Table 7.2.6.2 Support of Piping

Steel Pipe, Nominal Size of Pipe (in.)	Spacing of Supports (ft)	Nominal Size of Tubing Smooth Wall (in. O.D.)	Spacing of Supports (ft)
½	6	½	4
¾ or 1	8	⅝ or ¾	6
1¼ or larger (horizontal)	10	⅞ or 1 (horizontal)	8
1¼ or larger (vertical)	Every floor level	1 or larger (vertical)	Every floor level

For SI units, 1 ft = 0.305 m.

7.2.7 CSST. CSST piping systems shall be installed in accordance with this code and the manufacturer's installation instructions.

7.3 Concealed Piping in Buildings.

7.3.1 General. Gas piping in concealed locations shall be installed in accordance with this section.

7.3.2 Fittings in Concealed Locations. Fittings installed in concealed locations shall be limited to the following types:

(1) Threaded elbows, tees, couplings, caps, and plugs
(2) Brazed fittings
(3) Welded fittings
(4) Fittings listed to ANSI LC 1/CSA 6.26, *Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST)*, or ANSI LC 4/CSA 6.32, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems*

7.3.3 Piping in Partitions. Concealed gas piping shall not be located in solid partitions.

7.3.4 Tubing in Partitions. This provision shall not apply to tubing that pierces walls, floors, or partitions. Tubing installed vertically and horizontally inside hollow walls or partitions without protection along its entire concealed length shall meet the following requirements:

(1) A steel striker barrier not less than 0.0508 in. (1.3 mm) thick, or equivalent, is installed between the tubing and the finished wall and extends at least 4 in. (100 mm) beyond concealed penetrations of plates, firestops, wall studs, and so on.
(2) The tubing is installed in single runs and is not rigidly secured.

7.3.5 Piping in Floors.

7.3.5.1 Industrial Occupancies. In industrial occupancies, gas piping in solid floors such as concrete shall be laid in channels in the floor and covered to permit access to the piping with a minimum of damage to the building. Where piping in floor channels could be exposed to excessive moisture or corrosive substances, the piping shall be protected in an approved manner.

7.3.5.2 Other Occupancies. In other than industrial occupancies and where approved by the authority having jurisdiction, gas piping embedded in concrete floor slabs constructed with Portland cement shall be surrounded with a minimum of 1½ in. (38 mm) of concrete and shall not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. All piping, fittings, and risers shall be protected against corrosion in accordance with 7.2.2. Piping shall not be embedded in concrete slabs containing quickset additives or cinder aggregate.

7.3.6 Shutoff Valves in Tubing Systems. Shutoff valves in tubing systems in concealed locations shall be rigidly and securely supported independently of the tubing.

7.4 Piping in Vertical Chases. Where gas piping exceeding 5 psi (34 kPa) is located within vertical chases in accordance with 5.4.1, the requirements of 7.4.1 through 7.4.3 shall apply.

7.4.1 Pressure Reduction. Where pressure reduction is required in branch connections for compliance with 5.4.1, such reduction shall take place either inside the chase or immediately adjacent to the outside wall of the chase. Regulator venting and downstream overpressure protection shall comply with 5.7.5 and Section 5.8. The regulator shall be accessible for service and repair and vented in accordance with one of the following:

(1) Where the fuel gas is lighter than air, regulators equipped with a vent limiting means shall be permitted to be vented into the chase. Regulators not equipped with a vent limiting means shall be permitted to be vented either directly to the outdoors or to a point within the top 1 ft (0.3 m) of the chase.
(2) Where the fuel gas is heavier than air, the regulator vent shall be vented only directly to the outdoors.

7.4.2 Chase Construction. Chase construction shall comply with local building codes with respect to fire resistance and protection of horizontal and vertical openings.

7.4.3* Ventilation. A chase shall be ventilated to the outdoors and only at the top. The opening(s) shall have a minimum free area [in square inches (square meters)] equal to the product of one-half of the maximum pressure in the piping [in pounds per square inch (kilopascals)] times the largest nominal diameter of that piping [in inches (millimeters)], or the cross-sectional area of the chase, whichever is smaller. Where more than one fuel gas piping system is present, the free area for each system shall be calculated and the largest area used.

7.5 Gas Pipe Turns. Changes in direction of gas pipe shall be made by the use of fittings, factory bends, or field bends.

7.5.1 Metallic Pipe. Metallic pipe bends shall comply with the following:

(1) Bends shall be made only with bending tools and procedures intended for that purpose.
(2) All bends shall be smooth and free from buckling, cracks, or other evidence of mechanical damage.
(3) The longitudinal weld of the pipe shall be near the neutral axis of the bend.
(4) Pipe shall not be bent through an arc of more than 90 degrees.
(5) The inside radius of a bend shall be not less than 6 times the outside diameter of the pipe.

7.5.2 Plastic Pipe. Plastic pipe bends shall comply with the following:

(1) The pipe shall not be damaged, and the internal diameter of the pipe shall not be effectively reduced.
(2) Joints shall not be located in pipe bends.
(3) The radius of the inner curve of such bends shall not be less than 25 times the inside diameter of the pipe.

(4) Where the piping manufacturer specifies the use of special bending tools or procedures, such tools or procedures shall be used.

7.5.3 Elbows. Factory-made welding elbows or transverse segments cut therefrom shall have an arc length measured along the crotch of at least 1 in. (25 mm) for pipe sizes 2 in. (50 mm) and larger.

7.6 Drips and Sediment Traps.

7.6.1 Provide Drips Where Necessary. For other than dry gas conditions, a drip shall be provided at any point in the line of pipe where condensate could collect. Where required by the authority having jurisdiction or the serving gas supplier, a drip shall also be provided at the outlet of the meter. This drip shall be installed so as to constitute a trap wherein an accumulation of condensate shuts off the flow of gas before it runs back into the meter.

7.6.2 Location of Drips. All drips shall be installed only in such locations that they are readily accessible to permit cleaning or emptying. A drip shall not be located where the condensate is likely to freeze.

7.6.3 Sediment Traps. The installation of sediment traps shall be in accordance with 9.6.8.

7.7 Outlets.

7.7.1 Location and Installation.

7.7.1.1 The outlet fittings or piping shall be securely fastened in place.

7.7.1.2 Outlets shall not be located behind doors.

7.7.1.3 Outlets shall be located far enough from floors, walls, patios, slabs, and ceilings to permit the use of wrenches without straining, bending, or damaging the piping.

7.7.1.4 The unthreaded portion of gas piping outlets shall extend not less than 1 in. (25 mm) through finished ceilings or indoor or outdoor walls.

7.7.1.5 The unthreaded portion of gas piping outlets shall extend not less than 2 in. (50 mm) above the surface of floors or outdoor patios or slabs.

7.7.1.6 The provisions of 7.7.1.4 and 7.7.1.5 shall not apply to listed quick-disconnect devices of the flush-mounted type or listed gas convenience outlets. Such devices shall be installed in accordance with the manufacturers' installation instructions.

7.7.2 Cap All Outlets.

7.7.2.1 Each outlet, including a valve, shall be closed gastight with a threaded plug or cap immediately after installation and shall be left closed until the appliance or equipment is connected thereto. When an appliance or equipment is disconnected from an outlet and the outlet is not to be used again immediately, it shall be capped or plugged gastight.

Exception No. 1: Laboratory appliances installed in accordance with 9.6.2(1) shall be permitted.

Exception No. 2: The use of a listed quick-disconnect device with integral shutoff or listed gas convenience outlet shall be permitted.

7.7.2.2 Appliance shutoff valves installed in fireplaces shall be removed and the piping capped gastight where the fireplace is used for solid fuel burning.

7.8 Manual Gas Shutoff Valves.

Δ 7.8.1 Accessibility of Gas Valves.

***N* 7.8.1.1** System shutoff valves shall be readily accessible for operation and installed so as to be protected from physical damage.

***N* 7.8.1.2** System shutoff valves shall be marked with a metal tag or other permanent means attached by the installing agency so that the gas piping systems supplied through them can be readily identified.

7.8.2 Valves at Regulators. An accessible gas shutoff valve shall be provided upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve shall not be required at the second regulator.

7.8.3 Valves Controlling Multiple Systems.

7.8.3.1 Shutoff Valves for Multiple House Lines. In multiple-tenant buildings supplied through a master meter, through one service regulator where a meter is not provided, or where meters or service regulators are not readily accessible from the appliance or equipment location, an individual shutoff valve for each apartment or tenant line shall be provided at a convenient point of general accessibility. In a common system serving a number of individual buildings, shutoff valves shall be installed at each building.

7.8.3.2 Emergency Shutoff Valves. An exterior shutoff valve to permit turning off the gas supply to each building in an emergency shall be provided. The emergency shutoff valves shall be plainly marked as such and their locations posted as required by the authority having jurisdiction.

7.8.3.3 Shutoff Valve for Laboratories. Each laboratory space containing two or more gas outlets installed on tables, benches, or in hoods in educational, research, commercial, and industrial occupancies shall have a single shutoff valve through which all such gas outlets are supplied. The shutoff valve shall be accessible, located within the laboratory or adjacent to the laboratory's egress door, and identified.

***N* 7.8.4* System Shutoff Valves.** Where a system shutoff valve is installed, the valve shall comply with Section 5.11.

7.9 Prohibited Devices. Devices shall not be placed within the interior of gas piping or fittings where such devices reduce the cross-sectional area or otherwise obstruct the free flow of gas, except where allowance in the piping system design has been made for such devices.

7.10 Systems Containing Gas–Air Mixtures Outside the Flammable Range. Where gas–air mixing machines are employed to produce mixtures above or below the flammable range, they shall be provided with stops to prevent adjustment of the mixture to within or approaching the flammable range.

7.11 Systems Containing Flammable Gas–Air Mixtures.

7.11.1 Required Components. A central premix system with a flammable mixture in the blower or compressor shall consist of the following components:

(1) Gas-mixing machine in the form of an automatic gas–air proportioning device combined with a downstream blower or compressor
(2) Flammable mixture piping, minimum Schedule 40

(3) Automatic firecheck(s)
(4) Safety blowout(s) or backfire preventers for systems utilizing flammable mixture lines above 2½ in. (64 mm) nominal pipe size or the equivalent

7.11.2 Optional Components. The following components shall also be permitted to be utilized in any type of central premix system:

(1) Flowmeter(s)
(2) Flame arrester(s)

7.11.3 Additional Requirements. Gas-mixing machines shall have nonsparking blowers and shall be constructed so that a flashback does not rupture machine casings.

7.11.4* Special Requirements for Mixing Blowers. A mixing blower system shall be limited to applications with minimum practical lengths of mixture piping, limited to a maximum mixture pressure of 10 in. w.c. (2.5 kPa) and limited to gases containing no more than 10 percent hydrogen. The blower shall be equipped with a gas control valve at its air entrance arranged so that gas is admitted to the airstream, entering the blower in proper proportions for correct combustion by the type of burners employed, the said gas control valve being of either the zero governor or mechanical ratio valve type that controls the gas and air adjustment simultaneously. No valves or other obstructions shall be installed between the blower discharge and the burner or burners.

