINGERS, ROUGH HANDLING, OR VIBRATION COULD RESULT IN EARLY IGNITOR FAILURE. ONLY A QUALIFIED SERVICER SHOULD EVER HANDLE THE IGNITOR.

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

Have vent pipe checked to be sure it is not blocked by debris, which could permit fumes to enter the house. Replace any leaking or rusted sections of vent pipe.

AIR FILTER

WARNING

NEVER OPERATE FURNACE WITHOUT A FILTER INSTALLED AS DUST AND LINT WILL BUILD UP ON INTERNAL PARTS RESULTING IN LOSS OF EFFICIENCY, EQUIPMENT DAMAGE, AND POSSIBLE FIRE.

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

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

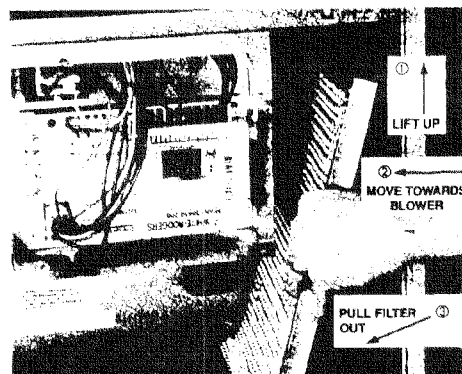


Figure 23 - Filter Removal

WARNING

DISCONNECT THE ELECTRICAL POWER TO THE FURNACE BEFORE REMOVING THE FILTER OR PERFORMING ANY OTHER MAINTENANCE.

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

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

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

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

MAINTENANCE

BLOWER MOTOR (QUALIFIED SERVICER ONLY)

If desired, the blower motor may be oiled by adding four (4) to six (6) drops of SAE#20 or #30 oil to each oil port, once a year. TO AVOID PREMATURE MOTOR FAILURE, DO NOT OVER OIL.

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

VENT BLOWER MOTOR (QUALIFIED SERVICER ONLY)

If desired, the vent blower motor may be oiled annually with six (6) drops of Anderoil 465 oil (three (3) drops in each oil tube - Figure 24). TO AVOID PREMATURE MOTOR FAILURE, DO NOT OVER OIL.

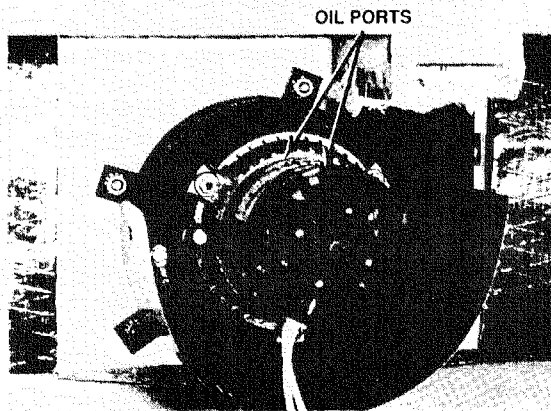


Figure 24 - Vent Blower Motor

FLUE PASSAGES (QUALIFIED SERVICER ONLY)

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

CLEANING FLUE PASSAGES (QUALIFIED SERVICER ONLY)

1. Turn off electrical power and gas supply to the furnace.
2. Remove the burner assembly by disconnecting the gas line and removing the manifold brackets from the partition panel.
3. Remove the flue from the induced draft blower and the collector box from the partition panel.
4. The primary heat exchanger tubes can be cleaned using a round wire brush attached to a length of high grade stainless steel cable, such as drain cleanout cable. Attach a variable speed reversible drill to the other end of the spring cable. Slowly rotate the cable with the drill and insert it into one of the primary heat exchanger tubes. While reversing the drill, work the cable in and out several times to obtain sufficient cleaning. Repeat for each tube.
5. When all heat exchanger tubes have been cleaned and the residue removed with a vacuum, replace all the parts in the reverse order in which they were removed.
6. To reduce the chances of repeated fouling of the flue passages, perform the steps listed in the System Operation Section.

SERVICING

TEST EQUIPMENT

Proper test equipment for accurate diagnosis is as essential as regulator 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-Ohm Meter - 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.

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 fifteen 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 forty (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 forty (40) seconds, locate and read across to the one (1) cubic foot dial column. There we find the number 90, which shows that ninety (90) cubic feet of gas will be consumed in one (1) hour.

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

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

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

EXAMPLE: GUI090B30A
INPUT: 90,000 BTU/HR
OUTPUT CAP: 71,000 BTU/HR

Should the figure you calculated not fall within five (5) percent of the nameplate rating of the unit, adjust the gas valve pressure regulator or resize orifices.



ALWAYS CONNECT A MANOMETER TO THE 1/8" PIPE TAP AT THE GAS VALVE 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 (counter-clockwise) 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.

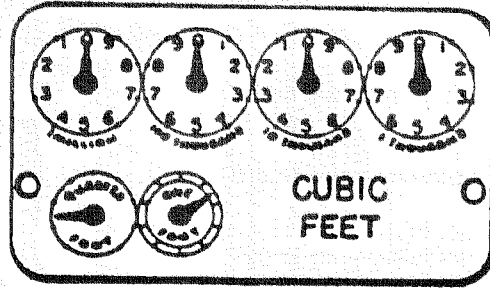
With propane gas, no unit gas valve regulator is used; however, the second stage supply line pressure regulator should be adjusted to give 11" water column with all other gas consuming appliances running.

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 (direct drive) or pulley adjustments of the motor and blower (belt drive).

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.

SERVICING



GAS RATE - CUBIC FEET PER HOUR

Figure 25

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

SERVICING

Complaint	No Heat			Unsatisfactory Heat					Test Method Remedy	See Service Procedure Reference		
POSSIBLE CAUSE DOTS IN ANALYSIS GUIDE INDICATE "POSSIBLE CAUSE"	SYMPTOM	System Will Not Start	Burner Won't Ignite	Burner Ignites-Locks Out	Burner Shuts Off prior to T'Stat being Satisfied	Short Cycles	Long Cycles	Soot and /or Fumes			To Much Heat	Not Enough Heat
Power Failure	●										Test Voltage	S-1
Blown Fuse	●										Test Voltage	S-4
Loose Connection	●										Check Wiring	S-2
Shorted or Broken Wires	●										Check Wiring	S-3
No Low Voltage	●										Check Transformer	S-4
Faulty Thermostat	●					●	●		●		Check Thermostat	S-3
Faulty Transformer	●										Check Transformer	S-4
Poor or High Resistance Ground				●							Measure Ground Resistance	S-23
Improper Heat Anticipator Setting						●	●		●	●	Adjust Heat Anticipator Setting	S-3
Improper Thermostat Location						●	●		●	●	Relocate Thermostat	
Faulty Limit or Roll Out Switch			●		●						Test Control	S-6 & 24
Faulty Flame Sensor				●							Test Flame Sensor	S-23
Faulty Ignition Control			●	●							Test Control	S-22
Gas Valve or Gas Supply Shut Off			●								Turn Valves to On Position	S-10
Faulty Induced Draft Blower			●					●			Test Blower	S-8 & 19
Broken or Shorted Ignitor			●								Test Ignitor	S-21
Faulty Combustion Relay			●		●						Test Relay	S-5
Dirty Flame Sensor, Low uA				●							Clean Flame Sensor	S-23
Flame Sensor not in Flame, Low uA				●							Test/Adjust Position of Flame Sensor	S-23
Faulty Gas Valve			●					●		●	Replace Gas Valve	S-10
Open Auxillary Limit			●		●						Reset Control	S-7
Improper Air Flow or Distribution					●					●	Check Duct Static	
Cycling on Limit					●	●				●	Check Controls & Temperature Rise	S-6
Delayed Ignition									●		Test for Delayed Ignition	S-15
Flashback								●			Test for Flashback	S-16
Orifice Size								●	●	●	Check Orifices	S-13
Gas Pressure			●					●	●	●	Check Gas Pressure	S-14
Cracked Heat Exchanger								●			Check Burner Flames	S-12
Stuck Gas Valve			●					●	●		Replace Gas Valve	S-10
Furnace Undersized										●	Replace with Proper Size Furnce	
Faulty Pressure Switch			●	●	●						Test Pressure Switch	S-19
Blocked or Restricted Flue								●			Check Flue/Drawdown Pressure	S-19
Open Roll Out Switch			●	●							Test Control	S-24
Collector Box "J" Tube Position			●	●							Test Negative Pressure	S-19
Bouncing On Pressure Switch				●							Test Negative Pressure	S-19

SERVICING

S-1 CHECKING VOLTAGE



Disconnect Electrical Power Supply:

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 percent.
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



Disconnect Electrical Power Supply:

1. Check wiring visually for signs of overheating, damaged insulations and loose connections.
2. Using 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



Disconnect Electrical Power Supply:

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



LINE VOLTAGE NOW PRESENT.

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 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 to 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 furnaces covered in this manual are:

GUI, GCI, GSI, with WR50A47 control	.80 Amps
GBI, GUI, GCI, GSI, with WR50A50 Integrated Control	.70 Amps

If the anticipator current draw is unknown, then an amp draw should be taken to determine the anticipator setting. Use an amprobe as shown in fig. 26.

SERVICING

S-3C Cooling Anticipator

The cooling anticipator is a small heater (resistor) in the thermostat. During the "OFF" cycle it heats the bimetal 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.

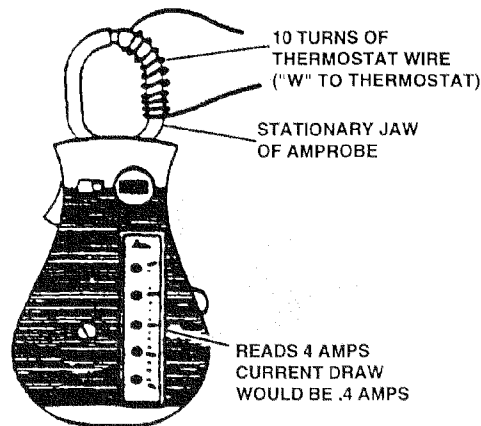


Figure 26

S-4 CHECKING TRANSFORMER AND CONTROL CIRCUIT

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.



WARNING

Disconnect Electrical Power Supply:

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.



WARNING

LINE VOLTAGE NOW PRESENT.

3. No voltage indicates faulty transformer, open fuse, bad wiring, bad splice, or open door switch.
4. Check transformer primary voltage at incoming line voltage connections, fuse, splices, and blower door.

5. 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) (Not Used on Models with WR50A50 Control)



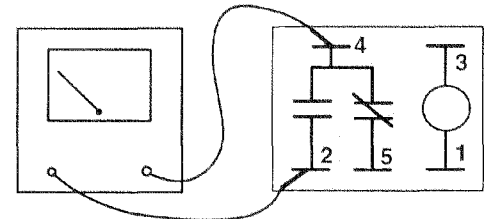
WARNING

Disconnect Electrical Power Supply:

1. Tag and disconnect all wires from male spade connections of relay.
2. Using an ohmmeter, test across the coil terminals - should read approximately 12 ohms (fig. 27).

