# 8.11 Inspecting Venting Systems

*SWS Detail: 5.0503 Appliance Venting; 5.0503.1 Fuel-Fired Appliance Venting; 5.0501 Combustion Appliance Zones*

Combustion gases are vented through vertical chimneys or other types of approved horizontal or vertical vent piping. Identifying the type of existing venting material, verifying the correct size of vent piping, and making sure the venting conforms to the applicable codes are important tasks in inspecting and repairing venting systems. Too large a vent often leads to condensation and corrosion. Too small a vent can result in spillage. The wrong vent materials can corrode or deteriorate from heat.

*See "NFPA Codes" on page 268.*

**Video: Natural drafting chimneys—** Discussion about the various type of appliances that use atmospheric chimneys.

## 8.11.1 Vent Connectors

A vent connector connects the appliance's venting outlet collar with the chimney. Approved vent connectors for gas-fired units are made from the following materials.

- Type-B vent, consisting of a galvanized steel outer pipe and aluminum inner pipe for gas-fired units.
- Type-L vent connector with a stainless-steel inner pipe and a galvanized-steel outer pipe for oil-fired units.
- Double-wall stove-pipe vent connector with a stainless-steel inner pipe and a black-steel outer pipe for solid-fuel units.
- Galvanized steel pipe for gas or oil-fired units only: *See table.*

**Table 8-7: Single-Wall Galvanized Vent Connector Thickness**

| Diameter of Vent Connector (inches) | Inches (gauge) |
|---|---|
| 5 and smaller | 0.022 (26 gauge) |
| 6 to 10 | 0.028 (24 gauge) |
| 11 to 16 | 0.034 (22 gauge) |
| Larger than 16 | 0.064 (16 gauge) |

From *International Mechanical Code 2009*

Double-wall vent connectors are the best option, especially for appliances with some non-vertical vent piping. A double-wall vent connector maintains flue gas temperature and prevents condensation. Gas appliances with draft hoods, installed in attics or crawl spaces must use a Type-B vent connector. Use Type-L double-wall vent pipe for oil vent connectors in attics and crawl spaces.

### Vent-Connector Requirements

Verify that vent connectors comply with these specifications.

- Vent connectors must be as large as the vent collar on the appliances they vent.
- Single wall vent-pipe sections must be fastened together with 3 screws or rivets.
- Vent connectors must be sealed tightly where they enter masonry chimneys.
- Vent connectors must be free of rust, corrosion, and holes.
- Maintain minimum clearances between vent connectors and combustibles.

**Table 8-8: Clearances to Combustibles for Vent Connectors**

| Vent Connector Type | Clearance |
|---|---|
| Single wall galvanized steel vent pipe | 6" (gas), 18" (oil) |
| Type-B double wall vent pipe (gas) | 1" (gas) |
| Type L double wall vent pipe | 3" or as listed (oil) |
| Single-wall stove pipe | 18" (wood) |
| Double-wall stove pipe | 9" or as listed (wood) |

- The chimney combining two draft-hood vent connectors must have a cross-sectional area equal to the area of the larger vent connector plus half the area of the smaller vent connector. This common vent must be no larger than 7 times the area of the smallest vent connector. For specific vent sizes, see the NFPA codes listed on *page 328.*

**Table 8-9: Areas of Round Vents**

| Vent diameter | 4" | 5" | 6" | 7" | 8" |
|---|---|---|---|---|---|
| Vent area (square inches) | 12.6 | 19.6 | 28.3 | 38.5 | 50.2 |

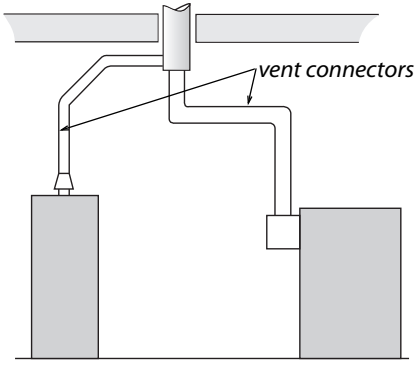
- The horizontal length of vent connectors shouldn't be more than 75% of the chimney's vertical height or have more than 18 inches horizontal run per inch of vent diameter.
- Vent connectors must have upward slope to their connection with the chimney. NFPA 54 requires a slope of at least $^1/_4$-inch of rise per foot of horizontal run so that combustion gases rise through the vent. The slope also prevents condensation from collecting in the vent and corroding it.