7.11.5 Installation of Gas-Mixing Machines.

Δ **7.11.5.1* Location.** The gas-mixing machine shall be located in a well-ventilated area or in a detached building or cutoff room provided with room construction and explosion vents in accordance with engineering methods. Such rooms or below-grade installations shall have adequate positive ventilation.

7.11.5.2 Electrical Requirements. Where gas-mixing machines are installed in well-ventilated areas, the type of electrical equipment shall be in accordance with *NFPA 70* for general service conditions unless other hazards in the area prevail. Where gas-mixing machines are installed in small detached buildings or cutoff rooms, the electrical equipment and wiring shall be installed in accordance with *NFPA 70* for hazardous locations (Articles 500 and 501, Class I, Division 2).

7.11.5.3 Air Intakes. Air intakes for gas-mixing machines using compressors or blowers shall be taken from outdoors whenever practical.

7.11.5.4* Controls. Controls for gas-mixing machines shall include interlocks and a safety shutoff valve of the manual reset type in the gas supply connection to each machine arranged to automatically shut off the gas supply in the event of high or low gas pressure. Except for open burner installations only, the controls shall be interlocked so that the blower or compressor stops operating following a gas supply failure. Where a system employs pressurized air, means shall be provided to shut off the gas supply in the event of air failure.

7.11.5.5 Installation in Parallel. Centrifugal gas-mixing machines in parallel shall be reviewed by the user and equipment manufacturer before installation, and means or plans for minimizing the effects of downstream pulsation and equipment overload shall be prepared and utilized as needed.

7.11.6 Use of Automatic Firechecks, Safety Blowouts, or Backfire Preventers. Automatic firechecks and safety blowouts or backfire preventers shall be provided in piping systems distributing flammable air–gas mixtures from gas-mixing machines to protect the piping and the machines in the event of flashback, in accordance with the following:

(1)* Approved automatic firechecks shall be installed upstream as close as practical to the burner inlets following the firecheck manufacturers' instructions.
(2) A separate manually operated gas valve shall be provided at each automatic firecheck for shutting off the flow of the gas–air mixture through the firecheck after a flashback has occurred. The valve shall be located upstream as close as practical to the inlet of the automatic firecheck. Caution: these valves shall not be reopened after a flashback has occurred until the firecheck has cooled sufficiently to prevent re-ignition of the flammable mixture and has been reset properly.
(3) A safety blowout or backfiring preventer shall be provided in the mixture line near the outlet of each gas-mixing machine where the size of the piping is larger than 2½ in. (64 mm) NPS, or equivalent, to protect the mixing equipment in the event of an explosion passing through an automatic firecheck. The manufacturers' instructions shall be followed when installing these devices, particularly after a disc has burst. The discharge from the safety blowout or backfire preventer shall be located or shielded so that particles from the ruptured disc cannot be directed toward personnel. Wherever there are interconnected installations of gas-mixing machines with safety blowouts or backfire preventers, provision shall be made to keep the mixture from other machines from reaching any ruptured disc opening. Check valves shall not be used for this purpose.
(4) Large-capacity premix systems provided with explosion heads (rupture discs) to relieve excessive pressure in pipelines shall be located at and vented to a safe outdoor location. Provisions shall be provided for automatically shutting off the supply of the gas–air mixture in the event of rupture.

7.12 Electrical Bonding and Grounding.

7.12.1 Pipe and Tubing Other than CSST. Each aboveground portion of a gas piping system, other than CSST, that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping, other than CSST, shall be considered to be bonded when it is connected to appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.

7.12.2* CSST. CSST gas piping systems, and gas piping systems containing one or more segments of CSST, shall be electrically continuous and bonded to the electrical service grounding electrode system or, where provided, lightning protection grounding electrode system.

7.12.2.1 The bonding jumper shall connect to a metallic pipe, pipe fitting, or CSST fitting.

7.12.2.2 The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent.

7.12.2.3* The length of the jumper between the connection to the gas piping system and the grounding electrode system shall not exceed 75 ft (22 m). Any additional grounding electrodes installed to meet this requirement shall be bonded to the electrical service grounding electrode system or, where provided, lightning protection grounding electrode system.

7.12.2.4 Bonding connections shall be in accordance with *NFPA 70.*

Δ **7.12.2.5** Devices used for the bonding connection shall be listed for the application in accordance with UL 467, *Grounding and Bonding Equipment.*

7.12.3 Arc-Resistant Jacketed CSST. CSST listed with an arc-resistant jacket or coating system in accordance with ANSI LC 1/CSA 6.26, *Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing,* shall be electrically continuous and bonded to an effective ground fault current path. Where any CSST component of a piping system does not have an arc-resistant jacket or coating system, the bonding requirements of 7.12.2 shall apply. Arc-resistant jacketed CSST shall be considered to be bonded when it is connected to appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.

Δ **7.12.4 Electrical Isolation.**

N **7.12.4.1*** Gas piping shall not be used as a grounding conductor or electrode.

N **7.12.4.2** Underground metallic piping shall be provided with a dielectric fitting installed at building penetrations.

N **7.12.4.2.1** Dielectric fittings shall not be installed underground.

7.12.5* Lightning Protection Systems. Where a lightning protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780.

7.13 Electrical Circuits. Electrical circuits shall not utilize gas piping or components as conductors.

Exception: Low-voltage (50 V or less) control circuits, ignition circuits, and electronic flame detection device circuits shall be permitted to make use of piping or components as a part of an electric circuit.

7.14 Electrical Connections.

7.14.1 All electrical connections between wiring and electrically operated control devices in a piping system shall conform to the requirements of *NFPA 70.*

7.14.2 Any essential safety control depending on electric current as the operating medium shall be of a type that shuts off (fail safe) the flow of gas in the event of current failure.

Chapter 8 Inspection, Testing, and Purging

8.1 Pressure Testing and Inspection.

8.1.1* General.

8.1.1.1 Prior to acceptance and initial operation, all piping installations shall be visually inspected and pressure tested to determine that the materials, design, fabrication, and installation practices comply with the requirements of this code.

8.1.1.2 Inspection shall consist of visual examination, during or after manufacture, fabrication, assembly, or pressure tests.

8.1.1.3 Where repairs or additions are made following the pressure test, the affected piping shall be tested. Minor repairs and additions are not required to be pressure tested, provided that the work is inspected and connections are tested with a noncorrosive leak-detecting fluid or other leak-detecting methods approved by the authority having jurisdiction.

8.1.1.4 Where new branches are installed to new appliance(s), only the newly installed branch(es) shall be required to be pressure tested. Connections between the new piping and the existing piping shall be tested with a noncorrosive leak-detecting fluid or approved leak-detecting methods.

8.1.1.5 A piping system shall be tested as a complete unit or in sections. Under no circumstances shall a valve in a line be used as a bulkhead between gas in one section of the piping system and test medium in an adjacent section, unless a double block and bleed valve system is installed. A valve shall not be subjected to the test pressure unless it can be determined that the valve, including the valve closing mechanism, is designed to safely withstand the pressure.

8.1.1.6 Regulator and valve assemblies fabricated independently of the piping system in which they are to be installed shall be permitted to be tested with inert gas or air at the time of fabrication.

8.1.1.7* Prior to testing, the interior of the pipe shall be cleared of all foreign material.

8.1.2 Test Medium. The test medium shall be air, nitrogen, carbon dioxide, or an inert gas. Oxygen shall not be used as a test medium.

8.1.3 Test Preparation.

8.1.3.1 Pipe joints, including welds, shall be left exposed for examination during the test.

Exception: Covered or concealed pipe end joints that have been previously tested in accordance with this code.

8.1.3.2 Expansion joints shall be provided with temporary restraints, if required, for the additional thrust load under test.

8.1.3.3 Appliances and equipment that are not to be included in the test shall be either disconnected from the piping or isolated by blanks, blind flanges, or caps. Flanged joints at which blinds are inserted to blank off other equipment during the test shall not be required to be tested.

8.1.3.4 Where the piping system is connected to appliances or equipment designed for operating pressures of less than the test pressure, such appliances or equipment shall be isolated from the piping system by disconnecting them and capping the outlet(s).

8.1.3.5 Where the piping system is connected to appliances or equipment designed for operating pressures equal to or greater than the test pressure, such appliances or equipment shall be isolated from the piping system by closing the individual appliance or equipment shutoff valve(s).

8.1.3.6 All testing of piping systems shall be performed in a manner that protects the safety of employees and the public during the test.

8.1.4 Test Pressure.

8.1.4.1 Test pressure shall be measured with a manometer or with a pressure measuring device designed and calibrated to read, record, or indicate a pressure loss due to leakage during the pressure test period. The source of pressure shall be isolated before the pressure tests are made. Mechanical gauges used

to measure test pressures shall have a range such that the highest end of the scale is not greater than 5 times the test pressure.

8.1.4.2 The test pressure to be used shall be no less than 1½ times the proposed maximum working pressure, but not less than 3 psi (20 kPa), irrespective of design pressure. Where the test pressure exceeds 125 psi (862 kPa), the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength of the pipe.

8.1.4.3* Test duration shall be not less than ½ hour for each 500 ft^3 (14 m^3) of pipe volume or fraction thereof. When testing a system having a volume less than 10 ft^3 (0.28 m^3) or a system in a single-family dwelling, the test duration shall be a minimum of 10 minutes. The duration of the test shall not be required to exceed 24 hours.

8.1.5 Detection of Leaks and Defects.

8.1.5.1 The piping system shall withstand the test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate the presence of a leak unless such reduction can be readily attributed to some other cause.

8.1.5.2 The leakage shall be located by means of an approved gas detector, a noncorrosive leak detection fluid, or other approved leak detection methods.

8.1.5.3 Where leakage or other defects are located, the affected portion of the piping system shall be repaired or replaced and retested.

8.2 Piping System Leak Check.

8.2.1 Test Gases. Leak checks using fuel gas shall be permitted in piping systems that have been pressure tested in accordance with Section 8.1.

8.2.2 Turning Gas On. During the process of turning gas on into a system of new gas piping, the entire system shall be inspected to determine that there are no open fittings or ends and that all valves at unused outlets are closed and plugged or capped.

8.2.3* Leak Check. Immediately after the gas is turned on into a new system or into a system that has been initially restored after an interruption of service, the piping system shall be checked for leakage. Where leakage is indicated, the gas supply shall be shut off until the necessary repairs have been made.

8.2.4 Placing Appliances and Equipment in Operation. Appliances and equipment shall not be placed in operation until after the piping system has been checked for leakage in accordance with 8.2.3, the piping system is purged in accordance with Section 8.3, and connections to the appliance are checked for leakage.

