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**Plumbing works — Code of practice —
Part 5: Water heaters**

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 644-5 was prepared by Technical Committee RSB/TC 17, *Urban planning*.

In the preparation of this standard, reference was made to the following standard:

Uniform Plumbing Code (2024 Edition, IAPMO)

The assistance derived from the above source is hereby acknowledged with thanks.

DRS 644 consists of the following parts, under the general title *Plumbing works — Code of practice*:

- *Part 1: General*
- *Part 2: Plumbing fixtures and fixture fittings*
- *Part 3: Water supply and distribution*
- *Part 4: Sanitary and drainage system installation*
- *Part 5: Water heaters*
- *Part 6: Fuel gas piping and firestop protection*
- *Part 7: Healthcare facilities and medical gas and medical vacuum systems*
- *Part 8: Alternate water sources for non-potable applications and non-potable rainwater catchment systems*

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Committee membership

The following organizations were represented on the Technical Committee on *Urban planning* (RSB/TC 17) in the preparation of this standard.

City of Kigali

Institute of Engineering Rwanda (IER)

Ministry of Infrastructure (MININFRA)

Rwanda Housing Authority (RHA)

Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA)

Rwanda Plumbers Organization (RPO)

Rwanda Polytechnic – Kigali College

Rwanda Polytechnic – Musanze College

Rwanda Transport Development Agency (RTDA)

Rwanda Utility Regulatory Authority (RURA)

Rwanda Water Resources Board (RWB)

University of Rwanda – College of Science and Technology (UR-CST)

Water and Sanitation Corporation (WASAC)

Water for People

Rwanda Standards Board (RSB) – Secretariat

Plumbing works — Code of practice — Part 5: Water heaters

1 Scope

This Draft Rwanda Standard provides recommendations and guidelines for construction, location and installation of fuel-burning and other types of water heaters heating potable water.

It also specifies requirements for construction, location and installation of chimneys, vents, and their connectors.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ASTM D3212, *Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*

UL 441 *Standard for Gas Vents*

UL 641 *Standard for Type L Low-Temperature Venting Systems*

UL 378 *Standard for Draft Equipment*

UL 1738 *Venting Systems for Gas-Burning Appliances, Categories II, III, and IV*

UL 103 *Standard for Factory-Built Chimneys for Residential Type and Building Heating Appliances*

UL 959 *Standard for Medium Heat Appliance Factory-Built Chimneys*

UL 2561 *Standard for 1400 Degree Fahrenheit Factory-Built Chimneys*

UL 1777 *Standard for Chimney Liners*

UL 378 *Standard for Wire Connectors*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in WDRS 644-1 apply.

4 Symbols (and abbreviated terms)

BTU British thermal units

FAN Minimum Vent Capacity (FAN Min)

NAT Maximum Vent Capacity (NAT Max)

ACH Air Change Per Hour

FVIR Flammable Vapor Ignition Resistant

5 Water heaters capacity, installation, permit and inspection

The minimum capacity for storage water heaters shall be in accordance with the first-hour rating listed in Table 1.

Table 1 — First hour rating¹

Number of Bathrooms	1 to 1.5			2 to 2.5				3 to 3.5			
Number of Bedrooms	1	2	3	2	3	4	5	3	4	5	6
First Hour Rating, ² Gallons	38	49	49	49	62	62	74	62	74	74	74

NOTE For SI units: 1 gallon = 3.785 L

¹ The first-hour rating is found on the "Energy Guide" label.

² Solar water heaters shall be sized to meet the appropriate first-hour rating as shown in the table

5.2 Listed appliances shall be installed in accordance with the manufacturer's installation instructions. Unlisted water heaters shall be permitted in accordance with the requirement of WDRS xxx-1.

5.3 Water heaters shall be installed in accordance with the manufacturer's installation instructions. The final installation shall be approved by the Competent Authority. It shall be unlawful for a person to install, remove, or replace or cause to be installed, removed, or replaced a water heater without using certified plumber as required by the Competent Authority.

5.5 Inspection shall be made after work authorized by the permit has been installed. The Competent Authority will make such inspection as deemed necessary to be assured that the work has been installed in accordance with the intent of this code. No appliance or part thereof shall be covered or concealed until the same has been inspected and approved by the Competent Authority.

6 Water heater requirements

6.1 Location

6.1.1 General

Water heater installations in bedrooms and bathrooms shall comply with one of the following [NFPA 54:10.27.1]:

- a) Water heater shall be of the direct-vent type. [NFPA 54:10.27.1(2)]
- b) Fuel-burning water heaters shall be permitted to be installed in a closet located in the bedroom or bathroom provided the closet is equipped with a listed, gasketed door assembly and a listed self-closing device. The self-closing door assembly shall meet the requirements of Clause 6.1.2. The door assembly shall be installed with a threshold and bottom door seal and shall meet the requirements of Clause 6.1.3. Combustion air for such installations shall be obtained from the outdoors in accordance with Clause 7.4. The closet shall be for the exclusive use of the water heater.

6.1.2 Self-closing doors

Self-closing doors shall swing easily and freely, and shall be equipped with a self-closing device to cause the door to close and latch each time it is opened. The closing mechanism shall not have a hold-open feature.

6.1.3 Gasketing

Gasketing on gasketed doors or frames shall be furnished in accordance with the published listings of the door, frame, or gasketing material manufacturer.

6.1.4 Exception:

Where acceptable to the Competent Authority, gasketing of non-combustible or limited-combustible material shall be permitted to be applied to the frame, provided closing and latching of the door are not inhibited.

6.2 Vent

Water heaters of other than the direct-vent type shall be located as close as practical to the chimney or gas vent.

6.3 Clearance

6.3.1 The clearance requirements for water heaters shall comply with 6.3.2 or 6.3.3.

6.3.2 The clearances shall not be such as to interfere with combustion air, draft hood clearance and relief, and accessibility for servicing. Listed water heaters shall be installed in accordance with their listings and the manufacturer's installation instructions.

6.3.3 Except as otherwise permitted in this standard, unlisted water heaters shall be approved by the Competent Authority prior to being installed. Clearance for unlisted water heaters shall be not less than 305 mm (12 inches) on all sides. Combustible floors under unlisted water heaters shall be protected in an approved manner. {NFPA 54-2018:10.27.2.2}

6.4 Pressure-limiting devices

A water heater installation shall be provided with overpressure protection using an approved, listed device installed in accordance with the terms of its listing and the manufacturer's installation instructions. Pressure relief devices shall have a pressure setting greater than the water service pressure and not exceed 150 psi (1034 kPa) as required in the following: Each pressure relief valve shall be an approved automatic type with drain, and each such relief valve shall be set at a pressure of not more than 150 psi (1034 kPa). No shutoff valve shall be installed between the relief valve and the system.

6.5 Temperature limiting devices

6.5.1 A water heater installation or a hot water storage vessel installation shall be provided with overtemperature protection by means of an approved, listed device installed in accordance with the terms of its listing and the manufacturer's installation instructions. {NFPA 54:10.26.5}

6.5.2 The installation of water heaters and hot storage vessels shall be provided with overtemperature protection by means of a listed device installed in accordance with the manufacturer's instructions.

6.6 Temperature, pressure, and vacuum relief devices

6.6.1 Temperature, pressure, and vacuum relief devices or combinations thereof, and automatic gas shutoff devices shall be installed in accordance with the terms of their listings and the manufacturer's installation instructions. A shutoff valve shall not be placed between the relief valve and the water heater or on discharge pipes between such valves and the atmosphere. The hourly British thermal units (Btu) (kW/h) discharge capacity or the rated steam relief capacity of the device shall be not less than the input rating of the water heater. {NFPA 54:10.26.6}

6.6.2 Discharge piping shall be installed in accordance with the requirements of DRS 644-4.

6.7 Lead content

Water heaters shall comply with the lead content requirements of DRS 644-4.

7 Oil-burning and other water heaters

7.1 Water heaters

Water heaters deriving heat from fuels or types of energy other than gas shall comply with the relevant applicable standards. Vents or chimneys for such appliances shall be of approved types. An adequate supply of air for combustion and for adequate ventilation of heater rooms or compartments shall be provided. Each such appliance shall be installed in a location approved by the Competent Authority and local and state fire-prevention agencies.

7.2 Safety devices

Storage-type water heaters and hot water boilers deriving heat from fuels or types of energy other than gas, shall be provided with, in addition to the primary temperature controls, an over-temperature safety protection device that complies with and is installed in accordance with nationally recognized applicable standards for such devices and a combination temperature and pressure-relief valve.

7.3 Oil-fired water heaters

Oil-fired water heaters shall be installed in accordance with the relevant applicable standards.

7.4 Indirect-fired water heaters

Indirect-fired water heaters shall be in accordance with the applicable standards for Boiler and Pressure Vessel Code or shall comply with one of the other applicable standards. Each water heater shall bear a label in accordance with applicable standards, or an approved testing agency, certifying and attesting that such an appliance has been tested, inspected and meets the requirements of the applicable standards or code.

7.4.1 Single-wall heat exchanger

An indirect-fired water heater that incorporates a single-wall heat exchanger shall be in accordance with the following requirements:

- (1) The heat transfer medium shall be either potable water or contain fluids recognized as safe by the Competent Authority in charge of food and drug as food grade.
- (2) Bear a label with the word "Caution," followed by the following statements:
 - (a) The heat-transfer medium shall be potable water or other nontoxic fluid recognized as safe by the Competent Authority in charge of Food and drugs.
 - (b) The maximum operating pressure of the heat exchanger shall not exceed the maximum operating pressure of the potable water supply.
- (3) The word "Caution" and the statements in letters shall have an uppercase height of not less than 0.120 of an inch (3.048 mm). The vertical spacing between lines of type shall be not less than 0.046 of an inch (1.168 mm). Lowercase letters shall be compatible with the uppercase letter size specification.

8 Air for combustion and ventilation

8.1 General

8.1.1 Air for combustion, ventilation, and dilution of flue gases for appliances installed in buildings shall be obtained by application of one of the methods covered in Clause 8.2 through Clause 8.3. Where the

requirements of Clause 8.2 are not met, outdoor air shall be introduced in accordance with methods covered in Clause 8.4 through Clause 8.3.

Exception: This provision shall not apply to direct vent appliances. {NFPA 54:9.3.1.1}

8.1.1 Other types of appliances

Appliances of other than natural draft design, appliances not designated as Category I vented appliances, and appliances equipped with power burners shall be provided with combustion, ventilation, and dilution air in accordance with the appliance manufacturer's instructions. [NFPA 54:9.3.1.2]

8.1.2 Draft hood and regulators

Where used, a draft hood or a barometric draft regulator shall be installed in the same room or enclosure as the appliance served so as to prevent any difference in pressure between the hood or regulator and the combustion air supply. [NFPA 54:9.3.1.4]

8.1.3 Makeup air

Where exhaust fans, clothes dryers, and kitchen ventilation systems interfere with the operation of appliances, makeup air shall be provided. NFPA 54:9.3.1.5]

8.2 Indoor combustion air

8.2.1 The required volume of indoor air shall be determined in accordance with the method in Clause 8.2.2 or Clause 8.2.3 except that where the air infiltration rate is known to be less than 0.40 ACH (air change per hour), the method in Clause 8.2.3 shall be used. The total required volume shall be the sum of the required volume calculated for all appliances located within the space. Rooms communicating directly with the space in which the appliances are installed through openings not furnished with doors, and through combustion air openings sized and located in accordance with Clause 8.3, are considered a part of the required volume. [NFPA 54:9.3.2]

8.2.2 Standard Method: The minimum required volume shall be 50 cubic feet per 1000 British thermal units per hour (Btu/h) (4.83 m³/kW). [NFPA 54:9.3.2.1]

8.2.3 Known Air Infiltration Rate Method: Where the air infiltration rate of a structure is known, the minimum required volume shall be determined as follows [NFPA 54:9.3.2.2]:

(1) For appliances other than fan-assisted, calculate using the following Equation. [NFPA 54:9.3.2.2(1)]

$$\text{Required Volume}_{\text{other}} \geq \frac{21 \text{ ft}^3}{\text{ACH}} \left(\frac{I_{\text{other}}}{1000 \text{ Btu/h}} \right)$$

(2) For fan-assisted appliances, calculate using the following Equation. [NFPA 54:9.3.2.2(2)]

$$\text{Required Volume}_{fan} \geq \frac{15 \text{ ft}^3}{ACH} \left(\frac{I_{fan}}{1000 \text{ Btu/h}} \right)$$

where

I_{other} = All appliances other than fan-assisted input in (Btu/h)

I_{fan} = Fan-assisted appliance input in (Btu/h)

ACH = Air change per hour (percent of volume of space exchanged per hour, expressed as a decimal)

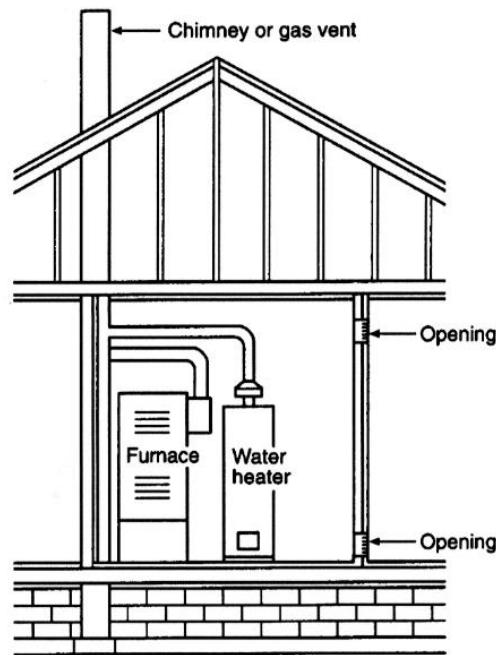
For SI units: 1 cubic foot = 0.0283 m³, 1000 British thermal units per hour = 0.293 kW

(3) For purposes of these calculations, an infiltration rate greater than 0.60 ACH shall not be used in the above equations. [NFPA 54:9.3.2.2(3)]

8.3 Indoor opening size and location

Openings used to connect indoor spaces shall be sized and located in accordance with the following:

- (1) **Combining spaces on the same story.** Each opening shall have a minimum free area of 1 square inch per 0.002 m²/kW (1000 Btu/h) of the total input rating of all appliances in the space but not less than 0.065 m² (100 square inches). One permanent opening shall commence within 305 mm (12 inches) of the top of the enclosure and one permanent opening shall commence within 305 mm (12 inches) of the bottom of the enclosure (see Figure 1). The minimum dimension of air openings shall not be less than 76 mm (3 inches).
- (2) **Combining spaces in different stories.** The volumes of spaces in different stories shall be considered as communicating spaces where such spaces are connected by one or more permanent openings in doors or floors having a total minimum free area of 2 square inches per 1000 Btu/h (0.004 m²/kW) of total input rating of all appliances. [NFPA 54:9.3.2.3]



**Figure 1 — All combustion air from adjacent indoor spaces through indoor combustion air openings
[NFPA 54: FIGURE A.9.3.2.3(1)]**

8.4 Outdoor combustion air

8.4.1 General

Outdoor combustion air shall be provided through opening(s) to the outdoors in accordance with the methods in Clause 8.4.2 or Clause 8.4.3. The minimum dimension of air openings shall not be less than 3 inches (76 mm). [NFPA 54:9.3.3]

(2) Combining spaces in different stories. The volumes of spaces in different stories shall be considered as communicating spaces where such spaces are connected by one or more permanent openings in doors or floors having a total minimum free area of 2 square inches per 0.004 m²/kW (1000 Btu/h) of total input rating of all appliances. [NFPA 54:9.3.2.3]

8.4.2 Two permanent openings method

Two permanent openings, one commencing within 305 mm (12 inches) of the top of the enclosure and one commencing within 305 mm (12 inches) of the bottom of the enclosure, shall be provided. The openings shall communicate directly, or by ducts, with the outdoors or spaces that freely communicate with the outdoors, as follows:

(1) Where directly communicating with the outdoors or where communicating to the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 0.0005 m²/kW (4000 Btu/h) of total input rating of all appliances in the enclosure. (See Figure 2 and Figure 3).

(2) Where communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 square inch per 0.001 m²/kW (2000 Btu/h) of total input rating of all appliances in the enclosure. [NFPA 54:9.3.3.1] (See Figure 4)

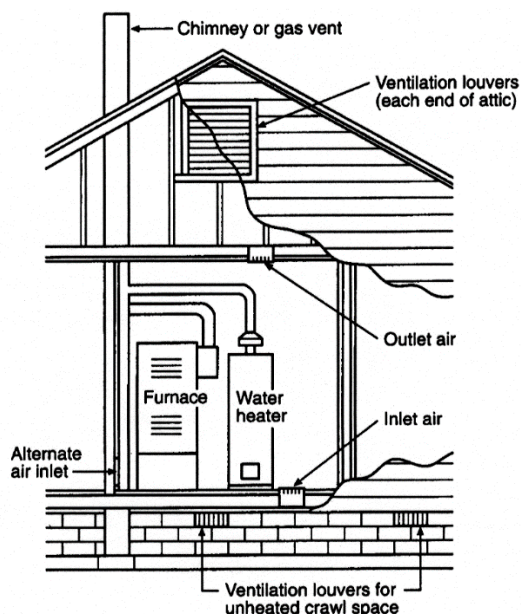
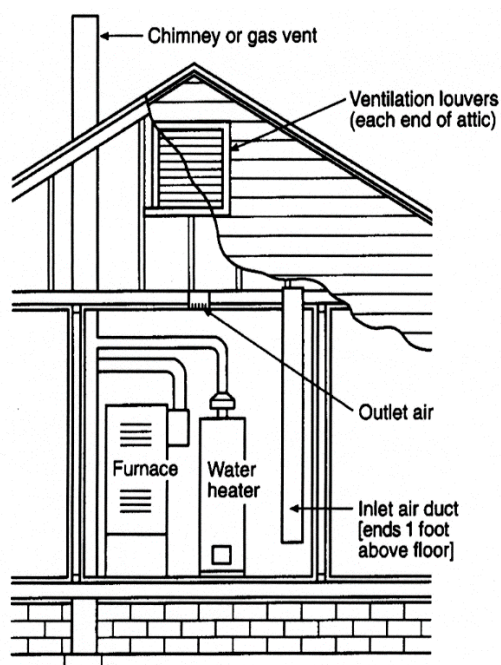


Figure 2 — All combustion air from outdoors – inlet air from ventilated crawl space and outlet air to ventilated attic [NFPA 54: FIGURE A.9.3.3.1(1)(a)]



For SI units: 1 foot = 304.8 mm

Figure 3 — All combustion air from outdoors through ventilated attic [NFPA 54: FIGURE A.9.3.3.1(1)(b)]

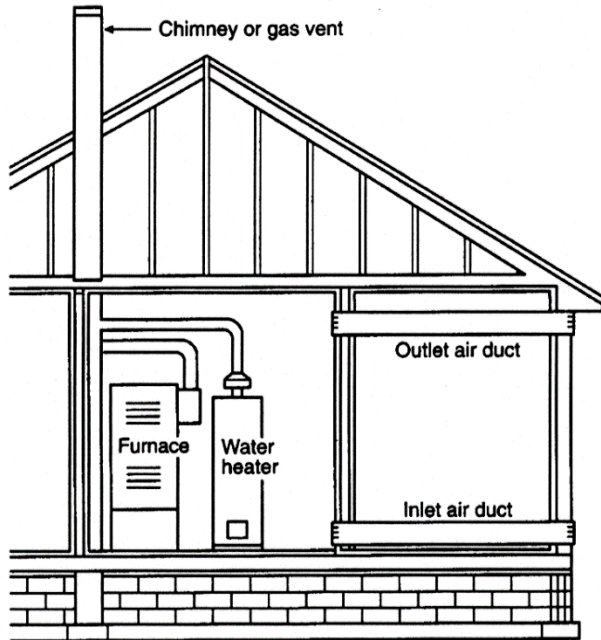


Figure 4 — All combustion air from outdoors through horizontal ducts [NFPA 54: FIGURE A.9.3.3.1(2)]

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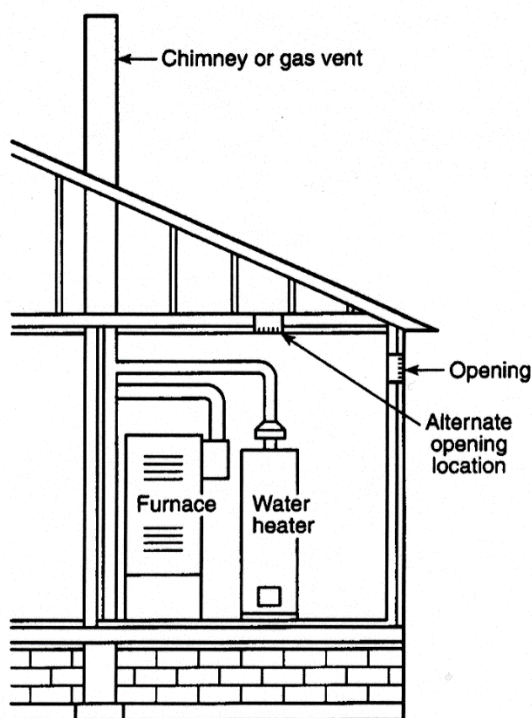


Figure 5 —All combustion air from outdoors through single combustion air opening [NFPA 54: FIGURE A.9.3.3.2]

8.4.3 One permanent opening method

One permanent opening, commencing within 12 inches (305 mm) of the top of the enclosure, shall be provided. The appliance shall have clearances of at least 1 inch (25.4 mm) from the sides and back and 6 inches (152 mm) from the front of the appliance. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that freely communicate with the outdoors (see Figure 5) and shall have a minimum free area of the following:

- (1) One square inch per 0.0007 m²/kW (3000 Btu/h) of the total input rating of all appliances located in the enclosure.
- (2) Not less than the sum of the areas of all vent connectors in the space. [NFPA 54:9.3.3.2]

8.5 Combination indoor and outdoor combustion air

8.5.1 The use of a combination of indoor and outdoor combustion air shall be in accordance with Clause 8.5.1 through Clause 8.5.3. [NFPA 54:9.3.4]

8.5.1 Indoor openings

Where used, openings connecting the interior spaces shall comply with 8.5.3. [NFPA 54:9.3.4(1)]

8.5.2 Outdoor opening(s) location

Outdoor opening(s) shall be located in accordance with Clause 8.4. [NFPA 54:9.3.4(2)]

8.5.3 Outdoor opening(s) size

The outdoor opening(s) size shall be calculated in accordance with the following:

- (1) The ratio of the interior spaces shall be the available volume of all communicating spaces divided by the required volume.
- (2) The outdoor size reduction factor shall be 1 minus the ratio of interior spaces.
- (3) The minimum size of outdoor opening(s) shall be the full size of outdoor opening(s) calculated in accordance with Clause 8.4 multiplied by the reduction factor. The minimum dimension of air openings shall not be less than 76 mm (3 inches). [NFPA 54:9.3.4(3)]

8.6 Engineered Installations

Engineered combustion air installations shall provide an adequate supply of combustion, ventilation, and dilution air determined using engineering methods. [NFPA 54:9.3.5]

8.7 Mechanical combustion air supply

8.7.1 Where all combustion air is provided by a mechanical air supply system, the combustion air shall be supplied from outdoors at the minimum rate of 0.35 cubic feet per minute per 0.034 (m³/min)/kW [1000 Btu/h] for all appliances located within the space. [NFPA 54:9.3.6]

8.7.2 Exhaust fans, where exhaust fans are installed, additional air shall be provided to replace the exhausted air. [NFPA 54:9.3.6.1]

8.7.3 Interlock, each of the appliances served shall be interlocked to the mechanical air supply system to prevent main burner operation where the mechanical air supply system is not in operation. [NFPA 54:9.3.6.2]

8.7.4 Specified combustion air, where combustion air is provided by the building's mechanical ventilation system, the system shall provide the specified combustion air rate in addition to the required ventilation air. [NFPA 54:9.3.6.3]

8.8 Louvers, grilles, and screens

8.8.1 The required size of openings for combustion, ventilation, and dilution air shall be based on the net free area of each opening. Where the free area through a design of louver, grille, or screen is known, it shall be used in calculating the size opening required to provide the free area specified. Where the louver and grille

design and free area are not known, it shall be assumed that wood louvers have 25 percent free area, and metal louvers and grilles have 75 percent free area. Nonmotorized louvers and grilles shall be fixed in the open position. [NFPA 54:9.3.7.1]

8.8.2 Minimum screen mesh size, screens shall not be smaller than 6.4 mm ($\frac{1}{4}$ of an inch) mesh. [NFPA 54:9.3.7.2]

8.8.2 Motorized louvers, motorized louvers shall be interlocked with the appliance so they are proven in the full open position prior to main burner ignition and during main burner operation. Means shall be provided to prevent the main burner from igniting should the louver fail to open during burner startup and to shut down the main burner if the louvers close during burner operation. [NFPA 54:9.3.7.3]

8.8.2 Combustion air ducts, combustion air ducts shall comply with the following [NFPA 54:9.3.8]:

(1) Ducts shall be constructed of galvanized steel or a material having equivalent corrosion resistance, strength, and rigidity.