If the coil does not test continuous - replace.

3. On the single pole double throw relays, test across terminals 4 and 5, should read continuous, 2 and 4 should have no reading.
4. Apply 24 volts to coil terminals and retest. 4 to 5 should have no reading, 2 to 4 should test continuous. If not, replace the relay.



TESTING FAN RELAY
Figure 27

S-6 CHECKING COMBINATION FAN AND LIMIT CONTROL (Not Used on Models with WR50A50 Control)

A combination fan and limit switch is used on furnaces using the WR50A47 ignition control. The limit setting is fixed and must not be readjusted in the field (Figure 28).

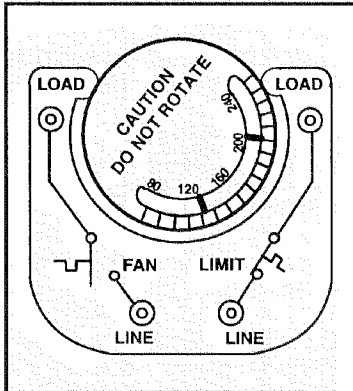
Depending on the individual type of furnace (upflow, counterflow, etc.) will determine as to what the cutout point setting of the control will be.

In all instances the limit 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.

SERVICING

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



HONEYWELL FAN AND LIMIT CONTROL
Figure 28

WARNING

Disconnect Electrical Power Supply:

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 the furnace recycle until the 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.

S-6A CHECKING PRIMARY LIMIT CONTROL (Models with WR50A50 Control)

Furnaces using the WR50A50 integrated ignition control use a non-adjustable automatic reset Klaxon type limit control (stat on a stick) part number 102508xx.

WARNING

Disconnect Electrical Power Supply:

1. Remove low voltage wires at limit control terminals.
2. With an ohmmeter, test between these two terminals (see fig. 29). Should read continuous unless heat exchanger temperature is above limit control setting. If not as above, replace the control.

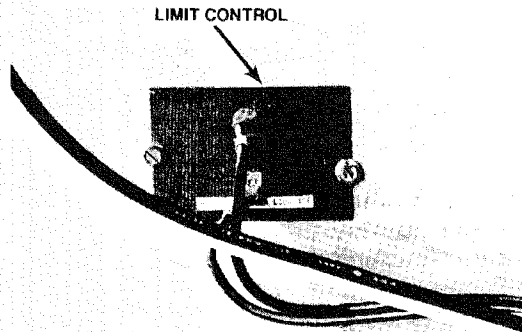


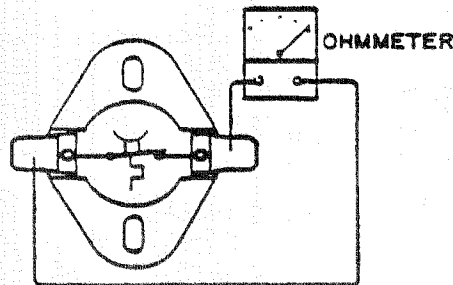
Figure 29

S-7 CHECKING AUXILIARY LIMIT CONTROL (Counterflow Models)

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

This control is 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.



LIMIT OR AUXILIARY LIMIT CONTROL
Figure 30

SERVICING



WARNING

Disconnect Electrical Power Supply:

1. Remove the wires from the auxiliary limit control terminals.
2. Using an ohmmeter, test for continuity across the two terminals (see fig. 30). No reading indicates the control is open. Push the red reset button, test again - if still open, replace the control.

NOTE: Refer to unit specifications for control setpoints.

S-8 CHECKING BLOWER MOTOR



WARNING

Disconnect Electrical Power Supply:

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.

T.O.D. PRIMARY LIMIT (102508)

Part Number	01	02	03	04	05	06	07	08	09	10	11	12	13	14
Open Setting	210	180	160	150	200	190	170	140	220	230	240	250	260	270
Color Code(s)	RED	BROWN	ORANGE	GREEN	BLUE	YELLOW	BLACK	WHITE	GREEN	GREEN	BLUE	BLUE	BLUE	RED
Color Code(s)	RED	BROWN	ORANGE	GREEN	BLUE	YELLOW	BLACK	WHITE	YELLOW	BLACK	RED	YELLOW	WHITE	YELLOW
GBI045A25A									X					
GBI070A30A											X			
GBI070A40A													X	
GBI090A30A						X								
GBI090A50A	X													
GBI115A35A	X													
GBI115A50A					X									
GBI140A50A	X													
GUI045(D,E)25A														X
GUI070(D,E)30A											X			
GUI070(D,E)40A												X		
GUI090(D,E)30A					X									
GUI090(D,E)50A									X					
GUI115(D,E)35A										X				
GUI115(D,E)50A											X			
GUI140(D,E)35A									X					
GUI140(D,E)50A									X					
GCI045D25A												X		
GCI070D35A									X					
GCI090D30A	X													
GCI090D50A					X									
GCI115D35A										X				
GCI115D50A						X								
GCI140D50A							X							
GSI045D25A													X	
GSI070D35A											X			
GSI090D30A					X									
GSI090D50A					X									
GSI115D35A									X					
GSI115D50A		X												
GSI140D50A							X							

SERVICING

S-9 CHECKING 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.

DISCHARGE CAPACITOR THROUGH A 20 TO 30 OHM RESISTOR BEFORE HANDLING

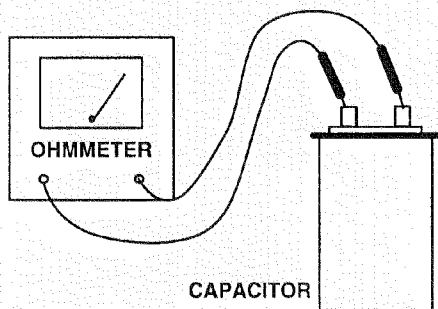
Two quick ways to test a capacitor are a resistance and a capacitance check.

S-9A Resistance Check



Disconnect Electrical Power Supply:

1. Discharge capacitor and remove wire leads.
2. Set an ohmmeter on its highest ohm scale and connect the leads to the capacitor (fig. 31).
 - 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.
 - d. Reverse leads and recheck.



TESTING CAPACITOR RESISTANCE
Figure 31

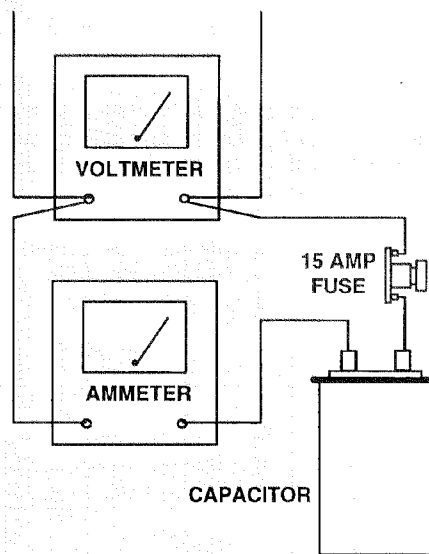
S-9B Capacitance Test



LINE VOLTAGE NOW PRESENT.

Using a hook-up as shown in fig.32, take the amperage and voltage readings and use them in the formula:

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



TESTING CAPACITANCE
Figure 32

S-10 CHECKING GAS VALVE (Redundant)

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 percent safety shut-off.



Disconnect Electrical Power Supply:

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.
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.

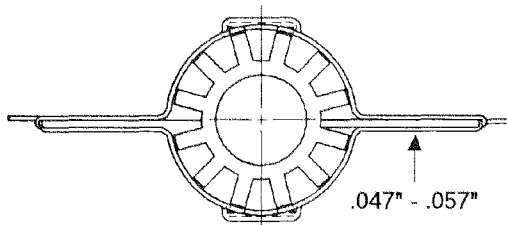
If not as above, replace the entire valve.

SERVICING

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.



STANDARD BURNER
Figure 33

WARNING

Disconnect Gas and Electrical Power Supply:

In checking main burners, look for signs of rust, oversized and undersized carryover ports restricted with foreign material, etc (Fig. 33).

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 manifold 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 redrilled. 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.

WARNING

Disconnect Gas and Electrical Power Supply:

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.

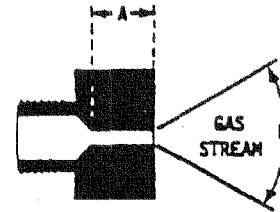


Figure 34

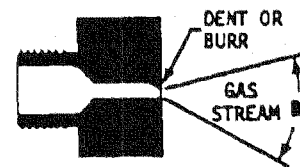


Figure 35

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.

WARNING

Disconnect Gas and Electrical Power Supply:

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 as shown in fig. 36.)
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 fig. 37.

WARNING

LINE VOLTAGE NOW PRESENT.

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 ± .3" w.c.
(Canadian - Sea Level 4.2" ± .3" w.c.)

SERVICING

For PROPANE GAS:

- Inlet pressure should be a nominal 11" w.c.
- 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.

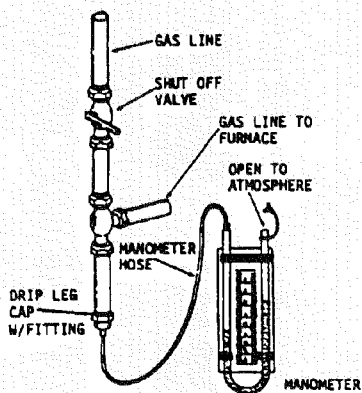
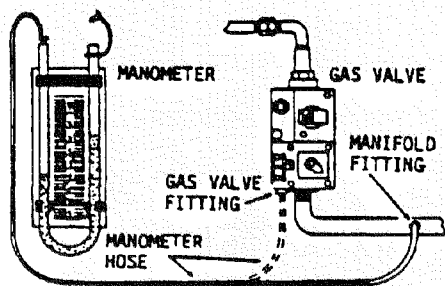


Figure 36

MEASURING INLET GAS PRESSURE



MEASURING MANIFOLD GAS PRESSURE

Figure 37

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:

- Improper gas pressure - adjust to proper pressure. (See S-14)
- Improper burner positioning - burners should be in locating slots, level front to rear and left to right.

- Carry over (lighter tube or cross lighter) obstructed - clean.
- Main burner orifice(s) deformed, or out of alignment to burner - replace.

S-16 CHECKING FOR FLASH-BACK

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:

- Improper gas pressure - adjust to proper pressure. See S-14.
- Check burner for proper alignment and/or replace burner.
- Improper orifice size - check orifice for obstruction.

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, etc. Whereas not enough static may result in motor overloading.

To determine proper air movement, proceed as follows:

- 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)
- Measure the static pressure of the supply duct. (Positive Pressure)
- Add the two (2) readings together for total external static pressure.

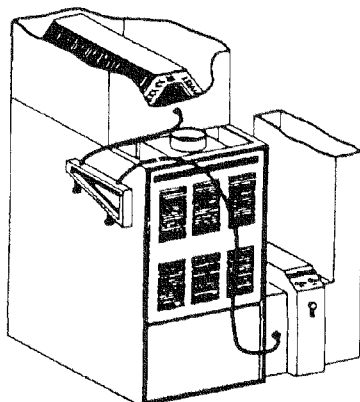
NOTE: Both readings may be taken simultaneously and read

SERVICING

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 (see figure 39).