8.3* Purging Requirements. The purging of piping shall be in accordance with 8.3.1 through 8.3.3.

8.3.1* Piping Systems Required to Be Purged Outdoors. The purging of piping systems shall be in accordance with 8.3.1.1 through 8.3.1.4 where the piping system meets either of the following:

(1) The design operating gas pressure is greater than 2 psig (14 kPag).
(2) The piping being purged contains one or more sections of pipe or tubing meeting the size and length criteria of Table 8.3.1.

Table 8.3.1 Size and Length of Piping*

Nominal Piping Size (in.)	Length of Piping (ft)
≥2½ <3	> 50
≥3 <4	> 30
≥4 <6	> 15
≥6 <8	> 10
≥8	Any length

For SI units, 1 in. = 25.4 mm; 1 ft = 0.305 m.
* CSST EHD size of 62 is equivalent to 2 in. nominal size pipe or tubing.

8.3.1.1 Removal from Service. Where existing gas piping is opened, the section that is opened shall be isolated from the gas supply and the line pressure vented in accordance with 8.3.1.3. Where gas piping meeting the criteria of Table 8.3.1 is removed from service, the residual fuel gas in the piping shall be displaced with an inert gas.

8.3.1.2* Placing in Operation. Where gas piping containing air and meeting the criteria of Table 8.3.1 is placed in operation, the air in the piping shall first be displaced with an inert gas. The inert gas shall then be displaced with fuel gas in accordance with 8.3.1.3.

8.3.1.3 Outdoor Discharge of Purged Gases. The open end of a piping system being pressure vented or purged shall discharge directly to an outdoor location. Purging operations shall comply with all of the following requirements:

(1) The point of discharge shall be controlled with a shutoff valve.
(2) The point of discharge shall be located at least 10 ft (3.0 m) from sources of ignition, at least 10 ft (3.0 m) from building openings and at least 25 ft (7.6 m) from mechanical air intake openings.
(3) During discharge, the open point of discharge shall be continuously attended and monitored with a combustible gas indicator that complies with 8.3.1.4.
(4) Purging operations introducing fuel gas shall be stopped when 90 percent fuel gas by volume is detected within the pipe.
(5) Persons not involved in the purging operations shall be evacuated from all areas within 10 ft (3.0 m) of the point of discharge.

8.3.1.4* Combustible Gas Indicator. Combustible gas indicators shall be listed and calibrated in accordance with the manufacturer's instructions. Combustible gas indicators shall numerically display a volume scale from 0 percent to 100 percent in 1 percent or smaller increments.

8.3.2* Piping Systems Allowed to Be Purged Indoors or Outdoors. The purging of piping systems shall be in accordance with the provisions of 8.3.2.1 where the piping system meets both of the following:

(1) The design operating pressure is 2 psig (14 kPag) or less.

(2) The piping being purged is constructed entirely from pipe or tubing not meeting the size and length criteria of Table 8.3.1.

8.3.2.1* Purging Procedure. The piping system shall be purged in accordance with one or more of the following:

(1) The piping shall be purged with fuel gas and shall discharge to the outdoors.
(2) The piping shall be purged with fuel gas and shall discharge to the indoors or outdoors through an appliance burner not located in a combustion chamber. Such burner shall be provided with a continuous source of ignition.
(3) The piping shall be purged with fuel gas and shall discharge to the indoors or outdoors through a burner that has a continuous source of ignition and that is designed for such purpose.
(4) The piping shall be purged with fuel gas that is discharged to the indoors or outdoors, and the point of discharge shall be monitored with a listed combustible gas detector in accordance with 8.3.2.2. Purging shall be stopped when fuel gas is detected.
(5) The piping shall be purged by the gas supplier in accordance with written procedures.

8.3.2.2 Combustible Gas Detector. Combustible gas detectors shall be listed and calibrated or tested in accordance with the manufacturer's instructions. Combustible gas detectors shall be capable of indicating the presence of fuel gas.

8.3.3 Purging Appliances and Equipment. After the piping system has been placed in operation, appliances and equipment shall be purged before being placed into operation.

Chapter 9 Appliance, Equipment, and Accessory Installation

9.1 General.

9.1.1* Appliances, Equipment, and Accessories to Be Approved. Appliances, equipment, and accessories shall be approved.

9.1.1.1 Listed appliances, equipment, and accessories shall be installed in accordance with Chapter 9 and the manufacturers' installation instructions.

9.1.1.2 Acceptance of unlisted appliances, equipment, and accessories shall be on the basis of engineering methods.

9.1.1.3 The unlisted appliance, equipment, or accessory shall be safe and suitable for the proposed service and shall be recommended for the service by the manufacturer.

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9.1.2 Added or Converted 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 9.3. Where existing facilities are not adequate, they shall be upgraded to meet Section 9.3 specifications.
(2) The installation components and appliances meet the clearances to combustible material provisions of 9.2.2. 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 Chapter 12. Where the existing venting system is not adequate, it shall be upgraded to comply with Chapter 12.

9.1.3 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.

9.1.4 Safety Shutoff Devices for Unlisted LP-Gas Appliances 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.

9.1.5 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 back pressure 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.

9.1.6* Protection of Appliances from Fumes or Gases Other than Products of Combustion.

9.1.6.1 Where corrosive or flammable process fumes or gases, such as carbon monoxide, hydrogen sulfide, ammonia, chlorine, and halogenated hydrocarbons, as are present, means for their safe disposal shall be provided.

9.1.6.2 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.

9.1.7 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.

9.1.8 Appliance Support.

9.1.8.1 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.

9.1.8.2 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.

9.1.9 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 9.1.10 through 9.1.12 shall be considered to comply with the intent of this provision.

9.1.10 Installation in Residential Garages.

9.1.10.1 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 burners and burner ignition devices are located not less than 18 in. (460 mm) above the floor unless listed as flammable vapor ignition resistant.

9.1.10.2 Such appliances shall be located or protected so they are not subject to physical damage by a moving vehicle.

9.1.10.3 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.

9.1.11 Installation in Commercial Garages.

9.1.11.1 Parking Structures. Appliances installed in enclosed, basement, and underground parking structures shall be installed in accordance with NFPA 88A.

9.1.11.2 Repair Garages. Appliances installed in repair garages shall be installed in accordance with NFPA 30A.

9.1.12 Installation in Aircraft Hangars. Heaters in aircraft hangars shall be installed in accordance with NFPA 409.

9.1.13 Appliance Physical Protection. Where locating appliances close to a passageway traveled by vehicles or machinery is necessary, guardrails or bumper plates shall be installed to protect the equipment from damage.

9.1.14 Venting of Flue Gases. Appliances shall be vented in accordance with the provisions of Chapter 12.

9.1.15 Extra Device or Attachment. No device or attachment shall be installed on any appliance that could in any way impair the combustion of gas.

• **9.1.16 Avoiding Strain on Gas Piping.** Appliances shall be supported and connected to the piping so as not to exert undue strain on the connections.

9.1.17 Gas 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 ANSI Z21.18/CSA 6.3, *Gas Appliance Pressure Regulators*, shall be installed.

• **9.1.18 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.

9.1.19 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.

Δ **9.1.20* 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.

9.1.21 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.

9.1.22* Existing Appliances. Existing appliance installations shall be inspected to verify compliance with the provisions of Section 9.3 and Chapter 12 where a component of the building envelope is modified as described by one or more of 9.1.22(1) through 9.1.22(6). Where the appliance installation does not comply with Section 9.3 and Chapter 12, the installation shall be altered as necessary to be in compliance with Section 9.3 and Chapter 12.

(1) The building is modified under a weatherization program.
(2) A building permit is issued for a building addition or exterior building modification.
(3) Three or more window assemblies are replaced.
(4) Three or more storm windows are installed over existing windows.
(5) One or more exterior door and frame assemblies are replaced.
(6) A building air barrier is installed or replaced.

9.2 Accessibility and Clearance.

9.2.1 Accessibility for Service. All appliances shall be located with respect to building construction and other equipment so as to permit access to the appliance. Sufficient clearance shall be maintained to permit 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 floored.

9.2.2 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 Chapters 10 and 12. *(Reference can also be made to NFPA 211.)*

9.2.3 Installation on Carpeting. Appliances shall not be installed on carpeting, unless the appliances are listed for such installation.

9.3* Air for Combustion and Ventilation.

9.3.1 General.

9.3.1.1 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 9.3.2 through 9.3.6. Where the requirements of 9.3.2 are not met, outdoor air shall be introduced in accordance with methods covered in 9.3.3 through 9.3.6.

Exception No. 1: This provision shall not apply to direct vent appliances.

Exception No. 2: Type 1 clothes dryers that are provided with make-up air in accordance with 10.4.4.

9.3.1.2 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.

9.3.1.3 Appliances shall be located so as not to interfere with proper circulation of combustion, ventilation, and dilution air.

9.3.1.4 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.

9.3.1.5 Where exhaust fans, clothes dryers, and kitchen ventilation systems interfere with the operation of appliances, make-up air shall be provided.

9.3.2 Indoor Combustion Air. The required volume of indoor air shall be determined in accordance with the method in 9.3.2.1 or 9.3.2.2 except that where the air infiltration rate is known to be less than 0.40 *ACH* (air change per hour), the method in 9.3.2.2 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 9.3.2.3, are considered a part of the required volume.

9.3.2.1* Standard Method. The minimum required volume shall be 50 ft^3/1000 Btu/hr (4.8 m^3/kW).

Δ 9.3.2.2* Known Air Infiltration Rate Method. Where the air infiltration rate of a structure is known, the minimum required volume shall be determined as follows:

(1) For appliances other than fan assisted, calculate using the following equation:

[9.3.2.2a]

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

(2) For fan-assisted appliances, calculate using the following equation:

[9.3.2.2b]

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

where:

I_{other} = all appliances other than fan-assisted input (Btu/hr)
I_{fan} = fan-assisted appliance input (Btu/hr)
ACH = air change per hour (percent of volume of space exchanged per hour, expressed as a decimal)

(3) For purposes of these calculations, an infiltration rate greater than 0.60 *ACH* shall not be used in Equations 9.3.2.2a and 9.3.2.2b.

9.3.2.3 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 $in.^2$/1000 Btu/hr (2200 mm^2/kW) of the total input rating of all appliances in the space but not less than 100 $in.^2$ (0.06 m^2). One permanent opening shall commence within 12 in. (300 mm) of the top of the enclosure and one permanent opening shall commence within 12 in. (300 mm) of the bottom of the enclosure. The minimum dimension of air openings shall not be less than 3 in. (80 mm).

(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 $in.^2$/1000 Btu/hr (4400 mm^2/kW) of total input rating of all appliances.

