

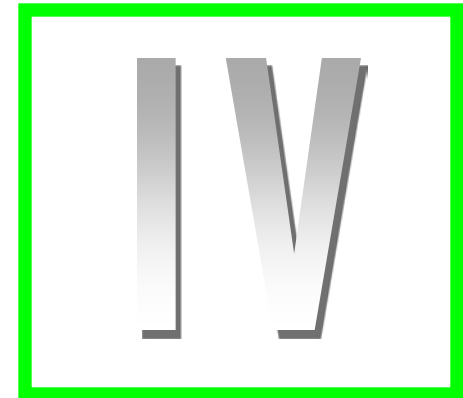
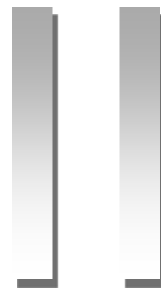
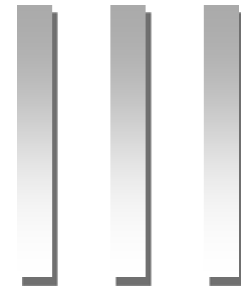
Gas Furnace Venting

Appliance Venting Categories

80% Induced Draft furnaces fall into class I, the inducer motor is only for moving gases through the heat exchanger.

140F

above dew point



Non Pos

Pos

Combustion Air / Vent Sizing

When Using The Concentric Vent Termination Kit

Subtract 5 ft From Total Pipe Length.

MAXIMUM ELBOWS AND VENT LENGTHS

Models Input BTUH (kW)	Pipe Size Inches (mm)	Maximum Number of Elbows*								Minimum Length
		1	2	3	4	5	6	7	8	
60,000 (17.6)	1-1/2 (38)	30	25	20	10	N/A	N/A	N/A	N/A	5
60,000 (17.6)	2 (51)	60	55	50	45	40	30	20	10	5
60,000 (17.6)	3 (76)	85	80	75	70	65	60	50	40	20
80,000 (23.4)	1-1/2 (38)	20	15	N/A	N/A	N/A	N/A	N/A	N/A	5
80,000 (23.4)	2 (51)	60	55	50	45	40	30	20	10	5
80,000 (23.4)	3 (76)	85	80	75	70	65	60	50	40	20
100,000 (29.3)	2 (51)	25	20	15	N/A	N/A	N/A	N/A	N/A	5
100,000 (29.3)	3 (76)	85	80	75	70	65	60	50	40	20
120,000 (35.1)	3 (76)	75	70	65	60	55	45	35	25	5

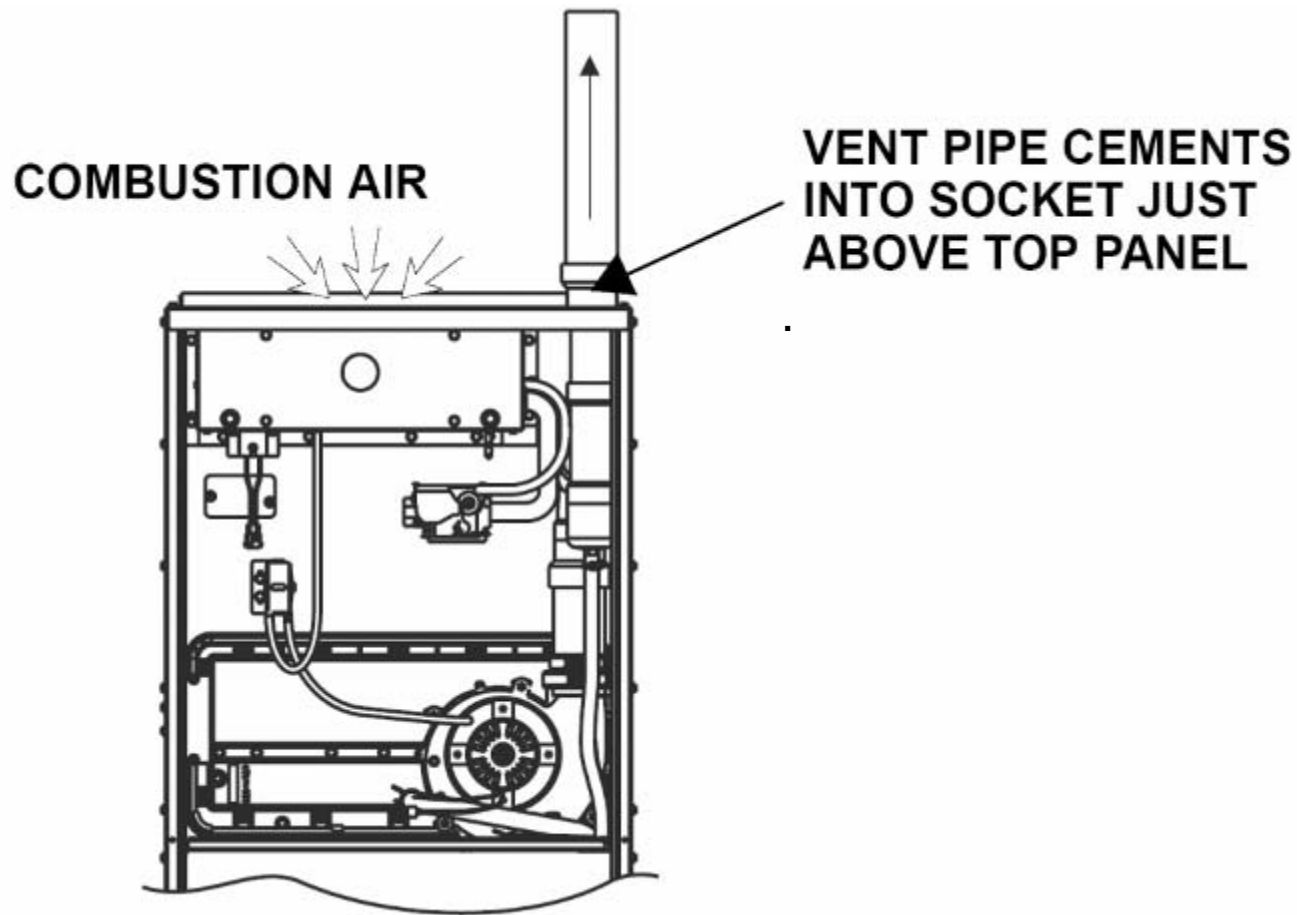
Termination elbows counted?

Consequences of too many elbows or smaller pipe than required?

The type of installation shown next will draw the air required for combustion from within the space surrounding the appliance and from areas or rooms adjacent to the space surrounding the appliance. This may be from within the space in a non-confined location or it may be brought into the furnace area from outdoors through permanent openings or ducts. It is not piped directly into the burner box. A single, properly sized pipe from the furnace vent connector to the outdoors must be provided. For upflow models, combustion air is brought into the furnace through the unit top panel opening. Do not install a pipe into the intake collar on top of the burner box. An **unconfined space** is not less than 50 cu. ft. per 1,000 Btu/ hr input rating for all of the appliances installed in that area. Rooms communicating directly with the space containing the appliances are considered part of the unconfined space, if openings are furnished with doors. A **confined space** is an area with less than 50 cu. ft. per 1,000 Btu/hr input rating for all of the appliances installed in that area. The following must be considered to obtain proper air for combustion and ventilation in confined spaces.

Combustion Air Source From Outdoors The blocking effects of louvers, grilles and screens must be given consideration in calculating free area. If the free area of a specific louver or grille is not known, to estimate free area.

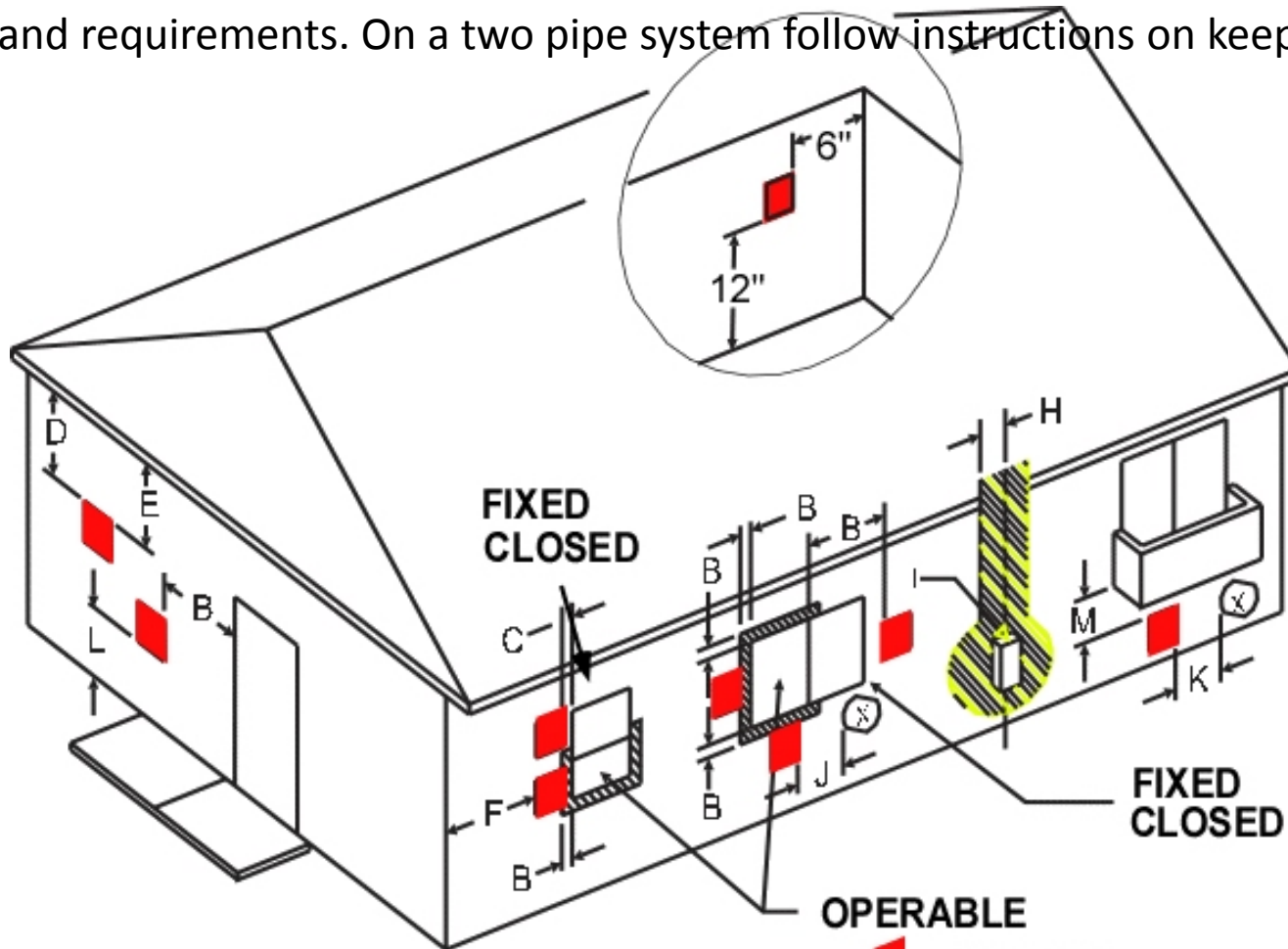
Ambient Combustion Air




Calculate for all of the appliances installed in that area.

Vent Pipe Clearances

IMPORTANT: The vent must be installed with the following minimum clearances. The vent must also comply with local codes and requirements. On a two pipe system follow instructions on keeping pipes together.



