

2021 Uniform Plumbing Code Part 2

Wisdom and Associates, Inc.

Air for Combustion & Ventilation

- This section covers natural draft and Category I Vented appliances
- All other follow manufacturers instructions, including:
 - Direct vent appliances
 - Type 1 clothes driers with makeup air

Makeup Air

- Where exhaust fans interfere with the operation of appliances, makeup air shall be provided.
- Clothes dryers, kitchen ventilation (506.1.3)

Air for Combustion & Ventilation

- Three types of combustion air:
 - All air from indoors
 - All air from outdoors
 - Combination of indoor and outdoor air

Indoor Combustion Air

- Two methods for indoor combustion air
- Standard method & known air infiltration rate method
- If the ACH of a home is less than 0.4, the known air infiltration rate method is used
- Rooms connected to the appliance space may be counted as part of the required space if connected by openings without doors or sized combustion air openings (506.2)

Combustion Air

This section covers natural draft and Category I vented appliances. In the state of Alaska, this would apply specifically to water heaters. All other draft types and categories must follow manufacturer instructions, including Type 1 clothes dryers with makeup air and direct vent appliances. Type 1 clothes dryers are residential clothes dryers. The UPC is written to cover all Category I gas fired appliances, refer to the local jurisdiction in your area to see what types of appliances would actually be covered under the UPC. (506.1)

What is ACH?

ACH (Air Changes per Hour) is determined by a blower door test of a finished home. The ACH rate of a home is how many times the entire heated interior volume of a house is exchanged every hour at a -50 Pascal test pressure. This ACH number is divided into the climate factor of the building to provide the “natural” ACH which is what the plumbing code uses for indoor combustion air formulas. Every new or existing home that receives Alaska Housing Finance Corporation funding gets a blower door test and an ACH number (over 40,000 homes in Alaska have had a blower door test)



A blower door set up and ready to test a house

Venting System Basics

There are three types of appliance draft; natural draft, assisted draft, and power draft. There are also two types of combustion; open and sealed.

Natural Draft

The first type of draft is natural draft. Naturally drafting appliances rely on the heat of the combustion products to rise up the chimney. There is no fan to assist combustion products to the outside. When a natural draft appliance is operating properly, the combustion products are buoyant enough to escape up the chimney. The pressure in the vent of a natural draft appliance is negative with reference to the combustion appliance zone. This means that if a hole was drilled in the vent of this type of appliances, air would be sucked into the vent. Situations like a blocked chimney or negative pressures can cause combustion products to be spilled into the combustion appliance zone.

Assisted Draft

A fan assisted combustion appliance differs from natural draft in that a fan is used to modify the flame shape to achieve greater efficiency, and to a lesser extent assist combustion products up the chimney. Similar to a natural draft appliance, the pressure in the vent is still negative with reference to the combustion appliance zone.

Power/Forced Draft

Similar to assisted draft combustion appliances, power/forced draft appliances also use a fan to modify the flame shape and achieve greater efficiency. The difference is that in a power/forced draft appliance the fan actively pushes combustion products up the chimney. The pressure in the vent is positive with reference to the combustion appliance zone.

Combustion Types

In addition to the three types of draft, there are two types of combustion; open and closed. Open combustion means that there is some portion of the combustion process that is open to the atmosphere in the building.

Closed combustion means that no part of the combustion process has access to the atmosphere in the building. These types of appliances have a sealed intake and exhaust pipe, sometimes one within the other.



Natural Draft Appliances



Fan Assisted Appliance



Sealed Combustion Appliance

Indoor Combustion Air

- Two methods for indoor combustion air
- Standard Method
- Known air infiltration method
- If the ACH of a home is less than 0.4, the known air infiltration rate method is used
- Rooms connected to the appliance space may be counted as part of the required space if connected by
- Openings without doors
- Sized combustion air openings (506.2)

Standard Method

- Standard Method
- 50 cubic feet per 1000 BTU/h of appliance input
- Areas the “freely” communicate
- Determine actual volume
- Calculate actual BTU/h of total input rating
(BTU / 1000) * 50

Known Air Infiltration Rate Method

- Two different methods; fan assisted and natural draft appliances
- **Natural Draft Appliances:**
 - $(21 \text{ ft}^3 / \text{ACH}) \times (\text{input of all non-fan assisted appliances} / 1,000 \text{ BTU/hr})$
 - Volume of space may not be less than 35 cubic feet per 1000 BTU/h input of all appliances
- **Fan Assisted Appliances:**
 - $(15 \text{ ft}^3 / \text{ACH}) \times (\text{input of all fan assisted appliances} / 1,000 \text{ BTU/hr})$
 - Volume of space may not be less than 25 cubic feet per 1000 BTU/h input of all appliances

Standard Method Example

How large a volume is needed for a 50,000 BTU/h input water heater?