9.3.3 Outdoor Combustion Air. Outdoor combustion air shall be provided through opening(s) to the outdoors in accordance with the methods in 9.3.3.1 or 9.3.3.2. The minimum dimension of air openings shall not be less than 3 in. (80 mm).

9.3.3.1 Two Permanent Openings Method. Two permanent openings, one commencing within 12 in. (300 mm) of the top of the enclosure and one commencing within 12 in. (300 mm) 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 $in.^2$/4000 Btu/hr (550 mm^2/kW) of total input rating of all appliances in the enclosure.

(2)* Where communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 $in.^2$/2000 Btu/hr (1100 mm^2/kW) of total input rating of all appliances in the enclosure.

9.3.3.2* One Permanent Opening Method. One permanent opening, commencing within 12 in. (300 mm) of the top of the enclosure, shall be provided. The appliance shall have clearances of at least 1 in. (25 mm) from the sides and back and 6 in. (150 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 and shall have a minimum free area of the following:

(1) 1 $in.^2$/3000 Btu/hr (700 mm^2/kW) 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

9.3.4 Combination Indoor and Outdoor Combustion Air. The use of a combination of indoor and outdoor combustion air shall be in accordance with the following:

(1) *Indoor openings.* Where used, openings connecting the interior spaces shall comply with 9.3.2.3.
(2) *Outdoor opening(s) location.* Outdoor opening(s) shall be located in accordance with 9.3.3.
(3) *Outdoor opening(s) size.* The outdoor opening(s) size shall be calculated in accordance with the following:
    (a) The ratio of the interior spaces shall be the available volume of all communicating spaces divided by the required volume.
    (b) The outdoor size reduction factor shall be 1 minus the ratio of interior spaces.
    (c) The minimum size of outdoor opening(s) shall be the full size of outdoor opening(s) calculated in accordance with 9.3.3, multiplied by the reduction factor. The minimum dimension of air openings shall not be less than 3 in. (80 mm).

9.3.5 Engineered Installations. Engineered combustion air installations shall provide an adequate supply of combustion, ventilation, and dilution air determined using engineering methods.

9.3.6 Mechanical Combustion Air Supply. 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 ft^3/min/1000 Btu/hr (0.034 m^3/min/kW) for all appliances located within the space.

9.3.6.1 Where exhaust fans are installed, additional air shall be provided to replace the exhausted air.

9.3.6.2 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.

9.3.6.3 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.

9.3.7 Louvers, Grilles, and Screens.

9.3.7.1 Louvers and Grilles. 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.

9.3.7.2 Minimum Screen Mesh Size. Screens shall not be smaller than ¼ in. (7 mm) mesh.

9.3.7.3 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.

9.3.8 Combustion Air Ducts. Combustion air ducts shall comply with 9.3.8.1 through 9.3.8.8.

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.

9.3.8.2 Ducts shall terminate in an unobstructed space, allowing free movement of combustion air to the appliances.

9.3.8.3 Ducts shall serve a single space.

9.3.8.4 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.

9.3.8.5 Ducts shall not be screened where terminating in an attic space.

9.3.8.6 Horizontal upper combustion air ducts shall not slope downward toward the source of combustion air.

9.3.8.7 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.

9.3.8.8 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 in. (300 mm) vertically from the adjoining finished ground level.

9.4 Appliances on Roofs.

9.4.1 General.

9.4.1.1 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 a 30 in. (760 mm) clearance between the entire service access panel(s) of the appliance and the wall of the enclosure.

9.4.1.2 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.

9.4.1.3 All access locks, screws, and bolts shall be of corrosion-resistant material.

9.4.2 Installation of Appliances on Roofs.

9.4.2.1 Appliances shall be installed in accordance with the manufacturers' installation instructions.

9.4.2.2 Appliances shall be installed on a well-drained surface of the roof. At least 6 ft (1.8 m) 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 42 in. (1.1 m) in height shall be provided on the exposed side.

Δ **9.4.2.3** Appliances requiring an external source of electrical power shall be installed in accordance with *NFPA 70*.

9.4.2.4 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.

9.4.3 Access to Appliances on Roofs.

9.4.3.1 Appliances located on roofs or other elevated locations shall be accessible.

9.4.3.2 Buildings of more than 15 ft (4.6 m) in height shall have an inside means of access to the roof, unless other means acceptable to the authority having jurisdiction are used.

9.4.3.3 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 22 in. × 24 in. (560 mm × 610 mm) 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 6 ft (1.8 m) 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 42 in. (1.1 m) 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 42 in. (1.1 m) in height.

9.4.3.4 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.

9.5 Appliances in Attics.

9.5.1 Attic Access. An attic in which an appliance is installed shall be accessible through an opening and passageway at least as large as the largest component of the appliance and not less than 22 in. × 30 in. (560 mm × 760 mm).

9.5.1.1 Where the height of the passageway is less than 6 ft (1.8 m), the distance from the passageway access to the appliance shall not exceed 20 ft (6.1 m) measured along the centerline of the passageway.

9.5.1.2 The passageway shall be unobstructed and shall have solid flooring not less than 24 in. (610 mm) wide from the entrance opening to the appliance.

9.5.2 Work Platform. A level working platform not less than 30 in. × 30 in. (760 mm × 760 mm) shall be provided in front of the service side of the appliance.

9.5.3 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.

9.6 Appliance and Equipment Connections to Building Piping.

9.6.1 Connecting Appliances and Equipment. Appliances and equipment shall be connected to the building piping in compliance with 9.6.5 through 9.6.7 by one of the following:

(1) Rigid metallic pipe and fittings.
(2) Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
(3) A connector for gas appliances listed in accordance with ANSI Z21.24/CSA 6.10, *Connectors for Gas Appliances.* The connector shall be used in accordance with the manufacturer's installation instructions and shall be in the same room as the appliance. Only one connector shall be used per appliance.
(4) A connector for outdoor gas appliances and manufactured homes listed in accordance with ANSI Z21.75/CSA 6.27, *Connectors for Outdoor Gas Appliances and Manufactured Homes.* Only one connector shall be used per appliance.
(5) CSST where installed in accordance with the manufacturer's installation instructions. CSST shall not be directly routed into a metallic appliance enclosure where the appliance is connected to a metallic vent that terminates above a roofline. CSST shall connect only to appliances that are fixed in place.
(6) Listed nonmetallic gas hose connectors in accordance with 9.6.2.
(7) Unlisted gas hose connectors for use in laboratories and educational facilities in accordance with 9.6.3.

9.6.1.1 Protection of Connectors. Connectors and tubing addressed in 9.6.1(2), 9.6.1(3), 9.6.1(4), 9.6.1(5), and 9.6.1(6) shall be installed to be protected against physical and thermal damage. Aluminum alloy tubing and connectors shall be coated to protect against external corrosion where they are in contact with masonry, plaster, or insulation or are subject to repeated wettings by such liquids as detergents, sewage, or water other than rainwater.

9.6.1.2 Materials addressed in 9.6.1(2), 9.6.1(3), 9.6.1(4), 9.6.1(5), and 9.6.1(6) shall not be installed through an opening in an appliance housing, cabinet, or casing, unless the tubing or connector is protected against damage.

9.6.1.3 Food Service Appliance Connectors. Connectors used with food service appliances that are moved for cleaning and sanitation purposes shall be installed in accordance with the connector manufacturer's installation instructions. Such connectors shall be listed in accordance with ANSI Z21.69/CSA 6.16, *Connectors for Movable Gas Appliances.*

9.6.1.4 Restraint. Movement of appliances with casters shall be limited by a restraining device installed in accordance with the connector and appliance manufacturer's installation instructions.

9.6.1.5* Suspended Low-Intensity Infrared Tube Heaters. Suspended low-intensity infrared tube heaters shall be connected to the building piping system with a connector listed for the application in accordance with ANSI Z21.24/CSA 6.10, *Connectors for Gas Appliances.*

(A) The connector shall be installed in accordance with the tube heater installation instructions and shall be in the same room as the appliance.

(B) Only one connector shall be used per appliance.

9.6.2 Use of Nonmetallic Gas Hose Connectors. Listed gas hose connectors shall be used in accordance with the manufacturer's installation instructions and as follows:

(1) *Indoor.* Indoor gas hose connectors shall be used only to connect laboratory, shop, and ironing appliances requiring mobility during operation and installed in accordance with the following:
   (a) An appliance shutoff valve shall be installed where the connector is attached to the building piping.
   (b) The connector shall be of minimum length and shall not exceed 6 ft (1.8 m).
   (c) The connector shall not be concealed and shall not extend from one room to another or pass through wall partitions, ceilings, or floors.

(2) *Outdoor.* Where outdoor gas hose connectors are used to connect portable outdoor appliances, the connector shall be listed in accordance with ANSI Z21.54/CSA 8.4, *Gas Hose Connectors for Portable Outdoor Gas-Fired Appliances*, and installed in accordance with the following:
   (a) An appliance shutoff valve, a listed quick-disconnect device, or a listed gas convenience outlet shall be installed where the connector is attached to the supply piping and in such a manner so as to prevent the accumulation of water or foreign matter.
   (b) This connection shall be made only in the outdoor area where the appliance is to be used.

9.6.3* Injection (Bunsen) burners used in laboratories and educational facilities shall be permitted to be connected to the gas supply by an unlisted hose.

9.6.4 Connection of Portable and Mobile Industrial Appliances.

9.6.4.1 Where portable industrial appliances or appliances requiring mobility or subject to vibration are connected to the building gas piping system by the use of a flexible hose, the hose shall be suitable and safe for the conditions under which it can be used.

9.6.4.2 Where industrial appliances requiring mobility are connected to the rigid piping by the use of swivel joints or couplings, the swivel joints or couplings shall be suitable for the service required and only the minimum number required shall be installed.

9.6.4.3 Where industrial appliances subject to vibration are connected to the building piping system by the use of all metal flexible connectors, the connectors shall be suitable for the service required.

9.6.4.4 Where flexible connections are used, they shall be of the minimum practical length and shall not extend from one room to another or pass through any walls, partitions, ceilings, or floors. Flexible connections shall not be used in any concealed location. They shall be protected against physical or thermal damage and shall be provided with gas shutoff valves in readily accessible locations in rigid piping upstream from the flexible connections.

9.6.5 Appliance Shutoff Valves and Connections. Each appliance connected to a piping system shall have an accessible, approved manual shutoff valve with a nondisplaceable valve member, or a listed gas convenience outlet. Appliance shutoff valves and convenience outlets shall serve a single appliance only and shall be installed in accordance with 9.6.5.1.

9.6.5.1 The shutoff valve shall be located within 6 ft (1.8 m) of the appliance it serves except as permitted in 9.6.5.2 or 9.6.5.3.

(A) Where a connector is used, the valve shall be installed upstream of the connector. A union or flanged connection shall be provided downstream from the valve to permit removal of appliance controls.