 VENT TERMINAL

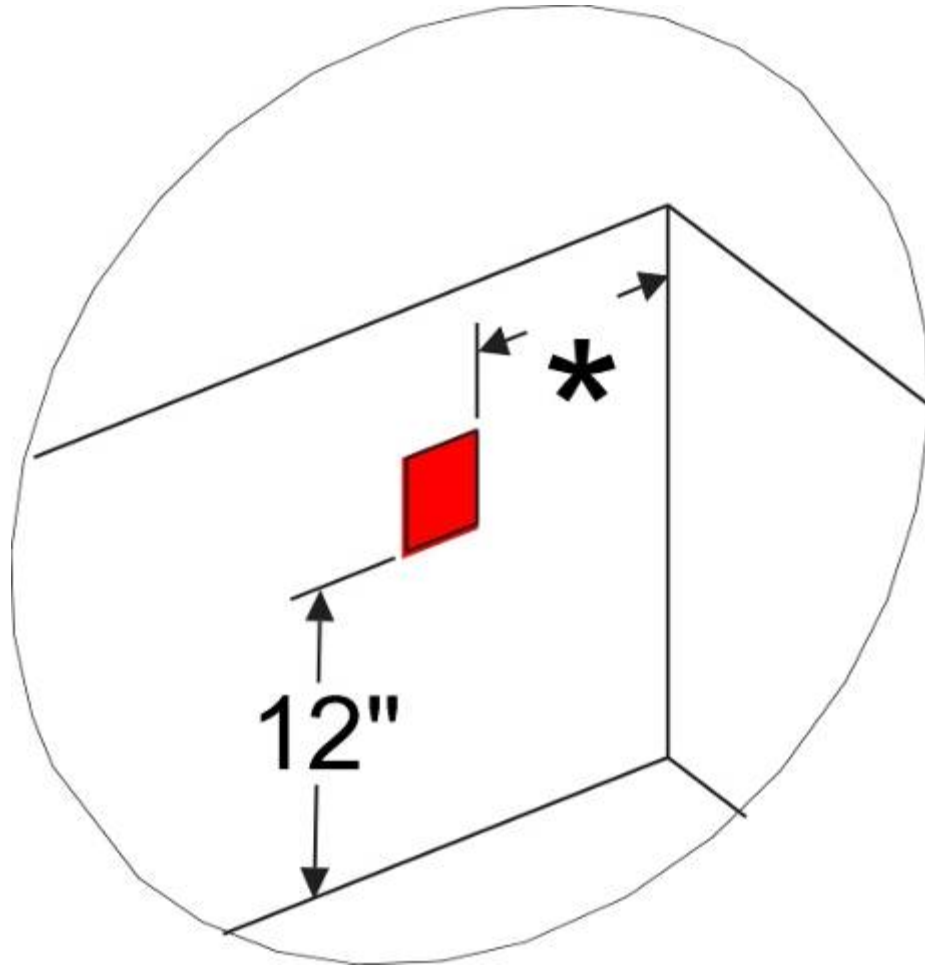
 AIR SUPPLY

 AREA WHERE TERMINAL IS NOT PERMITTED



Avoid This.... 😊

Clearance Above Grade



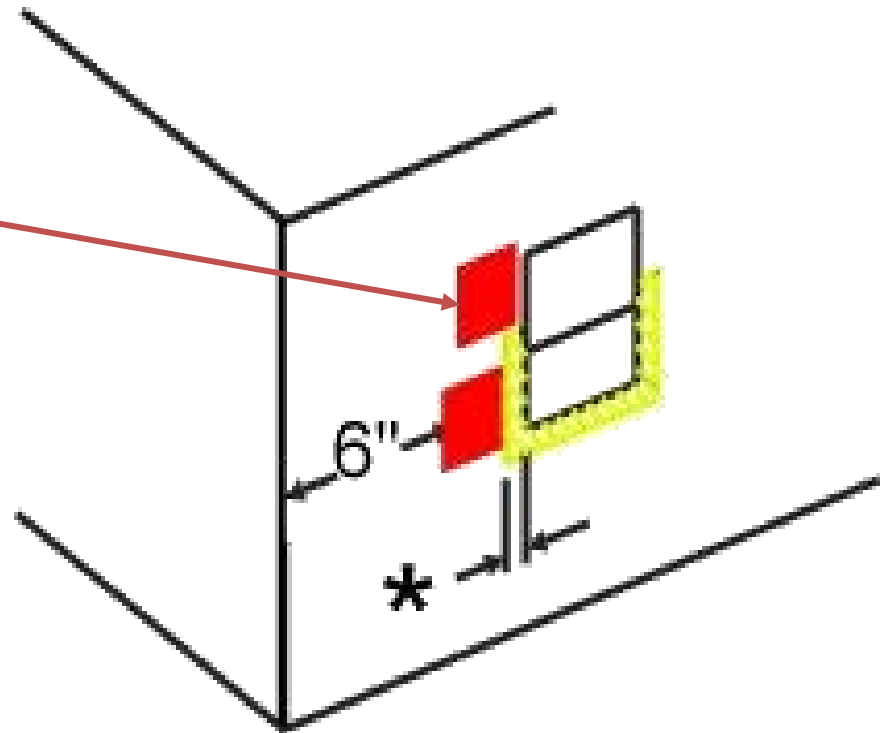
Clearance above:

- Grade
- Veranda
- Porch
- Deck
- Balcony

* = 9" for 10k to 50K BTUH
and 12" for 50K BTUH and
larger furnaces

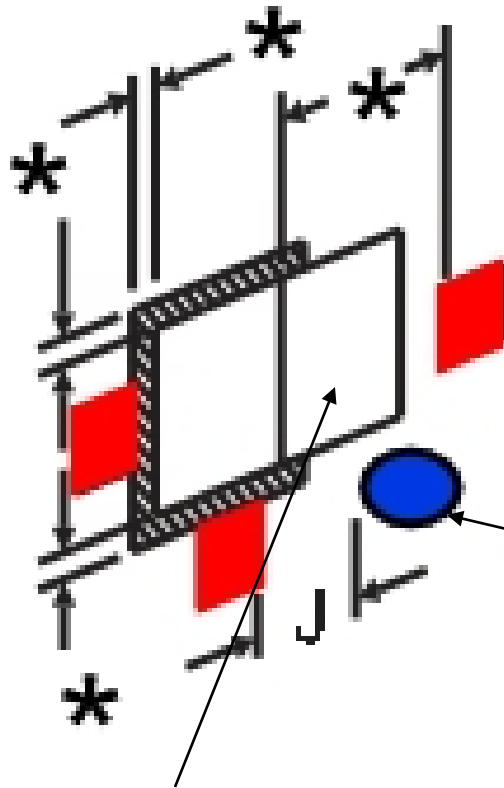
Window Clearance

- Clearance:
 - From fixed window to vent = 6"
 - Outside corner = 6"
- * = 9" for 10k to 50K BTUH and 12" for 50K BTUH and larger furnaces



B. Clearance to window or door that may be opened	6 inches for applications $\leq 10,000$ Btuh, 12 inches for appliances $> 10,000$ Btuh	6 inches for applications $\leq 10,000$ Btuh, 9 inches for appliances $> 10,000$ Btuh
C. Clearance to permanently closed window	and $\leq 100,000$ Btuh,	and $\leq 50,000$ Btuh,
F. Clearance to outside corner	36 in for appliances $> 100,000$ Btuh	12 inches for appliances $> 50,000$ Btuh

Window Clearance



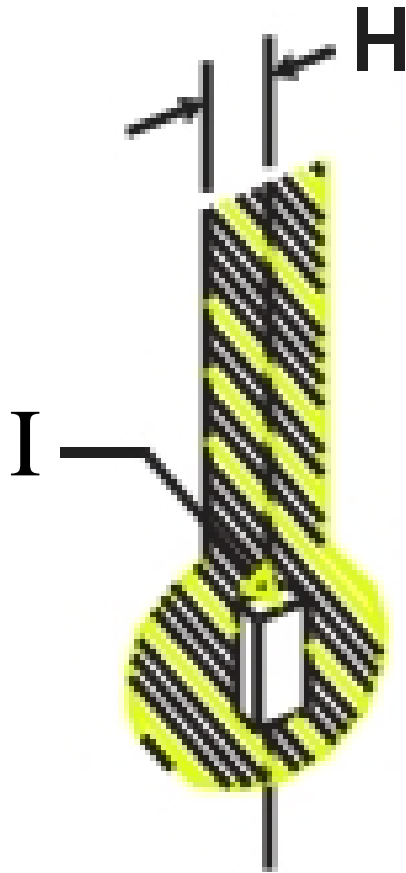
* = 9" for 10k to 50K BTUH
 and 12" for 50K BTUH and
 larger furnaces
 J= same as above

Fixed Window

Combustion air inlet on
 Two pipe systems

B. Clearance to window or door that may be opened	6 inches for applications $\leq 10,000$ Btuh, 12 inches for appliances $> 10,000$ Btuh and $\leq 100,000$ Btuh,	6 inches for applications $\leq 10,000$ Btuh, 9 inches for appliances $> 10,000$ Btuh and $\leq 50,000$ Btuh,
J. Clearance to nonmechanical air supply inlet to building or air inlet to any other inlet	36 in for appliances $> 100,000$ Btuh	12 inches for appliances $> 50,000$ Btuh

Clearance To A Meter/Regulator

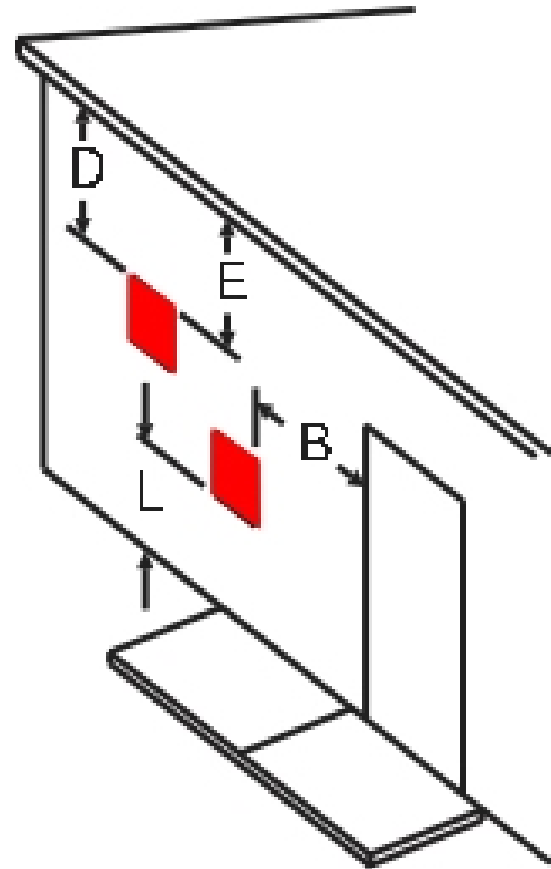


- $H = 9''$ for 10k to 50K BTUH and $12''$ for 50K BTUH and larger furnaces from centerline of meter/regulator
- $I = * = 9''$ for 10k to 50K BTUH and $12''$ for 50K BTUH and larger furnaces Gas regulator vent outlet.