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.



CHECKING STATIC PRESSURE
Figure 39

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.

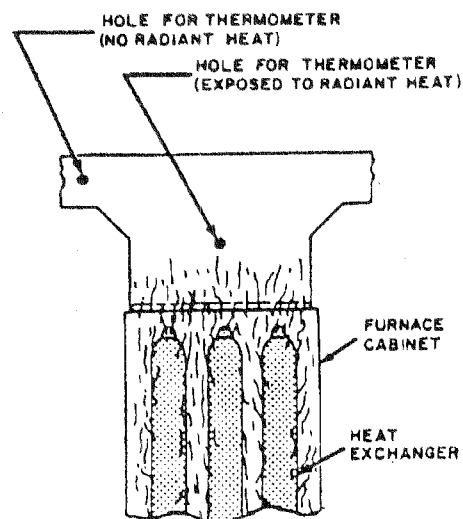
All furnaces are designed for a given range of temperature increase; that is the temperature of the air leaving the furnace minus the temperature of the air entering the furnace.

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 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.



AIR LEAVING TEMPERATURE LOCATION
Figure 40

S-19 CHECKING 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.

WARNING

Disconnect Electrical Power Supply:

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 switch reads as above proceed to Step 3, otherwise replace control.

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

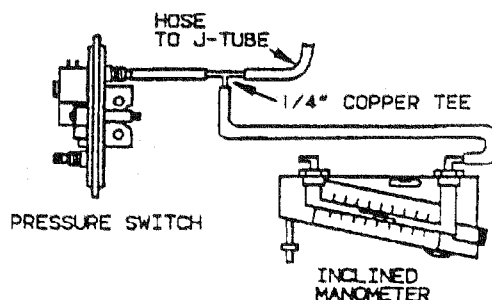


Figure 41

SERVICING

PRESSURE SWITCH TRIP POINTS AND USAGE

MODEL	MIN. NEG. PRESSURE WITH FLUE NOT FIRING 0 to 4000 ft.	MIN. NEG. PRESSURE WITH FLUE FIRING 0 to 4000 ft.	PRESSURE SWITCH TRIP POINTS AND USAGE					
			0 to 4000 ft.		4000 to 7000 ft.		7000 to 10000 ft.	
			TRIP POINT	PRESSURE SWITCH	TRIP POINT	HIGH ALTITUDE KIT	TRIP POINT	HIGH ALTITUDE KIT
ALL 80% FURNACES EXCEPT THOSE LISTED BELOW	-1.00 to -1.20	-0.60 to -0.65	-0.54	PROD.	-0.42	HAPS03	-0.30	HAPS02
GCIxxxDxxA	-1.10 to -1.30	-0.70 to -0.75	-0.65	PROD.	-0.54	HAPS04	-0.42	HAPS03

HAPS02 contains C6456509 PRESSURE SW.
HAPS04 contains C6456508 PRESSURE SW.

HAPS03 contains C6456505 PRESSURE SW.

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



WARNING

LINE VOLTAGE NOW PRESENT.

- Energize furnace for heating cycle. The combustion relay should be energized and the induced draft blower motor will begin to run. The inclined manometer should read approximately negative 1.0" to 1.2" w.c. with no combustion. Refer to the chart on the following page for pressure switch usage and trip points.

- 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.

- Reconnect all three wires to the control and place in a heating cycle.
- Begin to restrict the flue outlet until the pressure control trips - cycling OFF the burner. The trip points should be as shown on the following page.
- If not as listed, replace control.

The pressure control is a safety device to prevent the combustion cycle from occurring with inadequate venting caused by a restricted or blocked vent pipe.

The pressure readings listed in the Pressure Switch Usage and Trip Point table must be adhered to for proper operation.

S-20 HIGH ALTITUDE APPLICATION (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 high altitude kit required for different elevations.

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 C6437607 orifices)
8500 to 10000 ft.	Nat #47	HANG04 or NG04A High Altitude Orifice Kit (uses C6437604 orifices)
10000 to 11500 ft.	Nat #48	HANG05 or NG05A High Altitude Orifice Kit (uses C6437608 orifices)
0 to 4500 ft.	Propane #54	LPTK05 Propane Conversion Kit (uses C6437602 orifices)
4500 to 7500 ft.	Propane #55	HALP01 or 03 or LP01A Propane Conversion Kit (uses C6437609 orifices)
7500 to 11500 ft.	Propane #56	HALP02 or 04 or LP02A Propane Conversion Kit (uses C6437610 orifices)

SERVICING

High altitude pressure switches and kits are listed in the Pressure Switch Usage and Trip Point Chart.

S-21 CHECKING HOT SURFACE IGNITOR

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



Disconnect Electrical Power Supply:

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.



LINE VOLTAGE NOW PRESENT.

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

S-22 CHECKING WR50A47 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 ground or neutral lines may cause the control to lockout due to failure to flame sense.



To avoid the risk of electrical shock, wiring to the unit must be properly polarized and grounded. Disconnect power before performing service listed below.

The ground wire must run from the furnace all the way back to the electrical panel. Proper grounding can be confirmed by disconnecting the electrical power and measuring resistance between the neutral (white) connection and the burner closest to the flame sensor. Resistance should be less than 10 ohms.

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



Disconnect Electrical Power Supply:

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.



LINE VOLTAGE NOW PRESENT.

Furnace thermostat calling for heat (45 second preheat time).

1. Check for 120 volts from L1 terminal of control module to neutral. No voltage - check wire connections, continuity, 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 (5) seconds.

S-22A CHECKING WR50A50 INTEGRATED 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 sense flame.



To avoid the risk of electrical shock, wiring to the unit must be properly polarized and grounded. Disconnect power before performing service listed below.

The ground wire must run from the furnace all the way back to the electrical panel. Proper grounding can be confirmed by disconnecting the electrical power and measuring resistance between the neutral (white) connection and the burner closest to the flame sensor. Resistance should be less than 10 ohms.

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

The WR50A50 ignition control, controls all furnace operations including blower operation in air conditioning. Blower time

SERVICING

delays are controlled by the ignition control and are non-adjustable, see the specification section for blower delay information.



LINE VOLTAGE NOW PRESENT.

These tests must be completed within a given time frame due to the operation of the ignition control. See "Sequence of Operation" section for timing chart.

The ignition control is capable of diagnosing many furnace failures to speed troubleshooting. A flashing red diagnostic indicator light on the control flashes a code for any discovered failures. When the control is powered up normally the light will flash once for about one second. This can be used to test for 120 volts and 24 volts to the control since both must be present for the light to flash. If this step fails, check for 120 volts to the control and check the transformer and its associated wiring. If this step is successful give the control a call for heat and wait five (5) seconds or until the furnace goes into lockout. If the control detects a failure it will now be shown on the diagnostic indicator light. Refer to the "Sequence of Operation" section for more detail on failure codes.

To view the indicator light upon initial inspection of the furnace the blower door switch must be held closed while removing the blower compartment door. The indicator light may then be viewed by looking through the peep hole in the control compartment cover. Failure to hold the door switch closed while removing the blower compartment door will result in the loss of the stored failure code. In most cases recycling the ignition control will result in the same failure code originally displayed.

1. Check for 120 volts from Line 1 (BK6 wire) to line 2 neutral (WH-33 wire) at the ignition control. No voltage - check the door switch connections and wire harness for continuity.
2. Check for 24 volts from W to C at the thermostat connections on the ignition control. No voltage - check transformer, room thermostat, and wiring.
3. Check for 120 volts to the induced draft blower by measuring voltage between IND (VT-55) and neutral. No voltage - replace ignition control.
4. If voltage is present in Steps 1 through 3 and the induced draft blower is operating, check for 120 volts to the ignitor during the 17 second preheat cycle. Measure voltage between terminals IGN (R0-22) and neutral. No voltage - check pressure switch.
5. Seventeen seconds after a call for heat begin checking for 24 volts to the gas valve. Voltage will be present for seven seconds only if proof of flame has been estab-

lished. Measure voltage from Pin 9 MV terminal (GY-47 wire) to Pin 12 MV terminal (BR-21) on the ignition control 12 Pin connector. No voltage - replace ignition control.

6. If proof of flame was established 120 volts will be provided to the air circulation blower 54 seconds after a call for heat. Check for 120 volts from the CIR terminal (WH) wire to the heat terminal on the ignition control. No voltage - replace ignition control.

S-23 CHECKING FLAME SENSOR - FLAME RECTIFICATION - IGNITION CONTROL MODULE

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.

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.



Disconnect Electrical Power Supply:

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.

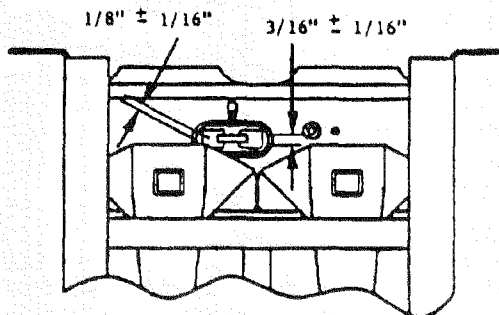


Figure 42

3. Be sure the negative side of the meter is to the wire and the positive of the meter is to terminal FP.



LINE VOLTAGE NOW PRESENT.

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.

SERVICING

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 micro-amps. From 8731 date code on, the control will have 10 to 14 micro-amps. The White-Rogers C6411102 with the red diagnostic indicator light and the White-Rogers 10207701 & 02 integrated controls 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-24 CHECKING VENT SAFETY SWITCH (Common Vent Models)

A temperature activated, manual reset control is mounted to the flue outlet box assembly.

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, 90C	250°F. $\pm$ 6°
GUI045E	200°F. $\pm$ 6°
GUI115, 140	275°F. $\pm$ 6°
GCI045, 115	200°F. $\pm$ 5°
GCI070, 140	225°F. $\pm$ 6°
GCI090	250°F. $\pm$ 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-25 CHECKING FLAME ROLLOUT SWITCH

A temperature activated manual reset control is mounted to the manifold assembly. Two (2) controls are used on GBI/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 overfiring condition or flame impingement on the heat shield may also cause the control to open.

To aid in identifying these controls, color coded labels have been affixed to the back of these controls. See chart below for temperature settings and color codes.