**Table 8-10: Connector Diameter vs. Maximum Horizontal Length**

| Diam (in) | 3" | 4" | 5" | 6" | 7" | 8" | 9" | 10" | 12" | 14" |
|---|---|---|---|---|---|---|---|---|---|---|
| Length (ft) | 4.5' | 6' | 7.5' | 9' | 10.5' | 12' | 13.5' | 15' | 18' | 21' |

From *International Fuel Gas Code 2000*

- When two vent connectors connect to a single chimney, the vent connector servicing the smaller appliance must enter the chimney above the vent for the larger appliance.




**Two vent connectors joining chimney:** The water heater's vent connector enters the chimney above the furnace because the water heater has a smaller input.

## 8.12 Chimneys

*SWS Detail: 5.0503 Appliance Venting; 5.0503.1 Fuel-Fired Appliance Venting*

There are two common types of vertical chimneys for venting combustion fuels that satisfy NFPA and ICC codes. First there are masonry chimneys lined with fire-clay tile, and second there are manufactured metal chimneys, including all-fuel metal chimneys, Type-B vent chimneys for gas appliances, and Type L chimneys for oil appliances.

*See "NFPA Codes" on page 268.*

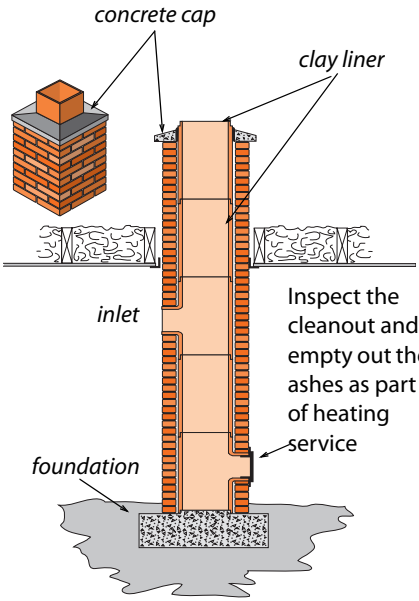
### 8.12.1 Masonry Chimneys

*SWS Detail: 5.0503.1 Fuel-Fired Appliance Venting*

Verify the following general specifications for building, inspecting, and repairing masonry chimneys.

- A masonry foundation should support every masonry chimney.

- Existing masonry chimneys should be lined with a fire clay flue liner. There should be a $^1/_2$-inch to 1-inch air gap between the clay liner and the chimney's masonry to insulate the liner. The liner shouldn't bond structurally to the outer masonry because the liner needs to expand and contract independently of the chimney's masonry structure. The clay liner can be sealed to the chimney cap with a flexible high-temperature sealant.



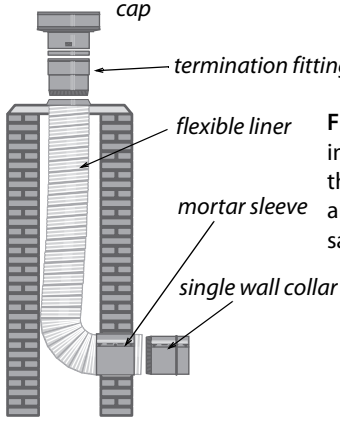

**Masonry chimneys:** Remain a very common vent for all fuels.

- Masonry chimneys should have a cleanout 12 inches or more below the lowest inlet. Clean mortar and brick dust out of the bottom of the chimney through the clean-out door, so that this debris won't eventually interfere with venting.
- Seal the chimney's penetrations through floors and ceilings with sheet metal and high-temperature sealant as a fire-stop and air barrier.
- Re-build deteriorated or unlined masonry chimneys as specified above or reline them as part of a heating-system replacement or a venting-safety upgrade. Or, install a new

metal chimney instead of repairing the existing masonry chimney.

## Metal Liners for Masonry Chimneys

Install or replace liners in unlined masonry chimneys or chimneys with deteriorated liners as part of heating system replacement. Orphaned water heaters may also need a chimney liner because the existing chimney may be too large. Use a correctly sized Type-B vent, a flexible or rigid stainless-steel liner, or a flexible aluminum liner.




**Flexible metal chimney liners:** The most important installation issues are sizing the liner correctly along with fastening and supporting the ends to prevent sagging.

Flexible liners require careful installation to avoid a low spot at the bottom, where the liner turns a right angle to pass through the wall of the chimney. Comply with the manufacturer's instructions, which usually require stretching the liner and fastening it securely at both ends, to prevent the liner from sagging and creating a low spot.