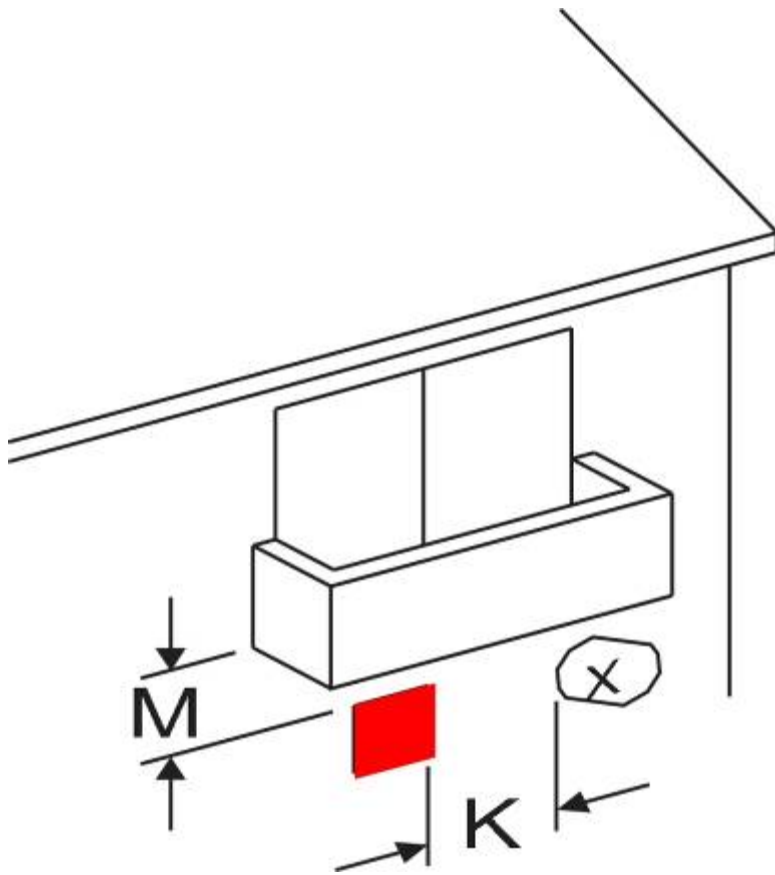
*Around the electrical and gas meters as well as a LP regulator there will always be a hole through the Building exterior. Keep vent terminations away from These.

Soffit Clearance

- Clearance D, B and E are = 9" for 10k to 50K BTUH and 12" for 50K BTUH and larger furnaces Gas regulator vent outlet.
- E is for unventilated soffit
- L is 3 feet clearance above a sidewalk, or paved driveway located on Public property.



Clearance Under Veranda

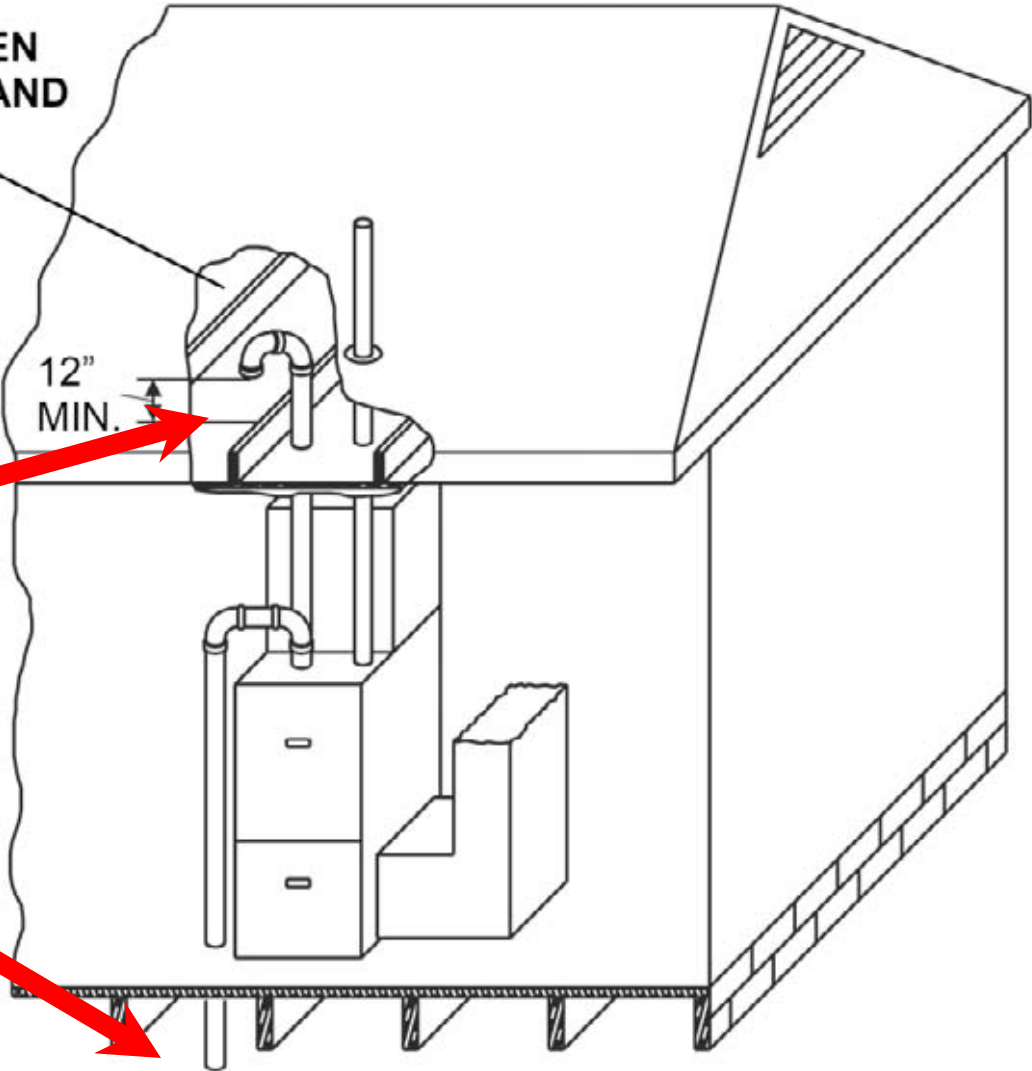


- $M = 9''$ for 10k to 50K BTUH and $12''$ for 50K BTUH and larger furnaces
- $K =$ Clearance to mechanical supply inlet (x) 3' above it within 10 horizontal.

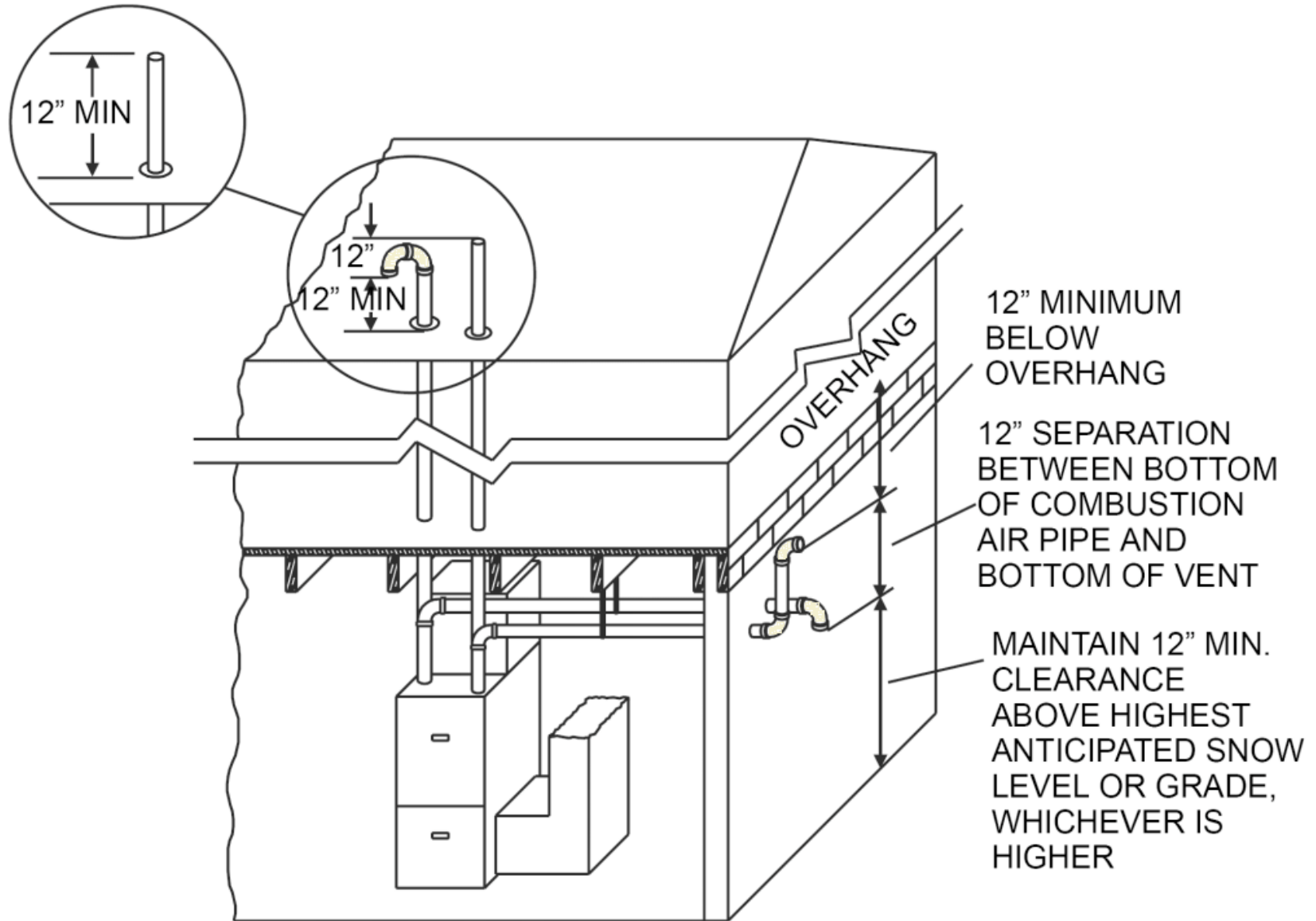
Ventilated Combustion Air

**12" MINIMUM BETWEEN
BOTTOM OF BELOW AND
ANY MATERIAL**

*When bring in combustion air from the vented attic be sure to prevent the intake pipe from being blocked by insulation.