- $50,000 \text{ BTU/h} / 1000 \text{ BTU/h} = 50$
- $50 * 50 \text{ cubic feet} = 2500 \text{ cubic feet}$
- *In a home with 8' ceilings, 312.5 square feet of floor area would be required*

Known Air Infiltration Rate Method Example - Natural Draft

Using a 50,000 BTU/hr natural draft water heater in a home with a .30 ACH, how large of a volume is needed?

- $(21 \text{ ft}^3 / .30) \times (50,000 / 1,000 \text{ BTU/hr}) = 3,500 \text{ cubic feet}$
- *In a home with 8' ceilings, 437.5 square feet would be required*

Known Air Infiltration Rate Method Example - Fan Assisted

Using a 50,000 BTU/hr fan assisted water heater in a home with a .30 ACH, how large of a volume is needed?

- $(15 \text{ ft}^3 / .30) \times (50,000 / 1,000 \text{ BTU/hr}) = 2,500 \text{ cubic feet}$
- *In a home with 8' ceilings, 312.5 square feet would be required*

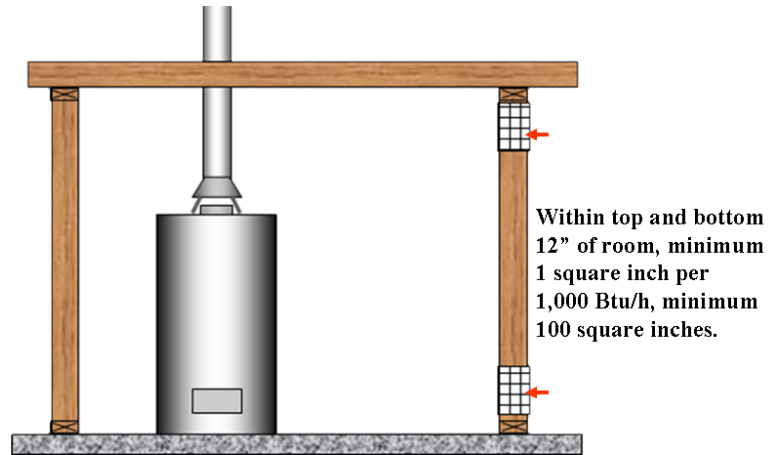
Air Changes per Hour

In the state of Alaska, 0.4 ACH is not considered particularly tight construction, especially if the home is new or was built since the early 1990's.

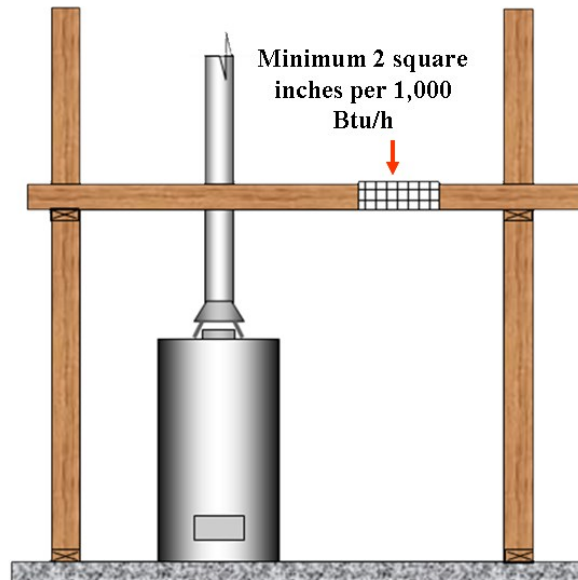
A home that meets the current new construction standard of 4 ACH at -50 Pascals blower door test will have a natural ACH of between 0.15 and 0.3.

Indoor Opening Size & Location

- Two different ways to connect indoor space for combustion air purposes:
1. Two openings on the same story
 2. One or more openings of different stories (506.3)
1. **Combining spaces on the same story:**
 - Two openings on the same story
 - 1 square inch per 1000 BTU/h appliance input
 - Minimum 100 square inches
 - Minimum 3 inch dimension
 - Within top 12" and bottom 12" of the room (506.3)



2. **Combining spaces on different stories:**
 - One or more openings
 - 2 square inches per 1000 BTU/h appliance input
 - Minimum 3 inch dimension
 - Ducts not allowed