(B) Shutoff valves serving decorative appliances in a fireplace shall not be located within the fireplace firebox except where the valve is listed for such use.

9.6.5.2 Shutoff valves serving appliances installed in vented fireplaces and ventless firebox enclosures shall not be required to be located within 6 ft (1.8 m) of the appliance where such valves are readily accessible and permanently identified. The piping from the shutoff valve to within 6 ft (1.8 m) of the appliance shall be designed, sized, installed, and tested in accordance with Chapters 5, 6, 7, and 8.

9.6.5.3 Where installed at a manifold, the appliance shutoff valve shall be located within 50 ft (15 m) of the appliance served and shall be readily accessible and permanently identified. The piping from the manifold to within 6 ft (1.8 m) of the appliance shall be designed, sized, installed, and tested in accordance with Chapters 5, 6, 7, and 8.

9.6.6 Quick-Disconnect Devices.

9.6.6.1 Quick-disconnect devices used to connect appliances to the building piping shall be listed in accordance with ANSI Z21.41/CSA 6.9, *Quick-Disconnect Devices for Use with Gas Fuel Appliances.*

9.6.6.2 Where installed indoors, an approved manual shutoff valve with a nondisplaceable valve member shall be installed upstream of the quick-disconnect device.

9.6.7 Gas Convenience Outlets. Gas convenience outlets shall be listed in accordance with ANSI Z21.90/CSA 6.24, *Gas Convenience Outlets and Optional Enclosures*, and installed in accordance with the manufacturer's installation instructions.

9.6.8 Sediment Trap. Where a sediment trap is not incorporated as a part of the appliance, a sediment trap shall be installed downstream of the appliance shutoff valve as close to the inlet of the appliance as practical at the time of appliance installation. The sediment trap shall be either a tee fitting with a capped nipple in the bottom outlet, as illustrated in Figure 9.6.8, or another device recognized as an effective sediment trap. Illuminating appliances, gas ranges, clothes dryers, decorative appliances for installation in vented fireplaces, gas fireplaces, and outdoor cooking appliances shall not be required to be so equipped.

9.6.9 Installation of Piping. Piping shall be installed in a manner not to interfere with inspection, maintenance, or servicing of the appliances.

9.7 Electrical.

9.7.1 Electrical Connections. Electrical connections between appliances and the building wiring, including the grounding of the appliances, shall conform to *NFPA 70.*

9.7.2 Electrical Ignition and Control Devices. Electrical ignition, burner control, and electrical vent damper devices shall not permit unsafe operation of the appliance in the event of electrical power interruption or when the power is restored.

9.7.3 Electrical Circuit. The electrical circuit employed for operating the automatic main gas control valve, automatic pilot, room temperature thermostat, limit control, or other electrical devices used with the appliances shall be in accordance with the wiring diagrams certified or approved by the original appliance manufacturer.

9.8 Room Temperature Thermostats.

9.8.1 Locations. Room temperature thermostats shall be installed in accordance with the manufacturer's instructions.

9.8.2 Drafts. Any hole in the plaster or panel through which the wires pass from the thermostat to the appliance being controlled shall be sealed so as to prevent drafts from affecting the thermostat.

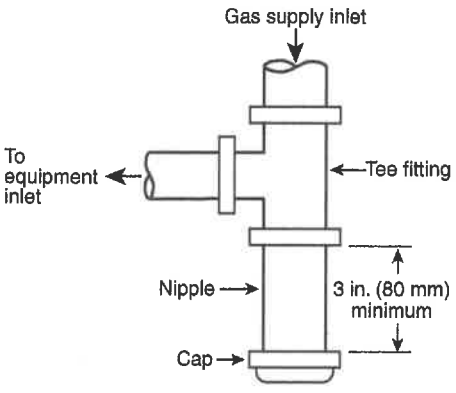


FIGURE 9.6.8 Method of Installing a Tee Fitting Sediment Trap.

Chapter 10 Installation of Specific Appliances

10.1 General.

10.1.1* Application. Appliances shall be installed in accordance with the manufacturers' installation instructions and, as elsewhere specified in this chapter, as applicable to the appliance. Unlisted appliances shall be installed as specified in this chapter as applicable to the appliances.

10.1.2* Installation in a Bedroom or Bathroom. Appliances shall not be installed so their combustion, ventilation, and dilution air are obtained only from a bedroom or bathroom unless the bedroom or bathroom has the required volume in accordance with 9.3.2.

10.1.3 Locations with Airhandlers. Where a draft hood–equipped appliance is installed in a space containing a furnace or other air handler, the ducts serving the furnace or air handler shall comply with 10.3.8.4.

Δ 10.2 Air-Conditioning Appliances.

***N* 10.2.1 Application.** Gas-fired air conditioners and heat pumps shall be listed in accordance with ANSI Z21.40.1/CSA 2.91, *Gas-Fired Heat Activated Air Conditioning and Heat Pump Appliances,* or ANSI Z21.40.2/CSA 2.92, *Air Conditioning and Heat Pump Appliances (Internal Combustion).*

10.2.2 Independent Gas Piping. Gas piping serving heating appliances shall be permitted to also serve cooling appliances where heating and cooling appliances cannot be operated simultaneously.

10.2.3 Connection of Gas Engine–Powered Air Conditioners. Gas engines shall not be rigidly connected to the gas supply piping.

Δ 10.2.4 Clearances for Indoor Installation. The installation of air-conditioning appliances shall comply with the following requirements:

(1) Air-conditioning appliances shall be installed with clearances in accordance with the manufacturer's instructions.
(2) Air-conditioning appliances shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material or appliance is protected as described in Table 10.2.4 and such reduction is allowed by the manufacturer's installation instructions.
(3) Where the furnace plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish where the clearance specified is 2 in. (50 mm) or less.
(4) Air-conditioning appliances shall have the clearance from supply ducts within 3 ft (0.9 m) of the furnace plenum be not less than that specified from the furnace plenum. No clearance is necessary beyond this distance.

Δ 10.2.5 Assembly and Installation. Unless the air-conditioning appliance is listed for installation on a combustible surface, or unless the surface is protected in an approved manner, it shall be installed on a surface of noncombustible construction with noncombustible material and surface finish and with no combustible material against the underside thereof.

Δ Table 10.2.4 Reduction of Clearances with Specified Forms of Protection

Type of protection applied to and covering all surfaces of combustible material within the distance specified as the required clearance with no protection	Where the required clearance with no protection from appliance, vent connector, or single-wall metal pipe is:									
	36 in.		18 in.		12 in.		9 in.		6 in.	
	Allowable Clearances with Specified Protection (in.)									
	Use Col. 1 for clearances above appliance or horizontal connector. Use Col. 2 for clearances from appliance, vertical connector, and single-wall metal pipe.									
	Above (Col. 1)	Sides and Rear (Col. 2)	Above (Col. 1)	Sides and Rear (Col. 2)	Above (Col. 1)	Sides and Rear (Col. 2)	Above (Col. 1)	Sides and Rear (Col. 2)	Above (Col. 1)	Sides and Rear (Col. 2)
(1) 3½ in. thick masonry wall without ventilated air space	—	24	—	12	—	9	—	6	—	5
(2) ½ in. insulation board over 1 in. glass fiber or mineral wool batts	24	18	12	9	9	6	6	5	4	3
(3) 0.024 in. (nominal 24 gauge) sheet metal over 1 in. 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 in. thick masonry wall with ventilated air space	—	12	—	6	—	6	—	6	—	6
(5) 0.024 in. (nominal 24 gauge) sheet metal with ventilated air space	18	12	9	6	6	4	5	3	3	2
(6) ½ in. thick insulation board with ventilated air space	18	12	9	6	6	4	5	3	3	3
(7) 0.024 in. (nominal 24 gauge) sheet metal with ventilated air space over 0.024 in. (nominal 24 gauge) sheet metal with ventilated air space	18	12	9	6	6	4	5	3	3	3
(8) 1 in. glass fiber or mineral wool batts sandwiched between two sheets 0.024 in. (nominal 24 gauge) sheet metal with ventilated air space	18	12	9	6	6	4	5	3	3	3

For SI units, 1 in. = 25.4 mm.

Notes:

(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.

(5) At least 1 in. (25 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 1 in. (25 mm) 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 lb/ft^3 (128 kg/m^3) 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 Btu in./ft^2/hr-°F (0.144 W/m-K) or less.

(9) At least 1 in. (25 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 Table 10.2.4.

(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 manufacturers' installation instructions.

10.2.6 Furnace Plenums and Air Ducts. Where an air conditioner is installed within an enclosure, the installation shall comply with 10.3.8.4.

10.2.7* Refrigeration Coils. The installation of refrigeration coils shall be in accordance with 10.3.9 and 10.3.10.

10.2.8 Switches in Electrical Supply Line. Means for interrupting the electrical supply to the air-conditioning appliance and to its associated cooling tower shall be in accordance with *NFPA 70, National Electrical Code.*

10.3 Central Heating Boilers and Furnaces.

***N* 10.3.1 Application.**

***N* 10.3.1.1** Central heating furnaces and boilers having input ratings up to and including 400,000 Btu/hr shall be listed in accordance with the following as applicable:

(1) Furnaces listed in accordance with ANSI Z21.47/CSA 2.3, *Gas-Fired Central Furnaces*
(2) Low-pressure boilers listed in accordance with ANSI Z21.13/CSA 4.9, *Gas-Fired Low-Pressure Steam and Hot Water Boilers*

N* 10.3.1.2 Furnaces and boilers having input ratings greater than 400,000 Btu/hr shall be listed or in accordance with 9.1.1.2 and 9.1.1.3.

10.3.2 Location. Central heating furnace and low-pressure boiler installations in bedrooms or bathrooms shall comply with one of the following:

(1) Central heating furnaces and low-pressure boilers shall be installed in a closet equipped with a weather-stripped door with no openings, and with a self-closing device. All combustion air shall be obtained from the outdoors in accordance with 9.3.3.
(2) Central heating furnaces and low-pressure boilers shall be of the direct vent type.

Δ 10.3.3 Clearances.

10.3.3.1 Listed central heating furnaces and low-pressure boilers shall be installed with clearances in accordance with the manufacturer's instructions.

10.3.3.2 Unlisted central heating furnaces and low-pressure boilers shall be installed with clearances from combustible material not less than those specified in Table 10.3.3.2.

10.3.3.3 Central heating furnaces and low-pressure boilers shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material or appliance is protected as described in Table 10.2.4 and Figure 10.3.3.3(a) through Figure 10.3.3.3(c), and such reduction is allowed by the manufacturer's installation instructions.

10.3.3.4 Front clearance shall be sufficient for servicing the burner and the furnace or boiler.

10.3.3.5 Where the furnace plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish where the clearance specified is 2 in. (50 mm) or less.

10.3.3.6 The clearances to these appliances shall not interfere with combustion air, draft hood clearance and relief, and accessibility for servicing.