Exception: Within dwellings units, unobstructed stud and joist spaces shall not be prohibited from conveying combustion air, provided that not more than one fireblock is removed. [NFPA 54:9.3.8.1]

(2) Ducts shall terminate in an unobstructed space, allowing free movement of combustion air to the appliances. [NFPA 54:9.3.8.2]

(3) Ducts shall serve a single space. [NFPA 54:9.3.8.3]

(4) Ducts shall not serve both upper and lower combustion air openings where both such openings are used. The separation between ducts serving upper and lower combustion air openings shall be maintained to the source of combustion air. [NFPA 54:9.3.8.4]

(5) Ducts shall not be screened where terminating in an attic space. [NFPA 54:9.3.8.5]

(6) Combustion air intake openings located on the exterior of the building shall have the lowest side of the combustion air intake openings located at least 12 inches (305 mm) vertically from the adjoining finished ground level. [NFPA 54:9.3.8.8]

(7) Horizontal upper combustion air ducts shall not slope downward toward the source of combustion air. [NFPA 54:9.3.8.6]

(8) The remaining space surrounding a chimney liner, gas vent, special gas vent, or plastic piping installed within a masonry, metal, or factory built chimney shall not be used to supply combustion air.

Exception: Direct-vent appliances designed for installation in a solid fuel-burning fireplace where installed in accordance with the manufacturer's installation instructions. [NFPA 54:9.3.8.7]

9 Appliance and equipment installation requirements

9.1 Dielectric insulator

The Competent Authority shall have the authority to require the use of an approved dielectric insulator on the water piping connections of water heaters and related water heating appliances.

9.2 Seismic provisions

Water heaters shall be anchored or strapped to resist horizontal displacement due to earthquake motion. Strapping shall be at points within the upper one-third and lower one-third of its vertical dimensions. At the lower point, a distance of not less than 4 inches (102 mm) shall be maintained from the controls with the strapping.

9.3 Appliance support

9.3.1 Appliances and equipment shall be furnished either with load distributing bases or with a sufficient number of supports to prevent damage to either the building structure or the appliance and the equipment. [NFPA 54:9.1.8.1]

9.3.2 At the locations selected for installation of appliances and equipment, the dynamic and static load carrying capacities of the building structure shall be checked to determine whether they are adequate to carry the additional loads. The appliances and equipment shall be supported and shall be connected to the piping so as not to exert undue stress on the connections. [NFPA 54:9.1.8.2]

9.4 Ground support

A water heater supported from the earth shall rest on level concrete or other approved base extending not less than 76 mm (3 inches) above the adjoining ground level.

9.5 Drainage pan

Where a water heater is located in an attic, in or on an attic ceiling assembly, floor-ceiling assembly, floor-subfloor assembly or where damage results from a leaking water heater, a watertight pan of corrosion-resistant materials shall be installed beneath the water heater in accordance with the following:

- (1) The drainage pan shall be provided with not less than 20 mm ($\frac{3}{4}$ of an inch) diameter drain to an approved location. The terminating end of the drainpipe shall be readily visible.
- (2) The drainage pan shall be not less than 38 mm ($1\frac{1}{2}$ inches) in depth.
- (3) Where a drainage pan pipe is installed, the material of the piping shall be rated for the temperature rating of the water heater and shall be approved for use with the liquid being discharged.
- (4) Discharge from a relief valve into a drainage pan shall be prohibited.

9.6 Added or converted equipment or appliances

When additional or replacement appliances or equipment is installed or an appliance is converted to gas from another fuel, the location in which the appliances or equipment is to be operated shall be checked to verify the following:

- (1) Air for combustion and ventilation is provided where required, in accordance with the provisions of Section XXXX. Where existing facilities are not adequate, they shall be upgraded to meet Section XXXX specifications.
- (2) The installation components and appliances meet the clearances to combustibles material provisions of Section XXXX. It shall be determined that the installation and operation of the additional or replacement appliances do not render the remaining appliances unsafe for continued operation.
- (3) The venting system is constructed and sized in accordance with the provisions of Clause 11. Where the existing venting system is not adequate, it shall be upgraded to comply with Clause 11. [NFPA 54:9.1.2]

9.7 Type of gas(es).

The appliance shall be connected to the fuel gas for which it was designed. No attempt shall be made to convert the appliance from the gas specified on the rating plate for use with a different gas without consulting the installation instructions, the serving gas supplier, or the appliance manufacturer for complete instructions. Listed appliances shall not be converted unless permitted by and in accordance with the manufacturer's installation instructions. [NFPA 54:9.1.3]

9.8 Safety shutoff devices for unlisted lp-gas appliance used indoors

Unlisted appliances for use with undiluted LP-Gases and installed indoors, except attended laboratory equipment, shall be equipped with safety shutoff devices of the complete shutoff type. [NFPA 54:9.1.4]

9.9 Use of air or oxygen under pressure

Where air or oxygen under pressure is used in connection with the gas supply, effective means such as a backpressure regulator and relief valve shall be provided to prevent air or oxygen from passing back into the gas piping. Where oxygen is used, installation shall be in accordance with NFPA 51. [NFPA 54:9.1.5]

9.10 Protection of gas appliances from fumes or gases other than products of combustion

Non-direct-vent appliances installed in beauty shops, barber shops, or other facilities where chemicals that generate corrosive or flammable products such as aerosol sprays are routinely used shall be located in a mechanical room separate or partitioned off from other areas with provisions for combustion and dilution air from outdoors. Direct-vent appliances in such facilities shall be in accordance with the appliance manufacturer's installation instructions. [NFPA 54:9.1.6.2]

9.11 Process air

In addition to air needed for combustion in commercial or industrial processes, process air shall be provided as required for cooling of appliances, equipment, or material; for controlling dew point, heating, drying, oxidation,

dilution, safety exhaust, odor control, and air for compressors; and for comfort and proper working conditions for personnel. [NFPA 54:9.1.7]

9.12 Flammable vapors

Appliances shall not be installed in areas where the open use, handling, or dispensing of flammable liquids occurs, unless the design, operation, or installation reduces the potential of ignition of the flammable vapors. Appliances installed in compliance with Clause 9.13 through Clause 9.15 shall be considered to comply with the intent of this provision. [NFPA 54:9.1.9]

9.13 Installation in residential garages

9.13.1 Appliances in residential garages and in adjacent spaces that open to the garage and are not part of the living space of a dwelling unit shall be installed so that all heating elements, switches, burners, and burner-ignition devices are located not less than 457 mm (18 inches) above the floor.

Exception: Listed flammable vapor ignition resistant (FVIR) appliances. {NFPA 54:9.1.10.1}

9.13.2 Appliances installed in garages, warehouses, or other areas subject to mechanical damage shall be guarded against such damage by being installed behind protective barriers or by being elevated or located out of the normal path of vehicles.

9.13.3 Where appliances are installed in a separate, enclosed space having access only from outside of the garage, such appliances shall be permitted to be installed at floor level, providing the required combustion air is taken from the exterior of the garage. [NFPA 54:9.1.10.3]

9.14 Installation in commercial garages

9.14.1 Appliances installed in commercial garages shall comply with Clause 9.14.2 and Clause 9.14.3.

9.14.2 Parking Structures

Appliances installed in enclosed, basement, and underground parking structures shall be installed in accordance with NFPA 88A. [NFPA 54:9.1.11.1]

9.14.3 Repair Garages

Appliances installed in repair garages shall be installed in accordance with NFPA 30A. [NFPA 54:9.1.11.2]

9.15 Installation in aircraft hangars

Heaters in aircraft hangars shall be installed in accordance with the NFPA 409. [NFPA 54:9.1.12]

9.16 Venting of flue gases

Appliances shall be vented in accordance with the provisions of Clause 11. [NFPA 54:9.1.14]

9.17 Extra device or attachment

No device or attachment shall be installed on any appliance that could in any way impair the combustion of gas. [NFPA 54:9.1.15]

9.18 Addition to existing system

When additional appliances are being connected to a gas piping system, the existing piping shall be checked to determine whether it has adequate capacity. If the capacity of the system is determined to be inadequate for the additional appliances, the existing system shall be enlarged as required, or separate gas piping of adequate capacity shall be provided. [NFPA 54:5.1.2]

9.19 Avoiding strain on gas piping

Appliances shall be supported and connected to the piping so as not to exert undue strain on the connections. [NFPA 54:9.1.16]

9.20 Appliance pressure regulators

Where the gas supply pressure is higher than that at which the appliance is designed to operate or varies beyond the design pressure limits of the appliance, a gas appliance pressure regulator listed in accordance with CSA/ANSI Z21.18/CSA 6.3 shall be installed. [NFPA 54:9.1.17]

9.21 Bleed lines for diaphragm-type valves

Bleed lines shall comply with the following requirements:

- (1) Diaphragm-type valves shall be equipped to convey bleed gas to the outdoors or into the combustion chamber adjacent to a continuous pilot.
- (2) In the case of bleed lines leading outdoors, means shall be employed to prevent water from entering this piping and also to prevent blockage of vents by insects and foreign matter.
- (3) Bleed lines shall not terminate in the appliance flue or exhaust system.
- (4) In the case of bleed lines entering the combustion chamber, the bleed line shall be located so the bleed gas is readily ignited by the pilot and the heat liberated thereby does not adversely affect the normal operation of the safety shutoff system. The terminus of the bleed line shall be securely held in a fixed position relative to the pilot. For manufactured gas, the need for a flame arrester in the bleed line piping shall be determined.
- (5) A bleed line(s) from a diaphragm-type valve and a vent line(s) from an appliance pressure regulator shall not be connected to a common manifold terminating in a combustion chamber. Bleed lines shall not terminate in positive-pressure-type combustion chambers. [NFPA 54:9.1.18]

9.22 Combination of appliances and equipment

Any combination of appliances, equipment, attachments, or devices used together in any manner shall comply with the standards that apply to the individual appliance and equipment. [NFPA 54:9.1.19]

9.23 Installation Instructions

The installer shall conform to the appliance and equipment manufacturers' recommendations in completing an installation. The installer shall leave the manufacturers' installation, operating, and maintenance instructions on the premises. [NFPA 54:9.1.20]

9.24 Protection of outdoor appliances

Appliances not listed for outdoor installation but installed outdoors shall be provided with protection to the degree that the environment requires. Appliances listed for outdoor installation shall be permitted to be installed without protection in accordance with the manufacturer's installation instructions. [NFPA 54:9.1.21]

9.25 Accessibility for service

All appliances shall be located with respect to building construction and other equipment so as to permit access for repair or replacement of the appliance. Clearance shall be maintained to permit removal of the appliance; cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls, and vent connections; the lubrication of moving parts where necessary; the adjustment and cleaning of burners and pilots; and the proper functioning of explosion vents, if provided. For attic installation, the passageway and servicing area adjacent to the appliance shall be in accordance with Clause 10.4. {NFPA 54:9.2.1}

Unless otherwise specified, clearances of not less than 762 mm (30 inches) in depth, width, and height of working space shall be maintained.

9.26 Clearance to combustible materials

Appliances and their vent connectors shall be installed with clearances from combustible material so their operation does not create a hazard to persons or property. Minimum clearances between combustible walls and the back and sides of various conventional types of appliances and their vent connectors are specified in Clause 11. [NFPA 54:9.2.2]

10 Appliances on roofs, in attics or under-floor spaces

10.1 General.

10.1.1 Appliances on roofs shall be designed or enclosed so as to withstand climatic conditions in the area in which they are installed. Where enclosures are provided, each enclosure shall permit easy entry and movement, shall be of reasonable height, and shall have at least 762 mm (a 30 inch) clearance between the entire service access panel(s) of the appliance, and the wall of the enclosure. [NFPA 54:9.4.1.1]

10.1.2 Load Capacity. Roofs on which appliances are to be installed shall be capable of supporting the additional load or shall be reinforced to support the additional load. [NFPA 54:9.4.1.2]

10.1.3 Fasteners. All access locks, screws, and bolts shall be of corrosion-resistant material. [NFPA 54:9.4.1.3]

10.2 Installation of appliances on roofs

10.2.1 General

Appliances shall be installed in accordance with the manufacturer's installation instructions. [NFPA 54:9.4.2.1]

10.2.2 Edge of Roof Clearance

Appliances shall be installed on a well-drained surface of the roof. At least 1829 mm (6 feet) of clearance shall be available between any part of the appliance and the edge of a roof or similar hazard, or rigidly fixed rails, guards, parapets, or other building structures at least 1067 mm (42 inches) in height shall be provided on the exposed side. [NFPA 54:9.4.2.2]

10.2.3 Guards and Rails

Guards or rails shall be required where the following exist:

- 1) The clearance between the appliance and a roof edge or open end of an equipment platform is less than 1829 mm (6 feet).
- (2) The open end of the equipment platform is located more than 762 mm (30 inches) above the roof, floor, or grade below.

Where guards or rails are installed, they shall be constructed so as to prevent the passage of a 21 inch (533 mm) diameter ball, resist the imposed loading conditions, and shall extend not less than 30 inches (762 mm) beyond each side of the equipment or appliance.

10.2.4 Guards shall not be required where a permanent fall arrest anchorage connector system in accordance with the applicable Standards is installed.

10.2.5 Electrical Power. Appliances requiring an external source of electrical power shall be installed in accordance with NFPA 70. [NFPA 54:9.4.2.3]

10.2.5 Platform or Walkway. Where water stands on the roof at the appliance or in the passageways to the appliance, or where the roof is of a design having a water seal, a suitable platform, walkway, or both shall be provided above the water line. Such platform(s) or walkway(s) shall be located adjacent to the appliance and control panels so that the appliance can be safely serviced where water stands on the roof. [NFPA 54:9.4.2.4]

10.3 Appliances on roofs

10.3.1 Appliances located on roofs or other elevated locations shall be accessible. [NFPA 54:9.4.3.1]

10.3.2 Access. Buildings of more than 4572 mm (15 feet) in height shall have an inside means of access to the roof, unless other means acceptable to the Competent Authority are used. [NFPA 54:9.4.3.2]

10.3.3 Access Type. The inside means of access shall be a permanent or foldaway inside stairway or ladder, terminating in an enclosure, scuttle, or trapdoor. Such scuttles or trapdoors shall be at least 559 mm by 610 mm (22 inches by 24 inches) in size, shall open easily and safely under all conditions, especially snow, and shall be constructed so as to permit access from the roof side unless deliberately locked on the inside.

At least 1829 mm (6 feet) of clearance shall be available between the access opening and the edge of the roof or similar hazard, or rigidly fixed rails or guards a minimum of 1067 mm (42 inches) in height shall be provided on the exposed side. Where parapets or other building structures are utilized in lieu of guards or rails, they shall be a minimum of 1067 mm (42 inches) in height. [NFPA 54:9.4.3.3]

10.3.4 Permanent Lighting. Permanent lighting shall be provided at the roof access. The switch for such lighting shall be located inside the building near the access means leading to the roof. [NFPA 54:9.4.3.4]

10.4 Appliances in attics and under-floor spaces

10.4.1 General

An attic or under-floor space in which an appliance is installed shall be accessible through an opening and passageway larger than the largest component of the appliance, and not less than 559 mm by 762 mm (22 inches by 30 inches). {NFPA 54:9.5.1}

10.4.2 Length of passageway

Where the height of the passageway is less than 6 feet (1829 mm), the distance from the passageway access to the appliance shall not exceed 6096 mm (20 feet) measured along the centerline of the passageway. [NFPA 54:9.5.1.1] Where the height of the passageway is 1829 mm (6 feet) or more, the distance from the passageway access to the appliance shall not exceed 15 240 mm (50 feet) measured along the centerline of the passageway.

10.4.3 Width of passageway

The passageway shall be unobstructed and shall have solid flooring not less than 24 inches (610 mm) wide from the entrance opening to the appliance. [NFPA 54:9.5.1.2]

10.4.4 Work platform

A level working platform not less than 762 mm by 762 mm (30 inches by 30 inches) shall be provided in front of the service side of the appliance. [NFPA 54:9.5.2]

10.4.5 Lighting and convenience outlet

A permanent 120 V receptacle outlet and a luminaire shall be installed near the appliance. The switch controlling the luminaire shall be located at the entrance to the passageway. [NFPA 54:9.5.3]

11 Venting of appliances

11.1 Listing

11.1.1 General

Type B and Type B-W gas vents shall comply with UL 441, and Type L gas vents shall comply with UL 641.

11.1.2 Installation

Listed chimneys and vents shall be installed in accordance with Section 509.0 and the manufacturers' installation instructions. [NFPA 54:12.2.1]

11.1.3 Prohibited discharge

Appliance vents shall not discharge into a space enclosed by screens having openings less than 6.4 mm ($\frac{1}{4}$ of an inch) mesh.

11.2 Connection to Venting Systems

Except as permitted in Clause 11.2.1 through Clause 11.2.7, all appliances shall be connected to venting systems. [NFPA 54:12.3.1]

11.2.1 Appliances Not Required to be Vented

The following appliances shall not be required to be vented:

(1) A single listed booster-type (automatic instantaneous) water heater, when designed and used solely for the sanitizing rinse requirements of a dishwashing machine, provided that the appliance is installed with the draft hood in place and unaltered, if a draft hood is required, in a commercial kitchen having a mechanical exhaust system. [Where installed in this manner, the draft hood outlet shall not be less than 914 mm (36 inches) vertically and 152 mm (6 inches) horizontally from any surface other than the appliance. [NFPA 54:12.3.2(5)]]

(2) Other appliances listed for unvented use and not provided with flue collars. [NFPA 54:12.3.2(10)]

11.2.2 Maximum Input Rating

Where any or all of the appliances in Clause 11.2.1(1) and Section 11.2.1(2) are installed so the aggregate input rating exceeds 207 W/m^3 (20 (Btu/h)/ft³) of room or space in which it is installed, one or more shall be provided with venting systems or other approved means for conveying the vent gases to the outdoors so that the aggregate input rating of the remaining unvented appliances does not exceed 207 W/m^3 (20 (Btu/h)/ft³). [NFPA 54:12.3.2.1]

11.2.3 Adjacent Room or Space

Where the calculation includes the volume of an adjacent room or space, the room or space in which the appliances are installed shall be directly connected to the adjacent room or space by a doorway, archway, or other opening of comparable size that cannot be closed. [NFPA 54:12.3.2.2]

11.2.4 Ventilating Hoods

The use of ventilating hoods and exhaust systems to vent appliances shall be limited to industrial appliances and appliances installed in commercial applications. [NFPA 54:12.3.3]

11.2.5 Well-Ventilated Spaces

The flue gases from industrial-type appliances shall not be required to be vented to the outdoors where such gases are discharged into a large and well-ventilated industrial space. [NFPA 54:12.3.4]

11.2.6 Direct-Vent Appliances

Listed direct vent appliances shall be installed in accordance with the manufacturer's installation instructions. [NFPA 54:12.3.5.1]

Through-the-wall vent terminations for listed direct-vent appliances shall be in accordance with Clause 11.7.7.2. [NFPA 54:12.3.5.2]

11.2.7 Appliances with Integral Vents

Appliances incorporating integral venting means shall be installed in accordance with Clause 11.7. [NFPA 54:12.3.6]

11.3 Minimum safe performance

11.3.1 General

Venting systems shall be designed and constructed to convey all flue and vent gases to the outdoors. [NFPA 54:12.1]

11.3.2 Appliance draft requirements

A venting system shall satisfy the draft requirements of the appliance in accordance with the manufacturer's instructions. [NFPA 54:12.4.1]

11.3.3 Appliance venting requirements

Appliances required to be vented shall be connected to a venting system designed and installed in accordance with the provisions of Clause 11.4 through Clause 11.12. [NFPA 54:12.4.2]

11.3.4 Mechanical draft systems

Mechanical draft systems shall be listed in accordance with UL 378 and installed in accordance with both the appliance and the mechanical draft system manufacturer's installation instructions. [NFPA 54:12.4.3.1]

11.3.5 Venting

Appliances requiring venting shall be permitted to be vented by means of mechanical draft systems of either forced or induced draft design. [NFPA 54:12.4.3.2]

11.3.6 Leakage

Forced draft systems and all portions of induced draft systems under positive pressure during operation shall be designed and installed so as to prevent leakage of flue or vent gases into a building. [NFPA 54:12.4.3.3]

11.3.7 Vent connectors

Vent connectors serving appliances vented by natural draft shall not be connected into any portion of mechanical draft systems operating under positive pressure. [NFPA 54:12.4.3.4]

11.3.8 Operation

Where a mechanical draft system is employed, provision shall be made to prevent the flow of gas to the main burners when the draft system is not performing so as to satisfy the operating requirements of the appliance for safe performance. [NFPA 54:12.4.3.5]

11.3.9 Ventilating hoods and exhaust systems

Where automatically operated appliances, other than food service appliances, are vented through a ventilating hood or exhaust system equipped with a damper or with a power means of exhaust, provisions shall be made to allow the flow of gas to the main burners only when the damper is open to a position to properly vent the appliance and when the power means of exhaust is in operation. [NFPA 54:12.4.4.1]

11.3.10 Circulating air ducts, above-ceiling air-handling spaces, and furnace plenums

Venting systems shall not extend into or pass through any fabricated air duct or furnace plenum. [NFPA 54:12.4.5.1]

11.3.11 Above-ceiling or non-ducted air handling system

Where a venting system passes through an above-ceiling air space or other non-ducted portion of an air-handling system, it shall conform to one of the following requirements:

(1) The venting system shall be a listed special gas vent, other system serving a Category III or Category IV appliance, or other positive pressure vent, with joints sealed in accordance with the appliance or vent manufacturer's instructions.

(2) The vent system shall be installed such that no fittings or joints between sections are installed in the above-ceiling space.

(3) The venting system shall be installed in a conduit or enclosure with joints between the interior of the enclosure and the ceiling space sealed. [NFPA 54:12.4.5.2]

11.4 Type of venting system to be used

11.4.1 Plastic Piping

Where plastic piping is used to vent an appliance, the appliance shall be listed for use with such venting materials and the appliance manufacturer's installation instructions shall identify the specific plastic piping material. The plastic pipe venting materials shall be labeled in accordance with the product standards specified by the appliance manufacturer or shall be listed and labeled in accordance with UL 1738. [NFPA 54:12.5.2]

The type of venting system to be used shall be in accordance with Table 2. [NFPA 54:12.5.1]

Table 2 — Type of venting system to be used {NFPA 54: TABLE 12.5.1}

Appliances	Type of venting system	Location of requirements
Listed Category I appliances Listed appliances equipped with draft hood Appliances listed for use with Type B gas vent	Type B gas vent	Clause 11.6
	Chimney	Clause 11.5
	Single-wall metal pipe	Clause 11.7
	Listed chimney lining system for gas venting	Clause 11.5.3
	Special gas vent listed for these appliances	Clause 11.4.3
Listed vented wall furnaces	Type B-W gas vent	Clause 11.6
Category II, Category III, and Category IV appliances	As specified or furnished by manufacturers of listed appliances	Clause 11.4.1 and Clause 11.5.3
Appliances that can be converted to use solid fuel Unlisted combination gas- and oil-burning appliances Combination gas- and solid fuel-burning appliances Appliances listed for use with chimneys only Unlisted appliances	Chimney	Clause 11.5
Listed combination gas- and oil-burning appliances	Type L vent	Clause 11.6
	Chimney	Clause 11.5
Decorative appliance in vented fireplace	Chimney	UMC Section 911.2

Gas-fired toilets	Single-wall metal pipe	Clause 11.7
Direct-vent appliances	—	Clause 11.2.6
Appliances with integral vents	—	Clause 11.2.7

11.4.2 Plastic vent joints

Plastic pipe and fittings used to vent appliances shall be installed in accordance with the appliance manufacturer's installation instructions. Plastic pipe venting materials listed and labeled in accordance with UL 1738 shall be installed in accordance with the vent manufacturer's installation instructions. Where primer is required, it shall be of a contrasting color. [NFPA 54:12.5.3]

11.4.3 Special gas vents

Special gas vents shall be listed and labeled in accordance with UL 1738 and installed in accordance with the special gas vent manufacturer's installation instructions. [NFPA 54:12.5.4]

11.5 Masonry, metal, and factory-built chimneys

11.5.1 Chimneys shall be installed in accordance with 11.5.1 through 11.5.3.

11.5.1 Factory-built chimneys

Factory-built chimneys shall be listed in accordance with UL 103, UL 959, or UL 2561. Factory-built chimneys used to vent appliances that operate at positive vent pressure shall be listed for such application. [NFPA 54:12.6.1.1]

Decorative shrouds addressed in 11.5.7 shall comply with UL 103 for factory -built residential chimneys.