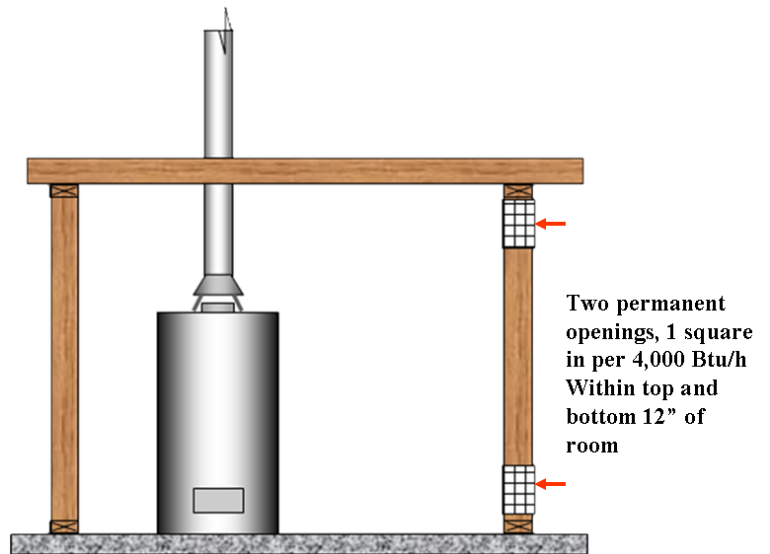


Outdoor Combustion Air

- Four ways to connect indoor spaces to the exterior for combustion air
 - Two direct permanent openings
 - Two vertical ducts
 - Two horizontal ducts
 - One permanent opening (506.4)

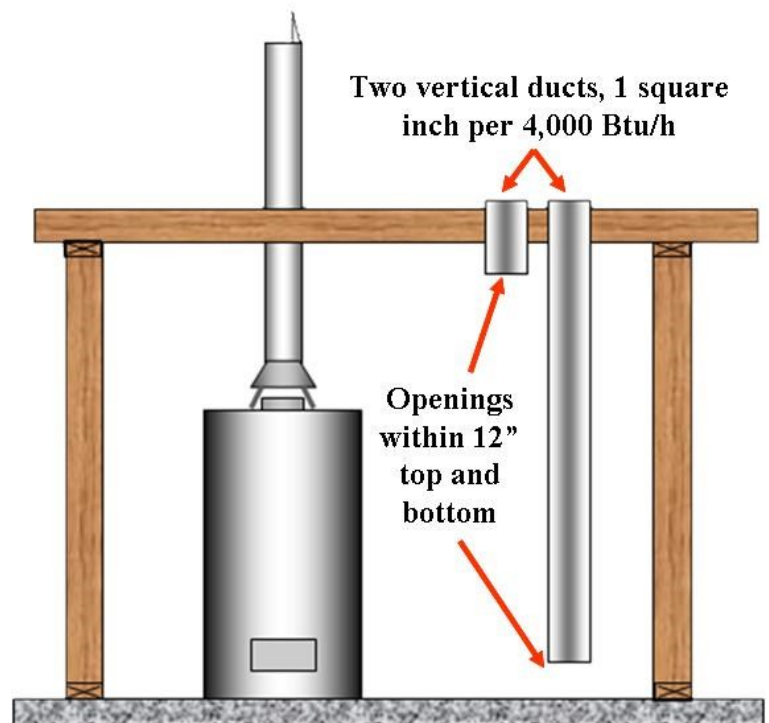
1. Two Permanent Openings

- 1 square inch per 4000 BTU/h appliance input
- Within top and bottom 12" of the room
- Minimum 3 inch dimension (506.4.1)
- Example
 - For a 50,000 BTU/h water heater, how large must two permanent openings to the outside be?
 - $50,000 \text{ BTU/h} / 4,000 = 12.5 \text{ square inches}$
 - Two 12.5 square inch openings are required



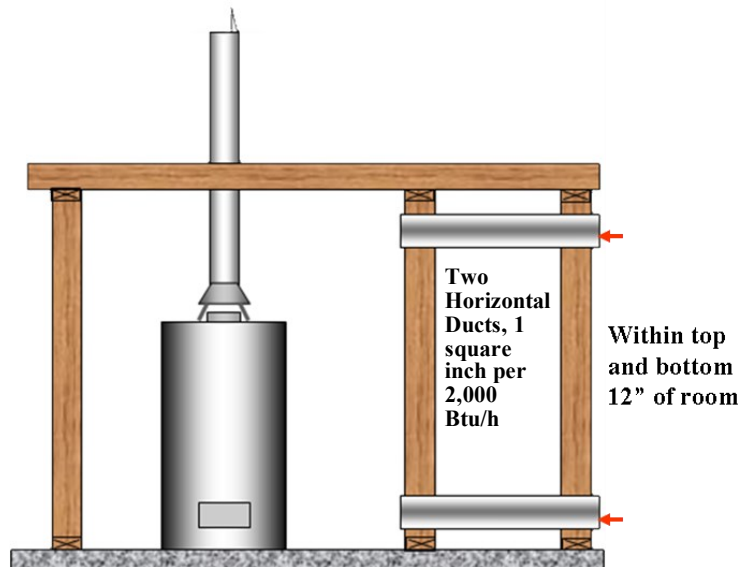
2. Two Vertical Ducts

- 1 square inch per 4,000 BTU/h appliance input
- Within top and bottom 12" of the room
- Minimum 3" dimension
- Caution in cold climates
- Example
 - For a 65,000 BTU/h water heater, how large must each vertical duct be?
 - $65,000 \text{ BTU/h} / 4000 \text{ BTU/h} = 16.25 \text{ square inches}$