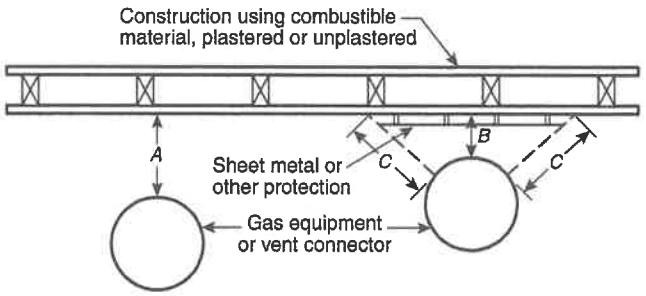
10.3.3.7 Supply air ducts connecting to listed central heating furnaces shall have the same minimum clearance to combustibles as required for the furnace supply plenum for a distance of not less than 3 ft (0.9 m) from the supply plenum. Clearance shall not be required beyond the 3 ft (0.9 m) distance.

10.3.3.8 Supply air ducts connecting to unlisted central heating furnaces equipped with temperature limit controls with a maximum setting of 250°F (121°C) shall have a minimum clearance to combustibles of 6 in. (150 mm) for a distance of not less than 6 ft (1.8 m) from the furnace supply plenum.

Δ Table 10.3.3.2 Clearances to Combustible Material for Unlisted Furnaces and Boilers

	Minimum Clearance (in.)					
Appliance	Above and Sides of Furnace Plenum	Top of Boiler	Jacket Sides and Rear	Front	Draft Hood and Barometric Draft Regulator	Single-Wall Vent Connector
I Automatically fired, forced air or gravity system, equipped with temperature limit control that cannot be set higher than 250°F (121°C)	6	—	6	18	6	18
II Automatically fired heating boilers — steam boilers operating at not over 15 psi (103 kPa) and hot water boilers operating at 250°F (121°C) or less	6	6	6	18	18	18
III Central heating boilers and furnaces, other than in I or II	18	18	18	18	18	18

For SI units, 1 in. = 25.4 mm.
Note: See Section 10.3 for additional requirements for central heating boilers and furnaces.



Notes:
(1) *A* equals the clearance with no protection specified in Tables 10.3.3.2 and 12.8.4.4 and in the sections applying to various types of equipment.
(2) *B* equals the reduced clearance permitted in accordance with Table 10.2.4.
(3) The protection applied to the construction using combustible material shall extend far enough in each direction to make *C* equal to *A*.

Δ FIGURE 10.3.3.3(a) Extent of Protection Necessary to Reduce Clearances from Gas Appliance or Vent Connectors.

Clearance shall not be required beyond the 6 ft (1.8 m) distance.

10.3.3.9 Central heating furnaces other than those listed in 10.3.3.7 or 10.3.3.8 shall have clearances from the supply ducts of not less than 18 in. (460 mm) from the furnace plenum for the first 3 ft (0.9 m), then 6 in. (150 mm) for the next 3 ft (0.9 m), and 1 in. (25 mm) beyond 6 ft (1.8 m).

10.3.4 Assembly and Installation. A central heating boiler or furnace shall be installed in accordance with the manufacturer's instructions in one of the following manners:

(1) On a floor of noncombustible construction with noncombustible flooring and surface finish and with no combustible material against the underside thereof
(2) On fire-resistive slabs or arches having no combustible material against the underside thereof

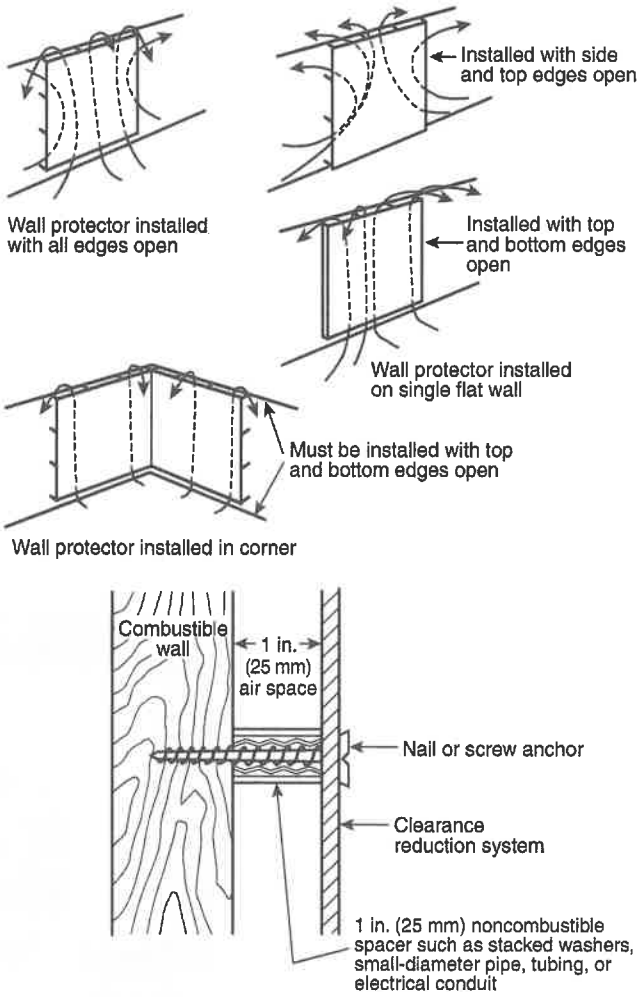
Exception No. 1: Appliances listed for installation on a combustible floor.

Exception No. 2: Installation on a floor protected in an approved manner.

10.3.5 Temperature or Pressure Limiting Devices. Steam and hot water boilers, respectively, shall be provided with approved automatic limiting devices for shutting down the burner(s) to prevent boiler steam pressure or boiler water temperature from exceeding the maximum allowable working pressure or temperature. Safety limit controls shall not be used as operating controls.

10.3.6 Low-Water Cutoff. All water boilers and steam boilers shall be provided with an automatic means to shut off the fuel supply to the burner(s) if the boiler water level drops below the lowest safe water line. In lieu of the low-water cutoff, water tube or coil-type boilers that require forced circulation to prevent overheating and failure shall have an approved flow sensing device arranged to shut down the boiler when the flow rate is inadequate to protect the boiler against overheating.

10.3.7* Steam Safety and Pressure Relief Valves. Steam and hot water boilers shall be equipped, respectively, with listed or approved steam safety or pressure relief valves of appropriate discharge capacity and conforming with ASME requirements. A shutoff valve shall not be placed between the relief valve and the boiler or on discharge pipes between such valves and the atmosphere.



Notes:
(1) Masonry walls can be attached to combustible walls using wall ties.
(2) Spacers should not be used directly behind appliance or connector.

Δ FIGURE 10.3.3.3(b) Wall Protector Clearance Reduction System.

10.3.7.1 Relief valves shall be piped to discharge near the floor.

10.3.7.2 The entire discharged piping shall be at least the same size as the relief valve discharge piping.

10.3.7.3 Discharge piping shall not contain threaded end connection at its termination point.

10.3.8 Furnace Plenums and Air Ducts.

10.3.8.1 Furnace plenums and air ducts shall be installed in accordance with NFPA 90A or NFPA 90B.

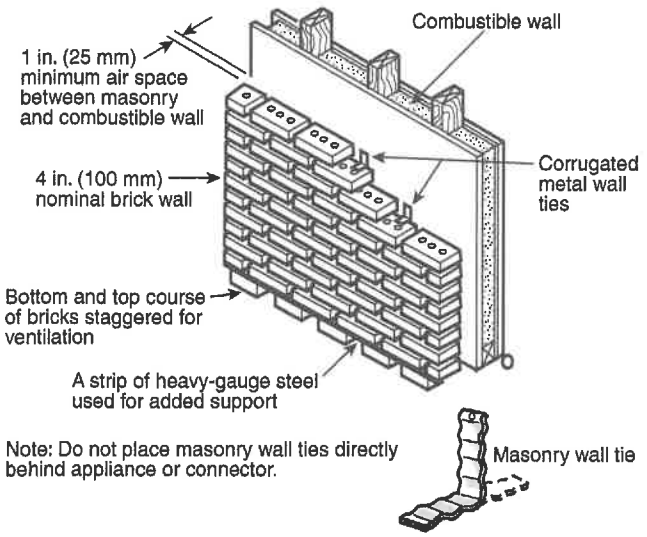


FIGURE 10.3.3.3(c) Masonry Clearance Reduction System.

10.3.8.2 A furnace plenum supplied as a part of a furnace shall be installed in accordance with the manufacturer's instructions.

10.3.8.3* Where a furnace plenum is not supplied with the furnace, any fabrication and installation instructions provided by the manufacturer shall be followed. The method of connecting supply and return ducts shall facilitate proper circulation of air.

10.3.8.4 Where a furnace is installed so supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace. Return air shall not be taken from the mechanical room containing the furnace.

10.3.9 Refrigeration Coils. The installation of refrigeration coils shall comply with the following requirements:

(1) A refrigeration coil shall not be installed in conjunction with a forced air furnace where circulation of cooled air is provided by the furnace blower, unless the blower has sufficient capacity to overcome the external static pressure resistance imposed by the duct system and refrigeration coil at the air flow rate for heating or cooling, whichever is greater.
(2) Furnaces shall not be located upstream from refrigeration coils, unless the refrigeration coil is designed or equipped so as not to develop excessive temperature or pressure.
(3) Refrigeration coils shall be installed in parallel with or on the downstream side of central furnaces to avoid condensation in the heating element, unless the furnace has been specifically listed for downstream installation. With a parallel flow arrangement, the dampers or other means used to control flow of air shall be sufficiently tight to prevent any circulation of cooled air through the furnace.
(4) Means shall be provided for disposal of condensate and to prevent dripping of condensate on the heating element.

10.3.10 Cooling Units Used with Heating Boilers.

10.3.10.1 Boilers, where used in conjunction with refrigeration systems, shall be installed so that the chilled medium is piped in parallel with the heating boiler with appropriate valves to prevent the chilled medium from entering the heating boiler.

10.3.10.2 Where hot water heating boilers are connected to heating coils located in air-handling units where they can be exposed to refrigerated air circulation, such boiler piping systems shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

10.4 Clothes Dryers.

N **10.4.1 Application.** Clothes dryers shall be listed in accordance with ANSI Z21.5.1/CSA 7.1, *Gas Clothes Dryer, Volume I, Type 1 Clothes Dryers*, or ANSI Z21.5.2/CSA 7.2, *Gas Clothes Dryer, Volume II, Type 2 Clothes Dryers*.