Vent Applications

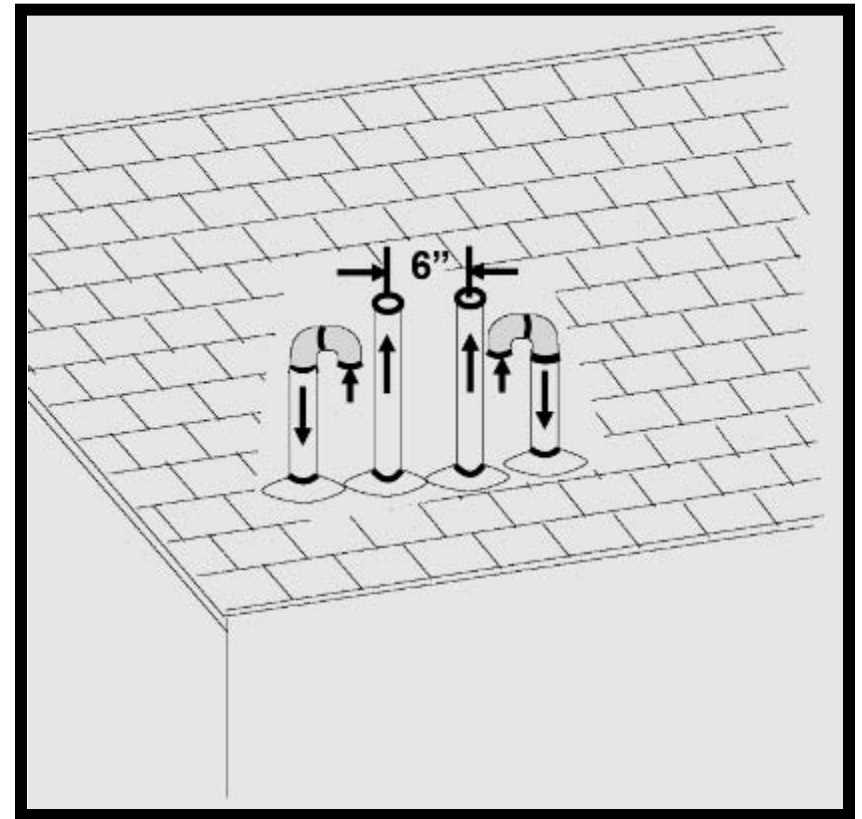
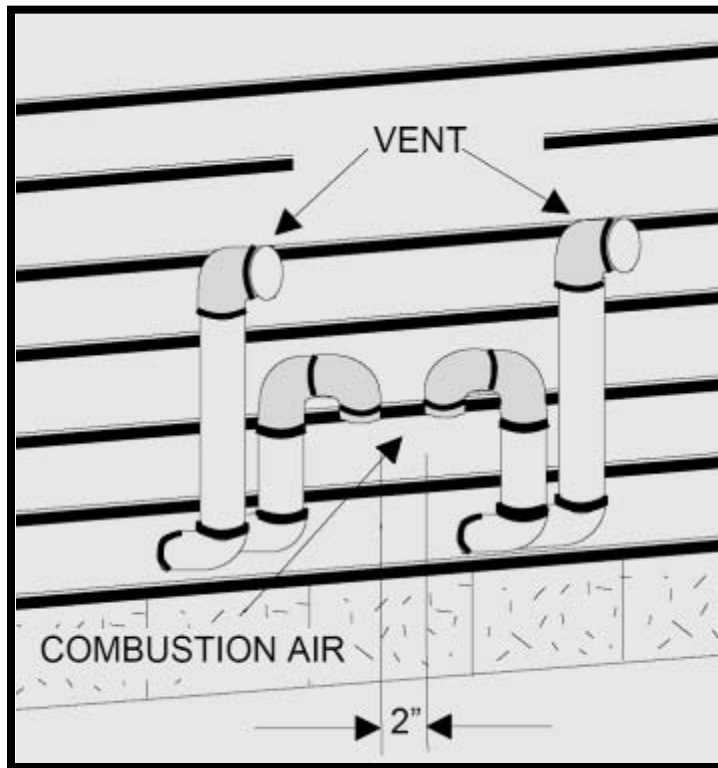


Roof mounted vertical terminals may be field fabricated. Standard PVC/ SRD fittings may be used. If installing a vertical venting system through any unconditioned space such as an attic or crawl space, it must be insulated.

1. Observe all clearances listed in vent clearances in these instructions.
2. Termination should be positioned where vent vapors are not objectionable.
3. Termination should be located where it will not be affected by wind gusts, light snow, or allow recirculation of flue gases.
4. Termination should be located where it cannot be damaged, plugged or restricted by tree limbs, leaves and branches.
5. Sealed combustion air systems must be installed so the vent and the combustion air pipes terminate in the same atmospheric zone.

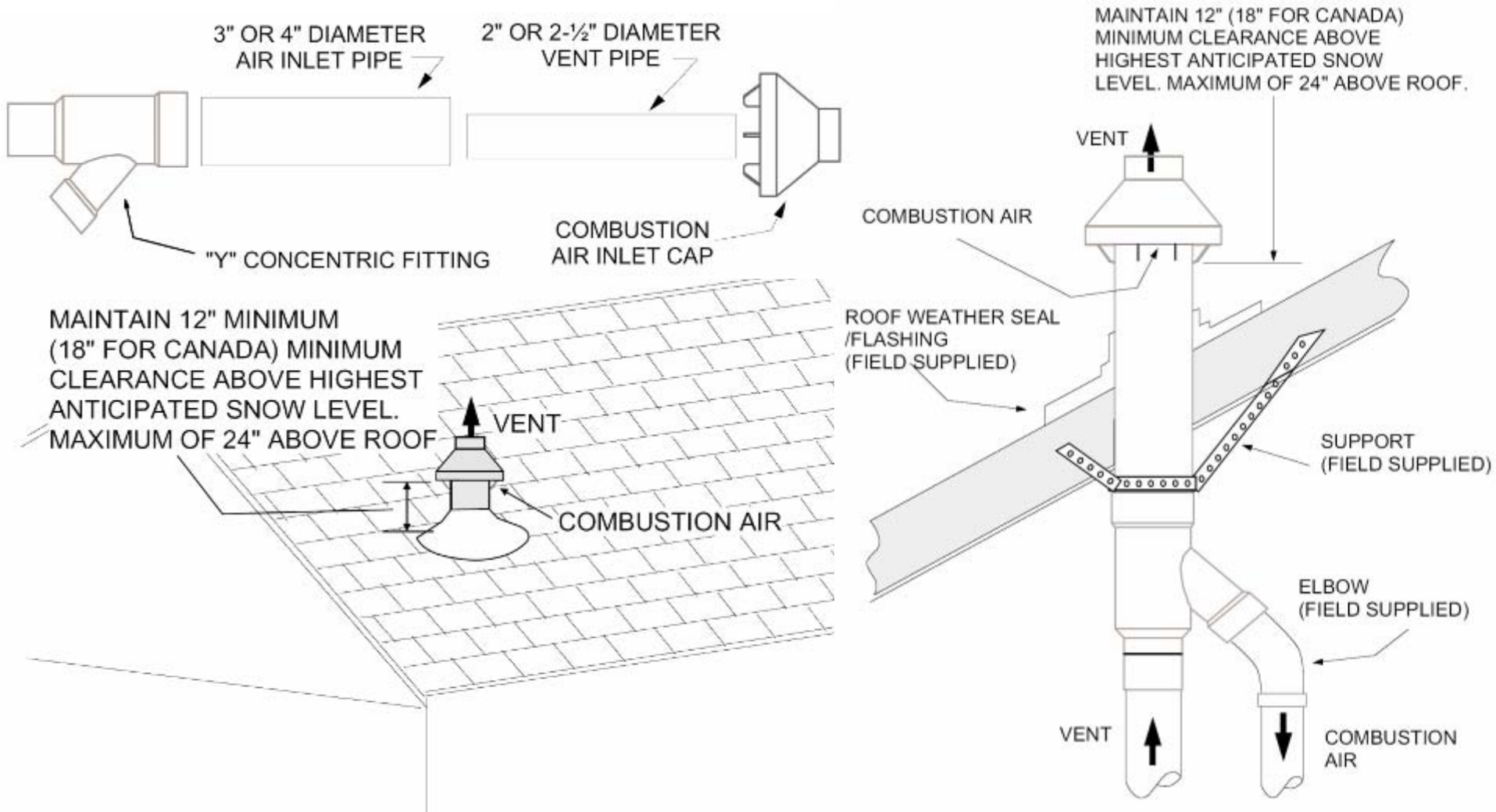
Multiple Unit Termination

Observe all clearances listed in vent clearances in the installation instructions. The sealed combustion system can be used for installations requiring more than one furnace in a structure. A separate sealed combustion air pipe and a separate vent pipe must be installed for each furnace. Do not connect more than one furnace to a combustion air pipe or a vent pipe. The combustion air and vent termination must be located as shown.



Vertical Roof Mounting

NOTE: Roof mounting is the recommended location.



Horizontal Sidewall Mounting

NOTE:
Securing strap must be field installed
to prevent movement of termination
kit in side wall.

STRAP
(FIELD SUPPLIED)

VENT

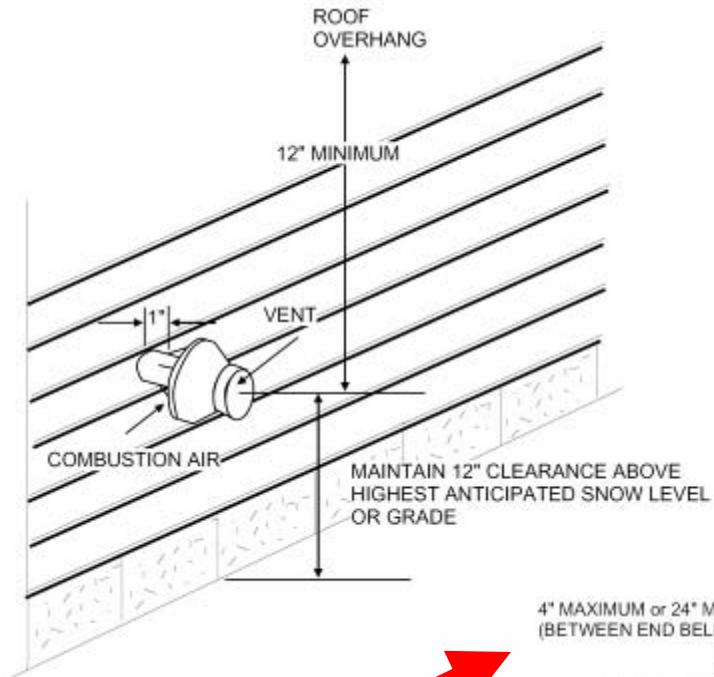
COMBUSTION
AIR

VENT

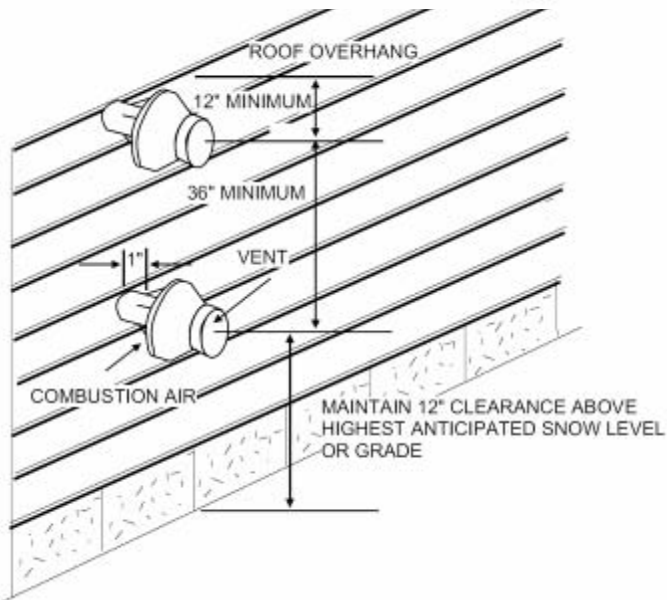
ELBOW
(FIELD SUPPLIED)