11.5.2 Metal chimneys

Metal chimneys shall be built and installed in accordance with NFPA 211. [NFPA 54:12.6.1.2]

11.5.3 Masonry chimneys

Masonry chimneys shall be built and installed in accordance with NFPA 211 and lined with one of the following:

- (1) Approved clay flue lining
- (2) A chimney lining system listed and labeled in accordance with UL 1777
- (3) Other approved material that resists corrosion, erosion, softening, or cracking from vent gases at temperatures up to 1800°F (982°C)

Exception: Masonry chimney flues lined with a chimney lining system specifically listed for use with listed appliances with draft hoods, Category I appliances, and other appliances listed for use with Type B vents shall be permitted. The liner shall be installed in accordance with the liner manufacturer's installation instructions. A

permanent identifying label shall be attached at the point where the connection is to be made to the liner. The label shall read "This chimney liner is for appliances that burn gas only. Do not connect to solid or liquid fuel-burning appliances or incinerators." [NFPA 54:12.6.1.3]

11.5.4 Termination

A chimney for residential-type or low-heat appliances shall extend at least 3 feet (914 mm) above the highest point where it passes through a roof of a building and at least 2 feet (610 mm) higher than any portion of a building within a horizontal distance of 3048 mm (10 feet). [NFPA 54:12.6.2.1] (See Figure 6)

11.5.5 Medium-heat gas appliances

A chimney for medium-heat appliances shall extend at least 3048 mm (10 feet) higher than any portion of any building within 7620 mm (25 feet). [NFPA 54:12.6.2.2]

11.5.6 Chimney height

A chimney shall extend at least 1524 mm (5 feet) above the highest connected appliance draft hood outlet or flue collar. [NFPA 54:12.6.2.3]

11.5.7 Decorative shrouds

Decorative shrouds shall not be installed at the termination of factory-built chimneys except where such shrouds are listed and labeled for use with the specific factory-built chimney system and are installed in accordance with the manufacturer's installation instructions. [NFPA 54:12.6.2.4]

11.5.8 Size of chimneys

The effective area of a chimney venting system serving listed appliances with draft hoods, Category I appliances, and other appliances listed for use with Type B vents shall be in accordance with one of the following methods:

- (1) Those listed in Clause 12.
- (2) The effective areas of the vent connector and chimney flue of a venting system serving a single appliance with a draft hood shall be not less than the area of the appliance flue collar or draft hood outlet or greater than seven times the draft hood outlet area.
- (3) The effective area of the chimney flue of a venting system serving two appliances with draft hoods shall be not less than the area of the larger draft hood outlet plus 50 percent of the area of the smaller draft hood outlet or greater than seven times the smaller draft hood outlet area.
- (4) Chimney venting systems using mechanical draft shall be sized in accordance with engineering methods.
- (5) Other engineering methods. [NFPA 54:12.6.3.1]

11.5.9 Inspection of chimneys

11.5.9.1 Before replacing an existing appliance or connecting a vent connector to a chimney, the chimney passageway shall be examined to ascertain that it is clear and free of obstructions and shall be cleaned if previously used for venting solid or liquid fuel-burning appliances or fireplaces. [NFPA 54:12.6.4.1]

11.5.9.2 Chimneys shall be lined in accordance with NFPA 211. [NFPA 54:12.6.4.2]

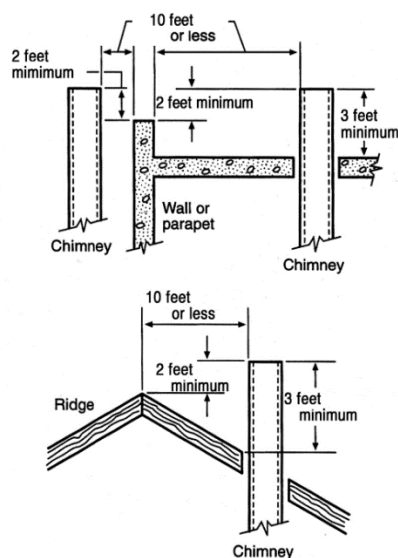
11.5.9.3 Cleanouts shall be examined and where they do not remain tightly closed when not in use, they shall be repaired or replaced. [NFPA 54:12.6.4.3]

11.5.9.4 When inspection reveals that an existing chimney is not safe for the intended application, it shall be repaired, rebuilt, lined, relined, or replaced with a vent or chimney to conform to NFPA 211 and shall be suitable for the appliances to be attached. [NFPA 54:12.6.4.4]

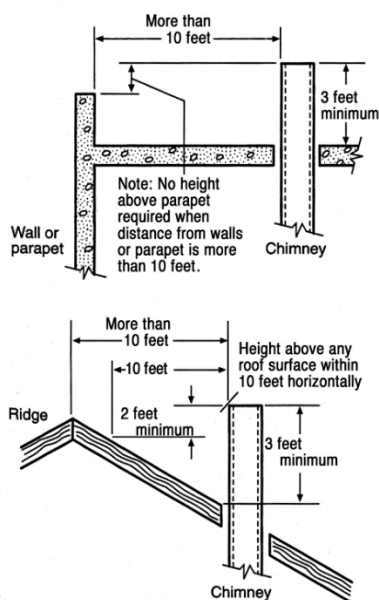
11.5.10 Chimney serving appliances burning other fuels

11.5.10.1 An appliance shall not be connected to a chimney flue serving a separate appliance designed to burn solid fuel. [NFPA 54:12.6.5.1]

11.5.10.2 Where one chimney serves gas appliances and liquid fuel-burning appliances, the appliances shall be connected through separate openings or connected through a single opening where joined by a suitable fitting located as close as practical to the chimney. Where two or more openings are provided into one chimney flue, they shall be at different levels. Where the gas appliance is automatically controlled, it shall be equipped with a safety shutoff device. [NFPA 54:12.6.5.2]



(a) Termination 10 feet or Less from Ridge, Wall, or Parapet



(b) Termination More Than 10 feet from Ridge, Wall, or Parapet

For SI units: 1 foot = 304.8 mm

Figure 6 — Typical termination locations for chimneys and single-wall metal pipes serving residential-type and low-heat appliance [NFPA: 54: FIGURE A.12.6.2.1]

11.5.10.3 A listed combination gas- and solid-fuel-burning appliance connected to a single chimney flue shall be equipped with a manual reset device to shut off gas to the main burner in the event of sustained backdraft or flue gas spillage. The chimney flue shall be sized to properly vent the appliance. [NFPA 54:12.6.5.3]

11.5.10.4 A single chimney flue serving a listed combination gas- and oil-burning appliance shall be sized in accordance with the appliance manufacturer's instructions. [NFPA 54:12.6.5.4]

11.5.11 Support of chimneys

All portions of chimneys shall be supported for the design and weight of the materials employed. Listed factory-built chimneys shall be supported and spaced in accordance with the manufacturer's installation instructions. [NFPA 54:12.6.6]

11.5.12 Cleanouts

Where a chimney that formerly carried flue products from liquid or solid fuel-burning appliances is used with an appliance using fuel gas, an accessible cleanout shall be provided. The cleanout shall have a tight-fitting cover and be installed so its upper edge is at least 152 mm (6 inches) below the lower edge of the lowest chimney inlet opening. [NFPA 54:12.6.7]

11.5.13 Space surrounding lining or vent

11.5.13.1 The remaining space surrounding a chimney liner, gas vent, special gas vent, or plastic piping installed within a masonry chimney shall not be used to vent another appliance. [NFPA 54:12.6.8.1]

11.5.13.2 The insertion of another liner or vent within the chimney as provided in this code and the liner or vent manufacturer's instructions. [NFPA 54:12.6.8.1]

11.5.13.3 The remaining space surrounding a chimney liner, gas vent, special gas vent, or plastic piping installed within a masonry, metal, or factory-built chimney flue shall not be used to supply combustion air. [NFPA 54:12.6.8.2]

11.5.13.4 Direct-vent appliances designed for installation in a solid fuel-burning fireplace were installed in accordance with the manufacturer's installation instructions. [NFPA 54:12.6.8.2]

11.6 Gas vents

11.6.1 General

The installation of gas vents shall meet the following requirements:

- (1) Gas vents shall be installed in accordance with the manufacturer's installation instructions.
- (2) A Type B-W gas vent shall have a listed capacity not less than that of the listed vented wall furnace to which it is connected.
- (3) Gas vents installed within masonry chimneys shall be installed in accordance with the manufacturer's installation instructions. Gas vents installed within masonry chimneys shall be identified with a permanent label installed at the point where the vent enters the chimney. The label shall contain the following language: "This gas vent is for appliances that burn gas. Do not connect to solid or liquid fuel-burning appliances or incinerators."
- (4) Screws, rivets, and other fasteners shall not penetrate the inner wall of double-wall gas vents, except at the transition from the appliance draft hood outlet, flue collar, or single-wall metal connector to a double-wall vent. [NFPA 54:12.7.2]

11.6.2 Gas vent termination

11.6.2.1 The termination of gas vents shall comply with the following requirements:

- (1) A gas vent shall terminate in accordance with one of the following:
 - (a) Gas vents that are 300 mm (12 inches) or less in size and located not less than 2438 mm (8 feet) from a vertical wall or similar obstruction shall terminate above the roof in accordance with Figure 7 and Table 3.
 - (b) Gas vents that are over 300 mm (12 inches) in size or are located less than 8 feet (2438 mm) from a vertical wall or similar obstruction shall terminate not less than 610 mm (2 feet) above the highest point where they pass through the roof and not less than 610 mm (2 feet) above any portion of a building within 3048 mm (10 feet) horizontally.
 - (c) Industrial appliances as provided in 11.2.5.
 - (d) Direct-vent systems as provided in 11.2.6.
 - (e) Appliances with integral vents as provided in 11.2.7.
 - (f) Mechanical draft systems as provided in 11.3.3 through 11.3.8.
 - (g) Ventilating hoods and exhaust systems as provided in 11.3.4.
- (2) A Type B or a Type L gas vent shall terminate at least 1524 mm (5 feet) in vertical height above the highest connected appliance draft hood or flue collar.
- (3) A Type B-W gas vent shall terminate at least 3658 mm (12 feet) in vertical height above the bottom of the wall furnace.
- (4) A gas vent extending through an exterior wall shall not terminate adjacent to the wall or below eaves or parapets, except as provided in 11.2.7 and 11.3.4 through 11.3.5.
- (5) Decorative shrouds shall not be installed at the termination of gas vents except where such shrouds are listed for use with the specific gas venting system and are installed in accordance with the manufacturer's installation instructions.
- (6) All gas vents shall extend through the roof flashing, roof jack, or roof thimble and terminate with a listed cap or listed roof assembly.
- (7) A gas vent shall terminate at least 914 mm (3 feet) above a forced air inlet located within 3048 mm (10 feet). [NFPA 54:12.7.3]

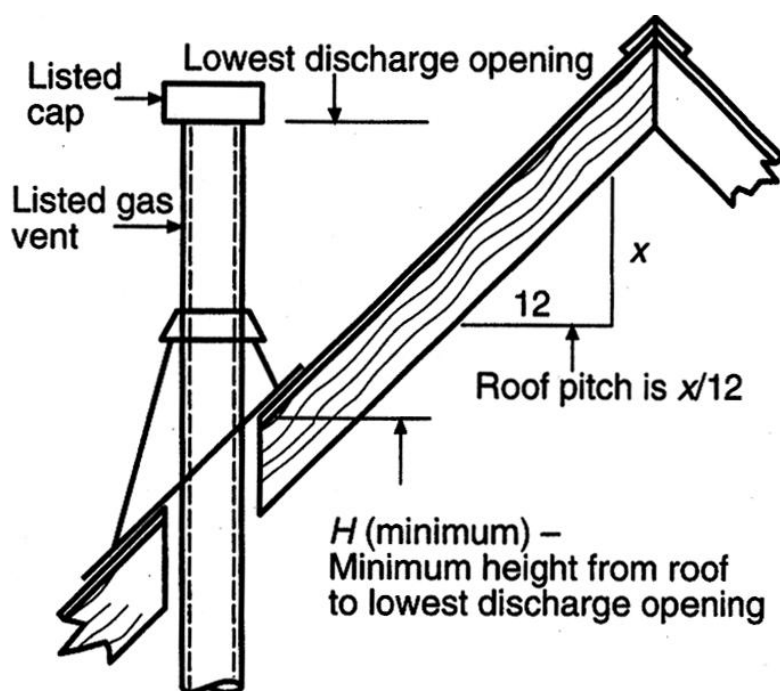


Figure 7 — Termination locations for gas vents with listed caps 12 inches or less in size at least 8 feet from a vertical wall [NFPA 54: FIGURE 12.7.3]

Table 3 — Roof slope heights [NFPA 54: TABLE 12.7.3]

ROOF SLOPE	H (minimum) (feet)
Flat to 6/12	1.0
Over 6/12 to 7/12	1.25
Over 7/12 to 8/12	1.5
Over 8/12 to 9/12	2.0
Over 9/12 to 10/12	2.5
Over 10/12 to 11/12	3.25
Over 11/12 to 12/12	4.0
Over 12/12 to 14/12	5.0
Over 14/12 to 16/12	6.0
Over 16/12 to 18/12	7.0
Over 18/12 to 20/12	7.5
Over 20/12 to 21/12	8.0
For SI Units: 1 inch = 25.4 mm, 1 foot = 304.8 mm	

11.6.2.2 Insulation protection shield

Where a vent passes through an insulated assembly, an approved metal shield constructed of steel having a thickness of not less than 26 gauge (0.0179 inch) (0.45 mm) (No. 26 gauge) shall be installed between the vent and insulation. The shield shall extend not less than 2 inches (51 mm) above the insulation and be secured to the structure in accordance with the manufacturer's installation instructions.

11.6.3 Size of gas vents

11.6.3.1 Venting systems shall be sized and constructed in accordance with 11.6.3.2 through 11.6.3.4 and the appliance manufacturer's instructions. [NFPA 54:12.7.4]

11.6.3.2 Category I Appliances: The sizing of natural draft venting systems serving one or more listed appliances equipped with a draft hood or appliances listed for use with a Type B gas vent, installed in a single story of a building, shall be in accordance with one of the following:

- (1) The provisions of Clause 12.
- (2) Vents serving fan-assisted combustion system appliances, or combinations of fan-assisted combustion system and draft hood-equipped appliances, shall be sized in accordance with Clause 12 or other engineering methods.
- (3) For sizing an individual gas vent for a single, draft hood-equipped appliance, the effective area of the vent connector and the gas vent shall be not less than the area of the appliance draft hood outlet or greater than seven times the draft hood outlet area.
- (4) For sizing a gas vent connected to two appliances with draft hoods, the effective area of the vent shall be not less than the area of the larger draft hood outlet plus 50 percent of the area of the smaller draft hood outlet or greater than seven times the smaller draft hood outlet area.
- (5) Engineering methods. [NFPA 54:12.7.4.1]

11.6.3.3 Vent Offsets: Type B and Type L vents sized in accordance with 11.6.3.2(3) or Section 11.6.3.2(4) shall extend in a generally vertical direction with offsets not exceeding 45 degrees (0.79 rad), except that a vent system having not more than one 60 degree (1.05 rad) offset shall be permitted. Any angle greater than 45 degrees (0.79 rad) from the vertical is considered horizontal. The total horizontal distance of a vent plus the horizontal vent connector serving draft hood-equipped appliances shall not be greater than 75 percent of the vertical height of the vent. [NFPA 54:12.7.4.2]

11.6.3.4 Category II, Category III, and Category IV Appliances: The sizing of gas vents for Category II, Category III, and Category IV appliances shall be in accordance with the appliance manufacturers' instructions. The sizing of plastic pipe specified by the appliance manufacturer as a venting material for Category II, III, and IV appliances shall be in accordance with the appliance manufacturers' instructions. [NFPA 54:12.7.4.3]

11.6.3.5 Sizing: Chimney venting systems using mechanical draft shall be sized in accordance with engineering methods. [NFPA 54:12.7.4.4]

11.6.4 Gas vents serving appliances on more than one floor

11.6.4.1 Where a common vent is installed in a multistory installation to vent Category I appliances located on more than one floor level, the venting system shall be designed and installed in accordance with engineering methods. Crawl spaces, basements, and attics shall be considered as floor levels. [NFPA 54:12.7.5.1]

11.6.4.2 Occupiable Space: All appliances connected to the common vent shall be located in rooms separated from occupiable space. Each of these rooms shall have provisions for an adequate supply of combustion, ventilation, and dilution air that is not supplied from occupiable space. [NFPA 54:12.7.5.2] (See Figure 8)

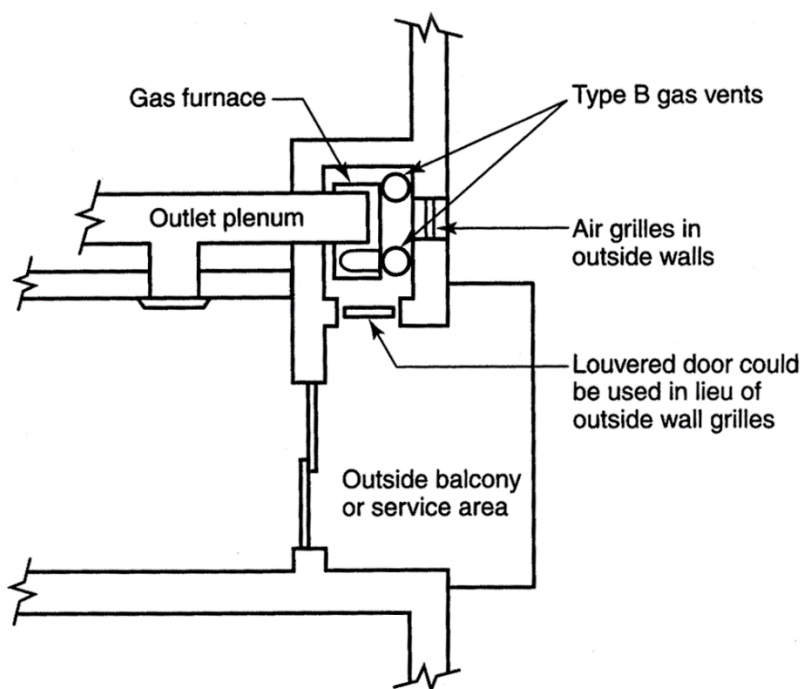


Figure 8 — Plan view of practical separation method for multi-storey gas venting [NFPA 54: FIGURE A.12.7.5.2]

11.6.4.3 Multistory Venting System: The size of the connectors and common segments of multistory venting systems for appliances listed for use with a Type B double-wall gas vent shall be in accordance with Table A.7, provided all of the following apply:

- (1) The available total height (H) for each segment of a multistory venting system is the vertical distance between the level of the highest draft hood outlet or flue collar on that floor and the centerline of the next highest interconnection tee.
- (2) The size of the connector for a segment is determined from the appliance's gas input rate and available connector rise and shall not be smaller than the draft hood outlet or flue collar size.
- (3) The size of the common vertical vent segment, and of the interconnection tee at the base of that segment, is based on the total appliance's gas input rate entering that segment and its available total height. [NFPA 54:12.7.5.3]

11.6.5 Support of gas vents

Gas vents shall be supported and spaced in accordance with the manufacturer's installation instructions. [NFPA 54:12.7.6]

11.6.6 Marking

In those localities where solid and liquid fuels are used extensively, gas vents shall be permanently identified by a label attached to the wall or ceiling at a point where the vent connector enters the gas vent. The label shall read: "This gas vent is for appliances that burn gas. Do not connect to solid or liquid fuel-burning appliances or incinerators." The Competent Authority shall determine whether its area constitutes such a locality. [NFPA 54:12.7.7]

11.7 Single-wall metal pipe

11.7.1 General

Single-wall metal pipe shall be constructed of galvanized sheet steel not less than 0.7722 mm (0.0304 of an inch) thick or of other approved, noncombustible, corrosion-resistant material. [NFPA 54:12.8.1]

11.7.2 Cold Climate

Uninsulated single-wall metal pipe shall not be used outdoors for venting appliances in regions where the 99 percent winter design temperature is below 32°F (0°C). [NFPA 54:12.8.2]

11.7.3 Termination

The termination of single-wall metal pipe shall meet the following requirements:

- (1) Single-wall metal pipe shall terminate at least 1524 mm (5 feet) in vertical height above the highest connected appliance draft hood outlet or flue collar. [NFPA 54:12.8.3(1)]
- (2) Single-wall metal pipe shall extend at least 610 mm (2 feet) above the highest point where it passes through a roof of a building and at least 610 mm (2 feet) higher than any portion of a building within a horizontal distance of 3048 mm (10 feet). [NFPA 54:12.8.3(2)]
- (3) An approved cap or roof assembly shall be attached to the terminus of a single-wall metal pipe. [NFPA 54:12.8.3(3)]

11.7.4 Installation with appliances permitted by Section 11.4

11.7.3.1 Single-wall metal pipe shall not be used as a vent in dwellings and residential occupancies [NFPA 54:12.8.4.1]

11.7.3.2 Limitations: Single-wall metal pipe shall be used only for runs directly from the space in which the appliance is located through the roof or exterior wall to the outer air. A pipe passing through a roof shall extend without interruption through the roof flashing, roof jacket, or roof thimble. [NFPA 54:12.8.4.2]

11.7.3.3 Attic or concealed space: Single-wall metal pipe shall not originate in any unoccupied attic or concealed space and shall not pass through any attic, inside wall, concealed space, or floor. [NFPA 54:12.8.4.3]

11.7.3.4 Incinerator: Single-wall metal pipe used for venting an incinerator shall be exposed and readily examinable for its full length and shall have required clearances maintained.

11.7.3.5 Clearances: Minimum clearances from single-wall metal pipe to combustible material shall be in accordance with Table 4. Reduced clearances from single-wall metal pipe to combustible material shall be as specified for vent connectors in Table 5. [NFPA 54:12.8.4.4]

11.7.3.6 Combustible exterior wall: Single-wall metal pipe shall not pass through a combustible exterior wall unless guarded at the point of passage by a ventilated metal thimble not smaller than the following:

(1) For listed appliances with draft hoods and appliances listed for use with Type B gas vents, the thimble shall be a minimum of 100 mm (4 inches) larger in diameter than the metal pipe. Where there is a run of not less than 1829 mm (6 feet) of metal pipe in the opening between the draft hood outlet and the thimble, the thimble shall be a minimum of 50 mm (2 inches) larger in diameter than the metal pipe.

(2) For unlisted appliances having draft hoods, the thimble shall be a minimum of 150 mm (6 inches) larger in diameter than the metal pipe.

(3) For residential and low-heat appliances, the thimble shall be a minimum of 300 mm (12 inches) larger in diameter than the metal pipe.