Δ **10.4.2 Clearance.** The installation of clothes dryers shall comply with the following requirements:

(1) Type 1 clothes dryers shall be installed with a minimum clearance of 6 in. (150 mm) from adjacent combustible material. Clothes dryers listed for installation at reduced clearances shall be installed in accordance with the manufacturer's installation instructions. Type 1 clothes dryers installed in closets shall be specifically listed for such installation.
(2) Type 2 clothes dryers shall be installed with clearances of not less than those shown on the marking plate and in the manufacturer's instructions. Type 2 clothes dryers designed and marked "For use only in noncombustible locations" shall not be installed elsewhere.

10.4.3 Exhausting to the Outdoors. Type 1 and Type 2 clothes dryers shall be exhausted to the outdoors.

10.4.4 Provisions for Make-Up Air.

10.4.4.1 Make-up air shall be provided for Type 1 clothes dryers in accordance with the manufacturers' installation instructions.

10.4.4.2 Provision for make-up air shall be provided for Type 2 clothes dryers, with a minimum free area of 1 in.^{2}/1000 Btu/hr (2200 mm^2/kW) total input rating of the dryer(s) installed.

10.4.5 Exhaust Ducts for Type 1 Clothes Dryers.

10.4.5.1 A clothes dryer exhaust duct shall not be connected into any vent connector, gas vent, chimney, crawl space, attic, or other similar concealed space.

10.4.5.2 Ducts for exhausting clothes dryers shall not be assembled with screws or other fastening means that extend into the duct and that would catch lint and reduce the efficiency of the exhaust system.

Δ **10.4.5.3** Exhaust ducts shall be constructed of rigid metallic material. Transition ducts used to connect the dryer to the exhaust duct shall be listed and labeled in accordance with UL 2158A, *Clothes Dryer Transition Ducts*, and installed in accordance with the clothes dryer manufacturer's installation instructions.

10.4.6 Exhaust Ducts for Type 2 Clothes Dryers.

10.4.6.1 Exhaust ducts for Type 2 clothes dryers shall comply with 10.4.5.

10.4.6.2 Exhaust ducts for Type 2 clothes dryers shall be constructed of sheet metal or other noncombustible material. Such ducts shall be equivalent in strength and corrosion resistance to ducts made of galvanized sheet steel not less than 0.0195 in. (0.5 mm) thick.

10.4.6.3 Type 2 clothes dryers shall be equipped or installed with lint-controlling means.

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10.4.6.4 Where ducts pass through walls, floors, or partitions, the space around the duct shall be sealed with noncombustible material.

10.4.6.5 Multiple installations of Type 2 clothes dryers shall be made in a manner to prevent adverse operation due to back pressures that might be created in the exhaust systems.

Δ **10.4.7 Multiple-Family or Public Use.** All clothes dryers installed for multiple-family or public use shall be installed as specified for a Type 2 clothes dryer under 10.4.6.

10.5 Conversion Burners. Installation of conversion burners shall conform to ANSI Z21.8, *Installation of Domestic Gas Conversion Burners.*

10.6 Decorative Appliances for Installation in Vented Fireplaces.

N **10.6.1 Application.** Decorative appliances for installation in vented fireplaces shall be listed in accordance with ANSI Z21.60/CSA 2.26, *Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces.*

Δ **10.6.2* Prohibited Installations.** Decorative appliances for installation in vented fireplaces shall not be installed in bathrooms or bedrooms unless the bedroom or bathroom has the required volume in accordance with 9.3.2.

10.6.3 Installation. A decorative appliance for installation in a vented fireplace shall be installed only in a vented fireplace having a working chimney flue and constructed of noncombustible materials. These appliances shall not be thermostatically controlled.

Δ **10.6.3.1** A decorative appliance for installation in a vented fireplace shall be installed in accordance with the manufacturer's installation instructions.

10.6.3.2 A decorative appliance for installation in a vented fireplace, where installed in a manufactured home, shall be listed for installation in manufactured homes.

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10.6.4 Fireplace Screens. A fireplace screen shall be installed with a decorative appliance for installation in a vented fireplace.

10.7 Gas Fireplaces, Vented.

N **10.7.1 Application.** Vented gas fireplaces shall be listed in accordance with ANSI Z21.50/CSA 2.22, *Vented Decorative Gas Appliances.*

Δ **10.7.2* Prohibited Installations.** Vented gas fireplaces shall not be installed in bathrooms or bedrooms unless the bedroom or bathroom has the required volume in accordance with 9.3.2.

Exception: Direct vent gas fireplaces.

Δ **10.7.3 Installation.** The installation of vented gas fireplaces shall comply with the following requirements:

(1) Vented gas fireplaces shall be installed in accordance with the manufacturer's installation instructions and where installed in or attached to combustible material shall be specifically listed for such installation.
(2) Panels, grilles, and access doors that are required to be removed for normal servicing operations shall not be attached to the building.
(3) Direct vent gas fireplaces shall be installed with the vent air intake terminal in the outdoors and in accordance with the manufacturer's instructions.

10.7.4 Combustion and Circulating Air. Combustion and circulating air shall be provided in accordance with Section 9.3.

Δ **10.8 Direct Gas-Fired Heating and Forced Ventilation Appliances.**

10.8.1 Application. Direct gas-fired heating and forced ventilation appliances for commercial and industrial applications shall be listed in accordance with the following standards as applicable:

(1) ANSI Z83.4/CSA 3.7, *Non-Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Application.*
(2) ANSI Z83.18, *Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Application.*

10.8.2 Prohibited Installations.

10.8.2.1 Direct gas-fired heating and forced ventilation appliances shall not serve any area containing sleeping quarters.

10.8.2.2 Non-recirculating direct gas-fired heating and forced ventilation appliances shall not recirculate room air.

10.8.2.3* Recirculating direct gas-fired industrial air heaters shall not recirculate room air in buildings that contain flammable solids, liquids, or gases; explosive materials; or substances that can become toxic when exposed to flame or heat.

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10.8.3 Installation. Installation of direct gas-fired heating and forced ventilation appliances shall comply with 10.8.3.1 through 10.8.3.3.

10.8.3.1 Direct gas-fired heating and forced ventilation appliances shall be installed in accordance with the manufacturer's instructions.

10.8.3.2 Direct gas-fired heating and forced ventilation appliances shall be permitted to provide fresh air ventilation.

10.8.3.3 Direct gas-fired heating and forced ventilation appliances shall be provided with access for removal of burners; for replacement of motors, controls, filters, and other working parts; and for adjustment and lubrication of parts requiring maintenance.

10.8.4 Clearance from Combustible Materials. Direct gas-fired heating and forced ventilation appliances shall be installed with a clearance from combustible materials of not less than that shown on the rating plate and the manufacturer's instructions.

10.8.5 Air Supply. The air supply to direct gas-fired heating and forced ventilation appliances shall be in accordance with 10.8.5.1 through 10.8.5.3.

N **10.8.5.1** All air to the non-recirculating direct gas-fired heating and forced ventilation appliance shall be ducted directly from outdoors.

N **10.8.5.2** Ventilation air to the recirculating direct gas-fired heating and forced ventilation appliance shall be ducted directly from outdoors. Air in excess of the minimum ventilation air specified on the heater's rating plate shall be taken from the building, ducted directly from outdoors, or a combination of both.

N **10.8.5.3** Where outdoor air dampers or closing louvers are used, they shall be verified to be in the open position prior to main burner operation.

10.8.6 Atmospheric Vents or Gas Reliefs or Bleeds. Direct gas-fired heating and forced ventilation appliances with valve train components equipped with atmospheric vents, gas reliefs, or bleeds shall have their vent lines, gas reliefs, or bleeds lead to a safe point outdoors. Means shall be employed on these lines to prevent water from entering and to prevent blockage from insects and foreign matter. An atmospheric vent line shall not be required to be provided on a valve train component equipped with a listed vent limiter.

Δ **10.8.7 Relief Openings.** The design of the installation shall include adequate provisions to permit the direct gas-fired heating and forced ventilation appliances to operate at their rated airflow without overpressurizing the space served by the heater by taking into account the structure's designed infiltration rate, properly designed relief openings, or an interlocked powered exhaust system, or a combination of these methods.

Δ **10.8.7.1** The structure's designed infiltration rate and the size of relief opening(s) shall be determined by engineering methods.

10.8.7.2 Louver or counterbalanced gravity damper relief openings shall be permitted. Where motorized dampers or closable louvers are used, they shall be proved to be in their open position prior to main burner operation.

10.8.8 Purging. Inlet ducting, when used, shall be purged with at least four air changes prior to an ignition attempt.

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10.9 Duct Furnaces.

N **10.9.1 Application.** Duct furnaces with inputs of 10 MBtu/hr or less shall be listed in accordance with ANSI Z83.8/CSA 2.6, *Gas Unit Heaters, as Packaged Heaters, Gas Utility Heaters, and Gas-fired Duct Furnaces.*

Δ **10.9.2 Clearances.** Duct furnaces shall be installed with clearances of at least 6 in. (150 mm) between adjacent walls, ceilings, and floors of combustible material, and the furnace draft hood and shall comply with the following:

(1) Duct furnaces listed for installation at lesser clearances shall be installed in accordance with the manufacturer's installation instructions.
(2) The clearance shall not interfere with combustion air and accessibility.

10.9.3 Installation of Duct Furnaces. Duct furnaces shall be installed in accordance with the manufacturers' instructions.

10.9.4 Access Panels. The ducts connected to duct furnaces shall have removable access panels on both the upstream and downstream sides of the furnace.

10.9.5 Location of Draft Hood and Controls. The controls, combustion air inlet, and draft hoods for duct furnaces shall be located outside the ducts. The draft hood shall be located in the same enclosure from which combustion air is taken.

10.9.6 Circulating Air. Where a duct furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace. The duct furnace shall be installed on the positive-pressure side of the circulating air blower.

10.9.7 Duct Furnaces Used with Refrigeration Systems.

10.9.7.1 A duct furnace shall not be installed in conjunction with a refrigeration coil where circulation of cooled air is provided by the blower.

Exception: Where the blower has sufficient capacity to overcome the external static resistance imposed by the duct system, the furnace, and the cooling coil and the air throughput necessary for heating or cooling, whichever is greater.

10.9.7.2 Duct furnaces used in conjunction with cooling appliances shall be installed in parallel with or on the upstream side of cooling coils to avoid condensation within heating elements. With a parallel flow arrangement, the dampers or other means used to control the flow of air shall be sufficiently tight to prevent any circulation of cooled air through the unit.

Exception: Where the duct furnace has been specifically listed for downstream installation.

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Δ **10.9.7.3*** Where a duct furnace is installed downstream of an evaporative cooler or air washer, the heat exchanger shall be constructed of corrosion-resistant materials. Air washers operating with chilled water that deliver air below the dew point of the ambient air at the duct furnace shall be considered as refrigeration systems.

Δ **10.9.8 Installation in Commercial Garages and Aircraft Hangars.** Duct furnaces installed in garages for more than three motor vehicles or in aircraft hangars shall be installed in accordance with 9.1.11 and 9.1.12.