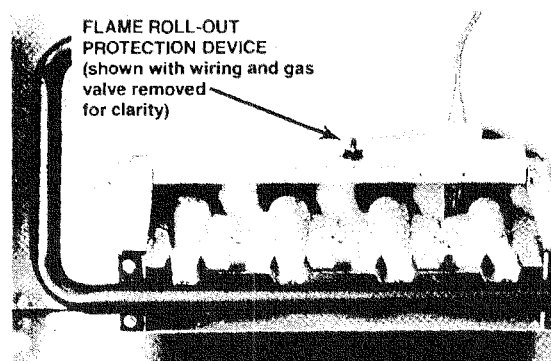
The controls are designed to open as follows:

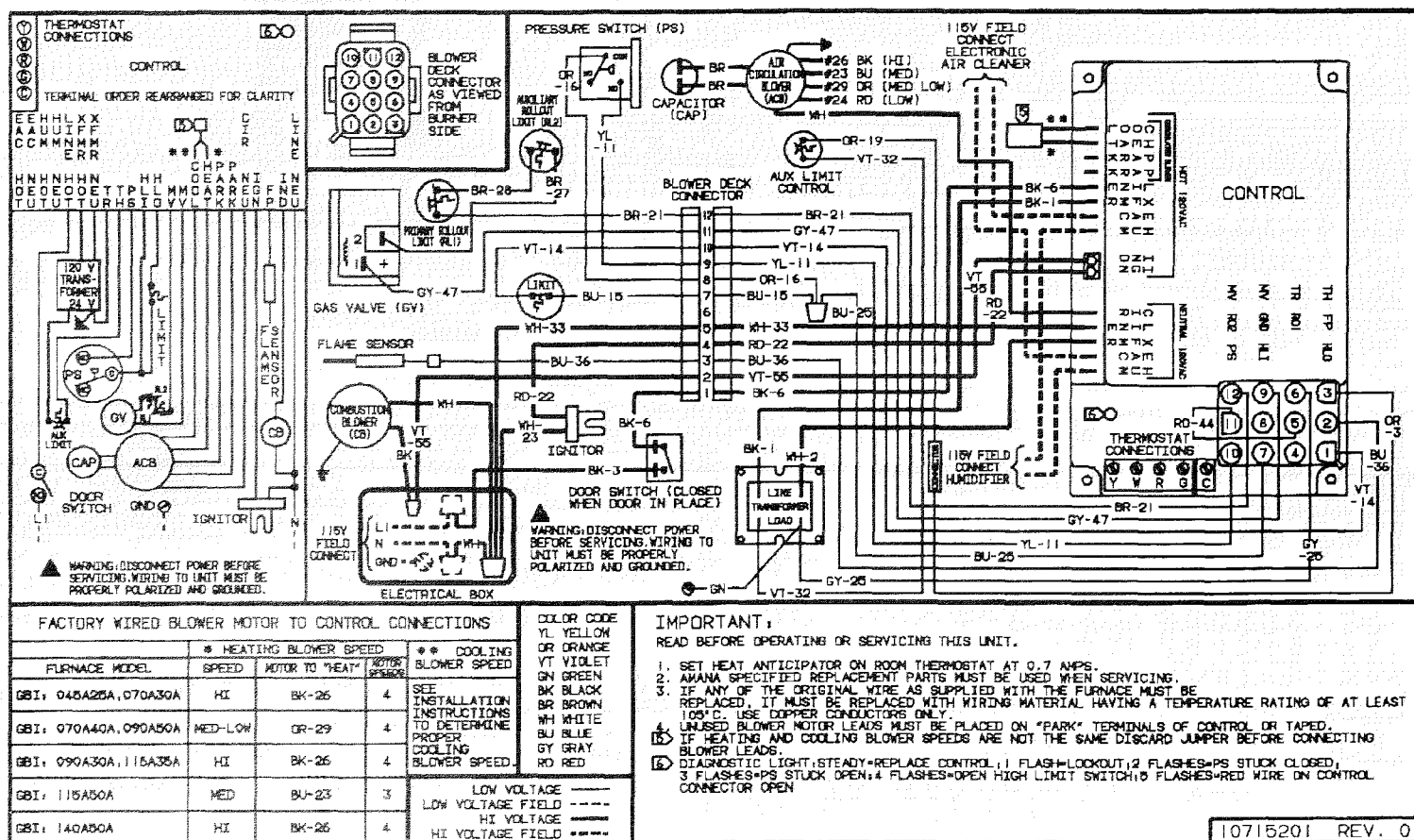
GBI045, 70, 90, 115, 140	350°	White
GBI045, 70, 90, 115, 140	250°	Blue
GUI045, 70, 90, 115, 140	350°	White
GSI045, 70, 90, 115, 140	350°	White
GSI045, 70, 90, 115, 140	250°	Blue
GCI045, 70, 90, 115, 140	325°	Red

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. Then look for the ignitor glowing which indicates there is power to the ignition control. 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.

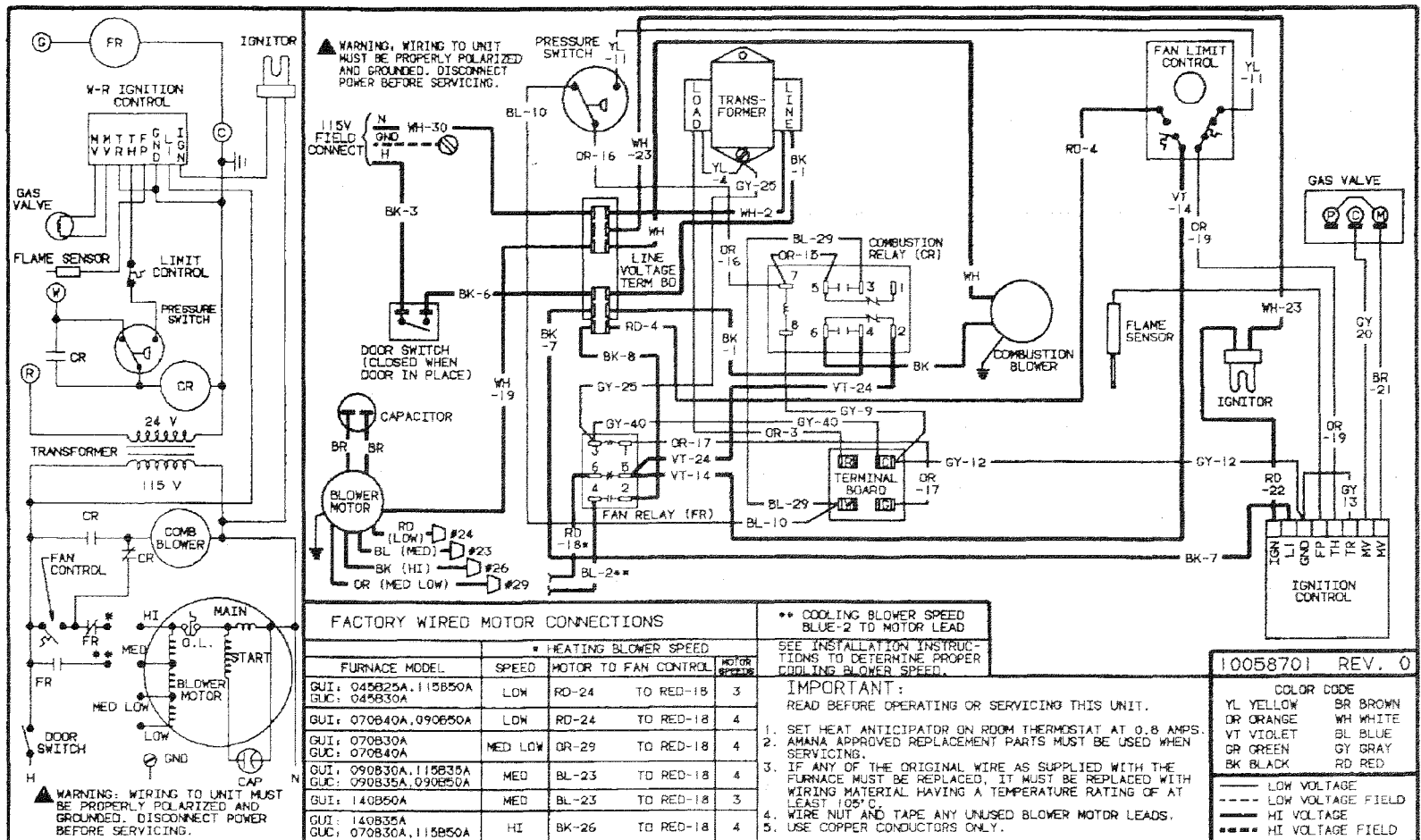




WARNING

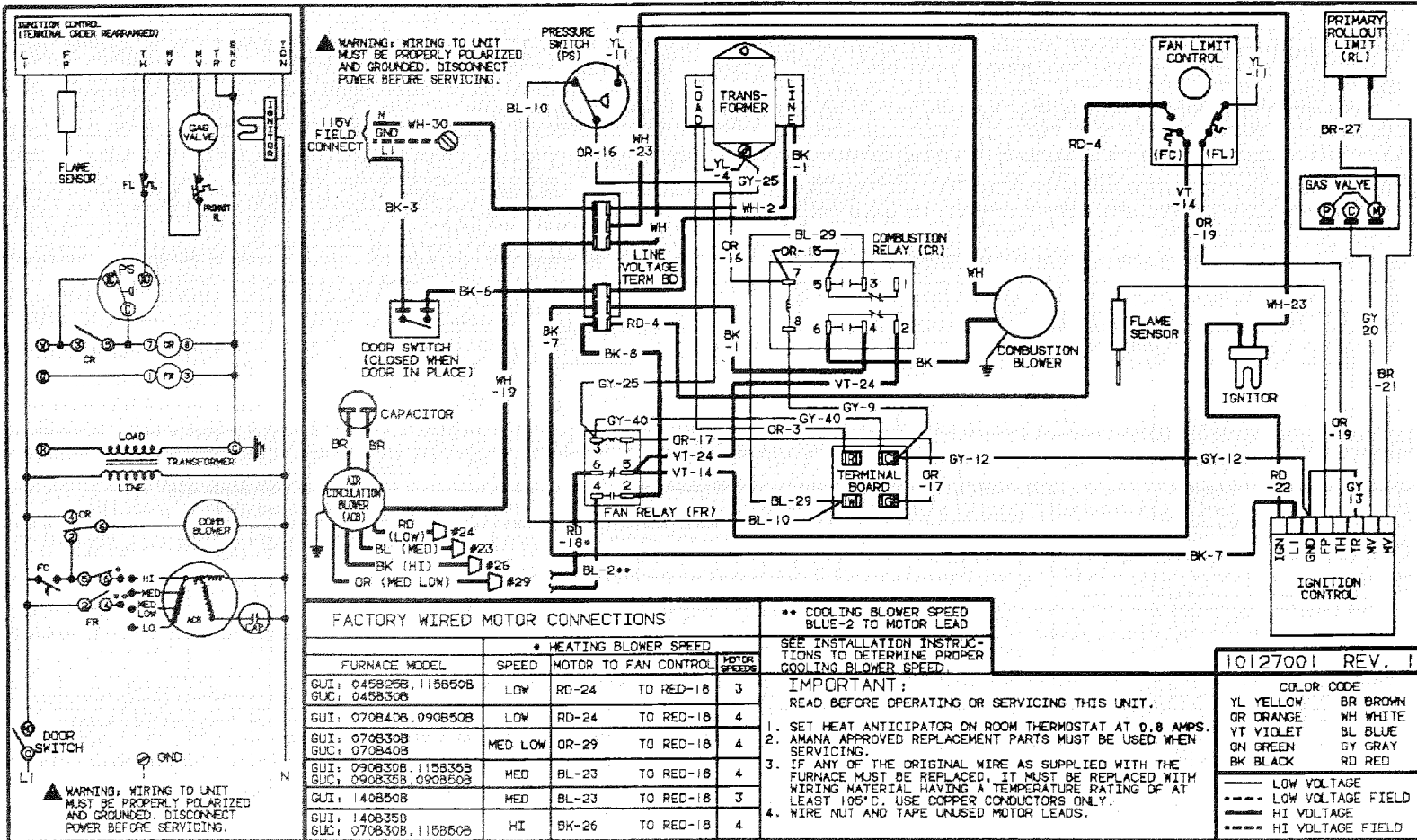
TO AVOID POSSIBLE ELECTRICAL SHOCK, PERSONAL INJURY, OR DEATH, DISCONNECT THE POWER BEFORE SERVICING.