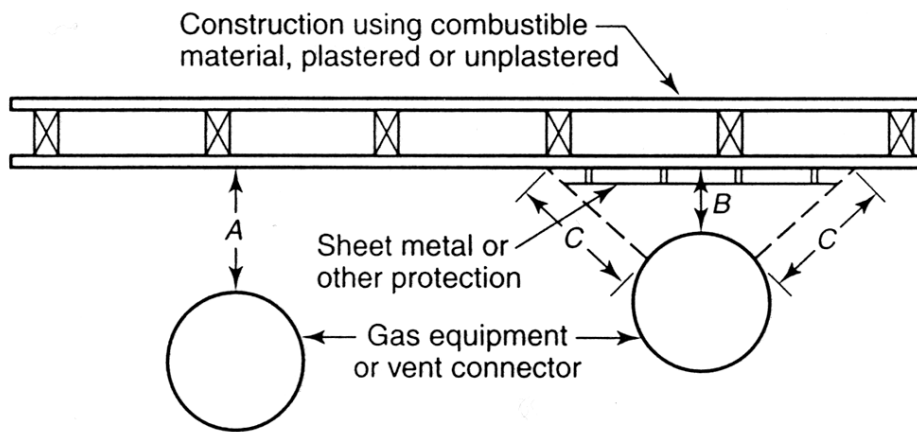
11.7.3.7 In lieu of thimble protection, all combustible material in the wall shall be removed a sufficient distance from the metal pipe to provide the specified clearance from such metal pipe to combustible material. Any material used to close up such opening shall be noncombustible. [NFPA 54:12.8.4.6]

Table 4 — Clearance for connectors {NFPA 54: TABLE 12.8.4.4}*

Minimum distance from combustible material (inches)				
Appliance	Listed type b gas vent material	Listed type I vent material	Single-wall metal pipe	Factory-built chimney sections
Listed appliances with draft hoods and appliances listed for use with Type B gas vents	As listed	As listed	6	As listed
Residential boilers and furnaces with listed gas 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

For SI units: 1 inch = 25.4 mm

* These clearances shall apply unless the installation instructions of a listed appliance or connector specify different clearances, in which case the listed clearances shall apply.



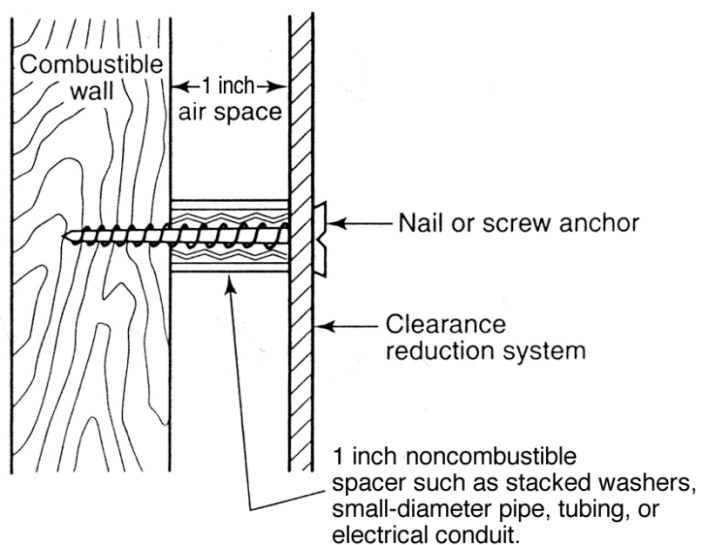
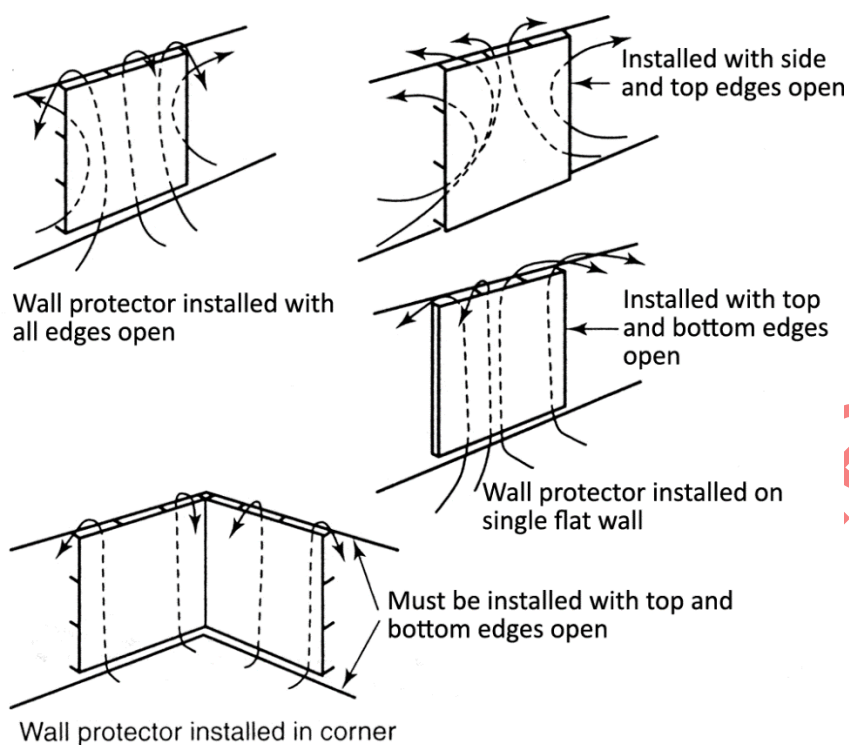
Notes:

¹ A – Equals the clearance with no protection specified in Table 4 and Table 5 and in the sections applying to various types of equipment.

² B – Equals the reduced clearance permitted in accordance with Table 5.

³ The protection applied to the construction using combustible material shall extend far enough in each direction to make C equal to A.

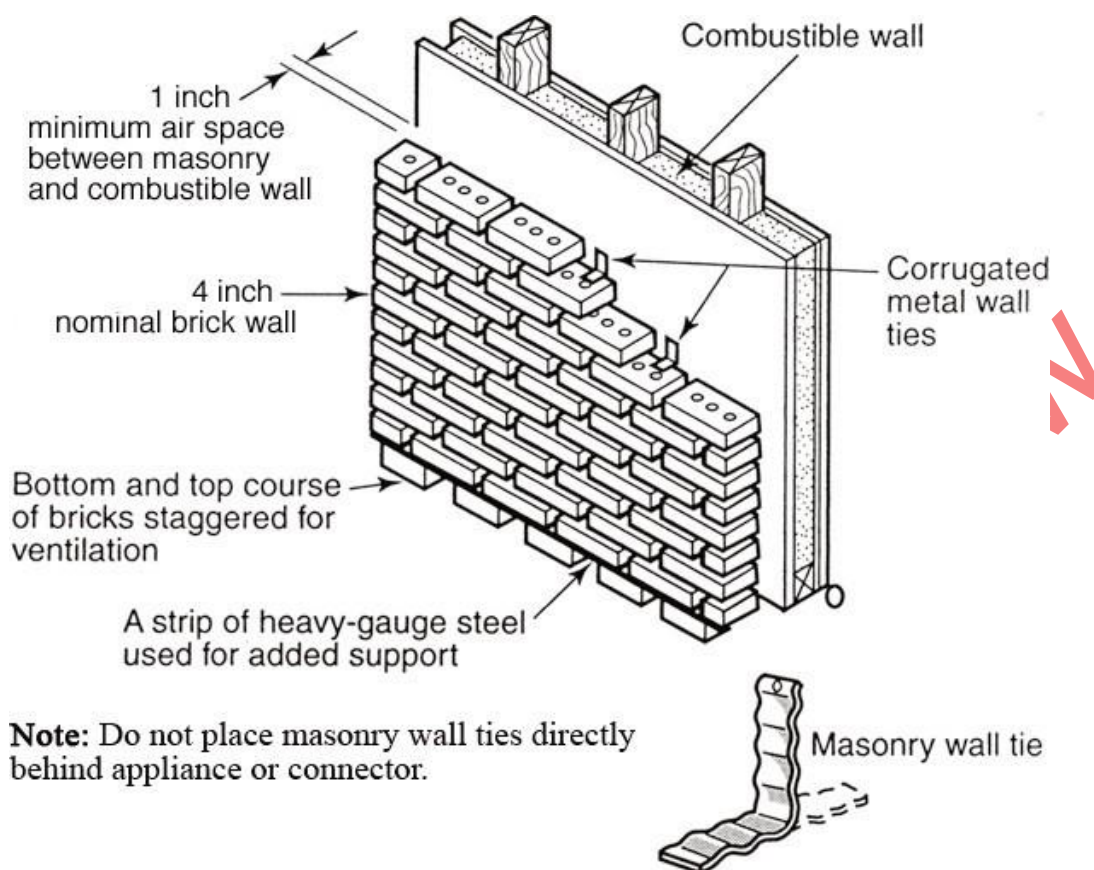
Figure 9 — Extent of protection necessary to reduce clearances from gas appliance or vent connectors [NFPA 54: FIGURE 10.3.3.3(a)]



For SI units: 1 inch = 25.4 mm

Note: Masonry walls shall be attached to combustible walls using wall ties. Spacers shall not be used directly behind appliance or connector.

Figure 10 — Wall protector clearance reduction system [NFPA 54: FIGURE 10.3.3.3(b)]



For SI units: 1 inch = 25.4 mm

Figure 11 — Masonry clearance reduction system [NFPA 54: FIGURE 10.3.3.3(c)]

11.7.3.8 Roof Thimble: Where a single-wall metal pipe passes through a roof constructed of combustible material, a noncombustible, nonventilating thimble shall be used at the point of passage. The thimble shall extend at least 457 mm (18 inches) above and 152 mm (6 inches) below the roof with the annular space open at the bottom and closed only at the top. The thimble shall be sized in accordance with Section 11.7.3.6. [NFPA 54:12.8.4.5]

11.7.5 Size of single-wall metal pipe

Single-wall metal piping shall comply with the following requirements:

(1) A venting system of a single-wall metal pipe shall be sized in accordance with one of the following methods and the appliance manufacturer's instructions:

(a) For a draft hood-equipped appliance, in accordance with Clause 12.

(b) For a venting system for a single appliance with a draft hood, the areas of the connector and the pipe each shall not be less than the area of the appliance flue collar or draft hood outlet, whichever is smaller. The vent area shall not be greater than seven times the draft hood outlet area.

(c) Engineering methods.

(2) Where a single-wall metal pipe is used and has a shape other than round, it shall have an equivalent effective area equal to the effective area of the round pipe for which it is substituted and the minimum internal dimension of the pipe shall be 50 mm (2 inches).

(3) The vent cap or a roof assembly shall have a venting capacity not less than that of the pipe to which it is attached. [NFPA 54:12.8.5]

Table 5 — Reduction of clearances with specified forms of protection^{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11} [NFPA 54: TABLE 10.2.4]

Type of protection applied to and covering all surfaces of combustible material within the distance specified as the required clearance with no protection [See Figure 9 through Figure 11]	Where the required clearance with no protection from appliance, vent connector, or single-wall metal pipe is:									
	36 (inches)		18 (inches)		12 (inches)		9 (inches)		6 (inches)	
	Allowable clearances with specified protection (inches)									
	Use column 1 for clearances above appliance or horizontal connector. Use column 2 for clearances from appliances, vertical connector, and single-wall metal pipe.									
	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2	Above column 1	Sides and rear column 2
(1) 3½ inch thick masonry wall without ventilated air space	—	24	—	12	—	9	—	6	—	5
(2) ½ of an inch insulation board over 1 inch glass fiber or mineral wool batts	24	18	12	9	9	6	6	5	4	3
(3) 0.024 inch (nominal 24 gauge) sheet metal over 1 inch glass fiber or mineral wool batts reinforced with wire on rear face with ventilated air space	18	12	9	6	6	4	5	3	3	3
(4) 3½ inch thick masonry wall with ventilated air space	—	12	—	6	—	6	—	6	—	6
(5) 0.024 inch (nominal 24 gauge) sheet metal with ventilated air space	18	12	9	6	6	4	5	3	3	2
(6) ½ of an inch thick insulation board with ventilated air space	18	12	9	6	6	4	5	3	3	3
(7) 0.024 inch (nominal 24 gauge) sheet metal with ventilated air space over 0.024 inch (nominal 24 gauge) sheet metal with ventilated air space	18	12	9	6	6	4	5	3	3	3
(8) 1 inch glass fiber or mineral wool batts sandwiched between two sheets 0.024 inch (nominal 24	18	12	9	6	6	4	5	3	3	3

gauge) sheet metal with ventilated air space										
NOTE For SI units: 1 inch = 25.4 mm ¹ Reduction of clearances from combustible materials shall not interfere with combustion air, draft hood clearance and relief, and accessibility of servicing. ² All clearances shall be measured from the outer surface of the combustible material to the nearest point on the surface of the appliance, disregarding any intervening protection applied to the combustible material. ³ Spacers and ties shall be of noncombustible material. No spacer or tie shall be used directly opposite the appliance or connector. ⁴ Where all clearance reduction systems use a ventilated air space, adequate provision for air circulation shall be provided as described. (See Figure 10 and Figure 11). ⁵ At least 1 inch (25.4 mm) shall be between clearance reduction systems and combustible walls and ceilings for reduction systems using a ventilated air space. ⁶ Where a wall protector is installed on a single flat wall away from corners, it shall have a minimum 25.4 mm (1 inch) air gap. To provide adequate air circulation, the bottom and top edges, or only the side and top edges, or all edges shall be left open. ⁷ Mineral wool batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot 128 kg/m³ (lb/ft³) and a minimum melting point of 1500°F (816°C). ⁸ Insulation material used as part of a clearance reduction system shall have a thermal conductivity of 1.0 British thermal unit inch per hour square foot degree Fahrenheit [Btu•in/(h•ft²•°F)] [0.1 W/(m•K)] or less. ⁹ At least 1 inch (25.4 mm) shall be between the appliance and the protector. The clearance between the appliance and the combustible surface shall not be reduced below that allowed in this table. ¹⁰ All clearances and thicknesses are minimum; larger clearances and thicknesses are acceptable. ¹¹ Listed single-wall connectors shall be installed in accordance with the terms of their listing and the manufacturer's installation instructions.										

11.7.6 Support of single-wall metal pipe

All portions of single-wall metal pipe shall be supported for the design and weight of the material employed. [NFPA 54:12.8.6]

11.7.7 Marking

11.7.7.1 General

Single-wall metal pipe shall comply with the marking provisions of 11.6.6. [NFPA 54:12.8.7]

Through-the-Wall Vent Termination.

Through-the-wall vent termination shall be in accordance with 11.7.7.1 through 11.7.7.4.

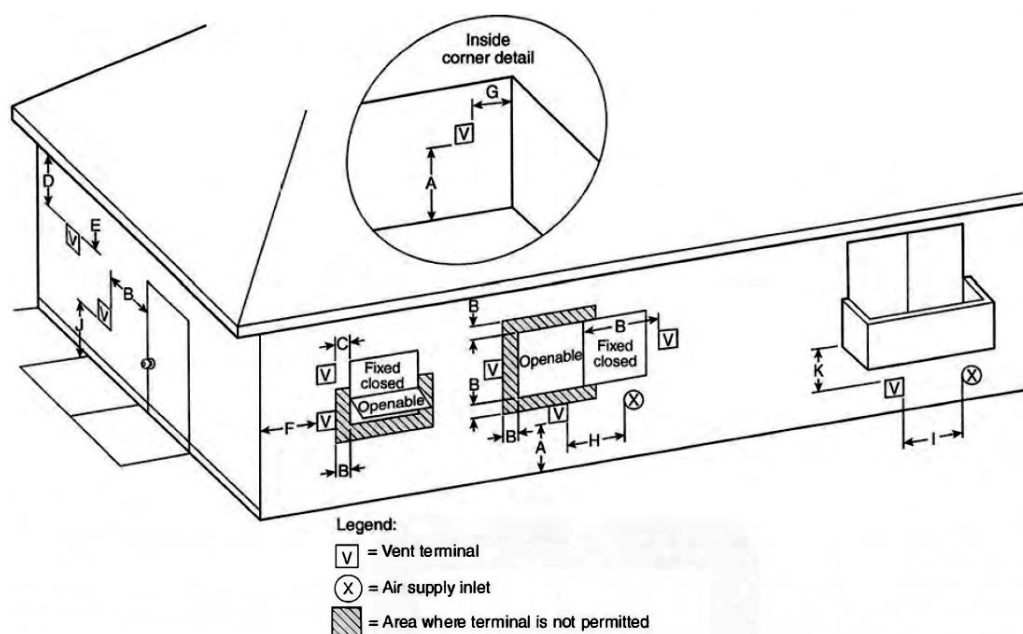


Figure 12 — Exit terminals of mechanical draft and direct-vent venting systems [NFPA 54: FIGURE 12.9.1]

Table 6 — Through-the-wall direct-vent termination clearances [NFPA 54: TABLE 12.9.1]

Figure clearance	Clearance location	Minimum clearances for direct vent terminals	Minimum clearances for non-direct vent terminals
A	Clearance above finished grade level, veranda, porch, deck, or balcony	12 inches	12 inches
B	Clearance to window or door that is openable	6 inches for appliances $\leq 10\,000$ Btu/hr	4 feet below or to side of opening or 1 foot above opening
		9 inches for appliances $> 10\,000$ Btu/hr $\leq 50\,000$ Btu/hr	
		12 inches for appliances $> 50\,000$ Btu/hr $\leq 150\,000$ Btu/hr	
		Appliances $> 150\,000$ Btu/hr, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for non-direct vent terminals in row B	
C	Clearance to non-openable window	None unless otherwise specified by the appliance manufacturer	

D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (610 mm) from the center line of the terminal	None unless otherwise specified by the appliance manufacturer
E	Clearance to unventilated soffit	None unless otherwise specified by the appliance manufacture
F	Clearance to outside corner of building	None unless otherwise specified by the appliance manufacture
G	Clearance to inside corner of building	None unless otherwise specified by the appliance manufacture
H	Clearance to non-mechanical air supply inlet to building and the combustion air inlet to any other appliance	Same clearance as specified for row B
I	Clearance to a mechanical air supply inlet	10 feet horizontally from inlet or 3 feet above inlet
J	Clearance above paved sidewalk or paved driveway located on public property or other areas where condensate or vapor can cause a nuisance or hazard	7 feet and not located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard
K	Clearance to underside of veranda, porch, deck, or balcony	12 inches where the area beneath the veranda, porch, deck, or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open.
NOTE For SI Units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW		

11.7.7.2 Clearance for through-the-wall vent termination

The clearance for through-the-wall direct and non-direct vent terminals shall be in accordance with Table 6 and Figure 12.

Exception: The clearances in Table 6 shall not apply to the combustion air intake of a direct vent appliance. [NFPA 54:12.9.1]

11.7.7.3 Annular spaces

Where vents, including those for direct-vent appliances or combustion air intake pipes, penetrate outside walls of buildings, the annular spaces around such penetrations shall be permanently sealed using approved materials to prevent entry of combustion products into the building. [NFPA 54:12.9.2]

11.7.7.4 Vent terminals

Vent systems for Category IV appliances that terminate through an outside wall of a building and discharge flue gases perpendicular to the adjacent wall shall be located not less than 3048 mm (10 feet) horizontally from an operable opening in an adjacent building.

Exception: This shall not apply to vent terminals that are 610 mm (2 feet) or more above or 7620 mm (25 feet) or more below operable openings. [NFPA 54:12.9.3]

11.7.8 Condensation drain

11.7.8.1 Collect and dispose of condensate from venting systems

Provision shall be made to collect and dispose of condensate from venting systems serving Category II and Category IV appliances and noncategorized condensing appliances. [NFPA 54:12.10.1]

11.7.8.2 Installation

Drains for condensate shall be installed in accordance with the appliance and vent manufacturers' installation instructions. [NFPA 54:12.10.2]

Vent Connectors for Category I Appliances.

A vent connector shall be used to connect an appliance to a gas vent, chimney, or single-wall metal pipe, except where the gas vent, chimney, or single-wall metal pipe is directly connected to the appliance. [NFPA 54:12.11.1]

11.7.8.3 Materials

11.7.8.3.1 A vent connector shall be made of noncombustible, corrosion-resistant material capable of withstanding the vent gas temperature produced by the appliance and of sufficient thickness to withstand physical damage. [NFPA 54:12.11.2.1]

11.7.8.3.2 Unconditioned area: Where the vent connector used for an appliance having a draft hood or a Category I appliance is located in or passes through an unconditioned area, attic, or crawl space, that portion of the vent connector shall be listed Type B, Type L, or listed vent material having equivalent insulation qualities. [NFPA 54:12.11.2.2]

11.7.8.3.3 Single-wall metal pipe located within the exterior walls of the building and located in an unconditioned area other than an attic or a crawl space having a local 99 percent winter design temperature of 5°F (-15°C) or higher. [NFPA 54:12.11.2.2]

11.7.8.3.4 Residential-Type appliances: Vent connectors for residential-type appliances shall comply with the following:

(1) Vent connectors for listed appliances having draft hoods, appliances having draft hoods and equipped with listed conversion burners, and Category I appliances that are not installed in attics, crawl spaces, or other unconditioned areas shall be one of the following:

- (a) Type B or Type L vent material.
 - (b) Galvanized sheet steel not less than 0.018 of an inch (0.457 mm) thick.
 - (c) Aluminum (1100 or 3003 alloy or equivalent) sheet not less than 0.027 of an inch (0.686 mm) thick.
 - (d) Stainless steel sheet not less than 0.012 of an inch (0.305 mm) thick.
 - (e) Smooth interior wall metal pipe having resistance to heat and corrosion equal to or greater than that of Section 11.7.8.3.4(1)(b), Section 11.7.8.3.4(1)(c), or Section 11.7.8.3.4(1)(d).
 - (f) A listed vent connector.
- (2) Vent connectors shall not be covered with insulation. [NFPA 54:12.11.2.3]

11.7.8.3.5 Listed insulated vent connectors shall be installed in accordance with the manufacturer's installation instructions. [NFPA 54:12.11.2.3]

11.7.8.3.6 Nonresidential low-heat appliances: A vent connector for a nonresidential low-heat appliance shall be a factory-built chimney section or steel pipe having resistance to heat and corrosion equivalent to that for the appropriate galvanized pipe as specified in Table 7. Factory-built chimney sections shall be joined together in accordance with the chimney manufacturer's instructions. [NFPA 54:12.11.2.4]

Table 7 — minimum thickness for galvanized steel vent connectors for low-heat appliances [NFPA 54: TABLE 12.11.2.4]

Diameter of connector (inches)	Minimum thickness (inches)
Less than 6	0.019
6 to less than 10	0.023
10 to 12 inclusive	0.029
14 to 16 inclusive	0.034
Over 16	0.056
NOTE For SI units: 1 inch = 25.4 mm, 1 square inch = 0.000645 m ²	

11.7.8.3.7 Medium-heat appliances: Vent connectors for medium-heat appliances shall be constructed of factory-built, medium-heat chimney sections or steel of a thickness not less than that specified in Table 8 and shall comply with the following:

- (1) A steel vent connector for an appliance with a vent gas temperature in excess of 538°C (1000°F) measured at the entrance to the connector shall be lined with medium-duty fire brick or the equivalent.
- (2) The lining shall be at least 64 mm (2½ inches) thick for a vent connector having a diameter or greatest cross-sectional dimension of 457 mm (18 inches) or less.
- (3) The lining shall be at least 114 mm (4½ inches) thick laid on the 114 mm (4½ inches) bed for a vent connector having a diameter or greatest cross-sectional dimension greater than 457 mm (18 inches).