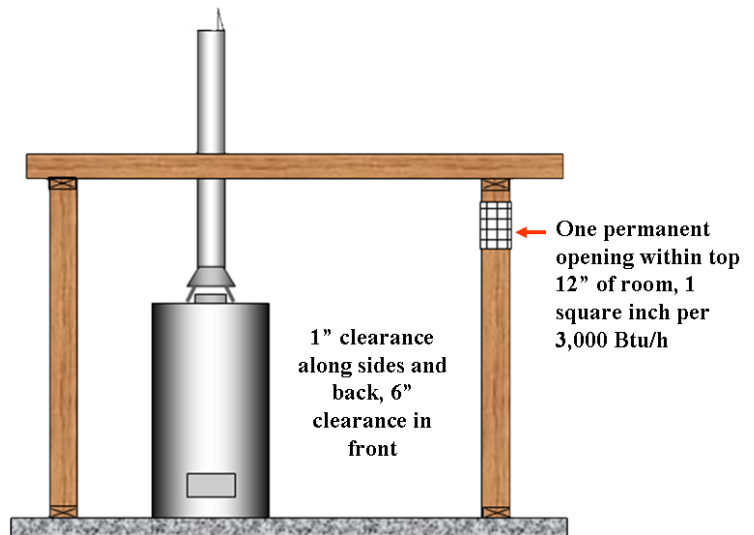
Two Horizontal Ducts

- 1 square inch per 2000 BTU/h appliance input
- Within top and bottom 12" of the room
- Minimum 3 inch dimension
- Example
- For a 50,000 BTU/h water heater, how large must each horizontal duct to the outside be?
- $50,000 \text{ BTU/h} / 2000 \text{ BTU/h} = 25 \text{ square inches}$



One Permanent Opening

- 1 square inch per 3000 BTU/h appliance input
- Not less than the vent connector area for all appliances
- Minimum appliance clearances of 1 inch along sides and 6 inches in front (506.4.2)
- Example
- For a 50,000 BTU/h water heater, how large must a single permanent opening to the outside be?
- $50,000 \text{ BTU/h} / 3000 \text{ BTU/h} = 16.67 \text{ square inches}$



Combination Indoor & Outdoor Combustion Air

- Indoor openings must comply with 506.3
 - Outdoor openings must comply with 506.4.1-2 (506.5)
1. Divide available indoor combustion air volume by the required indoor combustion air volume
 2. Subtract 1 from this number
 3. Multiply this number by the required amount of outdoor combustion air
- Example
 - 50,000 BTU/h water heater needs 2500 cubic feet of volume
 - Only 1000 cubic feet of volume available
 - How large must the outdoor air opening be?
1. Divide available indoor combustion air volume by the required indoor combustion air volume
 - $1000 / 2500 = 0.4$
 2. Subtract
 - $1 - 0.4 = 0.6$
 3. Multiply this number by the required amount of outdoor combustion air
 - $0.6 * 16.67 = 10.002$ square inches
 - Combining the inside volume in the calculation reduces the outdoor opening size requirement to 10.002 square inches

Mechanical Combustion Air Supply

- Supplied at a rate of 0.35 cubic feet per minute per 1000 BTU/h input (506.7)
- Example:
- 100,000 BTU/h input, how much air supply required?
- $100,000 \text{ BTU/h} / 1000 \text{ BTU/h} = 100$
- $100 * 0.35 = 35 \text{ cfm air supply}$

Exhaust Fans

- Where exhaust fans are installed, additional makeup air must be provided (506.7.1)

Interlock

- Each appliance shall be interlocked to prevent ignition if the air supply is not operating (506.7.2)

Specified Combustion Air

- If the combustion air is supplied by the ventilation system, the required combustion air is in addition to the ventilation requirement (506.7.3)

Louvers, Grilles, and Screens

- If the net free area is not know, use the following defaults:
- Metal, 75% of the total area is “free”
- Wood, 25% of the total area is “free”
- Louvers or grilles must be permanently fixed open (506.8)

Combustion Air Duct

- Ducts must be galvanized steel or equivalent
- Exception:
- Unobstructed stud and joist bays with no more than 1 fire block removed
- Duct openings in attics cannot be screened
- Exterior openings must be at least 12” above grade
- Ducts may not slope towards appliances
- Chimney openings may not be used for combustion air (506.9)

NFPA 31

Oil Burning and Other Water Heaters

- Other than gas follow referenced standards (UL)
- Oil fired NFPA 31
- Indirect water heaters ASME Boiler and Pressure Vessel Code
- Vents and chimneys of approved types
- Adequate combustion air
- Location per authority having jurisdiction (505.1)