WIRING DIAGRAMS



WARNING

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

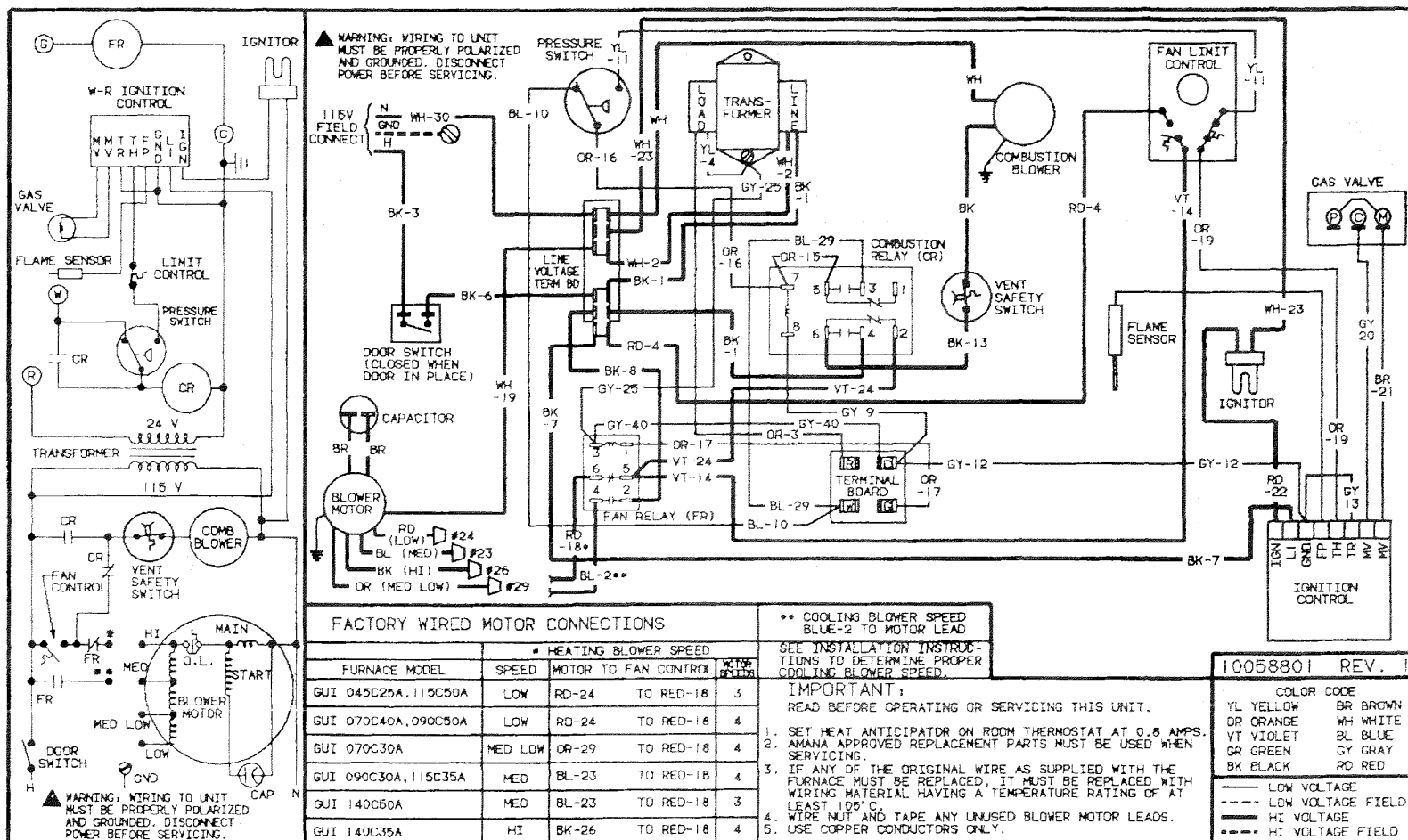


WIRING DIAGRAMS

**WARNING**

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

WIRING DIAGRAMS

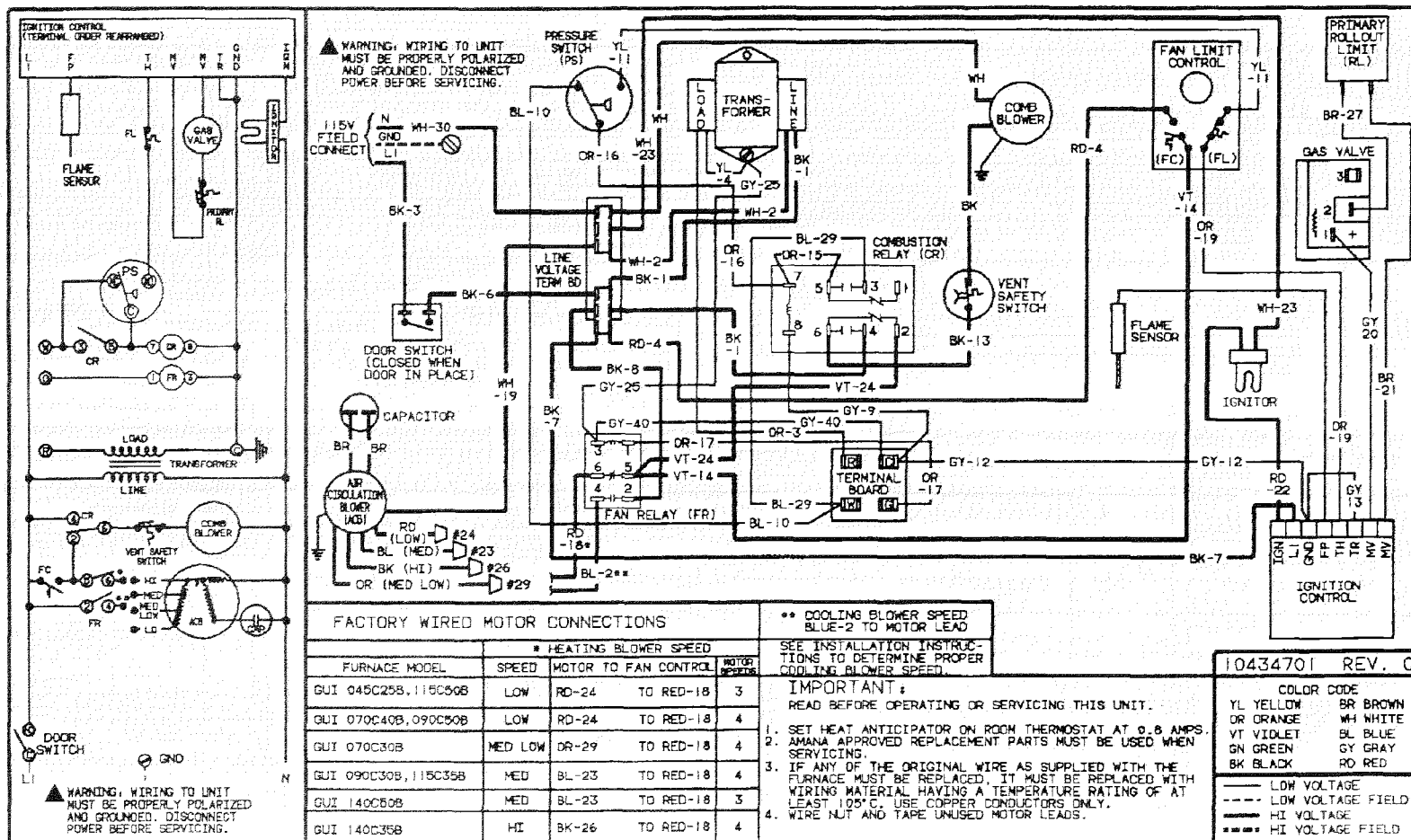


101 Rev. 1



WARNING

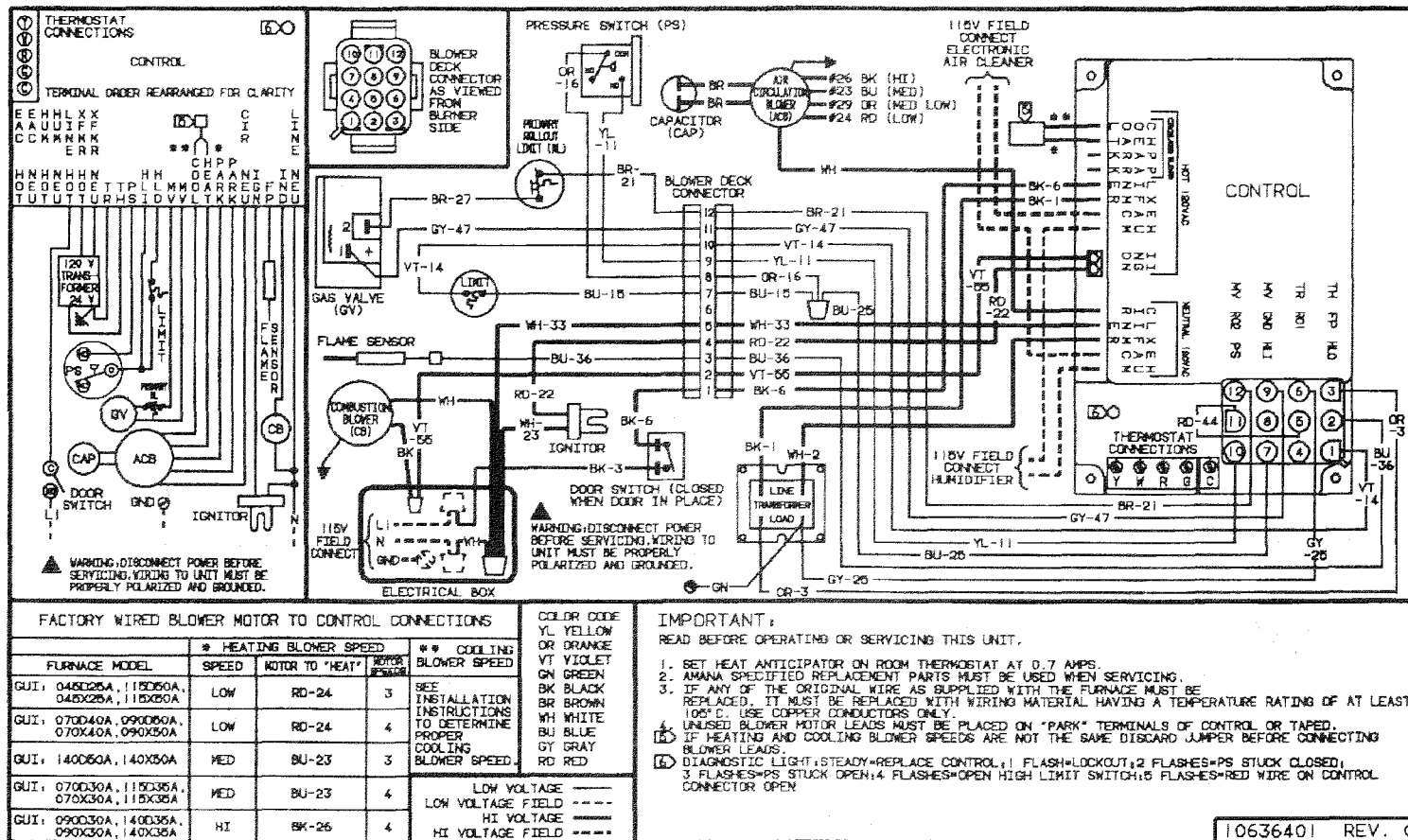
TO AVOID POSSIBLE ELECTRICAL SHOCK, PERSONAL INJURY, OR DEATH, DISCONNECT THE POWER BEFORE SERVICING.