1"
COMBUSTION
AIR INLET
VANES TO
WALL

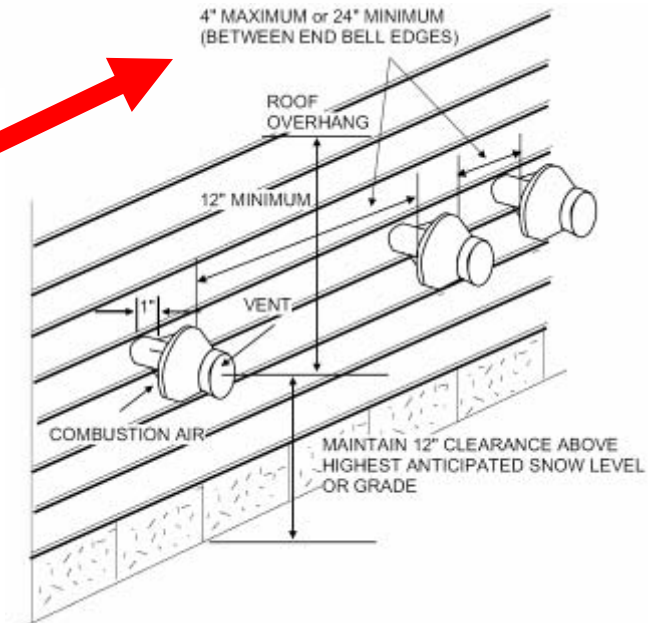
COMBUSTION
AIR



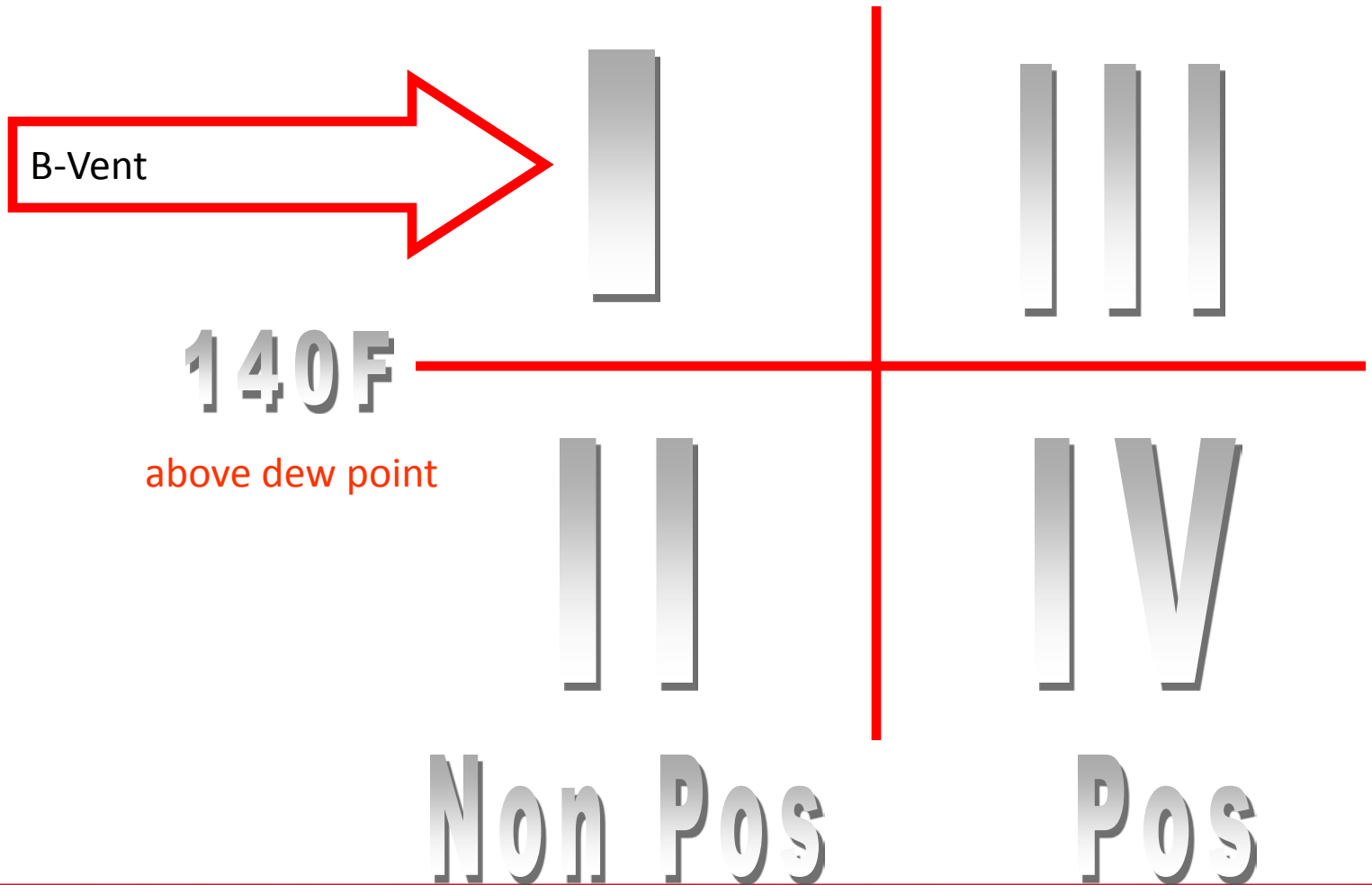
4" MAXIMUM or 24" MINIMUM
(BETWEEN END BELL EDGES)



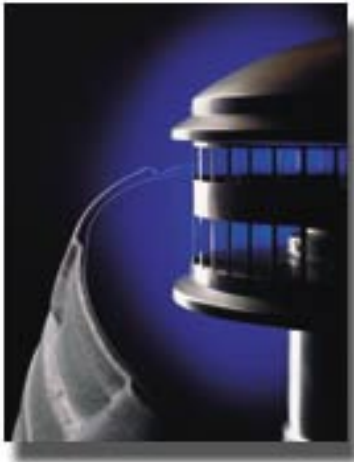
This is not a mistake –
keep vents within 4" or
get them apart by at
least 24"



Appliance Venting Categories



Why is proper vent sizing and installation so important?

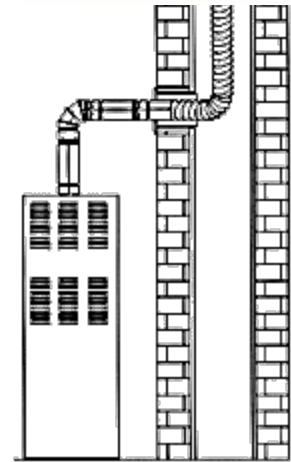


The “Three C’s”!

C Condensation

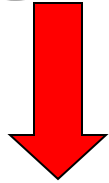
C Corrosion

CO



Condensation

Flue Spillage



Corrosion



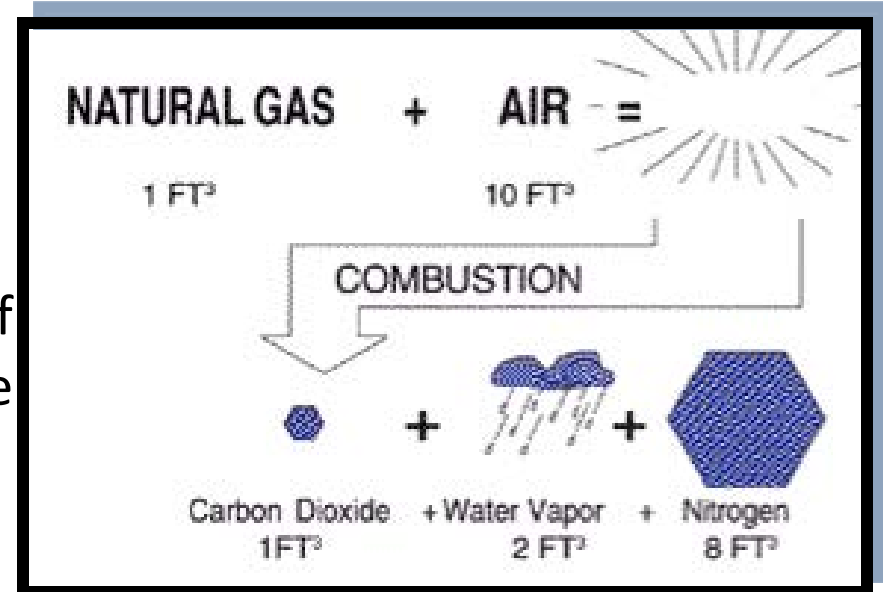
CO



Property Damage

Combustion Process

- Proper Combustion: 1ft³ gas to 10ft³ air
- By-products: CO², water vapor, nitrogen
- Incomplete Combustion: CO is produced
- Since water vapor is a by-product of combustion, the key is to make sure the flue gas temp stays above the condensation point (“dew point” until exiting the vent system



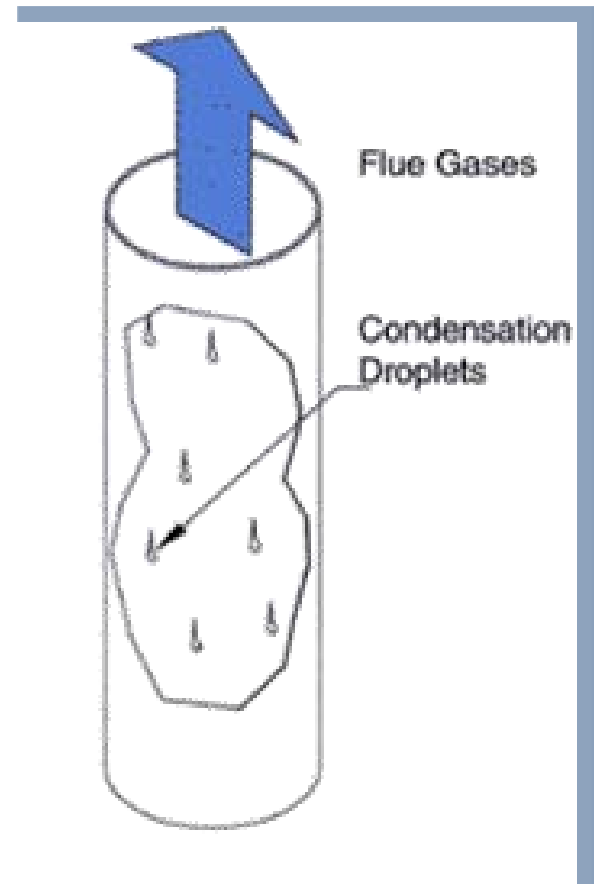
Reducing Condensation

- B-Vent connectors
- Correct Manifold Pressure
- Correct Temp Rise
- Common Vent Size
 - Critical when removing old furnace from common vent with water heater
- Make sure equipment cycle rate is acceptable



Dew Point

- Temp at which condensation occurs (Water vapor condenses to a liquid)
- Natural Draft with 40-50% excess air
 - dew point typically 121F
 - Flue Gas must be cooler than 121F for condensation to occur
- Induced draft furnace flue gas has a higher dew point



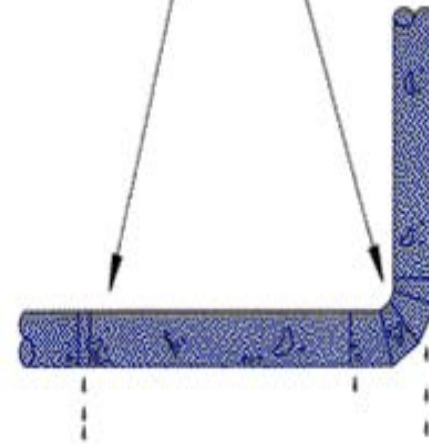
"Wet Time"