Safety Devices

- Storage water heaters and boilers, other than gas fired require secondary overtemperature protection
- Combination temperature and pressure relief valve (505.2)

Residential & Commercial Air For Combustion & Ventilation

- Worst case depressurization testing required on all installs (new and replacement)
- Measure flue and over fire draft and compare to manufacturer specifications
- Test method based on BPI-1200 the currently adopted weatherization standard (5.2.1.1)
- Where buildings are so tight that normal infiltration does not provide sufficient air for combustion, outside air shall be introduced (5.2.3)
- Slightly different standards for commercial vs. residential installations (5.2.4)

Residential & “Similar” Buildings

Air Taken From Indoors

- Confined Space: For the purposes of this standard, a space whose volume is less than 50 cubic per 1000 Btu/hr of the aggregate input rating of all appliances installed in that space. (3.3.14)
- Unconfined Space: Combustion air may be taken from indoors through normal infiltration
- Tight construction: One or more openings to outdoors, 1 square inch per 5000 BTU/h input (5.3.1)
- Conventional construction (not “tight”): Openings to adjacent interior spaces with sufficient volume, 1 square inch per 1000 BTU/h input (5.4.1)

A.5.2.1.1 One method of testing is as follows:

1. Close all interior and exterior doors, dampers, and windows in the building
2. Turn on building air exhaust systems, including clothes dryers, range hoods etc.
3. Operate the burner in the smallest oil heating appliance first, and then other appliances in order of increasing capacity. Measure and record the flue draft and over-fire draft of each appliance, and check for flue gas spillage
4. Check that the flue draft and over-fire draft are at a level that is required
5. The oil heating equipment installer should take action as needed to correct excessive depressurization of the appliance combustion air zone

A.5.2.3 Remedial actions to correct excessive negative pressure in the combustion air zone might include the following:

1. Air boots for oil burners to supply outdoor air directly to the burner
2. Air-in-a-can to supply outdoor air into the boiler/furnace room
3. Dedicated make-up air for kitchen exhausts
4. Blocked vent safety shut-off devices
5. Make-up air into furnace return ducts with barometric damper
6. Warning labels on whole house fans

NFPA 51

Residential & “Similar” Construction

All Air Taken From Outdoors

- Same rules as IFGC & UPC (5.4.2)

Commercial & Industrial

- Oil fired appliance on exterior wall, all combustion air directly from outdoors
- 1 square inch per 4,000 BTU/h input
- Minimum 35 square inches
- Oil fired appliance with no exterior wall, all combustion air directly from outdoors
- Size and type must be approved by the building official (5.1.1)

Venting of Appliances

- Venting systems design and constructed to carry flue gasses outside (509.1)
- Appliance categories based on:
- Positive or negative vent pressure
- Condensing or non-condensing

Reasons for proper sizing:

- Undersized vent will restrict flow and cause spillage
- Oversized vent will result in condensation

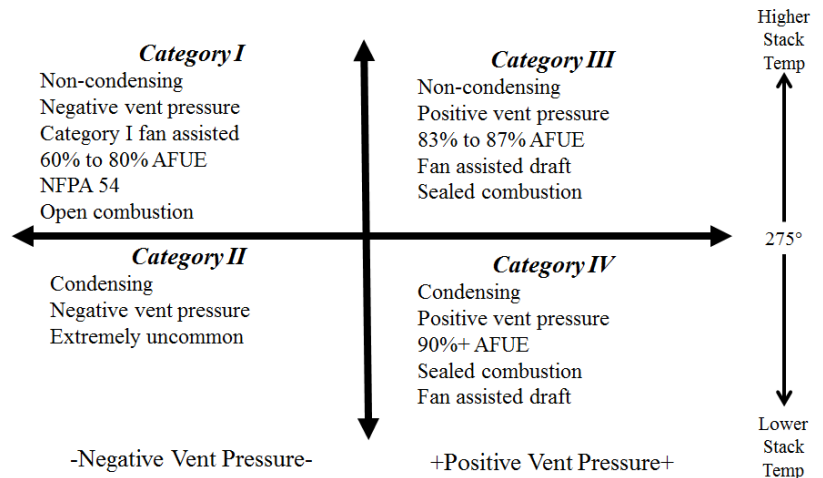
Factors that affect venting:

- Stack temperature
- Height of vent
- Size of vent
- Restrictions in the venting system
- Ambient outdoor temperature
- Negative pressure in the building

Appliances Not Required to be Vented

- Listed ranges (state ventilation code requires this)
- Built in domestic cooking units
- Listed hot plates and laundry stoves
- Listed Type 1 Clothes dryers
- A single listed booster type water heater in a commercial kitchen with mechanical exhaust system
- Listed refrigerators
- Counter appliances
- Direct gas fired makeup air heaters
- Other appliances listed for unvented use with no flue collar
- Specialized appliances such as lab burners and gas lights(509.2.1)
- Other codes and state fire marshal don't allow unvented appliances!