(4) Where factory-built chimney sections are installed, they shall be joined together in accordance with the chimney manufacturer's instructions. [NFPA 54:12.11.2.5]

Table 8 — Minimum thickness for steel vent connectors for medium-heat appliances [NFPA 54: TABLE 12.11.2.5]

Vent connector size		
Diameter (inches)	Area (square inches)	Minimum thickness (inches)
Up to 14	Up to 154	0.053
Over 14 to 16	154 to 201	0.067
Over 16 to 18	201 to 254	0.093
Over 18	Exceeding 254	0.123
For SI units: 1 inch = 25.4 mm, 1 square inch = 0.000645 m ²		

11.7.9 Size of vent connector

11.7.9.1 A vent connector for an appliance with a single draft hood or for a Category I fan-assisted combustion system appliance shall be sized and installed in accordance with Clause 12 or engineering methods. [NFPA 54:12.11.3.1]

11.7.9.2 Manifold: Where a single appliance having more than one draft hood outlet or flue collar is installed, the manifold shall be constructed according to the instructions of the appliance manufacturer. Where there are no instructions, the manifold shall be designed and constructed in accordance with engineering methods. As an alternative method, the effective area of the manifold shall equal the combined area of the flue collars or draft hood outlets, and the vent connectors shall have a minimum 305 mm (1 foot) rise. [NFPA 54:12.11.3.2]

11.7.9.3 Size: Where two or more appliances are connected to a common vent or chimney, each vent connector shall be sized in accordance with Clause 12 or engineering methods. [NFPA 54:12.11.3.3]

As an alternative method applicable only where all of the appliances are draft hood-equipped, each vent connector shall have an effective area not less than the area of the draft hood outlet of the appliance to which it is connected. [NFPA 54:12.11.3.4]

11.7.9.4 Height: Where two or more appliances are vented through a common vent connector or vent manifold, the common vent connector or vent manifold shall be located at the highest level consistent with available headroom and clearance to combustible material and sized in accordance with Clause 12 or engineering methods. [NFPA 54:12.11.3.5]

As an alternative method applicable only where there are two draft hood-equipped appliances, the effective area of the common vent connector or vent manifold and all junction fittings shall be not less than the area of the larger vent connector plus 50 percent of the area of the smaller flue collar outlet. [NFPA 54:12.11.3.6]

11.7.9.5 Size Increase: Where the size of a vent connector is increased to overcome installation limitations and obtain connector capacity equal to the appliance input, the size increase shall be made at the appliance draft hood outlet. [NFPA 54:12.11.3.7]

11.7.10 Two or more appliances connected to a single vent

11.7.10.1 Where two or more openings are provided into one chimney flue or vent, either of the following shall apply:

- (1) The openings shall be at different levels.
- (2) The connectors shall be attached to the vertical portion of the chimney or vent at an angle of 45 degrees (0.79 rad) or less relative to the vertical. [NFPA 54:12.11.4.1]

11.7.10.2 Height of Connector: Where two or more vent connectors enter a common vent, chimney flue, or single-wall metal pipe, the smaller connector shall enter at the highest level consistent with the available headroom or clearance to combustible material. [NFPA 54:12.11.4.2]

11.7.10.3 Pressure: Vent connectors serving Category I appliances shall not be connected to any portion of a mechanical draft system operating under positive static pressure, such as those serving Category III or Category IV appliances. [NFPA 54:12.11.4.3]

11.7.11 Clearance

Minimum clearances from vent connectors to combustible material shall be in accordance with Table 4.

Exception: The clearance between a vent connector and combustible material shall be permitted to be reduced where the combustible material is protected as specified for vent connectors in Table 5. [NFPA 54:12.11.5]

11.7.12 Joints

Joints between sections of connector piping and connections to flue collars or draft hood outlets shall be fastened in accordance with one of the following methods:

- (1) Mechanically fastened by means of not less than three sheet-metal screws equally spaced around the joint.
- (2) Vent connectors of listed vent material assembled and connected to flue collars or draft hood outlets in accordance with the manufacturer's instructions.
- (3) Other approved means. {NFPA 54:12.11.6}

11.7.13 Connector Junctions

Where vent connectors are joined together, the connection shall be made with a manufactured tee or wye fitting. [NFPA 54:12.11.7]

11.7.14 Slope

A vent connector shall be installed without any dips or sags and shall slope upward toward the vent or chimney at least ¼ inch per foot (20.8 mm/m).

Exception: Vent connectors attached to a mechanical draft system installed in accordance with appliance and the draft system manufacturers' instructions. [NFPA 54:12.11.8]

11.7.15 Length of vent connector

11.7.15.1 General

The length of vent connectors shall comply with Section 11.7.15.2 or Section 11.7.15.3.

11.7.15.2 Single wall connector

The maximum horizontal length of a single-wall connector shall be 75 percent of the height of the chimney or vent, except for engineered systems. [NFPA 54:12.11.9.1]

11.7.15.3 Type B double wall connector

The maximum horizontal length of a Type B double-wall connector shall be 100 percent of the height of the chimney or vent, except for engineered systems. The maximum length of an individual connector for a chimney or vent system serving multiple appliances, from the appliance outlet to the junction with the common vent or another connector, shall be 100 percent of the height of the chimney or vent. [NFPA 54:12.11.9.2]

11.7.15.4 Support

A vent connector shall be supported for the design and weight of the material employed to maintain clearances and prevent physical damage and separation of joints. [NFPA 54:12.11.10]

11.7.15.5 Chimney connection

Where entering a flue in a masonry or metal chimney, the vent connector shall be installed above the extreme bottom to avoid stoppage.

Where a thimble or slip joint is used to facilitate removal of the connector, the connector shall be firmly attached to or inserted into the thimble or slip joint to prevent the connector from falling out.

Means shall be employed to prevent the connector from entering so far as to restrict the space between its end and the opposite wall of the chimney flue. [NFPA 54:12.11.11.1 – 12.11.11.3]

11.7.16 Inspection

The entire length of a vent connector shall be readily accessible for inspection, cleaning, and replacement. [NFPA 54:12.11.12]

11.7.17 Fireplaces

A vent connector shall not be connected to a chimney flue serving a fireplace unless the fireplace flue opening is permanently sealed. [NFPA 54:12.11.13]

11.7.18 Passage through ceilings, floors, or walls

11.7.18.1 A vent connector shall not pass through a ceiling, floor, or fire-resistance-rated wall. A single-wall metal pipe connector shall not pass through an interior wall.

11.7.18.2 Vent connectors made of listed Type B or Type L vent material and serving listed appliances with draft hoods and other appliances listed for use with Type B gas vents that pass-through walls or partitions constructed of combustible material shall be installed with not less than the listed clearance to combustible material.

11.7.18.3 Vent connectors shall be permitted to pass through ceilings, floors, or walls in accordance with 11.7.3.2 and 11.7.3.6.

11.7.18.4 Vent connectors for medium-heat appliances shall not pass through walls or partitions constructed of combustible material. [NFPA 54:12.11.14.2]

11.8 Vent Connectors for Category II, Category III, and Category IV Appliances

The vent connectors for Category II, Category III, and Category IV appliances shall be in accordance with 11.4 through 11.4.3. [NFPA 54:12.12]

11.9 Appliances requiring draft hoods

11.9.1 General

11.9.1.1 Vented appliance shall be installed with draft hoods. [NFPA 54:12.13.1]

11.9.1.2 Dual oven-type combination ranges; direct vent appliances; fan-assisted combustion system appliances; appliances requiring chimney draft for operation; single-firebox boilers equipped with conversion burners with inputs greater than 117 kW (400 000 Btu/h); appliances equipped with blast, power, or pressure burners that are not listed for use with draft hoods; and appliances designed for forced venting. [NFPA 54:12.13.1]

11.9.2 Installation

A draft hood supplied with or forming a part of a listed vented appliance shall be installed without alteration, exactly as furnished and specified by the appliance manufacturer. [NFPA 54:12.13.2]

If a draft hood is not supplied by the appliance manufacturer where one is required, a draft hood shall be installed, be of a listed or approved type, and, in the absence of other instructions, be of the same size as the appliance flue collar. Where a draft hood is required with a conversion burner, it shall be of a listed or approved type. [NFPA 54:12.13.2.1]

11.9.3 Draft control devices

Where a draft control device is part of the appliance or is supplied by the appliance manufacturer, it shall be installed in accordance with the manufacturer's instructions. In the absence of manufacturer's instructions, the device shall be attached to the flue collar of the appliance or as near to the appliance as practical. [NFPA 54:12.13.3]

11.9.4 Additional Devices

Appliances requiring controlled chimney draft shall be permitted to be equipped with listed double-acting barometric draft regulators installed and adjusted in accordance with the manufacturer's instructions. [NFPA 54:12.13.4]

11.9.5 Location

Draft hoods and barometric draft regulators shall be installed in the same room or enclosure as the appliance in such a manner as to prevent any difference in pressure between the hood or regulator and the combustion air supply. [NFPA 54:12.13.5]

11.9.6 Positioning

Draft hoods and draft regulators shall be installed in the position for which they were designed with reference to the horizontal and vertical planes and shall be located so that the relief opening is not obstructed by any part of the appliance or adjacent construction. The appliance and its draft hood shall be located so that the relief opening is accessible for checking vent operation. [NFPA 54:12.13.6]

11.9.7 Clearance

A draft hood shall be located so that its relief opening is not less than 6 inches (152 mm) from any surface except that of the appliance it serves and the venting system to which the draft hood is connected. Where a greater or lesser clearance is indicated on the appliance label, the clearance shall not be less than that specified on the label. Such clearances shall not be reduced. [NFPA 54:12.13.7]

11.10 Manually operated dampers

A manually operated damper shall not be placed in any appliance vent connector. Fixed baffles and balancing baffles shall not be classified as manually operated dampers. Balancing baffles shall be mechanically locked in the desired position before placing the appliance in service. Balancing baffles shall be listed in accordance with UL 378. [NFPA 54:12.14.1 – 12.14.3]

11.11 Automatically operated vent dampers

11.11.1 Listing

An automatically operated vent damper shall be listed. [NFPA 54:12.15]

Automatically operated vent dampers for oil fired appliances shall comply with UL 17. The automatic damper control shall comply with UL 378.

11.12 Obstructions

Devices that retard the flow of vent gases shall not be installed in a vent connector, chimney, or vent. The following shall not be considered as obstructions:

- (1) Draft regulators and safety controls specifically listed for installation in venting systems and installed in accordance with the manufacturer's installation instructions.
- (2) Approved draft regulators and safety controls designed and installed in accordance with engineering methods.
- (3) Listed heat reclaimers and automatically operated vent dampers installed in accordance with the manufacturers' installation instructions.
- (4) Vent dampers serving listed appliances installed in accordance with Clause 12.1 or Clause 12.2 or engineering methods.
- (5) Approved economizers, heat reclaimers, and recuperators installed in venting systems of appliances not required to be equipped with draft hoods, provided the appliance manufacturer's instructions cover the installation of such a device in the venting system and performance in accordance with Clause 11.3 and Clause 11.3.2 is obtained. [NFPA 54:12.16]

12 Sizing of category I venting systems

12.1 Additional requirements to single appliance vent

12.1.1 General

Venting Table A.1 through Table A.6 shall not be used where obstructions are installed in the venting system. The installation of vents serving listed appliances with vent dampers shall be in accordance with the appliance manufacturer's instructions or in accordance with the following:

- (1) The maximum capacity of the vent system shall be determined using the "NAT Max" column.
- (2) The minimum capacity shall be determined as though the appliance were a fan-assisted appliance, using the "FAN Min" column to determine the minimum capacity of the vent system. Where the corresponding "FAN Min" is "NA," the vent configuration shall not be permitted and an alternative venting configuration shall be utilized. [NFPA 54:13.1.1]

12.1.2 Vent downsizing

Where the vent size determined from the tables is smaller than the appliance draft hood outlet or flue collar, the use of the smaller size shall be permitted, provided that the installation complies with all of the following requirements:

- (1) The total vent height (H) is at least 3048 mm (10 feet).

(2) Vents for appliance draft hood outlets or flue collars 300 mm (12 inches) in diameter or smaller are not reduced more than one table size.

(3) Vents for appliance draft hood outlets or flue collars larger than 300 mm (12 inches) in diameter are not reduced more than two table sizes.

(4) The maximum capacity listed in the tables for a fan-assisted appliance is reduced by 10 percent ($0.90 \times$ maximum table capacity).

(5) The draft hood outlet is greater than 100 mm (4 inches) in diameter. A 80 mm (3 inch) diameter vent shall not be connected to a 100 mm (4 inch) diameter draft hood outlet. This provision shall not apply to fan-assisted appliances. [NFPA 54:13.1.2]

12.1.3 Elbows

Single-appliance venting configurations with zero (0) lateral lengths in Table A.1, Table A.2, and Table A.5 shall not have elbows in the venting system. Single-appliance venting with lateral lengths include two 90 degrees (1.57 rad) elbows. For each additional elbow up to and including 45 degrees (0.79 rad), the maximum capacity listed in the venting tables shall be reduced by 5 percent. For each additional elbow greater than 45 degrees (0.79 rad) up to and including 90 degrees (1.57 rad), the maximum capacity listed in the venting tables shall be reduced by 10 percent. Where multiple offsets occur in a vent, the total lateral length of all offsets combined shall not exceed that specified in Table A.1 through Table A.5. [NFPA 54:13.1.3]

12.1.4 Zero lateral

Zero (0) lateral (L) shall apply only to a straight vertical vent attached to a top outlet draft hood or flue collar. [NFPA 54:13.1.4]

12.1.5 High-altitude installations

Sea level input ratings shall be used when determining maximum capacity for high-altitude installation. Actual input (derated for altitude) shall be used for determining minimum capacity for high-altitude installation. [NFPA 54:13.1.5]

12.1.6 Multiple input ratings

For appliances with more than one input rate, the minimum vent capacity (FAN Min) determined from Table A.1 through Table A.15 shall be less than the lowest appliance input rating, and the maximum vent capacity (FAN Max/NAT Max) determined from the tables shall be greater than the highest appliance rating input. [NFPA 54:13.1.6]

12.1.7 Corrugated chimney liners

Listed corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Table A.1 or Table A.2 for Type B vents with the maximum capacity reduced by 20 percent ($0.80 \times$ maximum capacity) and the minimum capacity as shown in Table A.1 or Table A.2.

Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with 12.1.3. The 20 percent reduction for corrugated metallic chimney liner systems includes an allowance for one long radius 90 degree (1.57 rad) turn at the bottom of the liner. [NFPA 54:13.1.7]

12.1.8 Connection to chimney liners

Connections between chimney liners and listed double-wall connectors shall be made with listed adapters designed for such purpose. [NFPA 54:13.1.8]

12.1.9 Vertical vent upsizing using the 7 times rule

Where the vertical vent has a larger diameter than the vent connector, the vertical vent diameter shall be used to determine the minimum vent capacity, and the connector diameter shall be used to determine the maximum vent capacity. The flow area of the vertical vent shall not exceed seven times the flow area of the listed appliance categorized vent area, flue collar area, or draft hood outlet area unless designed in accordance with engineering methods. [NFPA 54:13.1.9]

12.1.10 Draft Hood conversion accessories

Draft hood conversion accessories for use with masonry chimneys venting listed Category I fan-assisted appliances shall be listed and installed in accordance with the listed accessory manufacturer's installation instructions. [NFPA 54:13.1.10]

12.1.11 Chimney and vent location

Table A.1 through Table A.5 shall be used only for chimneys and vents not exposed to the outdoors below the roof line. A Type B vent or listed chimney lining system passing through an unused masonry chimney flue shall not be considered to be exposed to the outdoors. Where vents extend outdoors above the roof more than 5 feet (1524 mm) higher than required by Table 3, and where vents terminate in accordance with Clause 11.6.2.2, the outdoor portion of the vent shall be enclosed as required by this paragraph for vents not considered to be exposed to the outdoors, or such venting system shall be engineered. A Type B vent passing through an unventilated enclosure or chase insulated to a value of not less than R-8 shall not be considered to be exposed to the outdoors. Table A.3 in combination with Table A.6 shall be used for claytile-lined exterior masonry chimneys, provided all of the following requirements are met:

- (1) The vent connector is Type B double wall.
- (2) The vent connector length is limited to 18 inches per inch (18 mm/mm) of vent connector diameter.
- (3) The appliance is draft hood equipped.
- (4) The input rating is less than the maximum capacity given in Table A.3.
- (5) For a water heater, the outdoor design temperature shall not be less than 5°F (-15°C).
- (6) For a space-heating appliance, the input rating is greater than the minimum capacity given by Table A.6. [NFPA 54:13.1.11]

12.1.12 Corrugated vent connector size

Corrugated vent connectors shall not be smaller than the listed appliance categorized vent diameter, flue collar diameter, or draft hood outlet diameter. [NFPA 54:13.1.12]

12.1.13 Upsizing

Vent connectors shall not be upsized more than two sizes greater than the listed appliance categorized vent diameter, flue collar diameter, or draft hood outlet diameter. [NFPA 54:13.1.13]

12.1.14 Multiple vertical vent sizes

In a single run of vent or vent connector, more than one diameter and type shall be permitted to be used, provided that all the sizes and types are permitted by the tables. [NFPA 54:13.1.14]

12.1.15 Interpolation

Interpolation shall be permitted in calculating capacities for vent dimensions that fall between table entries. [NFPA 54:13.1.15]

12.1.16 Extrapolation

Extrapolation beyond the table entries shall not be permitted. [NFPA 54:13.1.16]

12.1.17 Sizing vents not covered by tables

Where a vent height is lower than 6 feet (1829 mm) or higher than shown in Table A.1 through Table A.15, an engineering method shall be used to calculate the vent capacity. [NFPA 54:13.1.17]

12.1.18 Height Entries

Where the actual height of a vent falls between entries in the height column of the applicable table in Table A.1 through Table A.6, either of the following shall be used:

- (1) Interpolation.
- (2) The lower appliance input rating shown in the table entries for FAN Max and NAT Max column values; and the higher appliance input rating for the FAN Min column values. [NFPA 54:13.1.18]

12.2 Additional requirements to multiple-appliance vent**12.2.1 General**

Venting Table A.7 through Table A.15 shall not be used where obstructions are installed in the venting system. The installation of vents serving listed appliances with vent dampers shall be in accordance with the appliance manufacturer's instructions, or in accordance with the following:

- (1) The maximum capacity of the vent connector shall be determined using the NAT Max column.
- (2) The maximum capacity of the vertical vent or chimney shall be determined using the FAN + NAT column when the second appliance is a fan-assisted appliance, or the NAT + NAT column when the second appliance is equipped with a draft hood.
- (3) The minimum capacity shall be determined as if the appliance were a fan-assisted appliance, as follows:
- (a) The minimum capacity of the vent connector shall be determined using the FAN Min column.
- (b) The FAN + FAN column shall be used when the second appliance is a fan-assisted appliance, and the FAN + NAT column shall be used when the second appliance is equipped with a draft hood, to determine whether the vertical vent or chimney configuration is not permitted (NA). Where the vent configuration is NA, the vent configuration shall not be permitted and an alternative venting configuration shall be utilized. [NFPA 54:13.2.1]

12.2.2 Vent connector maximum length

The maximum vent connector horizontal length shall be 18 inches per inch (18 mm/mm) of connector diameter as shown in Table 9, or as permitted by 12.2.3. [NFPA 54:13.2.2]

Table 9 — Vent connector maximum length [NFPA 54: TABLE 13.2.2]

CONNECTOR DIAMETER (inches)	MAXIMUM CONNECTOR HORIZONTAL LENGTH (feet)
3	4½
4	6
5	7½
6	9
7	10½
8	12
9	13½
10	15
12	18
14	21
16	24
18	27
20	30
22	33
24	36
For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm	

12.2.3 Vent connector exceeding maximum length

The vent connector shall be routed to the vent utilizing the shortest possible route. Connectors with longer horizontal lengths than those listed in Table 9 are permitted under the following conditions:

(1) The maximum capacity (FAN Max or NAT Max) of the vent connector shall be reduced 10 percent for each additional multiple of the length listed in Table 9. For example, the maximum length listed for a 100 mm (4 inch) connector is 1829 mm (6 feet). With a connector length greater than 6 feet (1829 mm) but not exceeding 3658 mm (12 feet), the maximum capacity must be reduced by 10 percent ($0.90 \times$ maximum vent connector capacity). With a connector length greater than 12 feet (3658 mm) but not exceeding 5486 mm (18 feet), the maximum capacity shall be reduced by 20 percent ($0.80 \times$ maximum vent capacity).

(2) For a connector serving a fan-assisted appliance, the minimum capacity (FAN Min) of the connector shall be determined by referring to the corresponding single appliance table. For Type B double-wall connectors, Table A.1 shall be used. For single-wall connectors, Table A.2 shall be used. The height (H) and lateral (L) shall be measured according to the procedures for a single appliance vent, as if the other appliances were not present. [NFPA 54:13.2.3]

12.2.4 Vent connector manifolds

Where the vent connectors are combined prior to entering the vertical portion of the common vent to form a common vent manifold, the size of the common vent manifold and the common vent shall be determined by applying a 10 percent reduction ($0.90 \times$ maximum common vent capacity) to the common vent capacity part of the common vent tables. The length of the common vent manifold (LM) shall not exceed 18 inches per inch (18 mm/mm) of common vent diameter (D). [NFPA 54:13.2.4]

12.2.5 Vent Offsets

Where the common vertical vent is offset, the maximum capacity of the common vent shall be reduced in accordance with Clause 12.2.6, and the horizontal length of the common vent offset shall not exceed 18 inches per inch (18 mm/mm) of common vent diameter (D). Where multiple offsets occur in a common vent, the total horizontal length of all offsets combined shall not exceed 18 inches per inch (18 mm/mm) of the common vent diameter. [NFPA 54:13.2.5]

12.2.6 Elbows in Vents

For each elbow up to and including 45 degrees (0.79 rad) in the common vent, the maximum common vent capacity listed in the venting tables shall be reduced by 5 percent. For each elbow greater than 45 degrees (0.79 rad) up to and including 90 degrees (1.57 rad), the maximum common vent capacity listed in the venting tables shall be reduced by 10 percent. [NFPA 54:13.2.6]

12.2.7 Elbows in connectors

The vent connector capacities listed in the common vent sizing tables include allowance for two 90-degree (1.57 rad) elbows. For each additional elbow up to and including 45 degrees (0.79 rad), the maximum vent connector capacity listed in the venting tables shall be reduced by 5 percent. For each elbow greater than 45 degrees (0.79 rad) up to and including 90 degrees (1.57 rad), the maximum vent connector capacity listed in the venting tables shall be reduced by 10 percent. [NFPA 54:13.2.7]

12.2.8 common vent minimum size

The cross-sectional area of the common vent shall be equal to or greater than the cross-sectional area of the largest connector. [NFPA 54:13.2.8]

12.2.9 Tee and wye fittings

Tee and wye fittings connected to a common gas vent shall be considered as part of the common gas vent and constructed of materials consistent with that of the common gas vent. [NFPA 54:13.2.9]

12.2.10 Size of Fittings

At the point where tee or wye fittings connect to a common gas vent, the opening size of the fitting shall be equal to the size of the common vent. Such fittings shall not be prohibited from having reduced size openings at the point of connection of appliance gas vent connectors. [NFPA 54:13.2.10]

12.2.11 High-Altitude Installations

Sea level input ratings shall be used when determining maximum capacity for high-altitude installation. Actual input (derated for altitude) shall be used for determining minimum capacity for high-altitude installation. [NFPA 54:13.2.11]

12.2.12 Vent Connector Rise

The vent connector rise (R) for each appliance shall be measured from the draft hood outlet or flue collar to the centerline where the vent gas streams come together. [NFPA 54:13.2.12]

12.2.13 Vent Height

The available total height (H) for multiple appliances on the same floor shall be measured from the highest draft hood outlet or flue collar up to the level of the outlet of the common vent. [NFPA 54:13.2.13]

12.2.14 Multistory Vent Height

Where appliances are located on more than one floor, the available total height (H) for each segment of the system shall be the vertical distance between the highest draft hood outlet or flue collar entering that segment and the centerline of the next higher interconnection tee. [NFPA 54:13.2.14]

12.2.15 Size of Vents for Multistory Installations

The size of the lowest connector and of the vertical vent leading to the lowest interconnection of a multistory system shall be in accordance with Table A.1 or Table A.2 for available total height (H) up to the lowest interconnection. [NFPA 54:13.2.15]

12.2.16 Multistory Type B Vents Required

Where used in multistory systems, vertical common vents shall be Type B double wall and shall be installed with a listed vent cap. [NFPA 54:13.2.16]

12.2.17 Multistory Vent Offsets and Capacity

Offsets in multistory common vent systems shall be limited to a single offset in each system, and systems with an offset shall comply with all of the following:

- (1) The offset angle shall not exceed 45 degrees (0.79 rad) from vertical.
- (2) The horizontal length of the offset shall not exceed 18 inches per inch (18 mm/mm) of common vent diameter of the segment in which the offset is located.
- (3) For the segment of the common vertical vent containing the offset, the common vent capacity listed in the common venting tables shall be reduced by 20 percent (0.80 x maximum common vent capacity).
- (4) A multistory common vent shall not be reduced in size above the offset. [NFPA 54:13.2.17]

12.2.18 Vertical Vent Size Limitation

Where two or more appliances are connected to a vertical vent or chimney, the flow area of the largest section of vertical vent or chimney shall not exceed seven times the smallest listed appliance categorized vent areas, flue collar area, or draft hood outlet area unless designed in accordance with engineering methods. [NFPA 54:13.2.18]

12.2.19 Two-Stage/Modulating Appliances

The minimum vent connector capacity (FAN Min) of appliances with more than one input rate shall be determined from the tables and shall be less than the lowest appliance input rating. The maximum vent connector capacity (FAN Max or NAT Max) shall be determined from the tables and shall be greater than the highest appliance input rating. [NFPA 54:13.2.19]