Corrosion only occurs when vent walls are wet

It's common for vent walls to be wet on initial startup

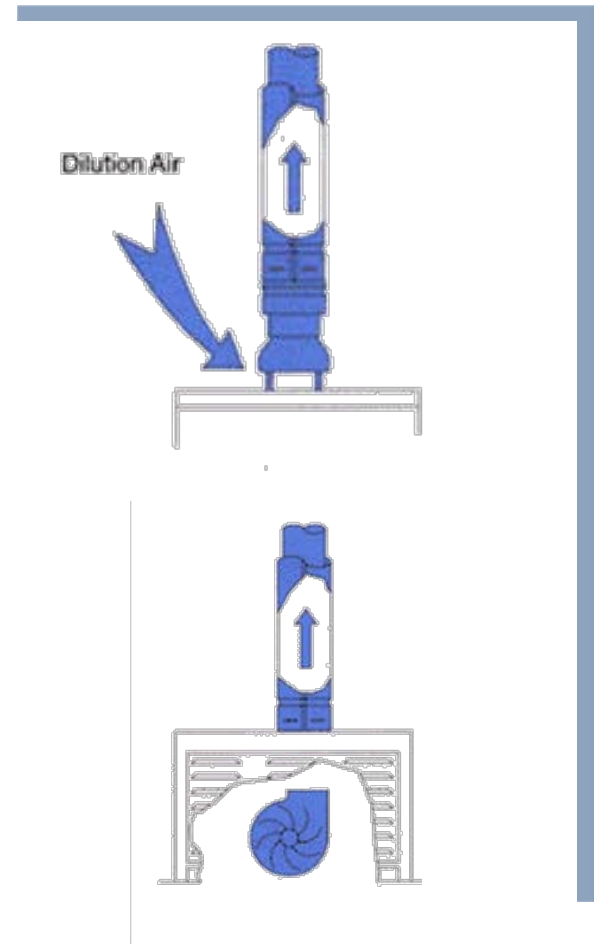
Vent must heat up quickly to dry condensation before equipment cycles off

Long "Wet Time"
equals corrosion



Natural Draft vs. Induced Draft

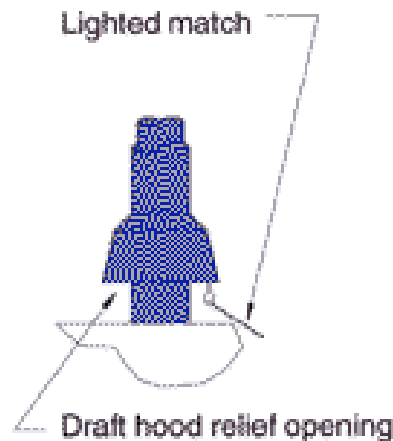
- Natural Draft appliances: Lifting Force is Heat
 - The greater difference between flue gas temp and air, the greater the lifting force
- Induced Draft: Flue products are forced out
- Inducer designed to assist the flow thru the appliance, not the vent! We are still relying on buoyancy of flue gases.



DRAFT HOOD SPILLAGE

While it is normal to have a little gas escape from the draft hood opening upon start-up, this spillage should occur for no longer than 1 to 2 minutes. The method of testing for draft hood spillage is illustrated in figure 87. After allowing the vent to warm up for a couple of minutes, hold the match up to the draft hood opening : illustrated. If the appliance and vent are operating properly, the flame should be drawn toward the draft hood. If the match goes out, this may indicate that flue gas is spilling out of the draft hood.

Figure 87.



If the flue gas spillage at the draft hood is related to the vent system, common causes of draft hood spillage include:

1. A partial or total blockage in the vent system.
2. An excessively long single-wall connector run.
3. A very cold environment with exposed single-wall connectors.
4. The vent height is too short or too many elbows.
5. Vent or vent connectors undersized.
6. Inadequate connector rise.
7. Improper vent cap - too restrictive.
8. Negative atmospheric pressure - fans, etc. with-in the building.
9. Large temperature differential indoors/ outdoors
10. Wind effects.

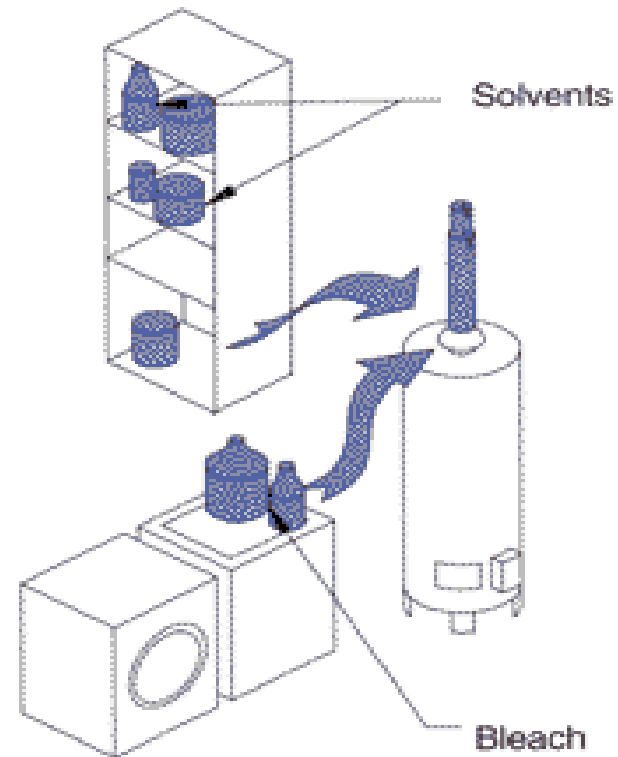
Combustion Air: The 2-Q's!

Quality

Quantity

Combustion Air Requirements : **Quality**

- Be aware of quality of combustion air
- Bleaches, paints, varnish, hairsprays, laundry products, etc. can create acid in flue products



Combustion Air Requirements : Quantity

- Is additional combustion air required?

Confined Space:

“Space volume is less than 50 cubic feet per 1000 bth per hour of all appliances installed in that space”

Unconfined Space:

“Space volume is greater than 50 cubic feet per 1000 bth per hour of all appliances installed in that space”

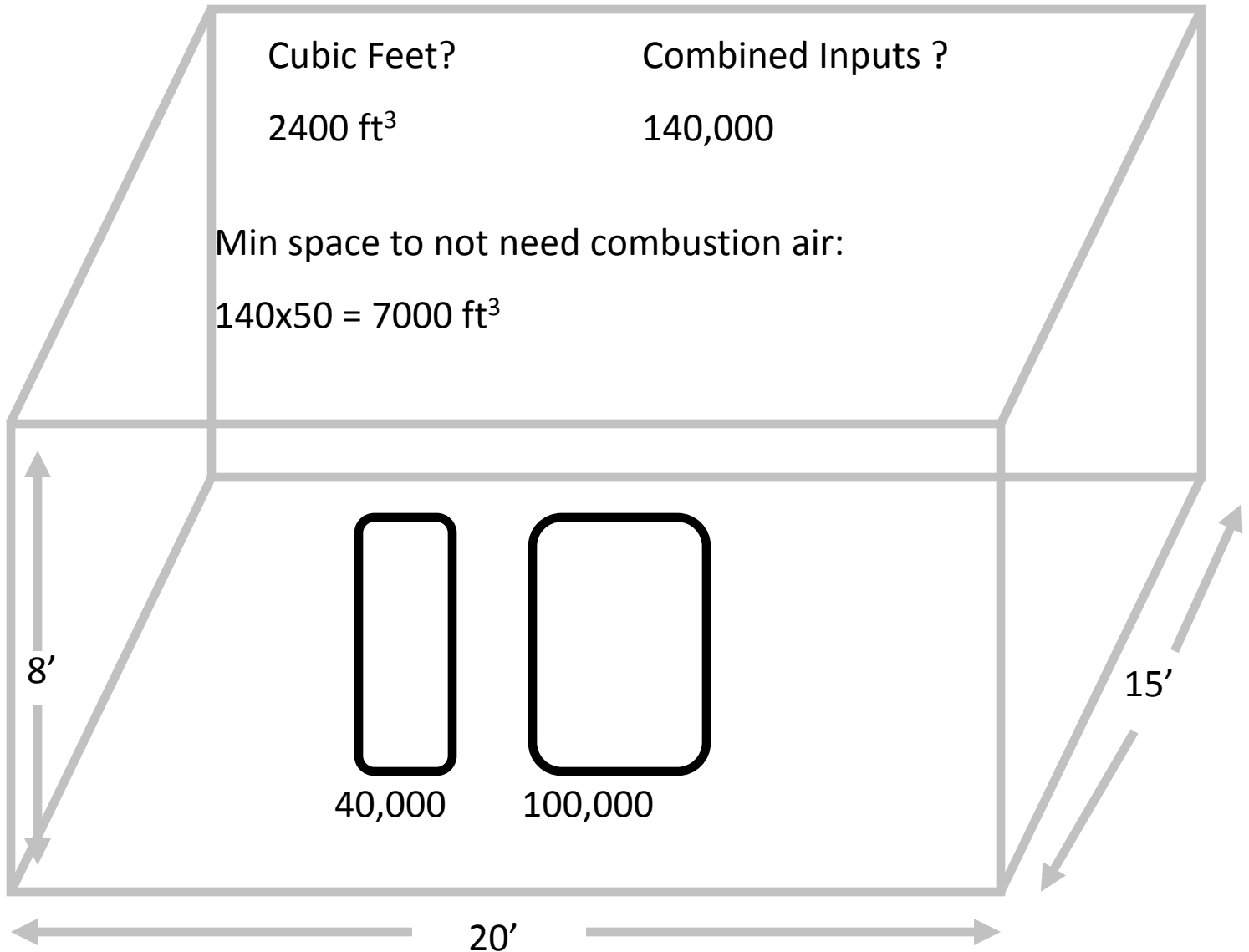
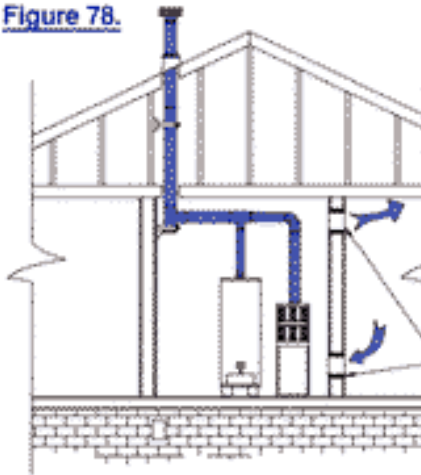


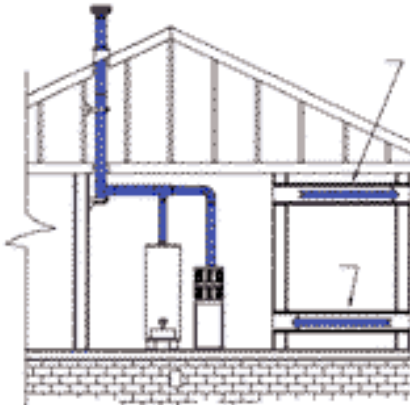
Figure 78.



ALL AIR FROM INSIDE BUILDING

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 appliances in the enclosure.

Figure 79.



ALL AIR FROM OUTDOORS

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 appliances in the enclosure. *

1 opening within 12" of floor and 1 opening within 12" of ceiling

1 sq in per 4,000 btuh if connected directly to outdoors

Cubic Feet?

Combined Inputs ?