Venting Matrix



Typical Category 1 Appliances covered by the UPC

Combustion Safety Objectives

1. Obtain “Worst Case” depressurization
2. Assess spillage
3. Assess CO (Carbon Monoxide)
4. Make recommendations

Worst Case Depressurization

- Set all combustion appliances to standby
- Ensure solid fuel burning appliances are extinguished, all damper shut
- Close all exterior windows and doors
- Close interior doors, except for rooms with exhaust fans and HVAC returns
- Leave any dedicated combustion air open

Assess Spillage

- If vent is cold (appliance turned off at arrival), assess spillage at 5 minutes
- If vent is warm (appliance on at arrival), or domestic water heater, assess spillage at 2 minutes
- Spillage testing locations; at draft hood, barometric damper
- Commonly vented appliance are tested in order of BTU/h input from smallest to largest

Assess CO (Carbon Monoxide)

- Assess CO after 5 minutes of appliance firing
- Must test undiluted flue gas



This photo shows smoke being pulled up the vent, indicating that proper draft has been established. Note the hole drilled in the hood to allow for CO testing. When problems are encountered with a combustion appliance spilling flue gasses, the person performing the test can refer to NFPA 31 or to the Building Performance Institute 1200 standard for further analysis and repair options.

Appliance	Threshold Limit
Central Furnace	400 ppm air free
Boiler	400 ppm air free
Floor Furnace	400 ppm air free
Gravity Furnace	400 ppm air free
Wall Furnace (BIV)	200 ppm air free
Wall Furnace (Direct Vent)	400 ppm air free
Vented Room Heater	200 ppm air free
Unvented Room Heater	200 ppm air free
Water Heater	200 ppm air free
Oven/Broiler	225 ppm as measured
Clothes Dryer	400 ppm air free
Refrigerator	25 ppm as measured
Gas Log (gas fireplace)	25 ppm as measured in vent
Gas Log (installed in wood burning fireplace)	400 ppm air free in firebox

This table from the BPI 1200 combustion safety procedure provides limits for carbon monoxide in undiluted flue gas.



A Category 1, open combustion, natural draft boiler commonly vented with a Category 1 open combustion, natural draft water heater.



A Category 3, sealed combustion, non-condensing boiler.



A Category 1, fan assisted draft, open combustion forced air furnace.



A Category 4, sealed combustion, condensing, power vented boiler.

Definitions

Chimney

- One or more vertical passageways conveying flue gasses to the exterior
- Can be used interchangeably with the term vent, although chimney typically refers to masonry

Vent

- A passageway used to convey flue gases from the appliance or vent connector to the outside

Vent Connector

- The pipe or duct that connects a fuel gas burning appliance to a vent or chimney
- Relatively short runs of vent used to connect an appliance to a chimney
- Where two or more appliances are commonly vented, at least one is using a vent connector
- Where one appliance is connected to a vent with no change in size or material, there is no vent connector

Single Wall Metal Pipe

- Un-insulated single wall metal pipe can't be used outdoors in cold climates (509.7.1)
- (99% winter design temp is less than 32°)
- Cannot be used as a vent in dwellings and residential occupancies (509.7.4.1)
- Single wall cannot originate in concealed or unoccupied space
- Shall not pass through attic, inside wall, concealed space or floor (509.7.3.2)
- Several other rules, all over-ridden by cold climate rule



The difference between a vent and a vent connector is important because the installation and sizing rules may be different. Vent connectors may not be installed in an enclosed location (such as within an enclosed wall), and they may not pass through walls, floors, ceilings and roofs. This restriction does not apply to vent connectors made from listed vent components, such as a Type B vent or a Type L vent.

Clearance for Connectors				
Minimum Distance from Combustible Materials (inches)				
Appliance	Listed Type B Gas Vent	Listed Type L Vent	Single-Wall Metal Pipe	Factory-Built Chimney Sections
Listed appliances with draft hoods for use with Type B gas vents	As listed	As listed	6	As listed
Residential boiler and furnaces with listed has conversion burner and with draft hood	6	6	9	As listed
Residential appliances listed for use with Type L vents	Not permitted	As listed	9	As listed
Unlisted residential appliances with draft hood	Not permitted	6	9	As listed
Residential and low heat appliances other than those above	Not permitted	9	18	As listed
Medium heat appliances	Not permitted	Not permitted	36	As listed

Two or More Appliances at a Single Vent

- Enter the connector at different levels, or
- Attached the vertical portion of the chimney or vent at less than a 45 degree angle (509.10.3)

Joints

- Joints fastened with sheet metal screws
- Or in accordance with manufacturer's specifications (509.10.5)

Slope

- Minimum $\frac{1}{4}$ per foot rise
- No dips or sags (509.10.6)

Length of Vent Connector

- Vent lengths shall be as short as practical
- Single Wall - Maximum horizontal length of no more than 75% of the total height of the chimney or vent
- Double Wall - Maximum horizontal length of no more than 100% of the total height of the chimney or vent (509.10.7)

Chimney Connection

- Vent connector must enter above the "extreme bottom" of the chimney (509.10.9)



Appliance connectors entering at different levels.