12.2.20 Corrugated Metallic Chimney Liner Reduction

Listed corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Table A.7 or Table A.8 for Type B vents, with the maximum capacity reduced by 20 percent (0.80 x maximum capacity) and the minimum capacity as shown in Table A.7 or Table A.8. Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with Clause 12.2.5 and Clause 12.2.6. The 20 percent reduction for corrugated metallic chimney liner systems includes an allowance for one long radius 90 degree (1.57 rad) turn at the bottom of the liner. [NFPA 54:13.2.20]

12.2.21 Chimneys and vents

Table A.7 through Table A.11 shall be used only for chimneys and vents not exposed to the outdoors below the roof line. A Type B vent or listed chimney lining system passing through an unused masonry chimney flue shall not be considered to be exposed to the outdoors. A Type B vent passing through an unventilated enclosure or chase insulated to a value of not less than R8 shall not be considered to be exposed to the outdoors. Where vents extend outdoors above the roof more than 5 feet (1524 mm) higher than required, and where vents terminate in accordance with Clause 11.6.2.1(1)(b), the outdoor portion of the vent shall be enclosed as required by this section for vents not considered to be exposed to the outdoors, or such venting system shall be engineered. Table A.12 through Table A.15 shall be used for clay tile lined exterior masonry chimneys, provided all the following conditions are met:

- (1) The vent connector is Type B double wall.
- (2) At least one appliance is draft hood equipped.
- (3) The combined appliance input rating is less than the maximum capacity given by Table A.12 (for NAT + NAT) or Table A.14 (for FAN + NAT).
- (4) The input rating of each space-heating appliance is greater than the minimum input rating given by Table A.13 (for NAT + NAT) or Table A.15 (for FAN + NAT).
- (5) The vent connector sizing is in accordance with Table A.9. [NFPA 54:13.2.22]

12.2.22 Vent connector sizing

Vent connectors shall not be increased more than two sizes greater than the listed appliance categorized vent diameter, flue collar diameter, or draft hood outlet diameter. Vent connectors for draft hood-equipped appliances shall not be smaller than the draft hood outlet diameter. Where a vent connector size(s) determined from the tables for a fan-assisted appliance(s) is smaller than the flue collar diameter, the use of the smaller size(s) shall be permitted, provided that the installation complies with all of the following conditions:

- (1) Vent connectors for fan-assisted appliance flue collars 300 mm (12 inches) in diameter or smaller are not reduced by more than one table size [e.g., 300 mm to 250 mm (12 inches to 10 inches) is a one-size reduction], and those larger than 12 inches (300 mm) in diameter are not reduced more than two table sizes [e.g., 600 mm to 500 mm (24 inches to 20 inches) is a two-size reduction].
- (2) The fan-assisted appliance(s) is common vented with a draft hood-equipped appliance(s).
- (3) The vent connector has a smooth interior wall. [NFPA 54:13.2.24]

12.2.23 Combination of pipe types and sizes

All combinations of pipe sizes, single-wall metal pipe, and double-wall metal pipe shall be 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 pipes, as if they were used for the entire length of the subject connector or vent. Where single-wall and Type B double-wall metal pipes are used for vent connectors within the same venting system, the common vent shall be sized using Table A.8 or Table A.10 as appropriate. [NFPA 54:13.2.25]

12.2.24 Multiple connector and vent sizes

Where Table A.7 through Table A.15 permits more than one diameter of pipe to be used for a connector or vent, all the permitted sizes shall be permitted to be used. [NFPA 54:13.2.26]

12.2.25 Interpolation

Interpolation shall be permitted in calculating capacities for vent dimensions that fall between table entries. [NFPA 54:13.2.27]

12.2.26 Extrapolation

Extrapolation beyond the table entries shall not be permitted. [NFPA 54:13.2.28]

12.2.27 Engineering methods

For vent heights lower than 1829 mm (6 feet) and higher than shown in the tables, engineering methods shall be used to calculate vent capacities. [NFPA 54:13.2.29]

12.2.28 Height entries

Where the actual height of a vent falls between entries in the height column of the applicable table in Table A.7 through Table A.15, either of the following shall be used:

((1) Interpolation.

(2) The lower appliance input rating shown in the table entries, for FAN Max and NAT Max column values; and the higher appliance input rating for the FAN Min column values. [NFPA 54:13.2.30]

Annex A (normative)

Type B double-wall gas vent, Masonry Chimney, Single-Wall metal pipe of Type B asbestos-Cement vent, Exterior masonry chimney, Type B double-wall vent

Table A.1— Type b double-wall gas vent [NFPA 54: TABLE 13.1(a)]

				Number of appliances:							Single					
				Appliance type:							Category I					
				Appliance vent connection:							Connected directly to vent					
		Vent diameter – D (inch)														
		3			4			5			6			7		
		Appliance input rating in thousands of BTU per hour														
Height H (feet)	Lateral L (feet)	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
6	0	0	78	46	0	152	86	0	251	141	0	375	205	0	524	285
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	321	217
	4	21	49	34	30	94	64	39	153	103	50	227	153	66	316	211
	6	25	46	32	36	91	61	47	149	100	59	223	149	78	310	205
8	0	0	84	50	0	165	94	0	276	155	0	415	235	0	583	320
	2	12	57	40	16	109	75	25	178	120	28	263	180	42	365	247
	5	23	53	38	32	103	71	42	171	115	53	255	173	70	356	237
	8	28	49	35	39	98	66	51	164	109	64	247	165	84	347	227
10	0	0	88	53	0	175	100	0	295	166	0	447	255	0	631	345
	2	12	61	42	17	118	81	23	194	129	26	289	195	40	402	273
	5	23	57	40	32	113	77	41	187	124	52	280	188	68	392	263
	10	30	51	36	41	104	70	54	176	115	67	267	175	88	376	245
15	0	0	94	58	0	191	112	0	327	187	0	502	285	0	716	390
	2	11	69	48	15	136	93	20	226	150	22	339	225	38	475	316
	5	22	65	45	30	130	87	39	219	142	49	330	217	64	463	300
	10	29	59	41	40	121	82	51	206	135	64	315	208	84	445	288
	15	35	53	37	48	112	76	61	195	128	76	301	198	98	429	275
20	0	0	97	61	0	202	119	0	349	202	0	540	307	0	776	430
	2	10	75	51	14	149	100	18	250	166	20	377	249	33	531	346
	5	21	71	48	29	143	96	38	242	160	47	367	241	62	519	337
	10	28	64	44	38	133	89	50	229	150	62	351	228	81	499	321
	15	34	58	40	46	124	84	59	217	142	73	337	217	94	481	308

	20	48	52	35	55	116	78	69	206	134	84	322	206	107	464	295
30	0	0	100	64	0	213	128	0	374	220	0	587	336	0	853	475
	2	9	81	56	13	166	112	14	283	185	18	432	280	27	613	394
	5	21	77	54	28	160	108	36	275	176	45	421	273	58	600	385
	10	27	70	50	37	150	102	48	262	171	59	405	261	77	580	371
	15	33	64	NA	44	141	96	57	249	163	70	389	249	90	560	357
	20	56	58	NA	53	132	90	66	237	154	80	374	237	102	542	343
	30	NA	NA	NA	73	113	NA	88	214	NA	104	346	219	131	507	321
50	0	0	101	67	0	216	134	0	397	232	0	633	363	0	932	518
	2	8	86	61	11	183	122	14	320	206	15	497	314	22	715	445
	5	20	82	NA	27	177	119	35	312	200	43	487	308	55	702	438
	10	26	76	NA	35	168	114	45	299	190	56	471	298	73	681	426
	15	59	70	NA	42	158	NA	54	287	180	66	455	288	85	662	413
	20	NA	NA	NA	50	149	NA	63	275	169	76	440	278	97	642	401
	30	NA	NA	NA	69	131	NA	84	250	NA	99	410	259	123	605	376
100	0	NA	NA	NA	0	218	NA	0	407	NA	0	665	400	0	997	560
	2	NA	NA	NA	10	194	NA	12	354	NA	13	566	375	18	831	510
	5	NA	NA	NA	26	189	NA	33	347	NA	40	557	369	52	820	504
	10	NA	NA	NA	33	182	NA	43	335	NA	53	542	361	68	801	493
	15	NA	NA	NA	40	174	NA	50	321	NA	62	528	353	80	782	482
	20	NA	NA	NA	47	166	NA	59	311	NA	71	513	344	90	763	471
	30	NA	NA	NA	NA	NA	NA	78	290	NA	92	483	NA	115	726	449
	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	147	428	NA	180	651	405

		Number of appliances:								Single							
		Appliance type:								Category I							
		Appliance vent connection:								Connected directly to vent							
		Vent diameter – D (inch)															
		8		9		10		12		14							
		Appliance input rating in thousands of BTU per hour															
Height H (feet)	Lateral L (feet)	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	
6	0	0	698	370	0	897	470	0	1121	570	0	1645	850	0	2267	1170	
	2	53	425	285	63	543	370	75	675	455	103	982	650	138	1346	890	
	4	79	419	279	93	536	362	110	668	445	147	975	640	191	1338	880	
	6	93	413	273	110	530	354	128	661	435	171	967	630	219	1330	870	

8	0	0	780	415	0	1006	537	0	1261	660	0	1858	970	0	2571	1320
	2	50	483	322	60	619	418	71	770	515	98	1124	745	130	1543	1020
	5	83	473	313	99	607	407	115	758	503	154	1110	733	199	1528	1010
	8	99	463	303	117	596	396	137	746	490	180	1097	720	231	1514	1000
10	0	0	847	450	0	1096	585	0	1377	720	0	2036	1060	0	2825	1450
	2	48	533	355	57	684	457	68	852	560	93	1244	850	124	1713	1130
	5	81	522	346	95	671	446	112	839	547	149	1229	829	192	1696	1105
	10	104	504	330	122	651	427	142	817	525	187	1204	795	238	1669	1080
15	0	0	970	525	0	1263	682	0	1596	840	0	2380	1240	0	3323	1720
	2	45	633	414	53	815	544	63	1019	675	86	1495	985	114	2062	1350
	5	76	620	403	90	800	529	105	1003	660	140	1476	967	182	2041	1327
	10	99	600	386	116	777	507	135	977	635	177	1446	936	227	2009	1289
	15	115	580	373	134	755	491	155	953	610	202	1418	905	257	1976	1250
20	0	0	1057	575	0	1384	752	0	1756	930	0	2637	1350	0	3701	1900
	2	41	711	470	50	917	612	59	1150	755	81	1694	1100	107	2343	1520
	5	73	697	460	86	902	599	101	1133	738	135	1674	1079	174	2320	1498
	10	95	675	443	112	877	576	130	1105	710	172	1641	1045	220	2282	1460
	15	111	654	427	129	853	557	150	1078	688	195	1609	1018	248	2245	1425
	20	125	634	410	145	830	537	167	1052	665	217	1578	990	273	2210	1390
30	0	0	1173	650	0	1548	855	0	1977	1060	0	3004	1550	0	4252	2170
	2	33	826	535	42	1072	700	54	1351	865	74	2004	1310	98	2786	1800
	5	69	811	524	82	1055	688	96	1332	851	127	1981	1289	164	2759	1775
	10	91	788	507	107	1028	668	125	1301	829	164	1944	1254	209	2716	1733
	15	105	765	490	124	1002	648	143	1272	807	187	1908	1220	237	2674	1692
	20	119	743	473	139	977	628	160	1243	784	207	1873	1185	260	2633	1650
	30	149	702	444	171	929	594	195	1189	745	246	1807	1130	305	2555	1585
50	0	0	1297	708	0	1730	952	0	2231	1195	0	3441	1825	0	4934	2550
	2	26	975	615	33	1276	813	41	1620	1010	66	2431	1513	86	3409	2125
	5	65	960	605	77	1259	798	90	1600	996	118	2406	1495	151	3380	2102
	10	86	935	589	101	1230	773	118	1567	972	154	2366	1466	196	3332	2064
	15	100	911	572	117	1203	747	136	1536	948	177	2327	1437	222	3285	2026
	20	113	888	556	131	1176	722	151	1505	924	195	2288	1408	244	3239	1987
	30	141	844	522	161	1125	670	183	1446	876	232	2214	1349	287	3150	1910
100	0	0	1411	770	0	1908	1040	0	2491	1310	0	3925	2050	0	5729	2950
	2	21	1155	700	25	1536	935	30	1975	1170	44	3027	1820	72	4313	2550
	5	60	1141	692	71	1519	926	82	1955	1159	107	3002	1803	136	4282	2531
	10	80	1118	679	94	1492	910	108	1923	1142	142	2961	1775	180	4231	2500
	15	93	1095	666	109	1465	895	126	1892	1124	163	2920	1747	206	4182	2469
	20	105	1073	653	122	1438	880	141	1861	1107	181	2880	1719	226	4133	2438

30	131	1029	627	149	1387	849	170	1802	1071	215	2803	1663	265	4037	2375
50	197	944	575	217	1288	787	241	1688	1000	292	2657	1550	350	3856	2250

Table A.2 — Type b double-wall gas vent [NFPA 54: TABLE 13.1(b)]

				Number of appliances:						Single							
				Appliance type:						Category I							
				Appliance vent connection:						Single-wall metal connector							
		Vent diameter – D (inch)															
		3		4		5		6		7							
		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	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	
	2	39	51	36	60	96	66	85	156	104	123	231	156	159	320	213	
	4	NA	NA	33	74	92	63	102	152	102	146	225	152	187	313	208	
	6	NA	NA	31	83	89	60	114	147	99	163	220	148	207	307	203	
8	0	37	83	50	58	164	93	83	273	154	123	412	234	161	580	319	
	2	39	56	39	59	108	75	83	176	119	121	261	179	155	363	246	
	5	NA	NA	37	77	102	69	107	168	114	151	252	171	193	352	235	
	8	NA	NA	33	90	95	64	122	161	107	175	243	163	223	342	225	
10	0	37	87	53	57	174	99	82	293	165	120	444	254	158	628	344	
	2	39	61	41	59	117	80	82	193	128	119	287	194	153	400	272	
	5	52	56	39	76	111	76	105	185	122	148	277	186	190	388	261	
	10	NA	NA	34	97	100	68	132	171	112	188	261	171	237	369	241	
15	0	36	93	57	56	190	111	80	325	186	116	499	283	153	713	388	
	2	38	69	47	57	136	93	80	225	149	115	337	224	148	473	314	
	5	51	63	44	75	128	86	102	216	140	144	326	217	182	459	298	
	10	NA	NA	39	95	116	79	128	201	131	182	308	203	228	438	284	
	15	NA	NA	NA	NA	NA	72	158	186	124	220	290	192	272	418	269	
20	0	35	96	60	54	200	118	78	346	201	114	537	306	149	772	428	
	2	37	74	50	56	148	99	78	248	165	113	375	248	144	528	344	
	5	50	68	47	73	140	94	100	239	158	141	363	239	178	514	334	
	10	NA	NA	41	93	129	86	125	223	146	177	344	224	222	491	316	
	15	NA	NA	NA	NA	NA	80	155	208	136	216	325	210	264	469	301	
	20	NA	NA	NA	NA	NA	NA	186	192	126	254	306	196	309	448	285	
30	0	34	99	63	53	211	127	76	372	219	110	584	334	144	849	472	
	2	37	80	56	55	164	111	76	281	183	109	429	279	139	610	392	

	5	49	74	52	72	157	106	98	271	173	136	417	271	171	595	382
	10	NA	NA	NA	91	144	98	122	255	168	171	397	257	213	570	367
	15	NA	NA	NA	115	131	NA	151	239	157	208	377	242	255	547	349
	20	NA	NA	NA	NA	NA	NA	181	223	NA	246	357	228	298	524	333
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	389	477	305
50	0	33	99	66	51	213	133	73	394	230	105	629	361	138	928	515
	2	36	84	61	53	181	121	73	318	205	104	495	312	133	712	443
	5	48	80	NA	70	174	117	94	308	198	131	482	305	164	696	435
	10	NA	NA	NA	89	160	NA	118	292	186	162	461	292	203	671	420
	15	NA	NA	NA	112	148	NA	145	275	174	199	441	280	244	646	405
	20	NA	NA	NA	NA	NA	NA	176	257	NA	236	420	267	285	622	389
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	315	376	NA	373	573	NA
100	0	NA	NA	NA	49	214	NA	69	403	NA	100	659	395	131	991	555
	2	NA	NA	NA	51	192	NA	70	351	NA	98	563	373	125	828	508
	5	NA	NA	NA	67	186	NA	90	342	NA	125	551	366	156	813	501
	10	NA	NA	NA	85	175	NA	113	324	NA	153	532	354	191	789	486
	15	NA	NA	NA	132	162	NA	138	310	NA	188	511	343	230	764	473
	20	NA	NA	NA	NA	NA	NA	168	295	NA	224	487	NA	270	739	458
	30	NA	NA	NA	NA	NA	NA	231	264	NA	301	448	NA	355	685	NA
	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	540	584	NA

		Number of appliances:						Single					
		Appliance type:						Category I					
		Appliance vent connection:						Single-wall metal connector					
		Vent diameter – D (inch)											
		8			9			10			12		
		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	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	211	695	369	267	894	469	371	1118	569	537	1639	849
	2	201	423	284	251	541	368	347	673	453	498	979	648
	4	237	416	277	295	533	360	409	664	443	584	971	638
	6	263	409	271	327	526	352	449	656	433	638	962	627
8	0	206	777	414	258	1002	536	360	1257	658	521	1852	967
	2	197	482	321	246	617	417	339	768	513	486	1120	743
	5	245	470	311	305	604	404	418	754	500	598	1104	730
	8	280	458	300	344	591	392	470	740	486	665	1089	715
10	0	202	844	449	253	1093	584	351	1373	718	507	2031	1057
	2	193	531	354	242	681	456	332	849	559	475	1242	848

	5	241	518	344	299	667	443	409	834	544	584	1224	825
	10	296	497	325	363	643	423	492	808	520	688	1194	788
15	0	195	966	523	244	1259	681	336	1591	838	488	2374	1237
	2	187	631	413	232	812	543	319	1015	673	457	1491	983
	5	231	616	400	287	795	526	392	997	657	562	1469	963
	10	284	592	381	349	768	501	470	966	628	664	1433	928
	15	334	568	367	404	742	484	540	937	601	750	1399	894
20	0	190	1053	573	238	1379	750	326	1751	927	473	2631	1346
	2	182	708	468	227	914	611	309	1146	754	443	1689	1098
	5	224	692	457	279	896	596	381	1126	734	547	1665	1074
	10	277	666	437	339	866	570	457	1092	702	646	1626	1037
	15	325	640	419	393	838	549	526	1060	677	730	1587	1005
	20	374	616	400	448	810	526	592	1028	651	808	1550	973
30	0	184	1168	647	229	1542	852	312	1971	1056	454	2996	1545
	2	175	823	533	219	1069	698	296	1346	863	424	1999	1308
	5	215	806	521	269	1049	684	366	1324	846	524	1971	1283
	10	265	777	501	327	1017	662	440	1287	821	620	1927	1243
	15	312	750	481	379	985	638	507	1251	794	702	1884	1205
	20	360	723	461	433	955	615	570	1216	768	780	1841	1166
	30	461	670	426	541	895	574	704	1147	720	937	1759	1101
50	0	176	1292	704	220	1724	948	295	2223	1189	428	3432	1818
	2	168	971	613	209	1273	811	280	1615	1007	401	2426	1509
	5	204	953	602	257	1252	795	347	1591	991	496	2396	1490
	10	253	923	583	313	1217	765	418	1551	963	589	2347	1455
	15	299	894	562	363	1183	736	481	1512	934	668	2299	1421
	20	345	866	543	415	1150	708	544	1473	906	741	2251	1387
	30	442	809	502	521	1086	649	674	1399	848	892	2159	1318
100	0	166	1404	765	207	1900	1033	273	2479	1300	395	3912	2042
	2	158	1152	698	196	1532	933	259	1970	1168	371	3021	1817
	5	194	1134	688	240	1511	921	322	1945	1153	460	2990	1796
	10	238	1104	672	293	1477	902	389	1905	1133	547	2938	1763
	15	281	1075	656	342	1443	884	447	1865	1110	618	2888	1730
	20	325	1046	639	391	1410	864	507	1825	1087	690	2838	1696
	30	418	988	NA	491	1343	824	631	1747	1041	834	2739	1627
	50	617	866	NA	711	1205	NA	895	1591	NA	1138	2547	1489

Table A.3 — Masonry chimney [NFPA 54: TABLE 13.1(c)]

		Number of appliances:						Single									
		Appliance type:						Category I									
		Appliance vent connection:						Type b double-wall connector									
		Type b double-wall connector diameter – D (inch) to be used with chimney areas within the size limits at bottom															
		3		4		5		6		7							
		Appliance input rating in thousands of BTU per hour															
Height H (feet)	Lateral L (feet)	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	
6	2	NA	NA	28	NA	NA	52	NA	NA	86	NA	NA	130	NA	NA	180	
	5		NA	25	NA	NA	49	NA	NA	82	NA	NA	117	NA	NA	165	
8	2	NA	NA	29	NA	NA	55	NA	NA	93	NA	NA	145	NA	NA	198	
	5		NA	26	NA	NA	52	NA	NA	88	NA	NA	134	NA	NA	183	
	8		NA	24	NA	NA	48	NA	NA	83	NA	NA	127	NA	NA	175	
10	2	NA	NA	31	NA	NA	61	NA	NA	103	NA	NA	162	NA	NA	221	
	5		NA	28	NA	NA	57	NA	NA	96	NA	NA	148	NA	NA	204	
	10		NA	25	NA	NA	50	NA	NA	87	NA	NA	139	NA	NA	191	
15	2	NA	NA	35	NA	NA	67	NA	NA	114	NA	NA	179	53	475	250	
	5		NA	35	NA	NA	62	NA	NA	107	NA	NA	164	NA	NA	231	
	10		NA	28	NA	NA	55	NA	NA	97	NA	NA	153	NA	NA	216	
	15		NA	NA	NA	NA	48	NA	NA	89	NA	NA	141	NA	NA	201	
20	2	NA	NA	38	NA	NA	74	NA	NA	124	NA	NA	201	51	522	274	
	5		NA	36	NA	NA	68	NA	NA	116	NA	NA	184	80	503	254	
	10		NA	NA	NA	NA	60	NA	NA	107	NA	NA	172	NA	NA	237	
	15		NA	NA	NA	NA	NA	NA	NA	97	NA	NA	159	NA	NA	220	
	20		NA	NA	NA	NA	NA	NA	NA	83	NA	NA	148	NA	NA	206	
30	2	NA	NA	41	NA	NA	82	NA	NA	137	NA	NA	216	47	581	303	
	5		NA	NA	NA	NA	76	NA	NA	128	NA	NA	198	75	561	281	
	10		NA	NA	NA	NA	67	NA	NA	115	NA	NA	184	NA	NA	263	
	15		NA	NA	NA	NA	NA	NA	NA	107	NA	NA	171	NA	NA	243	
	20		NA	NA	NA	NA	NA	NA	NA	91	NA	NA	159	NA	NA	227	
	30		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	188	
50	2	NA	NA	NA	NA	NA	92	NA	NA	161	NA	NA	251	NA	NA	351	
	5		NA	NA	NA	NA	NA	NA	NA	151	NA	NA	230	NA	NA	323	
	10		NA	NA	NA	NA	NA	NA	NA	138	NA	NA	215	NA	NA	304	
	15		NA	NA	NA	NA	NA	NA	NA	127	NA	NA	199	NA	NA	282	
	20		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	185	NA	NA	264	
	30		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Minimum internal area of chimney (square inches)		12			19			28			38			50			

Maximum internal area of chimney (square inches)	Seven times the listed appliance categorized vent area, flue collar area, or draft hood outlet areas.
For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m ² * NA: Not applicable.	