2400 ft³

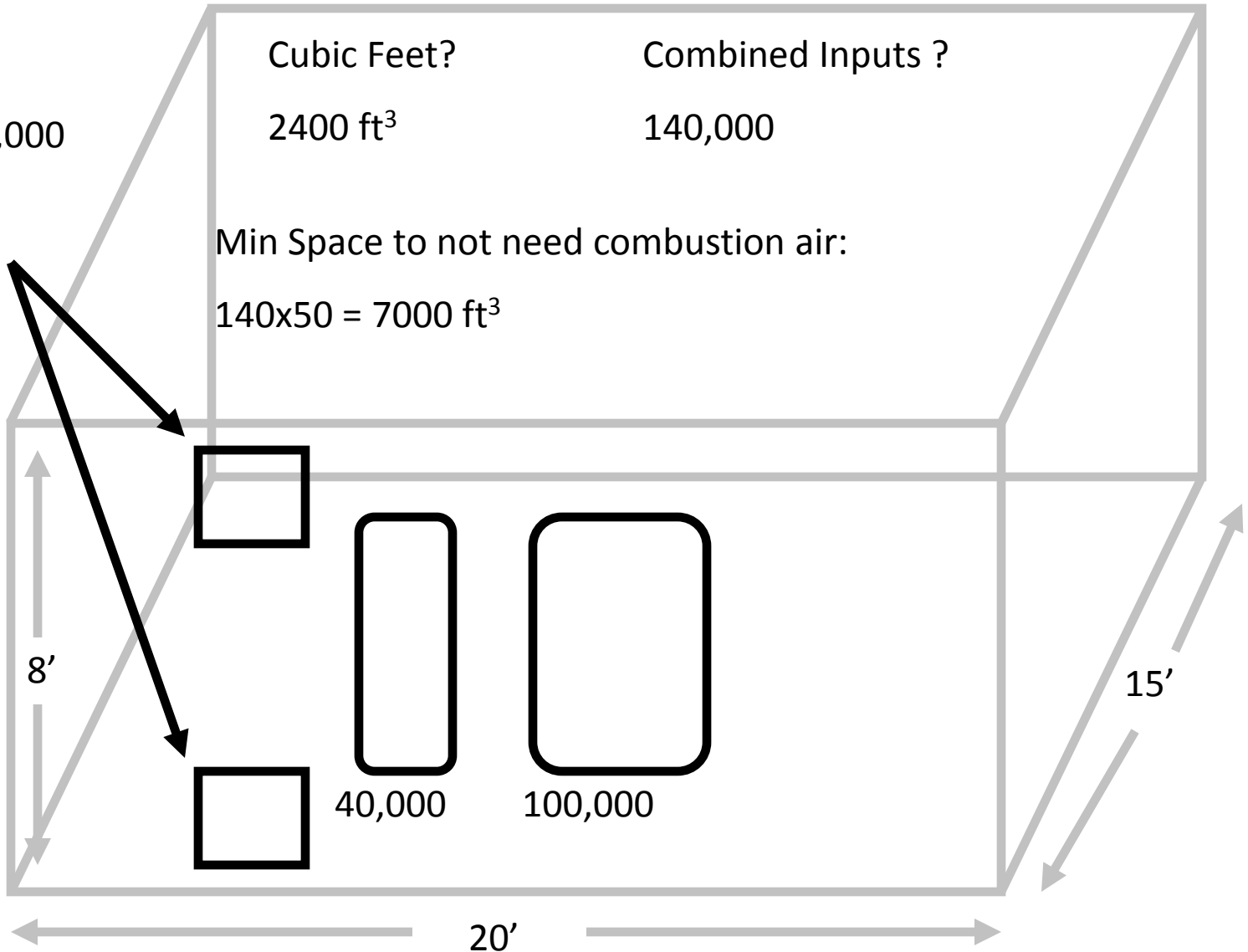
140,000

Min Space to not need combustion air:

140x50 = 7000 ft³

140,000/4,000

35in² each



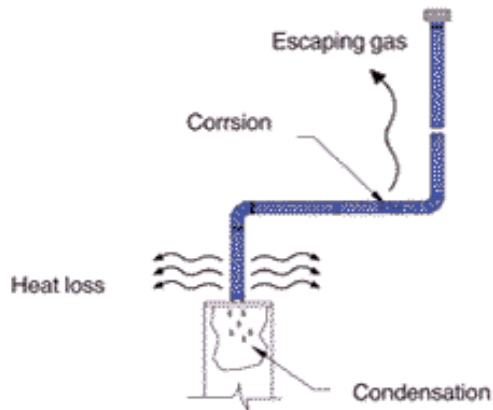
Vent Materials: Single Wall

SINGLE WALL CONNECTORS

Following the introduction of the more efficient, Category I (78 - 83% AFUE) gas appliances in the mid 1980's, the industry began to receive field reports that galvanized steel vent connectors were failing due to severe pitting and general corrosion.

An in-depth investigation conducted by the American Gas Association appears to conclude that single wall galvanized connectors permit a greater heat loss than double wall, air insulated vents, and the result is a tendency for more condensation in the vent connectors.

Figure 32.



- Allows great heat loss which can affect strength of draft and allow flue gases to drop below dew point
- 6" clearance to combustibles
- Minimize use!

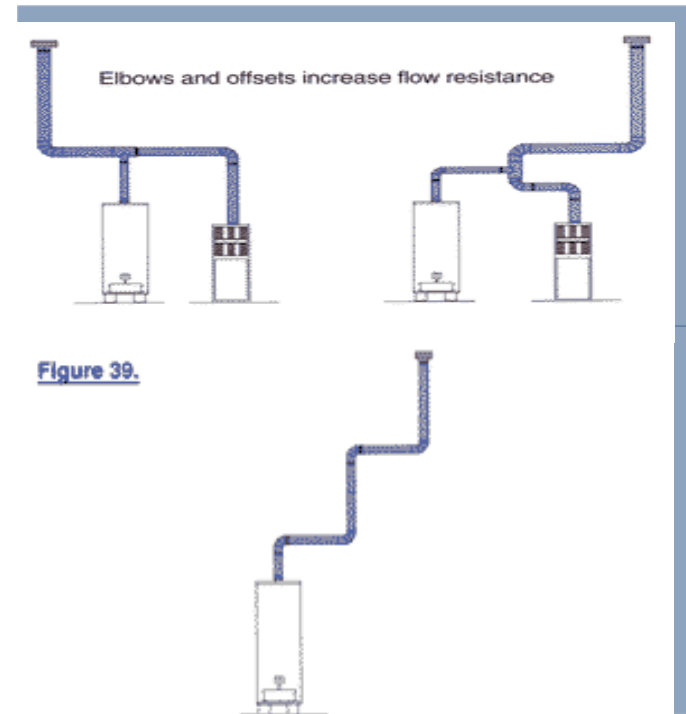
Vent Materials: B-Vent



- Dual wall pipe
- Aluminum liner with galvanized outer wall
- Reduces heat loss
 - Improves draft
 - Reduces condensation
 - Aluminum heats up quickly!
- 1" clearance to combustibles
- Type BW: Oval

Good Venting Practices: Avoid Restrictions

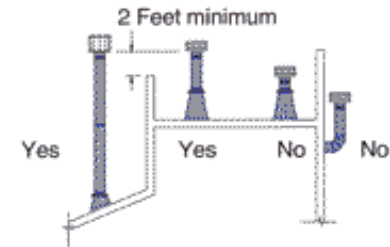
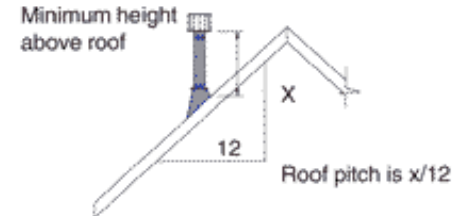
- Limit # of ells
- 40 or 60 deg elbows are preferable to 90s
- Charts allow 2 90s
 - Reduce capacity by 10% for each additional elbow
 - No more than 4 elbows allowed!



Good Venting Practices

- Minimum vent height 5'
 - 12' for wall furnaces
- No outdoor pipe runs
 - Construct a chase if necessary
- Use an approved cap
- Insure minimum height above roof based on roof pitch

e 46.



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

Good Venting Practices

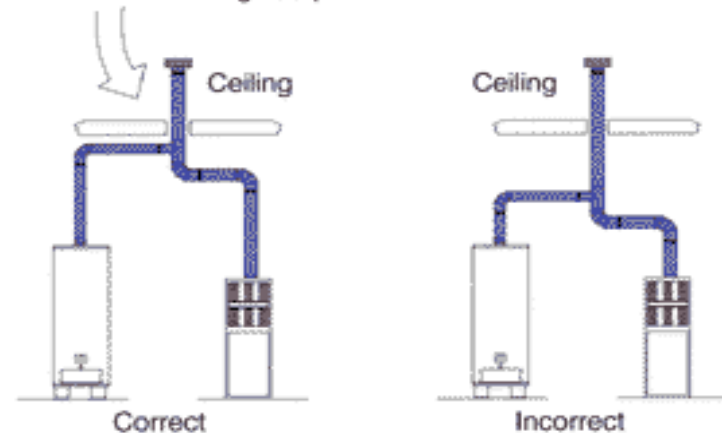
- Connector rise should be as high as possible
- Increases ability to draft
- Decreases material cost

USE AVAILABLE HEADROOM FOR BEST PERFORMANCE

In a common vent system, the rise in the connector has a major impact on vent performance. As noted, a small increase in connector rise can result in major savings, by permitting the use of a much shorter common vent. As shown in figure 65, the interconnection tee should be installed as high as possible. Take advantage of the Type B gas vent 1-inch clearance to combustibles.

Figure 65.

When you have a high ceiling, locate the Tee as high as possible.



True or False???

A fan assisted appliance with a 5" flue connection is always run in 5" pipe

False!!! Use the venting tables.

SINGLE APPLIANCE SIZING TABLES

DEFINITIONS

Single Appliance Vent:
An independent vent for one appliance.

Total Vent Height (H):
The vertical distance from the flue collar or draft hood outlet to the lowest discharge opening of the vent termination.

Lateral (L):
The horizontal distance or length of offset between the appliance outlet and the entry to the vertical vent.

Figure 57.

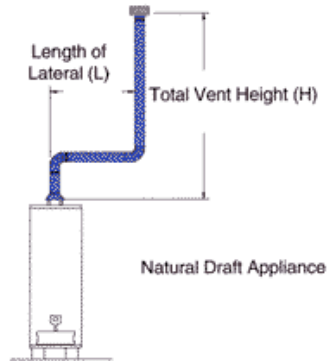


TABLE HEADINGS:

FAN: Applies to Category I fan-assisted combustion appliances

NAT: Applies to natural draft appliances equipped with a draft hood or draft diverter.

MIN: The minimum BTU heat input required in order to prevent condensation.

MAX: The highest BTU input allowed without causing draft hood spillage on natural draft appliances, or positive pressure in vents on fan-assisted appliances.

NR: Not recommended due to potential for condensate formation and/or pressurization of the venting system.

HOW TO USE THE SINGLE APPLIANCE VENT TABLE

To determine the proper vent size for a single appliance vent, use the Single Appliance Vent Tables as follows:

- 1.) When using Type B gas vent as the vent connector, select the Single Appliance Vent **Table I**. If single wall vent connectors are used, select the Single Appliance Vent **Table II**.
- 2.) Determine the **Total Vent Height** and length of **lateral** as shown in figure 57.
- 3.) In the **Height (H)** column at the far left of the table find a height equal to or less than the total height of the installation.
- 4.) Select the horizontal row for the appropriate **Lateral (L)** length equal to or greater than the lateral length determined for the appliance installation. (For straight vertical vents, use zero as the lateral length)
- 5.) For **natural draft appliances**, read across to the first column under **NAT Max**, which has a BTU capacity equal to or greater than the nameplate sea level input rating of the appliance. The proper vent size is shown at the top of the column.
- 6.) For **fan-assisted appliances**, read across to the first column under **FAN Min/Max** which has a **Min** value less than, or equal to the appliance input rating, and a **Max** value greater than or equal to the appliance input rating. The appliance input rating must fit within the Min and Max limits. The proper vent size is shown at the top of the column.