Multiple Input Ratings

- Appliances with multiple ratings:
- The highest input rating shall be less than MAX,
- The lowest input rating shall be greater than MIN (510.1.5)

Vertical Vent Upsizing Rule

- A vent cannot be larger than 7X the area of the smallest vent connector, flue collar or draft hood area connected to it (510.1.8)

Upsizing

- Vent connectors cannot be more the 2 sizes larger than listed vent diameter, flue collar or draft hood outlet (510.1.12)

Interpolation

- Interpolation within vent sizing tables is permitted, extrapolation is not
- You can work between the numbers in the table, but you can't go outside the table (510.1.14-15)

Engineering Methods

- Vent heights less than 6 feet require engineering
- Vent heights outside vent sizing tables must be engineered (510.1.16)

Vent Offset

- Vent capacity must be reduced when offsets are used
- The horizontal lengths of offsets can't exceed 18 inches per inch of common vent diameter (510.2.4)
- Offsets limited to 18" per 1" of vent diameter
- Measured center to center
- Each offset up to 45° requires a 5% reduction in max capacity
- Each offset up to 90° requires a 10% reduction in max capacity
- Up to two 90° offsets are allowed for in the common vent, just like for the vent connector (510.2.5)

7X Sizing Rule Example

Example: A vent has a 3" vent connector attached to it, what is the largest size the vent can be according to the 7X rule?

- $\text{Area of a circle} = \pi * r^2$
- $3.14 * 1.5^2 = 7.065 \text{ square inches in a 3 inch vent connector}$
- $7.065 * 7 = 49.455 \text{ is the largest vent size allowed}$
- *Convert 49.455 into a pipe diameter*
- $49.455 / \pi = 15.75$
- $\sqrt{15.75} = 3.96 \text{ radius}$
- $3.96 * 2 = 7.92 \text{ inch diameter vent is the largest allowed for a 3 inch vent connector}$

Interpolation Example

Example: Interpolation would be trying to figure out if an 11 inch diameter vent would work

10" = 1060

12" = 1587

$(1060 + 1587) / 2 = 1323.5$

The max capacity for an 11 inch diameter vent in this situation would be 1,323,500 BTU/h input



Sizing Category 1 Venting Systems

- Tables designed for sizing of Category I
- NAT (natural draft)
- FAN (fan assisted)
- Provides for natural draft, fan assisted draft, and combination of both into a single chimney (510.0)
- Tables 510.1.2(1) through 510.1.2(6) are listed for single appliance installations
- Tables 510.2(1) through 510.2(9) are for multiple appliance venting

Sizing Based On

- Number of appliances
- Type of vent
- Type of connector
- Appliance vent connection
- Vent diameter
- Appliance BTU/h input
- Chimney height
- Lateral length

Example 1

- According to Table 510.1.2(1), what is the maximum allowable input in BTU/h for a naturally aspirated water heater with a chimney height of 8 feet, no lateral, and a 4 inch vent diameter?

Type B Double Wall Gas Vent													
		Number of Appliances: Two or More											
		Appliance Type: Category I											
		Appliance Vent Connection: Type B Double Wall Connector											
		Vent Diameter – D (inch)											
		3			4			5			6		
		Appliance Input Rating in Thousands of BTU per Hour											
Vent Height H Feet	Connector Rise R Feet	Fan		Nat	Fan		Nat	Fan		Nat	Fan		Nat
		Min	Max	Man	Min	Max	Max	Min	Max	Man	Min	Max	Max
6	1	0	78	46	0	152	86	0	251	141	0	375	205
	2	13	51	36	18	97	67	27	157	105	32	232	157
	3	21	49	34	30	94	64	39	153	103	50	227	153
8	1	0	84	50	0	165	94	0	276	155	0	451	235
	2	12	57	40	16	109	75	25	178	120	28	263	180
	3	23	56	38	32	103	71	42	171	115	53	255	173

Sizing Category 1 Venting Systems

Example 2

- What would be the correct vent size required for a 15 foot tall fan assisted water heater vent with a 2 foot lateral and an 80,000 BTU/h input that has a single wall metal connector?