Flexible liners are easily damaged by falling masonry debris inside a deteriorating chimney. Use B-vent, L-vent, or single-wall stainless steel pipe instead of a flexible liner when the chimney is significantly deteriorated.

To minimize condensation, insulate the flexible liner — especially when installed in exterior chimneys. Consider fiberglass-

insulation jackets or perlite, if the manufacturer's instructions allow. Wood-stove chimney liners must be stainless steel and insulated.

Sizing flexible chimney liners correctly is very important. Oversizing is common and can lead to condensation and corrosion. The manufacturers of the liners include vent-sizing tables in their specifications. Liners should display a label from a testing lab like Underwriters Laboratories (UL).

**Masonry chimneys as structural hazards:** A building owner may want to consider reinforcing a deteriorated chimney by repointing masonry joints or parging the surface with reinforced plaster. Other options include demolishing the chimney or filling it with concrete to prevent it from damaging the building by collapsing during an earthquake.

### Solutions for Failed Chimneys

Sometimes a chimney is too deteriorated to be re-lined or repaired. In this case, abandon the old chimney, and install one of the following.

- A double-wall horizontal sidewall vent, equipped with a barometric draft control and a power venter mounted on the exterior wall. Maintain a 4-foot clearance between the ground and the vent's termination if you live where it snows.
- A new heating unit, equipped with a power burner or draft inducer, that is designed for horizontal or vertical venting.
- A new manufactured metal venting system.

**Table 8-11: Clearances to Combustibles for Common Chimneys**

| Chimney Type | Clearance |
|---|---|
| Interior chimney masonry w/ fireclay liner | 3" |
| Exterior masonry chimney w/ fireclay liner | 1" |
| All-fuel metal vent: insulated double-wall or triple-wall pipe | 2" |
| Type B double-wall vent (gas only) | 1" |
| Type L double-wall vent (oil) | 3" |
| Manufactured chimneys and vents list their clearances. | |

## 8.12.2 Manufactured Chimneys

*SWS Detail: 5.0503.1 Fuel-Fired Appliance Venting*

Manufactured metal chimneys have engineered parts that fit together in a prescribed way. Parts include: metal pipe, weight-supporting hardware, insulation shields, roof jacks, and chimney caps. One manufacturer's chimney may not be compatible with another's connective fittings.

All-fuel chimneys (also called Class A chimneys) are used primarily for the solid fuels: wood and coal. All-fuel metal chimneys come in two types: insulated double-wall metal pipe and triple-wall metal pipe. Comply with the manufacturer's specifications when you install these chimneys.

**All-fuel metal chimney:** These chimney systems include transition fittings, support brackets, roof jacks, and chimney caps. The pipe is double-wall insulated or triple-wall construction.

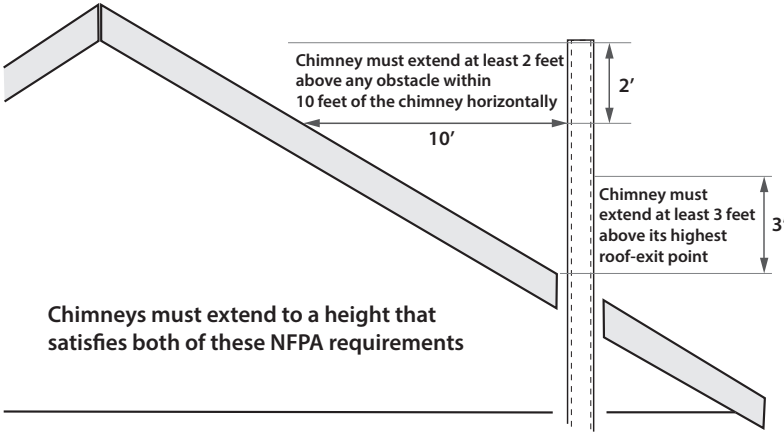
Type-B vent double-wall pipe is permitted as a chimney for gas appliances. Type BW pipe is manufactured for gas space heaters in an oval shape to fit inside wall cavities.

Type L double-wall pipe is used for oil chimneys.

## 8.12.3 Chimney Terminations

*SWS Detail: 5.0503.1 Fuel-Fired Appliance Venting*

Masonry chimneys and all-fuel metal chimneys should terminate at least three feet above the roof penetration and two feet above any obstacle within ten feet of the chimney outlet.




**Chimney terminations:** Should have vent caps and be given adequate clearance height from nearby building parts. These requirements are for both masonry chimneys and manufactured all-fuel chimneys.