WARNING

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

WIRING DIAGRAMS

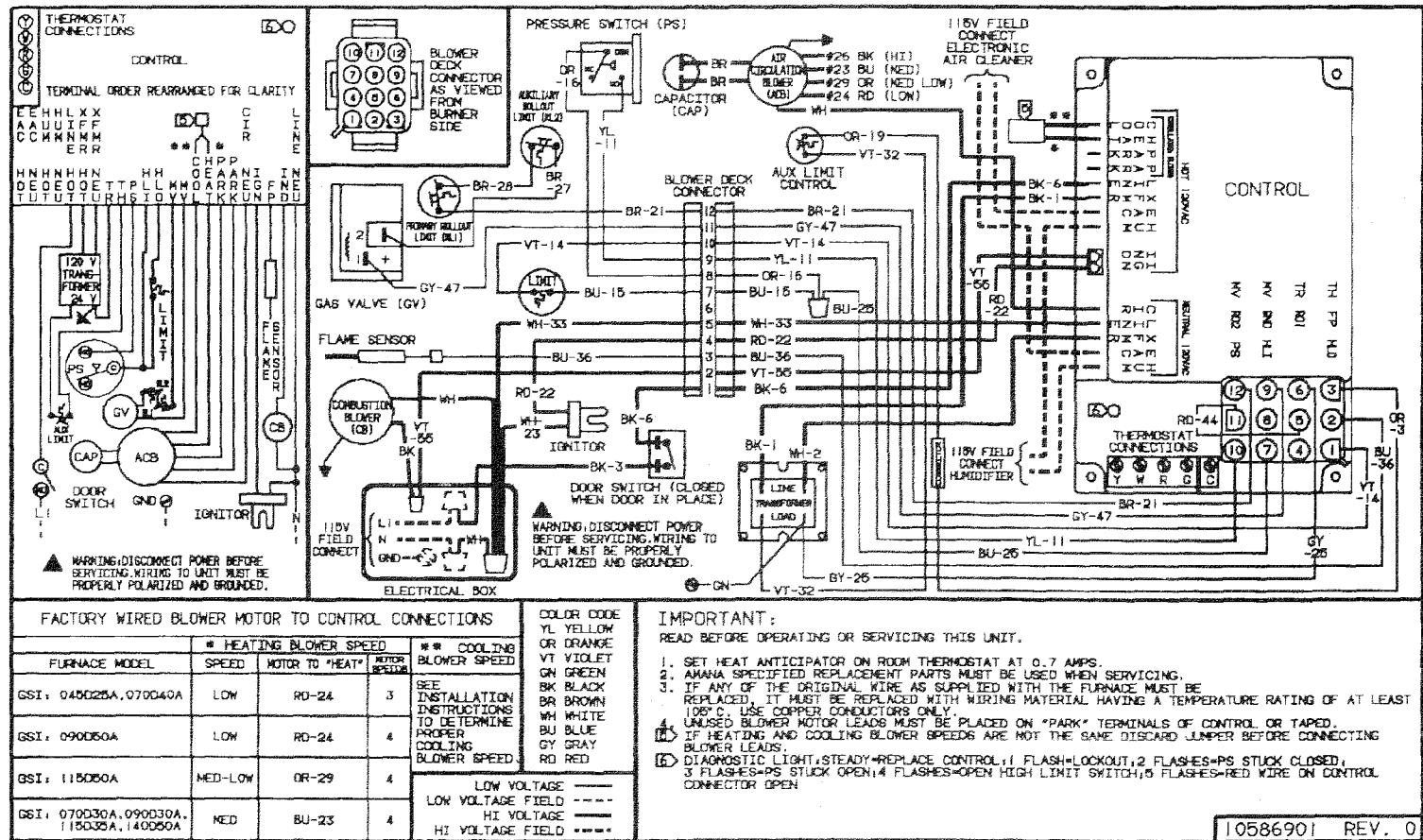


WARNING

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



WIRING DIAGRAMS

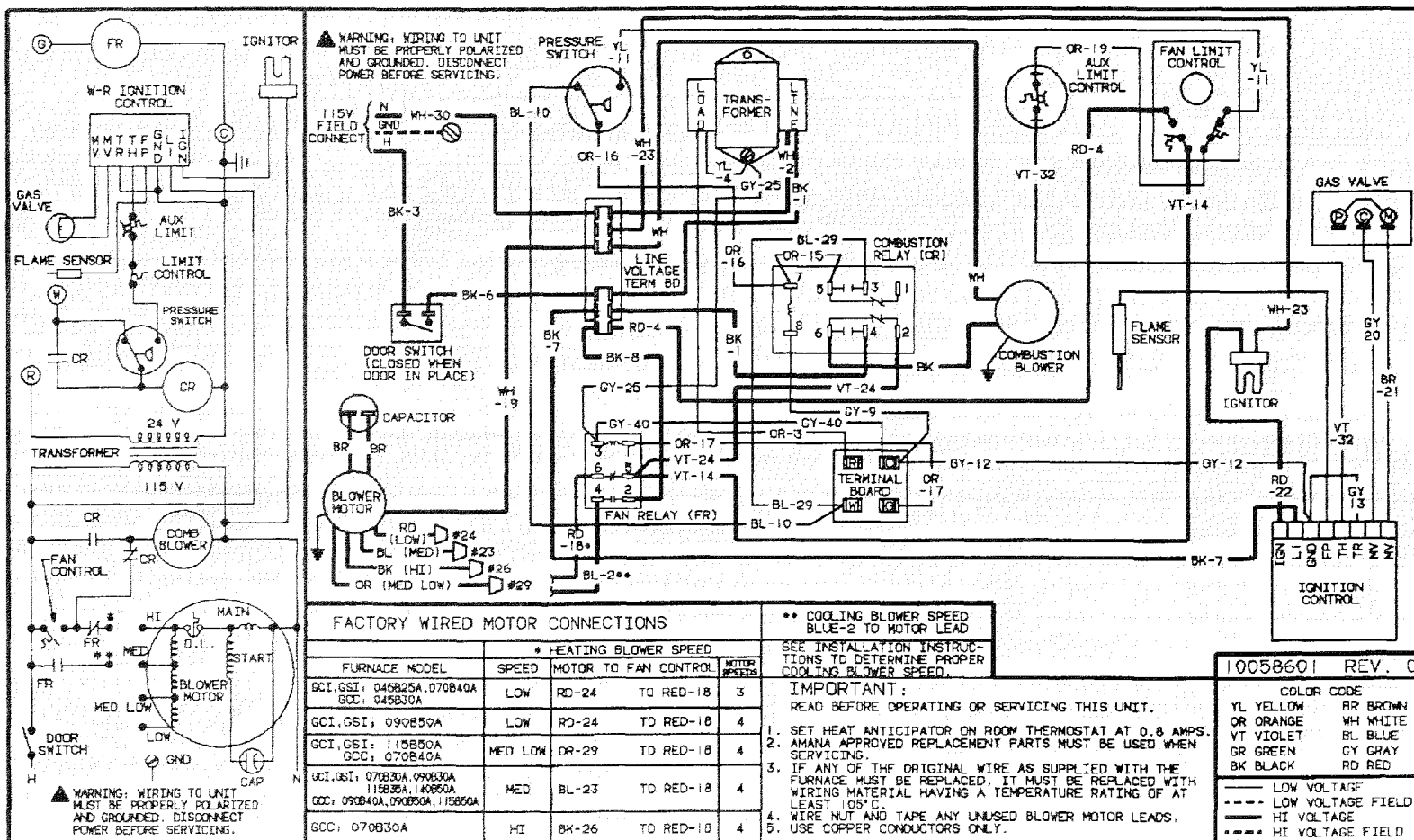


105 Rev. 1



WARNING

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

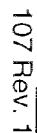


WIRING DIAGRAMS

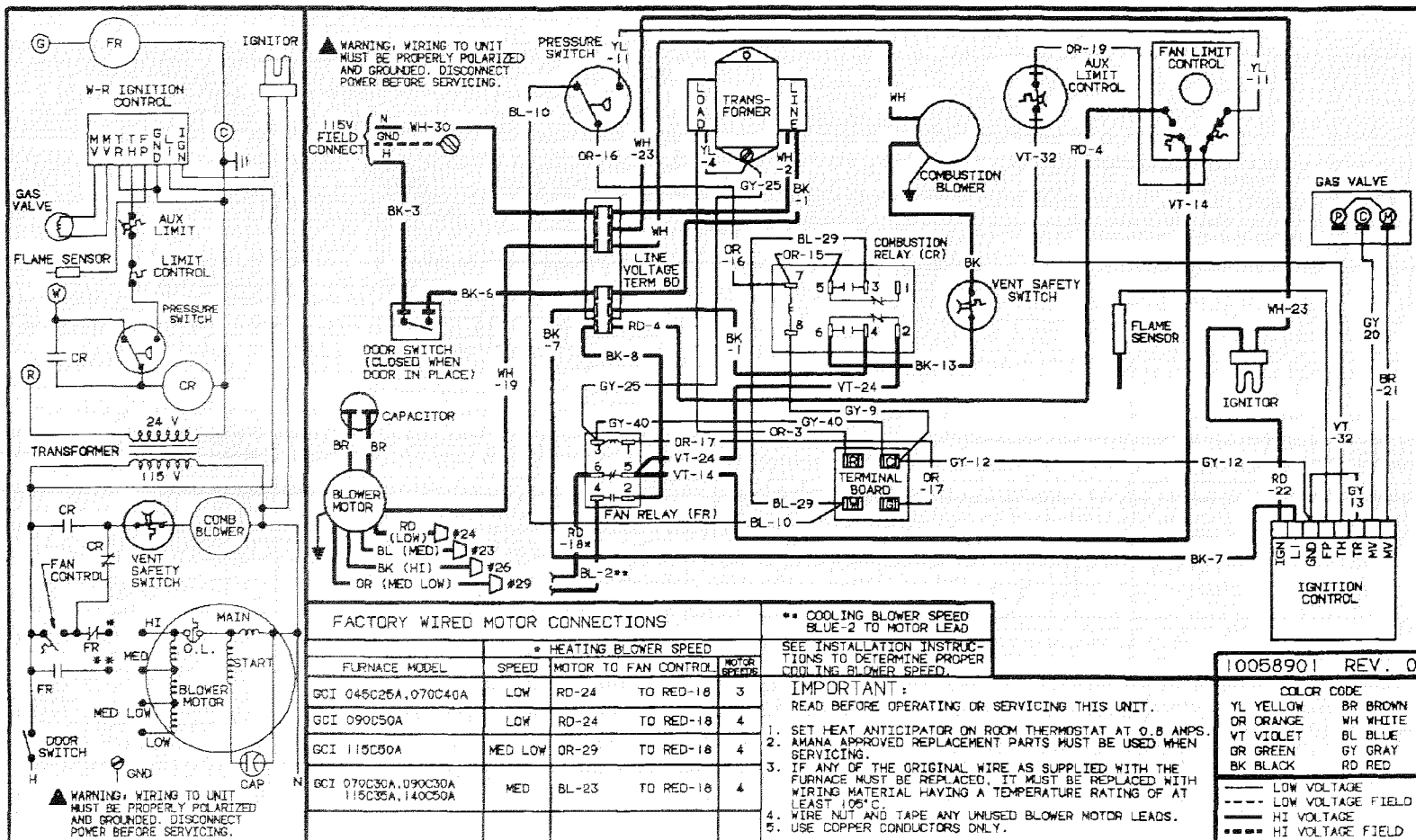
**WARNING**

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

10



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