NOTE:

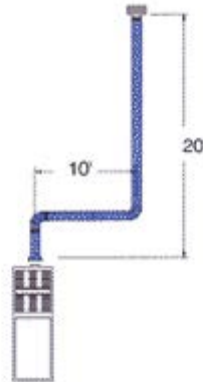
A. If Table II (single wall connectors) does not permit the appliance input rating to fit into a FAN Min/Max range or the table shows an "NR" (not recommended), the tables require the use of Type B gas vent as the vent connector. Switch to Table I.

B. If the vent size shown by the table is smaller than the appliance outlet size, it is important to refer to the rules for vent sizes less than the appliance outlet size.

TABLE 1
Capacity of TYPE B DOUBLE-WALL VENTS with
TYPE B DOUBLE-WALL CONNECTORS
Serving a Single Category I Appliance

A typical natural draft appliance venting example is shown in figure 59. The appliance has an input rating of 140,000 BTU per hour and a 6-inch draft hood outlet. The installation has a Total Vent Height of 20 feet, with a 10-foot lateral.

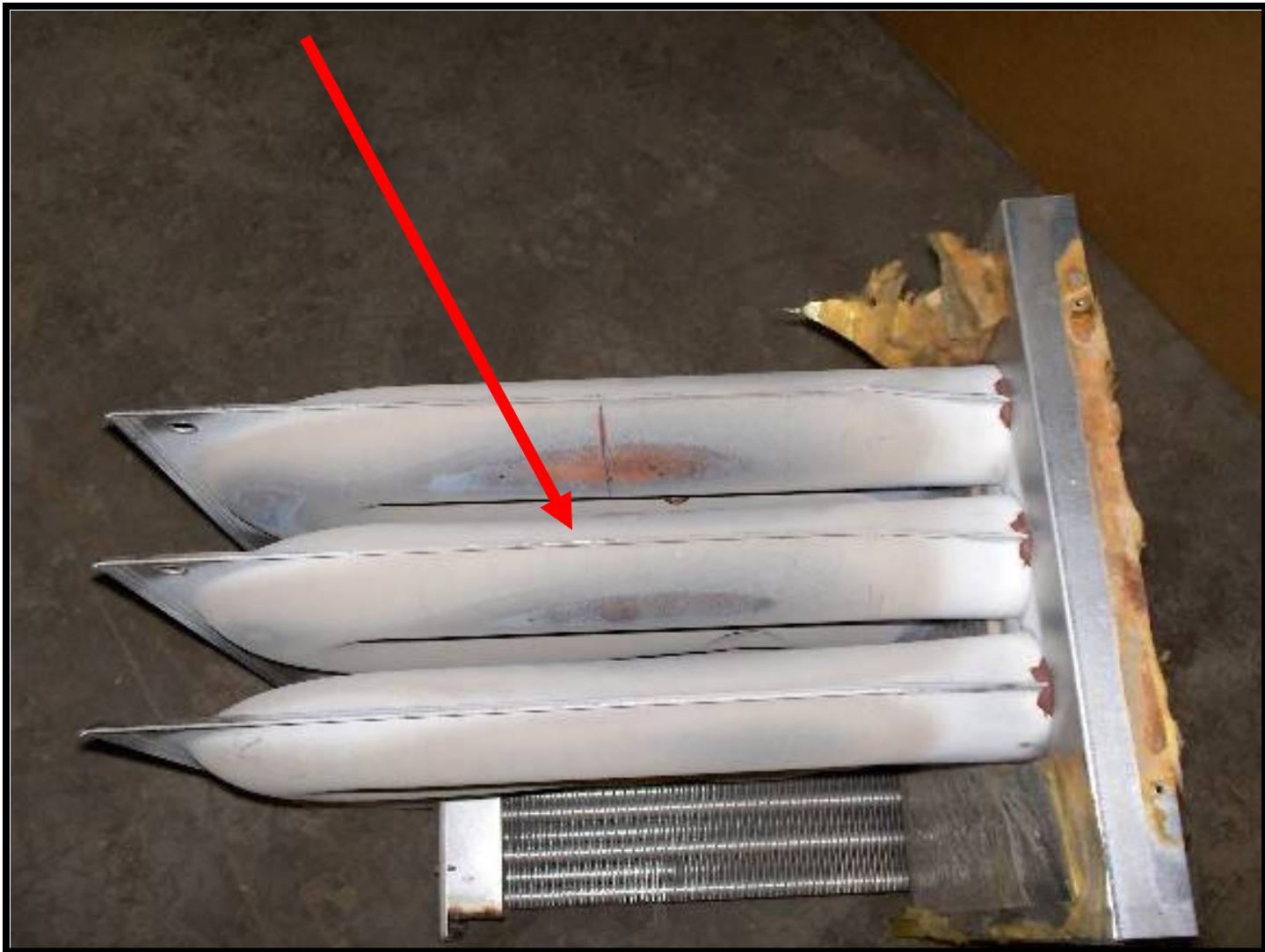
Figure 59.



Height H (ft)	Lateral L (ft)	Appliance Input Rating in Thousands of Btu Per Hour																							
		3"			4"			5"			6"			7"			8"			10"					
		FAN	NAT	max	FAN	NAT	max	FAN	NAT	max	FAN	NAT	max	FAN	NAT	max	FAN	NAT	max	FAN	NAT	max			
6	0	0	78	46	0	152	86	0	251	141	0	375	205	0	524	285	0	698	370	0	1121	570			
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	321	217	53	425	285	75	675	455			
	4	21	49	34	30	94	64	39	153	103	50	227	153	66	316	211	79	419	279	110	668	445			
	6	25	46	32	36	91	61	47	149	100	59	223	149	78	310	205	93	413	273	128	661	435			
8	0	0	84	50	0	165	94	0	276	155	0	415	235	0	583	320	0	780	415	0	1261	660			
	2	12	57	40	16	109	75	25	178	120	28	263	180	42	365	247	50	483	322	71	770	515			
	5	23	53	38	32	103	71	42	171	115	53	255	173	70	356	237	83	473	313	115	758	503			
	8	28	49	35	39	98	66	51	164	109	64	247	165	84	347	227	99	463	303	137	746	490			
10	0	0	88	53	0	175	100	0	295	166	0	447	255	0	631	345	0	847	450	0	1377	720			
	2	12	61	42	17	118	81	23	194	129	26	289	195	40	402	273	48	533	355	68	852	560			
	5	23	57	40	32	113	77	41	187	124	52	280	188	68	392	263	81	522	346	112	839	547			
	10	30	51	36	41	104	70	54	176	115	67	267	175	88	376	245	104	504	330	142	811	525			
15	0	0	94	58	0	191	112	0	327	187	0	502	285	0	716	390	0	970	525	0	1596	840			
	2	11	69	48	15	136	93	20	226	150	22	339	225	38	475	316	45	633	414	63	1019	675			
	5	22	65	45	30	130	87	39	219	142	49	330	217	64	463	300	76	620	403	105	1003	660			
	10	29	59	41	40	121	82	51	206	135	64	315	208	84	445	288	99	600	386	135	977	635			
20	0	0	97	61	0	202	119	0	349	202	0	540	307	0	776	430	0	1057	575	0	1756	930			
	2	10	75	51	14	149	100	18	250	166	20	377	249	33	531	346	41	711	470	59	1150	755			
	5	21	71	48	29	143	96	38	242	160	47	367	241	62	519	337	73	697	460	101	1133	738			
	10	28	64	44	38	133	89	50	229	150	62	351	228	81	499	321	95	675	443	130	1105	710			
30	0	0	100	64	0	213	128	0	376	220	0	587	336	0	853	475	0	1173	650	0	1977	1060			
	2	9	81	56	13	166	112	14	283	185	18	432	280	27	613	394	33	826	535	54	1351	865			
	5	21	77	54	28	160	108	36	275	176	45	421	273	58	600	385	69	811	524	96	1332	851			
	10	27	70	50	37	150	102	48	262	171	59	405	261	77	580	371	91	788	507	125	1301	829			
50	0	0	101	67	0	216	134	0	397	232	0	633	363	0	932	518	0	1297	708	0	2231	1195			
	2	8	86	61	11	183	122	14	320	206	15	497	314	22	715	445	26	975	615	41	1620	1010			
	5	20	82	NR	27	177	119	35	312	200	43	487	308	55	702	438	65	960	605	90	1600	996			
	10	26	76	NR	35	168	114	45	299	190	56	471	298	73	681	426	86	935	589	118	1567	972			
100	0	NR	NR	NR	0	218	NR	0	407	NR	0	665	400	0	997	560	0	1411	770	0	2491	1310			
	2	NR	NR	NR	10	194	NR	12	354	NR	13	566	375	18	831	510	21	1155	700	30	1975	1170			
	5	NR	NR	NR	26	189	NR	33	347	NR	40	557	369	52	820	504	60	1141	692	82	1955	1159			
	10	NR	NR	NR	33	182	NR	43	335	NR	53	542	361	68	801	493	80	1118	679	108	1923	1142			
200	0	NR	NR	NR	40	174	NR	50	321	NR	62	528	353	80	782	482	93	1095	666	126	1892	1124			
	2	NR	NR	NR	47	166	NR	59	311	NR	71	513	344	90	763	471	105	1073	653	141	1861	1107			
	5	NR	NR	NR	50	149	NR	63	275	169	76	440	278	97	642	401	113	888	556	151	1505	924			
	10	NR	NR	NR	69	131	NR	84	250	NR	99	410	259	123	605	376	141	844	522	183	1446	876			

- Tables allow two elbows.
 - More than two, reduce max capacity 10% for each elbow
- 20% Reduction from max capacity for flex liner

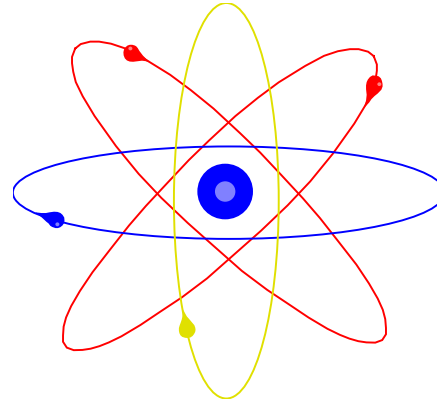
Proper Firing Rate and Airflow Setup is Critical!



COMBUSTION PROCESS

CH₄

O₂ O₂



CO₂

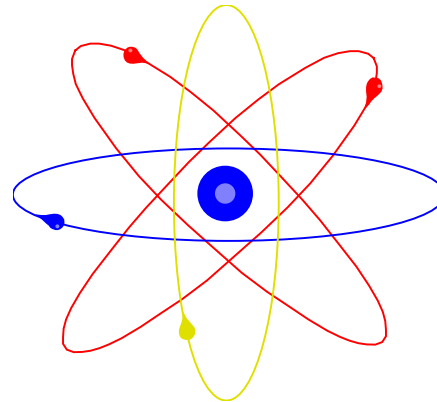
H₂O H₂O

INCOMPLETE COMBUSTION

CH₄ CH₄

CH₄ CH₄

O₂ O₂ O₂



CO₂ H₂O H₂O

H₂ H₂ H₂ H₂ H₂
H₂

C C CO