B-vent chimneys can terminate as close as one foot above flat roofs and above pitched roofs up to a $^{6}/_{12}$ roof pitch. As the pitch rises, the minimum required termination height, as measured from the high part of the roof slope, rises as shown in this table.

**Table 8-12: Roof Slope and B-Vent Chimney Height (ft)**

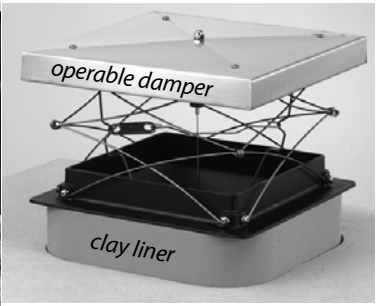
| flat-6/12 | 6/12-7/12 | 7/12-8/12 | 8/12-9/12 | 9/12-10/12 | 10/12-11/12 | 11/12-12/12 | 12/12-14/12 | 14/12-16/12 | 16/12-18/12 |
|---|---|---|---|---|---|---|---|---|---|
| 1' | 1' 3" | 1' 6" | 2' | 2' 6" | 3' 3" | 4' | 5′ | 6' | 7' |

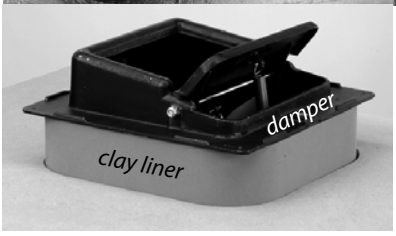
From *National Fuel Gas Code 2009*

## 8.12.4 Air Leakage through Masonry Chimneys

The existing fireplace damper or "airtight" doors seldom provide a good air seal. Help the clients decide whether they will use the fireplace in the future or whether to take it out of service. Consider these solutions for chimneys with ineffective or missing dampers.

- Install an inflatable chimney seal along with a notice of its installation to alert anyone wanting to start a fire to remove the seal first.
- Install an operable chimney-top damper and leave instructions on how to open and close it. Also notify users of which position is open and which is closed.
- Air seal the chimney top from the roof with a watertight, airtight seal. Also seal the chimney from the living space with foam board and drywall. If you install a permanent chimney seal such as this, post a notice at the fireplace saying that it is permanently disabled.

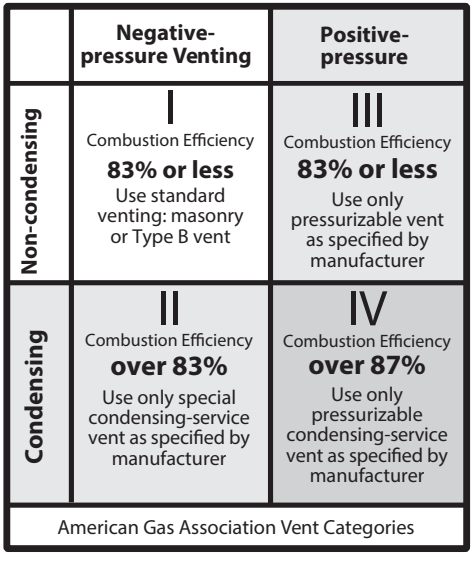




**Reducing air leakage through masonry chimneys:** You can seal a chimney off permanently, install an inflatable seal inside, or install a chimney-top damper from the outside to reduce air leakage through the chimney.

## 8.13 Special Venting Considerations for Gas

The American Gas Association (AGA) publishes a classification system for venting systems attached to natural-gas and propane appliances. This classification system assigns Roman numerals to four categories of venting based on whether there is positive or negative pressure in the vent and whether condensation is likely to occur in the vent.

**AGA venting categories:** The AGA classifies venting by whether there is positive or negative pressure in the vent and whether condensation is likely.




A majority of gas appliances found in homes and multifamily buildings are Category I, which have negative pressure in their vertical chimneys. We expect no condensation in the vent connector or chimney.

Condensing furnaces are usually Category IV, have positive pressure in their vent, and condensation occurring in both the appliance and vent. Category III vents are rare, however a few fan-assisted furnaces and boilers vent their flue gases through airtight non-condensing vents. Category II vents are very rare and beyond the scope of this discussion.