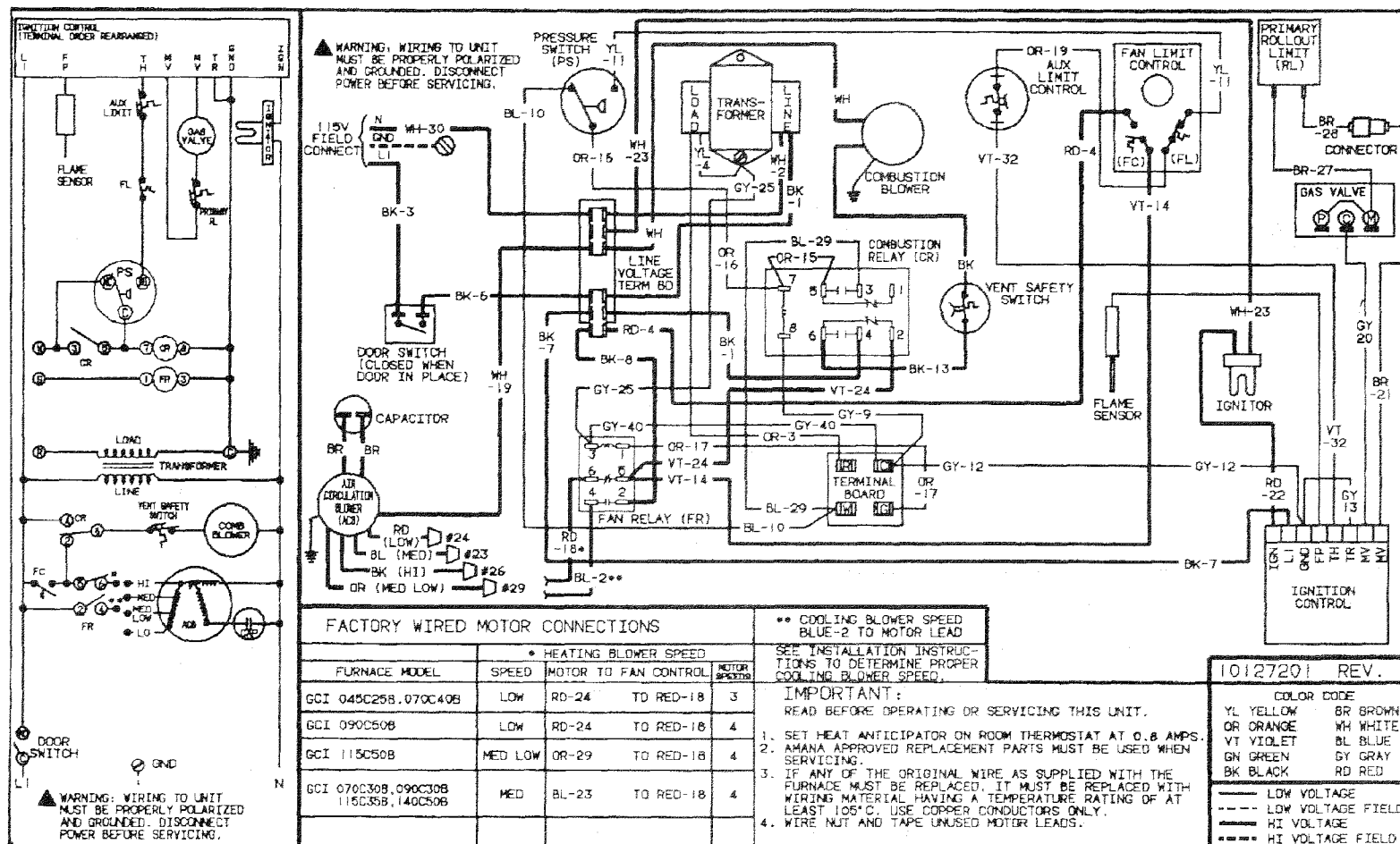


WIRING DIAGRAMS

**WARNING**

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

WIRING DIAGRAMS



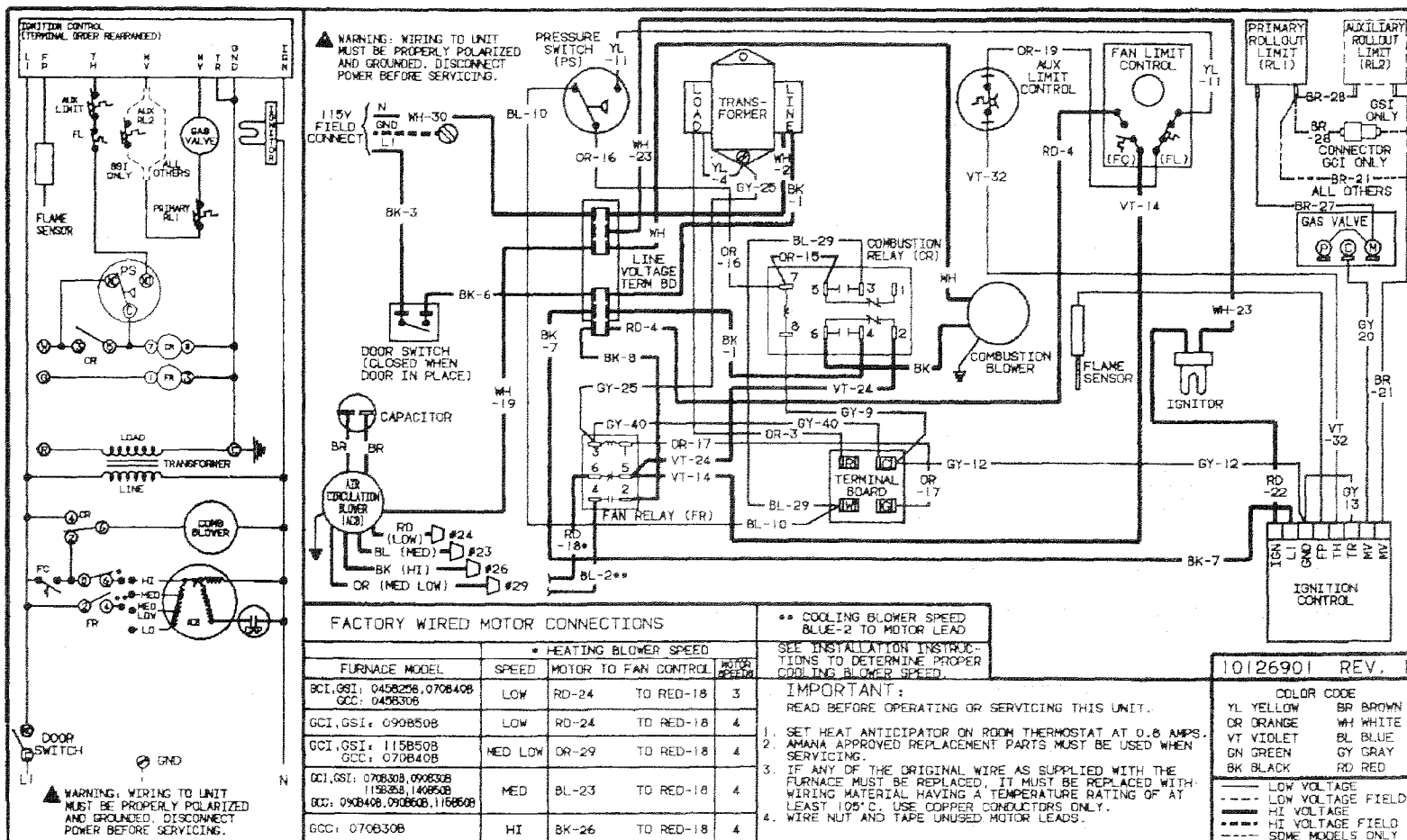
109 Rev. 1



WARNING

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





WIRING DIAGRAMS

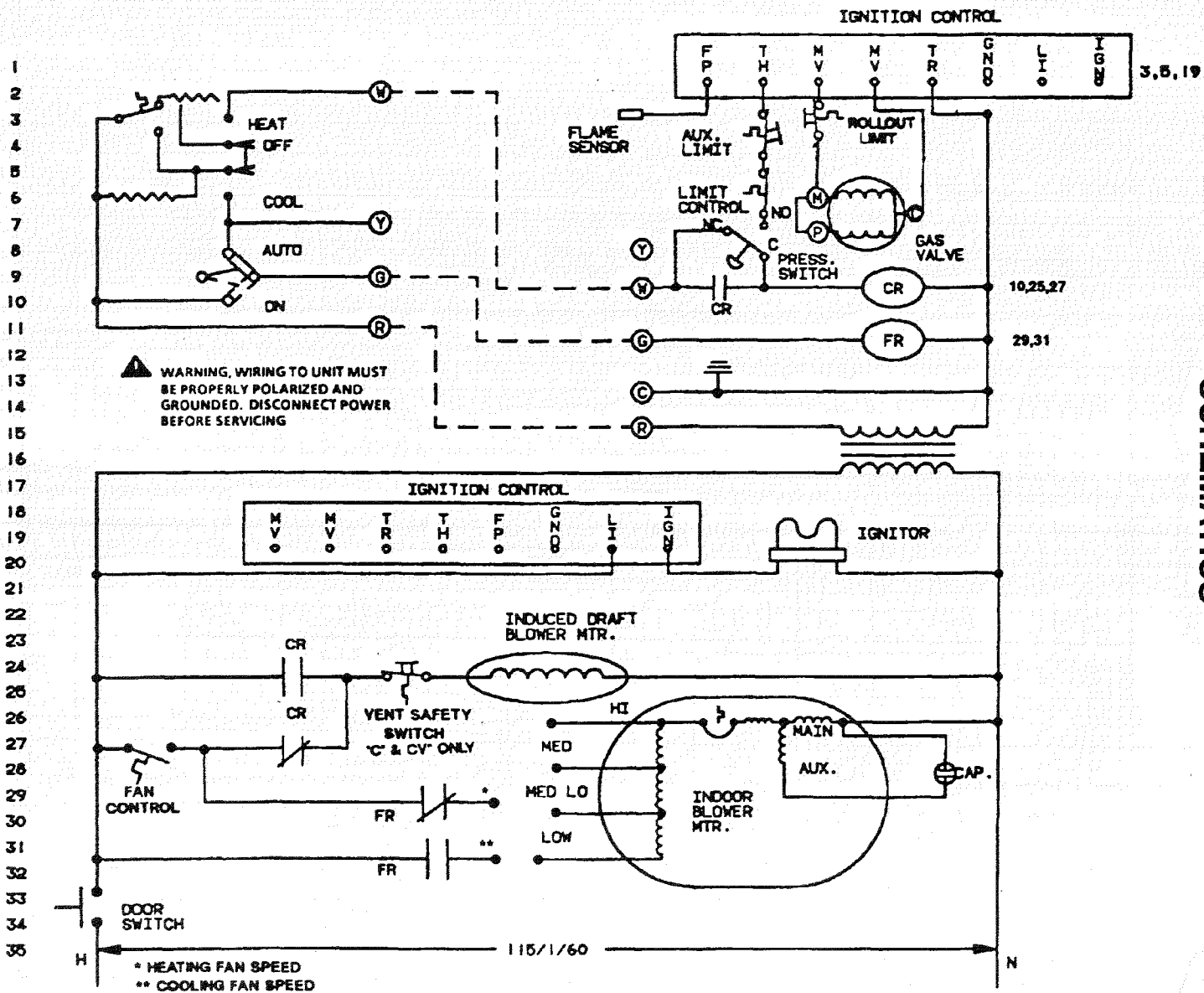
111 Rev. 1



WARNING

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

SCHEMATICS



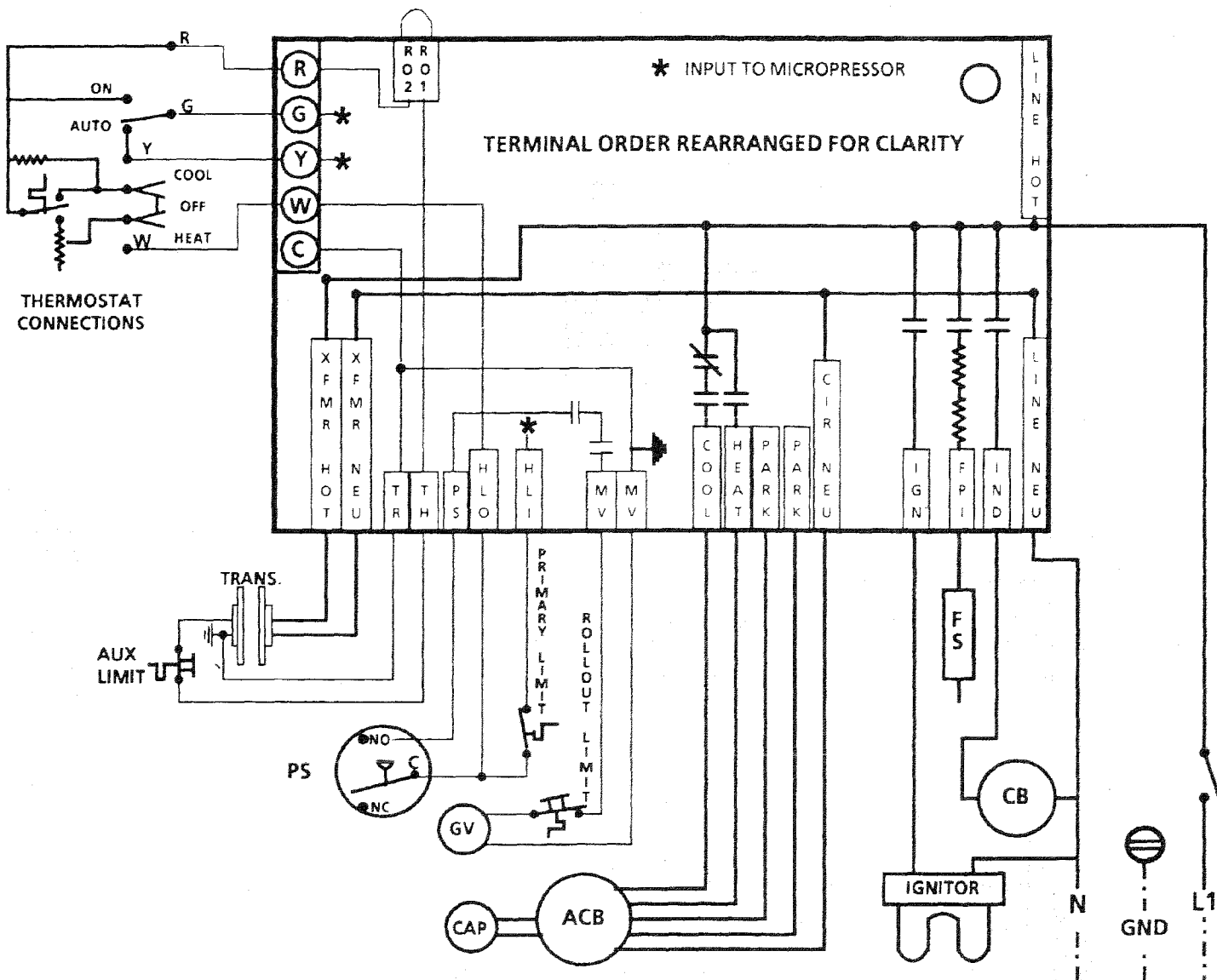
TYPICAL SCHEMATIC - MODELS with WR 50A47 (IGNITION CONTROL)