				Number of appliances:				Single					
				Appliance type:				Category I					
				Appliance vent connection:				Type B double-wall connector					
		type B double-wall connector diameter – D (inch) to be used with chimney areas within the size limits at bottom											
		8		9		10		12					
		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	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	2	NA	NA	247	NA	NA	320	NA	NA	401	NA	NA	581
	5	NA	NA	231	NA	NA	298	NA	NA	376	NA	NA	561
8	2	NA	NA	266	84	590	350	100	728	446	139	1024	651
	5	NA	NA	247	NA	NA	328	149	711	423	201	1007	640
	8	NA	NA	239	NA	NA	318	173	695	410	231	990	623
10	2	68	519	298	82	655	388	98	810	491	136	1144	724
	5	NA	NA	277	124	638	365	146	791	466	196	1124	712
	10	NA	NA	263	155	610	347	182	762	444	240	1093	668
15	2	64	613	336	77	779	441	92	968	562	127	1376	841
	5	99	594	313	118	759	416	139	946	533	186	1352	828
	10	126	565	296	148	727	394	173	912	567	229	1315	777
	15	NA	NA	281	171	698	375	198	880	485	259	1280	742
20	2	61	678	375	73	867	491	87	1083	627	121	1548	953
	5	95	658	350	113	845	463	133	1059	597	179	1523	933
	10	122	627	332	143	811	440	167	1022	566	221	1482	879
	15	NA	NA	314	165	780	418	191	987	541	251	1443	840
	20	NA	NA	296	186	750	397	214	955	513	277	1406	807
30	2	57	762	421	68	985	558	81	1240	717	111	1793	1112
	5	90	741	393	106	962	526	125	1216	683	169	1766	1094
	10	115	709	373	135	927	500	158	1176	648	210	1721	1025
	15	NA	NA	353	156	893	476	181	1139	621	239	1679	981
	20	NA	NA	332	176	860	450	203	1103	592	264	1638	940
	30	NA	NA	288	NA	NA	416	249	1035	555	318	1560	877
50	2	51	840	477	61	1106	633	72	1413	812	99	2080	1243

	5	83	819	445	98	1083	596	116	1387	774	155	2052	1225
	10	NA	NA	424	126	1047	567	147	1347	733	195	2006	1147
	15	NA	NA	400	146	1010	539	170	1307	702	222	1961	1099
	20	NA	NA	376	165	977	511	190	1269	669	246	1916	1050
	30	NA	NA	327	NA	NA	468	233	1196	623	295	1832	984
Minimum internal area of chimney (square inches)		63			78			95			132		
Maximum internal area of chimney (square inches)		Seven times the listed appliance categorized vent area, flue collar area, or draft hood outlet areas.											
For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²													
* NA: Not applicable													

Table A.4 — Masonry chimney NFPA 54: TABLE 13.1(d)]

				Number of appliances:						Single						
				Appliance type:						Category I						
				Appliance vent connection:						Single-wall metal connector						
		Single-wall metal connector diameter – D (inch) to be used with chimney areas within the size limits at bottom														
		3		4		5		6		7						
		Appliance input rating in thousands of BTU per hour														
Height H (feet)	Lateral L (feet)	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
6	2	NA	NA	28	NA	NA	52	NA	NA	86	NA	NA	130	NA	NA	180
	5	NA	NA	25	NA	NA	48	NA	NA	81	NA	NA	116	NA	NA	164
8	2	NA	NA	29	NA	NA	55	NA	NA	93	NA	NA	145	NA	NA	197
	5	NA	NA	26	NA	NA	51	NA	NA	87	NA	NA	133	NA	NA	182
	8	NA	NA	23	NA	NA	47	NA	NA	82	NA	NA	126	NA	NA	174
10	2	NA	NA	31	NA	NA	61	NA	NA	102	NA	NA	161	NA	NA	220
	5	NA	NA	28	NA	NA	56	NA	NA	95	NA	NA	147	NA	NA	203
	10	NA	NA	24	NA	NA	49	NA	NA	86	NA	NA	137	NA	NA	189
15	2	NA	NA	35	NA	NA	67	NA	NA	113	NA	NA	178	166	473	249
	5	NA	NA	32	NA	NA	61	NA	NA	106	NA	NA	163	NA	NA	230
	10	NA	NA	27	NA	NA	54	NA	NA	96	NA	NA	151	NA	NA	214
	15	NA	NA	NA	NA	NA	46	NA	NA	87	NA	NA	138	NA	NA	198
20	2	NA	NA	38	NA	NA	73	NA	NA	123	NA	NA	200	163	520	273
	5	NA	NA	35	NA	NA	67	NA	NA	115	NA	NA	183	NA	NA	252
	10	NA	NA	NA	NA	NA	59	NA	NA	105	NA	NA	170	NA	NA	235
	15	NA	NA	NA	NA	NA	NA	NA	NA	95	NA	NA	156	NA	NA	217
	20	NA	NA	NA	NA	NA	NA	NA	NA	80	NA	NA	144	NA	NA	202

30	2	NA	NA	41	NA	NA	81	NA	NA	136	NA	NA	215	158	578	302
	5	NA	NA	NA	NA	NA	75	NA	NA	127	NA	NA	196	NA	NA	279
	10	NA	NA	NA	NA	NA	66	NA	NA	113	NA	NA	182	NA	NA	260
	15	NA	NA	NA	NA	NA	NA	NA	NA	105	NA	NA	168	NA	NA	240
	20	NA	NA	NA	NA	NA	NA	NA	NA	88	NA	NA	155	NA	NA	223
	30			NA			NA			NA			NA			182
50	2	NA	NA	NA	NA	NA	91	NA	NA	160	NA	NA	250	NA	NA	350
	5	NA	NA	NA	NA	NA	NA	NA	NA	149	NA	NA	228	NA	NA	321
	10	NA	NA	NA	NA	NA	NA	NA	NA	136	NA	NA	212	NA	NA	301
	15	NA	NA	NA	NA	NA	NA	NA	NA	124	NA	NA	195	NA	NA	278
	20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	180	NA	NA	258
	30			NA			NA			NA			NA			NA
Minimum internal area of chimney (square inches)		12			19			28			38			50		
Maximum internal area of chimney (square inches)		Seven times the listed appliance categorized vent area, flue collar area, or draft hood outlet areas.														
For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m ²																
* NA: Not applicable.																

				Number of appliances:				Single					
				Appliance type:				Category I					
				Appliance vent connection:				Single-wall metal connector					
		Single-wall metal connector diameter – D (inch) to be used with chimney areas within the size limits at bottom											
		8		9			10			12			
		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	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	2	NA	NA NA	247	NA	NA NA	319	NA	NA NA	400	NA NA	NA NA	580
	5	NA		230	NA		297	NA		375			560
8	2	NA NA	NA NA	265	NA NA	NA NA	349	382	725	445	549	1021	650
	5	NA	NA	246	NA	NA	327	NA	NA NA	422	673	1003	638
	8			237			317	NA		408	747	985	621
10	2	216	518	297	271	654	387	373	808	490	536	1142	722
	5	NA	NA NA	276	334	635	364	459	789	465	657	1121	710
	10	NA		261	NA	NA	345	547	758	441	771	1088	665
15	2	211	611	335	264	776	440	362	965	560	520	1373	840
	5	261	591	312	325	755	414	444	942	531	637	1348	825
	10	NA	NA NA	294	392	722	392	531	907	504	749	1309	774

	15			278	452	692	372	606	873	481	841	1272	738
20	2	206	675	374	258	864	490	252	1079	625	508	1544	950
	5	255	655	348	317	842	461	433	1055	594	623	1518	930
	10	312	622	330	382	806	437	517	1016	562	733	1475	875
	15	NA	NA NA	311	442	773	414	591	979	539	823	1434	835
	20	NA		292	NA	NA	392	663	944	510	911	1394	800
30	2	200	759	420	249	982	556	340	1237	715	489	1789	1110
	5	245	737	391	306	958	524	417	1210	680	600	1760	1090
	10	300	703	370	370	920	496	500	1168	644	708	1713	1020
	15	NA NA	NA	349	428	884	471	572	1128	615	798	1668	975
	20	NA	NA	327	NA	NA NA	445	643	1089	585	883	1624	932
	30		NA	281	NA		408	NA	NA	544	1055	1539	865
50	2	191	837	475	238	1103	631	323	1408	810	463	2076	1240
	5	NA NA	NA	442	293	1078	593	398	1381	770	571	2044	1220
	10	NA NA	NA	420	355	1038	562	447	1337	728	674	1994	1140
	15	NA	NA	395	NA NA	NA	533	546	1294	695	761	1945	1090
	20	NA	NA	370	NA	NA NA	504	616	1251	660	844	1898	1040
	30		NA	318			458	NA	NA	610	1009	1805	970
Minimum internal area of chimney (square inches)		63			78			95			132		
Maximum internal area of chimney (square inches)		Seven times the listed appliance categorized vent area, flue collar area, or draft hood outlet areas.											
For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m2													
* NA: Not applicable.													

Table A.5 — Single-wall metal pipe or TYPE B asbestos-cement vent [NFPA 54: TABLE 13.1(e)]

			Number of appliances:			Single				
			Appliance type:			Draft hood-equipped				
			Appliance vent connection:			Connected directly to pipe or vent				
			Diameter – D (inch)							
			to be used with chimney areas within the size limits at bottom							
			3	4	5	6	7	8	10	12
Height H (feet)	Lateral L (feet)	Appliance input rating in thousands of BTU per hour								
		Maximum appliance input rating in thousands of BTU per hour								
6	0	39	70	116	170	232	312	500	750	
	2	31	55	94	141	194	260	415	620	
	5	28	51	88	128	177	242	390	600	
8	0	42	76	126	185	252	340	542	815	

	2	32	61	102	154	210	284	451	680
	5	29	56	95	141	194	264	430	648
	10	24	49	86	131	180	250	406	625
10	0	45	84	138	202	279	372	606	912
	2	35	67	111	168	233	311	505	760
	5	32	61	104	153	215	289	480	724
	10	27	54	94	143	200	274	455	700
	15	NA	46	84	130	186	258	432	666
15	0	49	91	151	223	312	420	684	1040
	2	39	72	122	186	260	350	570	865
	5	35	67	110	170	240	325	540	825
	10	30	58	103	158	223	308	514	795
	15	NA	50	93	144	207	291	488	760
	20	NA	NA	82	132	195	273	466	726
20	0	53	101	163	252	342	470	770	1190
	2	42	80	136	210	286	392	641	990
	5	38	74	123	192	264	364	610	945
	10	32	65	115	178	246	345	571	910
	15	NA	55	104	163	228	326	550	870
	20	NA	NA	91	149	214	306	525	832
30	0	56	108	183	276	384	529	878	1370
	2	44	84	148	230	320	441	730	1140
	5	NA	78	137	210	296	410	694	1080
	10	NA	68	125	196	274	388	656	1050
	15	NA	NA	113	177	258	366	625	1000
	20	NA	NA	99	163	240	344	596	960
	30	NA	NA	NA	NA	192	295	540	890
50	0	NA	120	210	310	443	590	980	1550
	2	NA	95	171	260	370	492	820	1290
	5	NA	NA	159	234	342	474	780	1230
	10	NA	NA	146	221	318	456	730	1190
	15	NA	NA	NA	200	292	407	705	1130
	20	NA	NA	NA	185	276	384	670	1080
	30	NA	NA	NA	NA	222	330	605	1010

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²

* NA: Not applicable.

Table A.6 — Exterior masonry chimney [NFPA 54: TABLE 13.1(f)]

			Number of appliances:			Single		
			Appliance type:			Nat		
			Appliance vent connection:			Type b double-wall connector		
Minimum allowable input rating of space-heating appliance in thousands of BTU per hour								
Vent height H (feet)	INTERNAL AREA OF CHIMNEY (square inches)							
	12	19	28	38	50	63	78	113
6 8 10 15 20 30 50	Local 99% winter design temperature: 37°F or greater							
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	NA	0	0	0	0	0	0	0
	NA	NA	123	190	249	184	0	0
	NA	NA	NA	NA	NA	393	334	0
NA	NA	NA	NA	NA	NA	NA	NA	579
6 8 10 15 20 30 50	Local 99% winter design temperature: 27°F to 36°F							
	0	0	68	116	156	180	212	266
	0	0	82	127	167	187	214	263
	0	51	97	141	183	201	225	265
	NA	NA	NA	NA	233	253	274	305
	NA	NA	NA	NA	NA	307	330	362
	NA	NA	NA	NA	NA	419	445	485
NA	NA	NA	NA	NA	NA	NA	763	
6 8 10 15 20 30 50	Local 99% winter design temperature: 17°F to 26°F							
	NA	NA	NA	NA	NA	215	259	349
	NA	NA	NA	NA	197	226	264	352
	NA	NA	NA	NA	214	245	278	358
	NA	NA	NA	NA	NA	296	331	398
	NA	NA	NA	NA	NA	352	387	457
	NA	NA	NA	NA	NA	NA	507	581
NA	NA	NA	NA	NA	NA	NA	NA	
6 8 10 15 20	Local 99% winter design temperature: 5°F to 16°F							
	NA	NA	NA	NA	NA	NA	NA	416
	NA	NA	NA	NA	NA	NA	312	423
	NA	NA	NA	NA	NA	289	331	430
	NA	NA	NA	NA	NA	NA	393	485
	NA	NA	NA	NA	NA	NA	450	547
	NA	NA	NA	NA	NA	NA	NA	682

30	NA	NA	NA	NA	NA	NA	NA	972
50								
Local 99% winter design temperature: -10°F to 4°F								
6	NA	NA	NA	NA	NA	NA	NA	484
8	NA	NA	NA	NA	NA	NA	NA	494
10	NA	NA	NA	NA	NA	NA	NA	513
15	NA	NA	NA	NA	NA	NA	NA	586
20	NA	NA	NA	NA	NA	NA	NA	650
30	NA	NA	NA	NA	NA	NA	NA	805
50	NA	NA	NA	NA	NA	NA	NA	1003
Local 99% winter design temperature: -11°F or lower Not recommended for any vent configurations								
For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m ² , °C = (°F-32)/1.8								
Notes:								
NA: Not applicable.								

Table A.7 — TYPE B Double-wall vent [NFPA 54: TABLE 13.2(a)]

				Number of appliances:						Two or more						
				Appliance type:						Category I						
				Appliance vent connection:						Type b double-wall connector						
		Vent connector capacity														
		Type b double-wall vent and connector diameter – d (inch)														
		3		4		5		6		7						
		Appliance input rating limits in thousands of BTU per hour														
Vent Height H (feet)	Connector Rise R (feet)	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
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225	142
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253	168
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275	189
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243	148
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269	175
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290	198
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257	154
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282	182
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303	205
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298	163

	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320	193
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339	218
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334	171
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354	202
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371	228
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	391	182
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408	215
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423	242
50	1	19	71	36	30	133	64	43	216	101	57	349	145	78	477	197
	2	21	73	43	32	137	76	45	223	119	59	358	172	81	490	234
	3	22	75	48	33	141	86	46	229	134	61	366	194	83	502	263
100	1	18	82	37	28	158	66	40	262	104	53	442	150	73	611	204
	2	19	83	44	30	161	79	42	267	123	55	447	178	75	619	242
	3	20	84	50	31	163	89	44	272	138	57	452	200	78	627	272

	Common vent capacity											
	Type B double-wall common vent diameter – D (inch)											
	4			5			6			7		
	Combined appliance input rating in thousands of BTU per hour											
Vent height <i>H</i> (feet)	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
8	101	90	73	155	129	114	224	178	163	339	275	223
10	110	97	79	169	141	124	243	194	178	367	299	242
15	125	112	91	195	164	144	283	228	206	427	352	280
20	136	123	102	215	183	160	314	255	229	475	394	310
30	152	138	118	244	210	185	361	297	266	547	459	360
50	167	153	134	279	244	214	421	353	310	641	547	423
100	175	163	NA	311	277	NA	489	421	NA	751	658	479

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²
NA: Not applicable.

		Number of appliances:			Two or more					
		Appliance type:			Category I					
		Appliance vent connection:			Type b double-wall connector					
		Vent connector capacity								
		Type B double-wall vent and connector diameter – <i>D</i> (inch)								
		8			9			10		
		Appliance input rating limits in thousands of BTU per hour								
Vent height <i>H</i> (feet)	Connector rise <i>R</i> (feet)	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	92	296	185	109	376	237	128	466	289
	2	95	333	220	112	424	282	131	526	345
	3	97	363	248	114	463	317	134	575	386
8	1	100	320	194	118	408	248	138	507	303
	2	103	356	230	121	454	294	141	564	358
	3	105	384	258	123	492	330	143	612	402
10	1	106	341	200	125	436	257	146	542	314
	2	109	374	238	128	479	305	149	596	372
	3	111	402	268	131	515	342	152	642	417
15	1	110	389	214	134	493	273	162	609	333
	2	112	419	253	137	532	323	165	658	394
	3	115	445	286	140	565	365	167	700	444
20	1	107	436	224	131	552	285	158	681	347
	2	110	463	265	134	587	339	161	725	414
	3	113	486	300	137	618	383	164	764	466
30	1	103	512	238	125	649	305	151	802	372
	2	105	535	282	129	679	360	155	840	439
	3	108	555	317	132	706	405	158	874	494
50	1	97	627	257	120	797	330	144	984	403
	2	100	645	306	123	820	392	148	1014	478
	3	103	661	343	126	842	441	151	1043	538
100	1	91	810	266	112	1038	341	135	1285	417
	2	94	822	316	115	1054	405	139	1306	494
	3	97	834	355	118	1069	455	142	1327	555

	Common vent capacity								
	Type B double-wall common vent diameter – <i>D</i> (inch)								
	8			9			10		
	Combined appliance input rating in thousands of BTU per hour								
Vent height H (feet)	FAN+FAN	FAN+NAT	NAT+NAT	FAN+FAN	FAN+NAT	NAT+NAT	FAN+FAN	FAN+NAT	NAT+NAT
6	404	314	260	547	434	335	672	520	410

8	444	348	290	602	480	378	740	577	465
10	477	377	315	649	522	405	800	627	495
15	556	444	365	753	612	465	924	733	565
20	621	499	405	842	688	523	1035	826	640
30	720	585	470	979	808	605	1209	975	740
50	854	706	550	1164	977	705	1451	1188	860
100	1025	873	625	1408	1215	800	1784	1502	975
For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m ²									

		Vent connector capacity											
		Type B double-wall vent and connector diameter – D (inch)											
		12			14			16			18		
		Appliance input rating limits in thousands of BTU per hour											
Vent height h (feet)	Connector rise R (feet)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		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
	4	180	897	616	230	1231	827	287	1617	1081	352	2069	1370
	6	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
	4	192	952	644	244	1307	884	305	1719	1150	372	2211	1460
	6	198	1050	772	252	1445	1072	313	1902	1390	380	2434	1770
10	2	196	870	536	249	1195	730	311	1570	955	379	2049	1205
	4	201	997	664	256	1371	924	318	1804	1205	387	2332	1535
	6	207	1095	792	263	1509	1118	325	1989	1455	395	2556	1865
15	2	214	967	568	272	1334	790	336	1760	1030	408	2317	1305
	4	221	1085	712	279	1499	1006	344	1978	1320	416	2579	1665
	6	228	1181	856	286	1632	1222	351	2157	1610	424	2796	2025
20	2	223	1051	596	291	1443	840	357	1911	1095	430	2533	1385
	4	230	1162	748	298	1597	1064	365	2116	1395	438	2778	1765
	6	237	1253	900	307	1726	1288	373	2287	1695	450	2984	2145
30	2	216	1217	632	286	1664	910	367	2183	1190	461	2891	1540
	4	223	1316	792	294	1802	1160	376	2366	1510	474	3110	1920
	6	231	1400	952	303	1920	1410	384	2524	1830	485	3299	2340
50	2	206	1479	689	273	2023	1007	350	2659	1315	435	3548	1665
	4	213	1561	860	281	2139	1291	359	2814	1685	447	3730	2135
	6	221	1631	1031	290	2242	1575	369	2951	2055	461	3893	2605
100	2	192	1923	712	254	2644	1050	326	3490	1370	402	4707	1740
	4	200	1984	888	263	2731	1346	336	3606	1760	414	4842	2220

	6	208	2035	1064	272	2811	1642	346	3714	2150	426	4968	2700
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	Common vent capacity											
	Type B double-wall common vent diameter – D (inch)											
	12			14			16			18		
	Combined appliance input rating in thousands of BTU per hour											
Vent height <i>H</i> (feet)	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
8	994	773	652	1423	1103	912	1927	1491	1190	2507	1936	1510
10	1076	841	712	1542	1200	995	2093	1625	1300	2727	2113	1645
15	1247	986	825	1794	1410	1158	2440	1910	1510	3184	2484	1910
20	1405	1116	916	2006	1588	1290	2722	2147	1690	3561	2798	2140
30	1658	1327	1025	2373	1892	1525	3220	2558	1990	4197	3326	2520
50	2024	1640	1280	2911	2347	1863	3964	3183	2430	5184	4149	3075
100	2569	2131	1670	3732	3076	2450	5125	4202	3200	6749	5509	4050

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²
* NA: Not applicable.

		Number of appliances:			Two or more					
		Appliance type:			Category i					
		Appliance vent connection:			Type b double-wall connector					
		Vent connector capacity								
		Type b double-wall vent and connector diameter – D (inch)								
		20			22			24		
		Appliance input rating limits in thousands of btu per hour								
Vent Height H (feet)	Connector Rise R (feet)	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max
6	2 4 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 4 6	NA 471 478	NA 2737 3018	NA 1800 2180	NA 560 568	NA 3319 3665	NA 2180 2640	NA 662 669	NA 3957 4373	NA 2590 3130
10	2 4 6	NA 486 494	NA 2887 3169	NA 1890 2290	NA 581 589	NA 3502 3849	NA 2280 2760	NA 686 694	NA 4175 4593	NA 2710 3270
15	2 4	NA 523 533	NA 3197 3470	NA 2060 2510	NA 624 634	NA 3881 4216	NA 2490 3030	NA 734 743	NA 4631 5035	NA 2960 3600

	6									
20	2 4 6	NA 554 567	NA 3447 3708	NA 2180 2650	NA 661 671	NA 4190 4511	NA 2630 3190	NA 772 785	NA 5005 5392	NA 3130 3790
30	2 4 6	NA 619 632	NA 3840 4080	NA 2365 2875	NA 728 741	NA 4861 4976	NA 2860 3480	NA 847 860	NA 5606 5961	NA 3410 4150
50	2 4 6	NA 580 594	NA 4601 4808	NA 2633 3208	NA 709 724	NA 5569 5826	NA 3185 3885	NA 851 867	NA 6633 6943	NA 3790 4620
100	2 4 6	NA 523 539	NA 5982 6143	NA 2750 3350	NA 639 654	NA 7254 7453	NA 3330 4070	NA 769 786	NA 8650 8892	NA 3950 4810

	Common vent capacity								
	Type B double-wall common vent diameter – D (inch)								
	20			22			24		
	Combined appliance input rating in thousands of BTU per hour								
VENT									
HEIGHT H (Feet)	FAN+FAN	FAN+NAT	NAT+NAT	FAN+FAN	FAN+NAT	NAT+NAT	FAN+FAN	FAN+NAT	NAT+NAT
6	2838	2180	1660	3488	2677	1970	4206	3226	2390
8	3162	2439	1860	3890	2998	2200	4695	3616	2680
10	3444	2665	2030	4241	3278	2400	5123	3957	2920
15	4026	3133	2360	4971	3862	2790	6016	4670	3400
20	4548	3552	2640	5573	4352	3120	6749	5261	3800
30	5303	4193	3110	6539	5157	3680	7940	6247	4480
50	6567	5240	3800	8116	6458	4500	9837	7813	5475
100	8597	6986	5000	10 681	8648	5920	13 004	10 499	7200

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²
* NA: Not applicable.