## 8.13.1 Venting Fan-Assisted Furnaces and Boilers

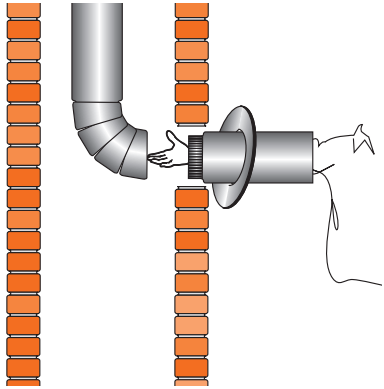
*SWS Detail: 5.0503.1 Fuel-Fired Appliance Venting*

Newer gas-fired fan-assisted central furnaces and boilers eliminate dilution air and may have slightly cooler flue gases compared to their predecessors. The chimney may experience more condensation than in the past. Inspect the existing chimney to verify that it's in good condition when considering replacing an

old natural-draft unit. Reline the chimney when you see any of these conditions.

- When the existing masonry chimney is unlined.
- When the old clay or metal chimney liner is deteriorated.
- When the new furnace has a smaller input (BTUH) than the old one, the liner should be sized to the new furnace and the existing water heater.

**B-vent chimney liner:** Double wall Type-B vent is the most commonly available chimney liner and is recommended over flexible liners. Rigid stainless-steel single wall liners are also a permanent solution to deteriorated chimneys.



## Liner Materials for 80+ Furnaces

For gas-fired 80+ AFUE furnaces, a chimney liner should consist of one of these four materials.

1. A type-B vent
2. A rigid or flexible stainless steel liner (preferably insulated)
3. A poured masonry liner
4. An insulated flexible aluminum liner

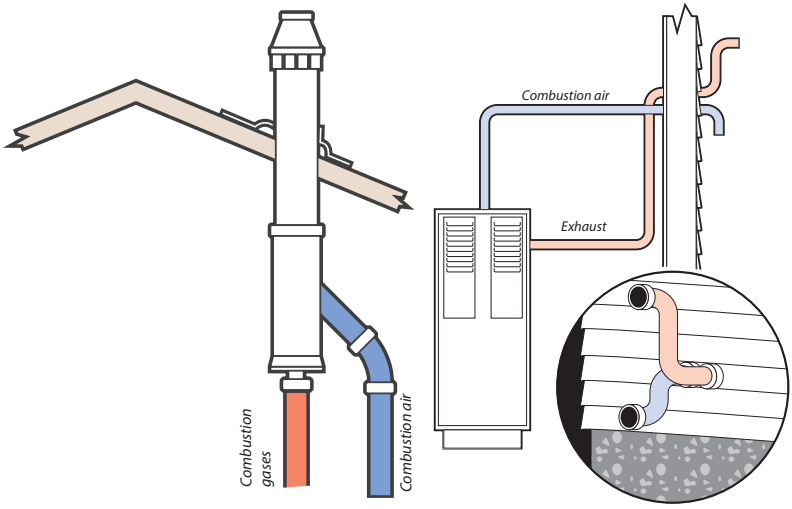
Chimney relining is expensive. Therefore consider a power-vented sealed-combustion unit when an existing chimney is inadequate for a new fan-assisted appliance.

## 8.13.2 Venting Sealed-Combustion Furnaces and Boilers

*SWS Detail: 5.0503.1 Fuel-Fired Appliance Venting*

Some space heaters, furnaces, and boilers use factory-built metal chimneys with single stainless steel liners that vent horizontally under positive pressure.

Condensing furnaces usually employ horizontal or vertical plastic-pipe chimneys.




**Two types of sealed-combustion vents:** On the left is a concentric vent exiting through a roof. On the right is a plastic-pipe vent and combustion-air opens through the wall.

## 8.13.3 Sidewall Power Venting

*SWS Detail: 5.0503.1 Fuel-Fired Appliance Venting*

Stainless-steel vents powered by fans in gas and oil appliances exit through walls and don't require vertical chimneys.

**Table 8-13: Characteristics of Gas Furnaces and Boilers**

| Annual Fuel Utilization Efficiency (AFUE) | Operating characteristics |
|---|---|
| 70+ | Category I, draft diverter, no draft fan, standing pilot, non-condensing, indoor combustion and dilution air. |
| 80+ | Category I, no draft diverter, fan-assisted draft, electronic ignition, indoor combustion air, no dilution air. |
| 80+ | Category III, horizontal fan-pressurized non-condensing vent, indoor combustion air, no dilution air. |
| 90+ | Category IV, no draft diverter, fan-assisted draft, low-temperature plastic venting, positive draft, electronic ignition, condensing heat exchanger, outdoor combustion air is strongly recommended. |

**Video: Heating and Cooling Efficiency**

— An explanation of the various types in terms related to efficiency