(Rollout Limit not used on "A" models, Aux. Limit not used on GVI models)



WARNING

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

SCHEMATICS

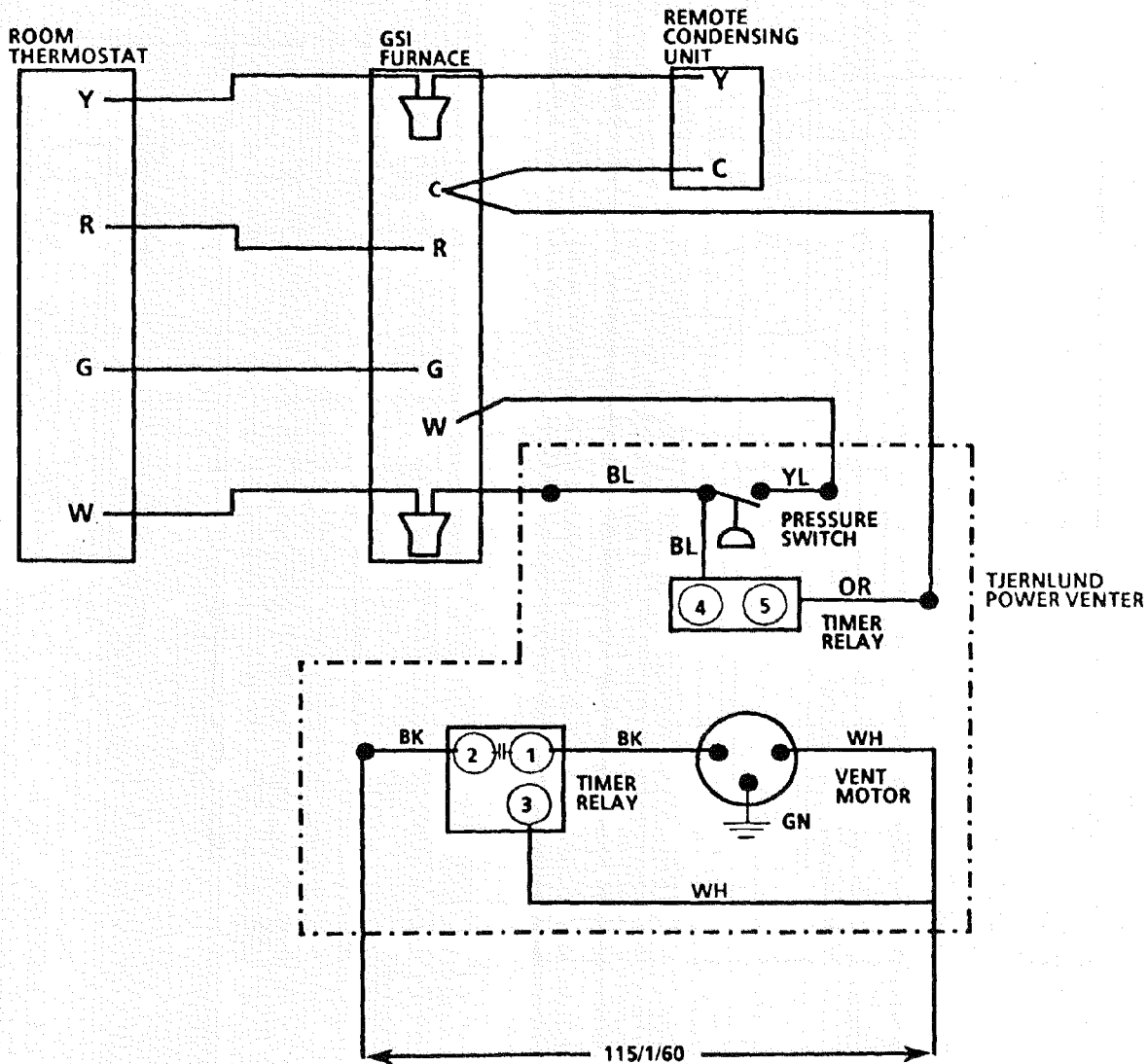


WARNING

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

TYPICAL SCHEMATIC - WR 50A50, Integrated Control AMANA Part# 10207701

SCHEMATICS



TYPICAL SCHEMATIC - GUI, GSI, with TJERNLUND Power Venter

WARNING TO AVOID POSSIBLE ELECTRICAL SHOCK, PERSONAL INJURY, OR DEATH, DISCONNECT THE POWER BEFORE SERVICING.