Table A.8 — Type B double-wall vent [NFPA 54: TABLE 13.2(b)]

					Number of appliances:						Two or more					
					Appliance type:						Category I					
					Appliance vent connection:						Single-wall metal connector					
		Vent connector capacity														
		Single-wall metal vent connector diameter – d (inch)														
		3			4			5			6			7		
		Appliance input rating limits in thousands of BTU per hour														
Vent height h (feet)	Connector rise r (feet)	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

6	1	NA	NA	26	NA	NA	46	NA	NA	71	NA	NA	102	207	223	140
	2	NA	NA	31	NA	NA	55	NA	NA	85	168	182	123	215	251	167
	3	NA	NA	34	NA	NA	62	121	131	95	175	198	138	222	273	188
8	1	NA	NA	27	NA	NA	48	NA	NA	75	NA	NA	106	226	240	145
	2	NA	NA	32	NA	NA	57	125	126	89	184	193	127	234	266	173
	3	NA	NA	35	NA	NA	64	130	138	100	191	208	144	241	287	197
10	1	NA	NA	28	NA	NA	50	119	121	77	182	186	110	240	253	150
	2	NA	NA	33	84	85	59	124	134	91	189	203	132	248	278	183
	3	NA	NA	36	89	91	67	129	144	102	197	217	148	257	299	203
15	1	NA	NA	29	79	87	52	116	138	81	177	214	116	238	291	158
	2	NA	NA	34	83	94	62	121	150	97	185	230	138	246	314	189
	3	NA	NA	39	87	100	70	127	160	109	193	243	157	255	333	215
20	1	49	56	30	78	97	54	115	152	84	175	238	120	233	325	165
	2	52	59	36	82	103	64	120	163	101	182	252	144	243	346	197
	3	55	62	40	87	107	72	125	172	113	190	264	164	252	363	223
30	1	47	60	31	77	110	57	112	175	89	169	278	129	226	380	175
	2	51	62	37	81	115	67	117	185	106	177	290	152	236	397	208
	3	54	64	42	85	119	76	122	193	120	185	300	172	244	412	235
50	1	46	69	34	75	128	60	109	207	96	162	336	137	217	460	188
	2	49	71	40	79	132	72	114	215	113	170	345	164	226	473	223
	3	52	72	45	83	136	82	119	221	123	178	353	186	235	486	252
100	1	45	79	34	71	150	61	104	249	98	153	424	140	205	585	192
	2	48	80	41	75	153	73	110	255	115	160	428	167	212	593	228
	3	51	81	46	79	157	85	114	260	129	168	433	190	222	603	256

VENT HEIGHT H (feet)	Common vent capacity											
	Type b double-wall common vent diameter – D (inch)											
	4			5			6			7		
	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
6	NA	78	64	NA	113	99	200	158	144	304	244	196
8	NA	87	71	NA	126	111	218	173	159	331	269	218
10	NA	94	76	163	137	120	237	189	174	357	292	236
15	121	108	88	189	159	140	275	221	200	416	343	274
20	131	118	98	208	177	156	305	247	223	463	383	302
30	145	132	113	236	202	180	350	286	257	533	446	349
50	159	145	128	268	233	208	406	337	296	622	529	410
100	166	153	NA	297	263	NA	469	398	NA	726	633	464

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²
 * NA: Not applicable.

		Number of appliances:			Two or more					
		Appliance type:			Category I					
		Appliance vent connection:			Single-wall metal connector					
		Vent connector capacity								
		Single-wall metal vent connector diameter – D (inch)								
		8			9			10		
		Appliance input rating limits in thousands of btu per hour								
Vent height h (feet)	Connector rise R (feet)	Fan		Nat	Fan		Nat	Fan		Nat
		Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	262	293	183	325	373	234	447	463	286
	2	271	331	219	334	422	281	458	524	344
	3	279	361	247	344	462	316	468	574	385
8	1	285	316	191	352	403	244	481	502	299
	2	293	353	228	360	450	292	492	560	355
	3	302	381	256	370	489	328	501	609	400
10	1	302	335	196	372	429	252	506	534	308
	2	311	369	235	381	473	302	517	589	368
	3	320	398	265	391	511	339	528	637	413
15	1	312	380	208	397	482	266	556	596	324
	2	321	411	248	407	522	317	568	646	387
	3	331	438	281	418	557	360	579	690	437
20	1	306	425	217	390	538	276	546	664	336

	2	317	453	259	400	574	331	558	709	403
	3	326	476	294	412	607	375	570	750	457
30	1	296	497	230	378	630	294	528	779	358
	2	307	521	274	389	662	349	541	819	425
	3	316	542	309	400	690	394	555	855	482
50	1	284	604	245	364	768	314	507	951	384
	2	294	623	293	376	793	375	520	983	458
	3	304	640	331	387	816	423	535	1013	518
100	1	269	774	249	345	993	321	476	1236	393
	2	279	788	299	358	1011	383	490	1259	469
	3	289	801	339	368	1027	431	506	1280	527

	Common vent capacity								
	Type B double-wall common vent diameter – d (inch)								
	8			9			10		
	Combined appliance input rating in thousands of BTU per hour								
Vent height H (feet)	FAN+FAN	FAN+NAT	NAT+NAT	FAN+FAN	FAN+NAT	NAT+NAT	FAN+FAN	FAN+NAT	NAT+NAT
6	398	310	257	541	429	332	665	515	407
8	436	342	285	592	473	373	730	569	460
10	467	369	309	638	512	398	787	617	487
15	544	434	357	738	599	456	905	718	553
20	606	487	395	824	673	512	1013	808	626
30	703	570	459	958	790	593	1183	952	723
50	833	686	535	1139	954	689	1418	1157	838
100	999	846	606	1378	1185	780	1741	1459	948

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m² .

Table A.9 — Masonry chimney [NFPA 54: TABLE 13.2(c)]

				Number of appliances:				Two or more								
				Appliance type:				Category I								
				Appliance vent connection:				Type b double-wall connector								
				Vent connector capacity												
				Type B double-wall vent connector diameter – D (inch)												
				3		4		5		6		7				
				Appliance input rating limits in thousands of BTU per hour												
Vent height h (feet)	Connector rise R (feet)	FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max

6	1	24	33	21	39	62	40	52	106	67	65	194	101	87	274	141
	2	26	43	28	41	79	52	53	133	85	67	230	124	89	324	173
	3	27	49	34	42	92	61	55	155	97	69	262	143	91	369	203
8	1	24	39	22	39	72	41	55	117	69	71	213	105	94	304	148
	2	26	47	29	40	87	53	57	140	86	73	246	127	97	350	179
	3	27	52	34	42	97	62	59	159	98	75	269	145	99	383	206
10	1	24	42	22	38	80	42	55	130	71	74	232	108	101	324	153
	2	26	50	29	40	93	54	57	153	87	76	261	129	103	366	184
	3	27	55	35	41	105	63	58	170	100	78	284	148	106	397	209
15	1	24	48	23	38	93	44	54	154	74	72	277	114	100	384	164
	2	25	55	31	39	105	55	56	174	89	74	299	134	103	419	192
	3	26	59	35	41	115	64	57	189	102	76	319	153	105	448	215
20	1	24	52	24	37	102	46	53	172	77	71	313	119	98	437	173
	2	25	58	31	39	114	56	55	190	91	73	335	138	101	467	199
	3	26	63	35	40	123	65	57	204	104	75	353	157	104	493	222
30	1	24	54	25	37	111	48	52	192	82	69	357	127	96	504	187
	2	25	60	32	38	122	58	54	208	95	72	376	145	99	531	209
	3	26	64	36	40	131	66	56	221	107	74	392	163	101	554	233
50	1	23	51	25	36	116	51	51	209	89	67	405	143	92	582	213
	2	24	59	32	37	127	61	53	225	102	70	421	161	95	604	235
	3	26	64	36	39	135	69	55	237	115	72	435	180	98	624	260
100	1	23	46	24	35	108	50	49	208	92	65	428	155	88	640	237
	2	24	53	31	37	120	60	51	224	105	67	444	174	92	660	260
	3	25	59	35	38	130	68	53	237	118	69	458	193	94	679	285

VENT HEIGHT H (feet)	Common vent capacity														
	Minimum internal area of masonry chimney flue (square inches)														
	12			19			28			38			50		
	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
6	NA	74	25	NA	119	46	NA	178	71	NA	257	103	NA	351	143
8	NA	80	28	NA	130	53	NA	193	82	NA	279	119	NA	384	163
10	NA	84	31	NA	138	56	NA	207	90	NA	299	131	NA	409	177
15	NA	NA	36	NA	152	67	NA	233	106	NA	334	152	523	467	212
20	NA	NA	41	NA	NA	75	NA	250	122	NA	368	172	565	508	243
30	NA	NA	NA	NA	NA	NA	NA	270	137	NA	404	198	615	564	278

50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	620	328
100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	348

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²

* NA: Not applicable.

		Number of appliances:			Two or more					
		Appliance type:			Category I					
		Appliance vent connection:			Type b double-wall connector					
		Vent connector capacity								
		Type b double-wall vent connector diameter – d (inch)								
		8		9			10			
		Appliance input rating limits in thousands of BTU per hour								
Vent height h (feet)	Connector rise R (feet)	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	104	370	201	124	479	253	145	599	319
	2	107	436	232	127	562	300	148	694	378
	3	109	491	270	129	633	349	151	795	439
8	1	113	414	210	134	539	267	156	682	335
	2	116	473	240	137	615	311	160	776	394
	3	119	517	276	139	672	358	163	848	452
10	1	120	444	216	142	582	277	165	739	348
	2	123	498	247	145	652	321	168	825	407
	3	126	540	281	147	705	366	171	893	463
15	1	125	511	229	153	658	297	184	824	375
	2	128	558	260	156	718	339	187	900	432
	3	131	597	292	159	760	382	190	960	486
20	1	123	584	239	150	752	312	180	943	397
	2	126	625	270	153	805	354	184	1011	452
	3	129	661	301	156	851	396	187	1067	505
30	1	119	680	255	145	883	337	175	1115	432
	2	122	715	287	149	928	378	179	1171	484
	3	125	746	317	152	968	418	182	1220	535
50	1	115	798	294	140	1049	392	168	1334	506
	2	118	827	326	143	1085	433	172	1379	558
	3	121	854	357	147	1118	474	176	1421	611
100	1	109	907	334	134	1222	454	161	1589	596
	2	113	933	368	138	1253	497	165	1626	651
	3	116	956	399	141	1282	540	169	1661	705

	Common vent capacity								
	Minimum internal area of masonry chimney flue (square inches)								
	63			78			113		
	Combined appliance input rating in thousands of BTU per hour								
VENT HEIGHT H(feet)	FAN+FAN	FAN+NAT	NAT+NAT	FAN+FAN	FAN+NAT	NAT+NAT	FAN+FAN	FAN+NAT	NAT+NAT
6	NA	458	188	NA	582	246	1041	853	NA
8	NA	501	218	724	636	278	1144	937	408
10	606	538	236	776	686	302	1226	1010	454
15	682	611	283	874	781	365	1374	1156	546
20	742	668	325	955	858	419	1513	1286	648
30	816	747	381	1062	969	496	1702	1473	749
50	879	831	461	1165	1089	606	1905	1692	922
100	NA	NA	499	NA	NA	669	2053	1921	1058

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²
* NA: Not applicable.

Table A.10 — Masonry chimney [NFPA 54: TABLE 13.2(d)]

				Number of appliances:				Two or more								
				Appliance type:				Category I								
				Appliance vent connection:				Single-wall metal connector								
		Vent connector capacity														
		Single-wall metal vent connector diameter – D (inch)														
		3	4			5			6			7				
		Appliance input rating limits in thousands of BTU per hour														
Vent height h (feet)	Connector rise R (feet)	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
6	1	NA	NA	21	NA	NA	39	NA	NA	66	179	191	100	231	271	140
	2	NA	NA	28	NA	NA	52	NA	NA	84	186	227	123	239	321	172
	3	NA	NA	34	NA	NA	61	134	153	97	193	258	142	247	365	202
8	1	NA	NA	21	NA	NA	40	NA	NA	68	195	208	103	250	298	146
	2	NA	NA	28	NA	NA	52	137	139	85	202	240	125	258	343	177
	3	NA	NA	34	NA	NA	62	143	156	98	210	264	145	266	376	205
10	1	NA	NA	22	NA	NA	41	130	151	70	202	225	106	267	316	151
	2	NA	NA	29	NA	NA	53	136	150	86	210	255	128	276	358	181
	3	NA	NA	34	97	102	62	143	166	99	217	277	147	284	389	207
15	1	NA	NA	23	NA	NA	43	129	151	73	199	271	112	268	376	161

	2	NA	NA	30	92	103	54	135	170	88	207	295	132	277	411	189
	3	NA	NA	34	96	112	63	141	185	101	215	315	151	286	439	213
20	1	NA	NA	23	87	99	45	128	167	76	197	303	117	265	425	169
	2	NA	NA	30	91	111	55	134	185	90	205	325	136	274	455	195
	3	NA	NA	35	96	119	64	140	199	103	213	343	154	282	481	219
30	1	NA	NA	24	86	108	47	126	187	80	193	347	124	259	492	183
	2	NA	NA	31	91	119	57	132	203	93	201	366	142	269	518	205
	3	NA	NA	35	95	127	65	138	216	105	209	381	160	277	540	229
50	1	NA	NA	24	85	113	50	124	204	87	188	392	139	252	567	208
	2	NA	NA	31	89	123	60	130	218	100	196	408	158	262	588	230
	3	NA	NA	35	94	131	68	136	231	112	205	422	176	271	607	255
100	1	NA	NA	23	84	104	49	122	200	89	182	410	151	243	617	232
	2	NA	NA	30	88	115	59	127	215	102	190	425	169	253	636	254
	3	NA	NA	34	93	124	67	133	228	115	199	438	188	262	654	279

	Common vent capacity														
	Minimum internal area of masonry chimney flue (square inches)														
	12		19			28			38			50			
	Combined appliance input rating in thousands of BTU per hour														
Vent Height H(Feet)	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	NA	NA	25	NA	118	45	NA	176	71	NA	255	102	NA	348	142
8	NA	NA	28	NA	128	52	NA	190	81	NA	276	118	NA	380	162
10	NA	NA	31	NA	136	56	NA	205	89	NA	295	129	NA	405	175
15	NA	NA	36	NA	NA	66	NA	230	105	NA	335	150	NA	400	210
20	NA	NA	NA	NA	NA	74	NA	247	120	NA	362	170	NA	503	240
30	NA	NA	NA	NA	NA	NA	NA	NA	135	NA	398	195	NA	558	275
50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	612	325
100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²

* NA: Not applicable.

	Number of appliances:	Two or more
	Appliance type:	Category I
	Appliance vent connection:	Single-wall metal connector
Vent connector capacity		

		Single-wall metal vent connector diameter – D (inch)								
		8			9			10		
		Appliance input rating limits in thousands of BTU per hour								
		FAN		NAT	FAN		NAT	FAN		NAT
Vent height h (feet)	Connector rise R (feet)	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	292	366	200	362	474	252	499	594	316
	2	301	432	231	373	557	299	509	696	376
	3	309	491	269	381	634	348	519	793	437
8	1	313	407	207	387	530	263	529	672	331
	2	323	465	238	397	607	309	540	766	391
	3	332	509	274	407	663	356	551	838	450
10	1	333	434	213	410	571	273	558	727	343
	2	343	489	244	420	640	317	569	813	403
	3	352	530	279	430	694	363	580	880	459
15	1	349	502	225	445	646	291	623	808	366
	2	359	548	256	456	706	334	634	884	424
	3	368	586	289	466	755	378	646	945	479
20	1	345	569	235	439	734	306	614	921	387
	2	355	610	266	450	787	348	627	986	443
	3	365	644	298	461	831	391	639	1042	496
30	1	338	665	250	430	864	330	600	1089	421
	2	348	699	282	442	908	372	613	1145	473
	3	358	729	312	452	946	412	626	1193	524
50	1	328	778	287	417	1022	383	582	1302	492
	2	339	806	320	429	1058	425	596	1346	545
	3	349	831	351	440	1090	466	610	1386	597
100	1	315	875	328	402	1181	444	560	1537	580
	2	326	899	361	415	1210	488	575	1570	634
	3	337	921	392	427	1238	529	589	1604	687

	Common vent capacity								
	Minimum internal area of masonry chimney flue (square inches)								
	63			78			113		
	Combined appliance input rating in thousands of BTU per hour								
Vent height H (feet)	FAN+FAN	FAN+NAT	NAT+NAT	FAN+FAN	FAN+NAT	NAT+NAT	FAN+FAN	FAN+NAT	NAT+NAT
6	NA	455	187	NA	579	245	NA	846	NA
8	NA	497	217	NA	633	277	1136	928	405
10	NA	532	234	771	680	300	1216	1000	450
15	677	602	280	866	772	360	1359	1139	540
20	765	661	321	947	849	415	1495	1264	640
30	808	739	377	1052	957	490	1682	1447	740

50	NA	821	456	1152	1076	600	1879	1672	910
100	NA	NA	494	NA	NA	663	2006	1885	1046

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m²
 * NA: Not applicable.

Table A.11 — Single-wall metal pipe or type b asbestos-cement vent [NFPA 54: TABLE 13.2(e)]

				Number of appliances:		Two or more	
				Appliance type:		Draft hood-equipment	
				Appliance vent connection:		Direct to pipe or vent	
		Vent connector capacity					
		Vent connector diameter – D (inch)					
		3	4	5	6	7	8
Total vent Height H (feet)	Connector Rise R (feet)	Maximum appliance input rating in thousands of BTU per hour					
		21	40	68	102	146	205
6-8	2	28	53	86	124	178	235
	3	34	61	98	147	204	275
	1	23	44	77	117	179	240
15	2	30	56	92	134	194	265
	3	35	64	102	155	216	298
30 and up	1	25	49	84	129	190	270
	2	31	58	97	145	211	295
	3	36	68	107	164	232	321

Total vent height H (feet)	Common vent capacity						
	Common vent diameter – D (inch)						
	4	5	6	7	8	10	12
	Combined appliance input rating in thousands of BTU per hour						
6	48	78	111	155	205	320	NA
8	55	89	128	175	234	365	505
10	59	95	136	190	250	395	560
15	71	115	168	228	305	480	690
20	80	129	186	260	340	550	790
30	NA	147	215	300	400	650	940

50	NA	NA	NA	360	490	810	1190
For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m ²							
* NA: Not applicable.							

Table A.12 — Exterior masonry chimney [NFPA 54: TABLE 13.2(f)]

				Number of appliances:		Two or more		
				Appliance type:		NAT + NAT		
				Appliance vent connection:		Type b double-wall connector		
Combined appliance maximum input rating in thousands of BTU per hour								
Vent height H (feet)	Internal area of chimney (square inches)							
	12	19	28	38	50	63	78	113
6	25	46	71	103	143	188	246	NA
8	28	53	82	119	163	218	278	408
10	31	56	90	131	177	236	302	454
15	NA	67	106	152	212	283	365	546
20	NA	NA	NA	NA	NA	325	419	648
30	NA	NA	NA	NA	NA	NA	496	749
50	NA	NA	NA	NA	NA	NA	NA	922
100	NA	NA	NA	NA	NA	NA	NA	NA

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Table A.13 — Exterior masonry chimney [NFPA 54: TABLE 13.2(g)]

				Number of appliances:		Two or more		
				Appliance type:		NAT + NAT		
				Appliance vent connection:		Type b double-wall connector		
Minimum allowable input rating of space-heating appliance in thousands of BTU per hour								
Vent height H (feet)	Internal area of chimney (square inches)							
	12	19	28	38	50	63	78	113
Local 99% winter design temperature: 37°F or greater								
6	0	0	0	0	0	0	0	NA
8	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
15	NA	0	0	0	0	0	0	0
20	NA	NA	NA	NA	NA	184	0	0
30	NA	NA	NA	NA	NA	393	334	0
50	NA	NA	NA	NA	NA	NA	NA	579
100	NA	NA	NA	NA	NA	NA	NA	NA
Local 99% winter design temperature: 27°F to 36°F								
6	0	0	68	NA	NA	180	212	NA
8	0	0	82	NA	NA	187	214	263
10	0	51	NA	NA	NA	201	225	265
15	NA	NA	NA	NA	NA	253	274	305
20	NA	NA	NA	NA	NA	307	330	362
30	NA	NA	NA	NA	NA	NA	445	485
50	NA	NA	NA	NA	NA	NA	NA	763
100	NA	NA	NA	NA	NA	NA	NA	NA
Local 99% winter design temperature: 17°F to 26°F								
6	NA	NA	NA	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA	NA	264	352
10	NA	NA	NA	NA	NA	NA	278	358
15	NA	NA	NA	NA	NA	NA	331	398
20	NA	NA	NA	NA	NA	NA	387	457
30	NA	NA	NA	NA	NA	NA	NA	581

50	NA	NA	NA	NA	NA	NA	NA	862
100	NA	NA	NA	NA	NA	NA	NA	NA
Local 99% winter design temperature: 5°F to 16°F								
6	NA	NA	NA	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA	NA	NA	NA
10	NA	NA	NA	NA	NA	NA	NA	430
15	NA	NA	NA	NA	NA	NA	NA	485
20	NA	NA	NA	NA	NA	NA	NA	547
30	NA	NA	NA	NA	NA	NA	NA	682
50	NA	NA	NA	NA	NA	NA	NA	NA
100	NA	NA	NA	NA	NA	NA	NA	NA
Local 99% winter design temperature: 4°F or lower Not recommended for any vent configurations								
For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m ² , °C = (°F-32)/1.8								
NA: Not applicable.								

Table A.14 — Exterior masonry chimney [NFPA 54: TABLE 13.2(h)]

				Number of appliances:		Two or more		
				Appliance type:		FAN + NAT		
				Appliance vent connection:		Type b double-wall connector		
Combined appliance maximum input rating in thousands of BTU per hour								
Vent height H (feet)	Internal area of chimney (square inches)							
	12	19	28	38	50	63	78	113
6	74	119	178	257	351	458	582	853
8	80	130	193	279	384	501	636	937
10	84	138	207	299	409	538	686	1010
15	NA	152	233	334	467	611	781	1156
20	NA	NA	250	368	508	668	858	1286
30	NA	NA	NA	404	564	747	969	1473
50	NA	NA	NA	NA	NA	831	1089	1692
100	NA	NA	NA	NA	NA	NA	NA	1921

Table A.15 — Exterior masonry chimney [NFPA 54: TABLE 13.2(i)]

	Number of appliances:	Two or more
	Appliance type:	FAN + NAT
	Appliance vent connection:	Type b double-wall connector
Minimum allowable input rating of space-heating appliance in thousands of BTU per hour		

Vent height H (feet)	Internal area of chimney (square inches)							
	12	19	28	38	50	63	78	113
Local 99% winter design temperature: 37°F or greater								
6	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
15	NA	0	0	0	0	0	0	0
20	NA	NA	123	190	249	184	0	0
30	NA	NA	NA	334	398	393	334	0
50	NA	NA	NA	NA	NA	714	707	579
100	NA	NA	NA	NA	NA	NA	NA	1600
Local 99% winter design temperature: 27°F to 36°F								
6	0	0	68	116	156	180	212	266
8	0	0	82	127	167	187	214	263
10	0	51	97	141	183	201	225	265
15	NA	111	142	183	233	253	274	305
20	NA	NA	187	230	284	307	330	362
30	NA	NA	NA	330	319	419	445	485
50	NA	NA	NA	NA	NA	672	705	763
100	NA	NA	NA	NA	NA	NA	NA	1554
Local 99% winter design temperature: 17°F to 26°F								
6	0	55	99	141	182	215	259	349
8	52	74	111	154	197	226	264	352
10	NA	90	125	169	214	245	278	358
15	NA	NA	167	212	263	296	331	398
20	NA	NA	212	258	316	352	387	457
30	NA	NA	NA	362	429	470	507	581
50	NA	NA	NA	NA	NA	723	766	862
100	NA	NA	NA	NA	NA	NA	NA	1669
Local 99% winter design temperature: 5°F to 16°F								
6	NA	78	121	166	214	252	301	416
8	NA	94	135	182	230	269	312	423
10	NA	111	149	198	250	289	331	430
15	NA	NA	193	247	305	346	393	485
20	NA	NA	NA	293	360	408	450	547
30	NA	NA	NA	377	450	531	580	682
50	NA	NA	NA	NA	NA	797	853	972
100	NA	NA	NA	NA	NA	NA	NA	1833

Local 99% winter design temperature: -10°F to 4°F								
6	NA	NA	145	196	249	296	349	484
8	NA	NA	159	213	269	320	371	494
10	NA	NA	175	231	292	339	397	513
15	NA	NA	NA	283	351	404	457	586
20	NA	NA	NA	333	408	468	528	650
30	NA	NA	NA	NA	NA	603	667	805
50	NA	NA	NA	NA	NA	NA	955	1003
100	NA	NA	NA	NA	NA	NA	NA	NA
Local 99% winter design temperature: -11°F or lower Not recommended for any vent configurations								
For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW, 1 square inch = 0.000645 m ² , °C = (°F-32)/1.8								
NA: Not applicable.								

Bibliography

- [1] *Uniform Plumbing Code* (2024 Edition, IAPMO)

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