Type B Double Wall Gas Vent													
		Number of Appliances: Single											
		Appliance Type: Category I											
		Appliance Vent Connection: Single Wall Metal Connector											
		Vent Diameter – D (inch)											
		3			4			5			6		
		Appliance Input Rating in Thousands of BTU per Hour											
Height H (feet)	Latera l L (feet)	Fan		Nat	Fan		Nat	Fan		Nat	Fan		Nat
		Min	Max	Man	Min	Max	Max	Min	Max	Man	Min	Max	Max
6	0	38	77	45	59	151	85	85	249	140	126	373	204
	2	39	51	36	60	96	66	85	156	104	123	231	156
	4	NA	NA	33	74	92	63	102	152	102	146	225	152
	6	NA	NA	31	83	89	60	114	147	99	163	220	148
8	0	37	83	50	58	164	93	83	273	154	123	41	234
	2	39	56	39	59	108	75	83	176	119	121	264	179
	5	NA	NA	37	77	102	69	107	168	114	151	252	171
	8	NA	NA	33	90	95	64	122	161	107	175	243	163
10	0	37	87	53	57	174	99	82	293	165	120	444	254
	2	39	61	41	59	117	80	82	193	128	119	287	194
	5	52	56	39	76	111	76	105	185	122	148	277	186
	10	NA	NA	34	97	100	68	132	171	112	188	261	171
15	0	36	93	57	56	190	111	80	325	186	116	499	283
	2	38	69	47	57	136	93	80	225	149	115	337	224
	5	51	63	44	75	128	86	102	216	140	144	326	217
	10	NA	NA	39	95	116	79	128	21	131	182	308	203
	15	NA	NA	NA	NA	NA	72	157	186	124	220	290	192

Sizing Category 1 Venting Systems

Example 3

- What would be the correct vent size required for a 15 foot tall fan assisted water heater vent with a 2 foot lateral and an 80,000 BTU/h input that has a single wall metal connector?

Type B Double Wall Gas Vent													
		Number of Appliances: Single											
		Appliance Type: Category I											
		Appliance Vent Connection: Connected Directly To Vent											
		Vent Diameter – D (inch)											
		3			4			5			6		
		Appliance Input Rating in Thousands of BTU per Hour											
Height H (feet)	Lateral L (feet)	Fan		Nat	Fan		Nat	Fan		Nat	Fan		Nat
		Min	Max	Man	Min	Max	Max	Min	Max	Man	Min	Max	Max
6	0	0	78	46	0	152	86	0	251	141	0	375	205
	2	13	51	36	18	97	67	27	157	105	32	232	157
	4	21	49	34	30	94	64	39	153	103	50	227	153
	6	25	46	32	36	91	61	47	149	100	59	223	149
8	0	0	84	50	0	165	94	0	276	155	0	415	235
	2	12	57	40	16	109	75	25	178	120	28	263	180
	5	23	52	38	32	103	71	42	171	115	53	255	173
	8	28	49	35	39	96	66	51	164	109	64	247	165
10	0	0	88	53	0	175	100	0	295	166	0	447	255
	2	12	61	42	17	118	81	23	194	129	26	289	195
	5	23	57	40	32	113	77	41	187	124	52	280	188
	10	30	21	36	41	104	70	54	176	115	67	267	175

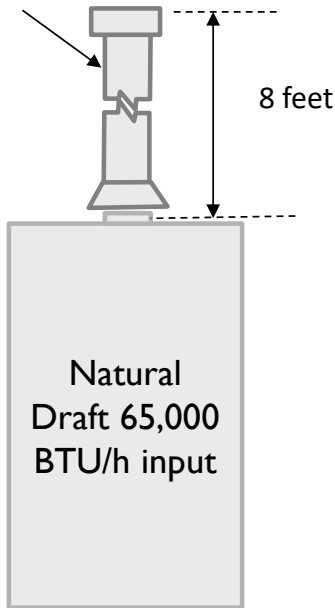
Sizing Category 1 Venting Systems

Example 4

- What is vent for

Type B
Gas Vent

the correct size
this installation?



Type B Double Wall Gas Vent													
		Number of Appliances: Single											
		Appliance Type: Category I											
		Appliance Vent Connection: Connected Directly To Vent											
		Vent Diameter – D (inch)											
		3			4			5			6		
		Appliance Input Rating in Thousands of BTU per Hour											
Height H (feet)	Lateral L (feet)	Fan		Nat	Fan		Nat	Fan		Nat	Fan		Nat
		Min	Max	Man	Min	Max	Max	Min	Max	Man	Min	Max	Max
6	0	0	78	46	0	152	86	0	251	141	0	375	205
	2	13	51	36	18	97	67	27	157	105	32	232	157
	4	21	49	34	30	94	64	39	153	103	50	227	153
	6	25	46	32	36	91	61	47	149	100	59	223	149
8	0	0	84	50	0	165	94	0	276	155	0	415	235
	2	12	57	40	16	109	75	25	178	120	28	263	180
	5	23	52	38	32	103	71	42	171	115	53	255	173
	8	28	49	35	39	96	66	51	164	109	64	247	165