10.10 Floor Furnaces.

N **10.10.1 Application.** Floor furnaces shall be listed in accordance with ANSI Z21.86/CSA 2.32, *Vented Gas-Fired Space Heating Appliances.*

Δ **10.10.2 Installation.** The installation of floor furnaces shall comply with the following requirements:

(1) Floor furnaces shall be installed in accordance with the manufacturers' installation instructions.
(2) Thermostats controlling floor furnaces shall not be located in a room or space that can be separated from the room or space in which the register of the floor furnace is located.

10.10.3 Temperature Limit Controls. Automatically operated floor furnaces shall be equipped with temperature limit controls.

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10.10.4 Combustion and Circulating Air. Combustion and circulating air shall be provided in accordance with Section 9.3.

10.10.5 Placement. The following provisions apply to furnaces that serve one story:

(1) *Floors.* Floor furnaces shall not be installed in the floor of any doorway, stairway landing, aisle, or passageway of any enclosure, public or private, or in an exitway from any such room or space.

(2) *Walls and Corners.* The register of a floor furnace with a horizontal warm air outlet shall not be placed closer than 6 in. (150 mm) from the nearest wall. A distance of at least 18 in. (460 mm) from two adjoining sides of the floor furnace register to walls shall be provided to eliminate the necessity of occupants walking over the warm air discharge. The remaining sides shall be a minimum of 6 in. (150 mm) from a wall. Wall register models shall not be placed closer than 6 in. (150 mm) to a corner.

(3) *Draperies.* The furnace shall be placed so that a door, drapery, or similar object cannot be nearer than 12 in. (300 mm) to any portion of the register of the furnace.

10.10.6 Bracing. The space provided for the furnace shall be framed with doubled joists and with headers not lighter than the joists.

10.10.7 Support. Means shall be provided to support the furnace when the floor register is removed.

10.10.8 Clearance. The lowest portion of the floor furnace shall have at least a 6 in. (150 mm) clearance from the general ground level. A reduced clearance to a minimum of 2 in. (50 mm) shall be permitted, provided the lower 6 in. (150 mm) portion of the floor furnace is sealed by the manufacturer to prevent entrance of water. Where these clearances are not present, the ground below and to the sides shall be excavated to form a "basin-like" pit under the furnace so that the required clearance is provided beneath the lowest portion of the furnace. A 12 in. (300 mm) clearance shall be provided on all sides except the control side, which shall have an 18 in. (460 mm) clearance.

10.10.9 Access. The space in which any floor furnace is installed shall be accessible by an opening in the foundation not less than 24 in. × 18 in. (610 mm × 460 mm) or by a trapdoor not less than 24 in. × 24 in. (610 mm × 610 mm) in any cross-section thereof, and a passageway not less than 24 in. × 18 in. (610 mm × 460 mm) in any cross-section thereof.

10.10.10 Seepage Pan. Where the excavation exceeds 12 in. (300 mm) in depth or water seepage is likely to collect, a watertight copper pan, concrete pit, or other suitable material shall be used, unless adequate drainage is provided or the appliance is sealed by the manufacturer to meet this condition. A copper pan shall be made of not less than 16 oz/ft^2 (4.9 kg/m^2) sheet copper. The pan shall be anchored in place so as to prevent floating, and the walls shall extend at least 4 in. (100 mm) above the ground level with at least a 6 in. (150 mm) clearance on all sides, except on the control side, which shall have at least an 18 in. (460 mm) clearance.

10.10.11 Wind Protection. Floor furnaces shall be protected, where necessary, against severe wind conditions.

10.10.12 Upper Floor Installations. Floor furnaces shall be permitted to be installed in an upper floor, provided the furnace assembly projects below into a utility room, closet, garage, or similar nonhabitable space. In such installations, the floor furnace shall be enclosed completely (entirely separated from the nonhabitable space) with means for air intake to meet the provisions of Section 9.3, with access for servicing, minimum furnace clearances of 6 in. (150 mm) to all sides and bottom, and with the enclosure constructed of Portland cement plaster or metal lath or other noncombustible material.

10.10.13 First Floor Installation. Floor furnaces installed in the first or ground floors of buildings shall not be required to be enclosed unless the basements of these buildings have been converted to apartments or sleeping quarters, in which case the floor furnace shall be enclosed as specified for upper floor installations and shall project into a nonhabitable space.

10.11 Food Service Appliance, Floor-Mounted.

N **10.11.1 Application.** Floor-mounted food service appliances shall be listed in accordance with ANSI Z83.11/CSA 1.8, *Gas Food Service Equipment.*

10.11.2 Clearance for Listed Appliances. Floor-mounted food service appliances, such as ranges for hotels and restaurants, deep fat fryers, unit broilers, kettles, steam cookers, steam generators, and baking and roasting ovens, shall be installed at least 6 in. (150 mm) from combustible material except that at least a 2 in. (50 mm) clearance shall be maintained between a draft hood and combustible material. Floor-mounted food service appliances listed for installation at lesser clearances shall be installed in accordance with the manufacturer's installation instructions. Appliances designed and marked "For use only in noncombustible locations" shall not be installed elsewhere.

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10.11.3 Mounting on Combustible Floor.

10.11.3.1 Floor-mounted food service appliances that are listed specifically for installation on floors constructed of combustible material shall be permitted to be installed on combustible floors in accordance with the manufacturer's installation instructions.

10.11.3.2 Floor-mounted food service appliances that are not listed for installation on a combustible floor shall be installed in accordance with 10.11.4 or be installed in accordance with one of the following:

(1) Where the appliance is set on legs that provide not less than 18 in. (460 mm) open space under the base of the appliance or where it has no burners and no portion of any oven or broiler within 18 in. (460 mm) of the floor, it shall be permitted to be installed on a combustible floor without special floor protection, provided at least one sheet metal baffle is between the burner and the floor.

(2) Where the appliance is set on legs that provide not less than 8 in. (200 mm) open space under the base of the appliance, it shall be permitted to be installed on combustible floors, provided the floor under the appliance is protected with not less than ⅜ in. (9.5 mm) insulating millboard covered with sheet metal not less than 0.0195 in. (0.5 mm) thick. The preceding specified floor protection shall extend not less than 6 in. (150 mm) beyond the appliance on all sides.

(3) Where the appliance is set on legs that provide not less than 4 in. (100 mm) under the base of the appliance, it shall be permitted to be installed on combustible floors, provided the floor under the appliance is protected with hollow masonry not less than 4 in. (100 mm) in thickness covered with sheet metal not less than 0.0195 in. (0.5 mm) thick. Such masonry courses shall be laid with ends unsealed and joints matched in such a way as to provide for free circulation of air through the masonry.

(4) Where the appliance does not have legs at least 4 in. (100 mm) high, it shall be permitted to be installed on combustible floors, provided the floor under the appliance is protected by two courses of 4 in. (100 mm) hollow clay tile, or equivalent, with courses laid at right angles and with ends unsealed and joints matched in such a way as to provide for free circulation of air through such masonry courses, and covered with steel plate not less than $\frac{3}{16}$ in. (4.8 mm) in thickness.

10.11.4 Installation on Noncombustible Floor.

10.11.4.1 Floor-installed food service appliances that are designed and marked "For use only in noncombustible locations" shall be installed on floors of noncombustible construction with noncombustible flooring and surface finish and with no combustible material against the underside thereof, or on noncombustible slabs or arches having no combustible material against the underside thereof.

10.11.4.2 Such construction shall in all cases extend not less than 12 in. (300 mm) beyond the appliance on all sides.

10.11.5 Combustible Material Adjacent to Cooking Top. Food service ranges shall be installed to provide clearance to combustible material of not less than 18 in. (460 mm) horizontally for a distance up to 2 ft (0.6 m) above the surface of the cooking top where the combustible material is not completely shielded by high shelving, a warming closet, or other system. Reduced combustible material clearances are permitted where protected in accordance with Table 10.2.4.

10.11.6 Use with Casters. Floor-mounted appliances with casters shall be listed for such construction and shall be installed in accordance with the manufacturer's installation instructions for limiting the movement of the appliance to prevent strain on the connection.

10.11.7 Level Installation. Floor-mounted food service appliances shall be installed level on a firm foundation.

10.11.8* Ventilation. Means shall be provided to properly ventilate the space in which a food service appliance is installed to permit proper combustion of the gas.

10.12 Food Service Appliances, Counter Appliances.

N **10.12.1 Application.** Food service counter appliances shall be listed in accordance with ANSI Z83.11/CSA 1.8, *Gas Food Service Equipment.*

10.12.2 Vertical Clearance. A vertical distance of not less than 48 in. (1.2 m) shall be provided between the top of all food service hot plates and griddles and combustible material.

Δ **10.12.3 Clearance for Appliances.** Food service counter appliances, where installed on combustible surfaces, shall be installed with a minimum horizontal clearance of 6 in. (150 mm) from combustible material, except that at least a 2 in. (50 mm) clearance shall be maintained between a draft hood and combustible material. Food service counter appliances listed for installation at lesser clearances shall be installed in accordance with the manufacturer's installation instructions.

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10.13 Household Cooking Appliances.

N **10.13.1 Application.** Household cooking appliances shall be listed in accordance with ANSI Z21.1/CSA 1.1, *Household Cooking Gas Appliances.*

10.13.2 Installation. Floor-mounted and built-in household cooking appliances shall be installed in accordance with the manufacturer's installation instructions.

Δ **10.13.3 Clearances.** Floor-mounted household cooking appliances, where installed on combustible floors, shall be set on their own bases or legs and shall not interfere with combustion air, accessibility for operation, and servicing.

Δ **10.13.3.1* Vertical Clearance Above Cooking Top.** Household cooking appliances shall have a vertical clearance above the cooking top of not less than 30 in. (760 mm) to combustible material or metal cabinets. A minimum clearance of 24 in. (610 mm) shall be permitted when one of the following is installed:

(1) The underside of the combustible material or metal cabinet above the cooking top is protected with not less than ¼ in. (6 mm) insulating millboard covered with sheet metal not less than 0.0122 in. (0.3 mm) thick.
(2) A metal ventilating hood of sheet metal not less than 0.0122 in. (0.3 mm) thick is installed above the cooking top with a clearance of not less than ¼ in. (6 mm) between the hood and the underside of the combustible material or metal cabinet, and the hood is at least as wide as the appliance and is centered over the appliance.
(3) A cooking appliance or microwave oven is installed over a cooking appliance and conforms to the terms of the upper appliance's manufacturer's installation instructions.

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10.14 Illuminating Appliances.

10.14.1 Clearances for Listed Appliances. Listed illuminating appliances shall be installed in accordance with the manufacturer's installation instructions.

10.14.2 Clearances for Unlisted Appliances.

10.14.2.1 Enclosed Type. Clearance shall comply with the following:

(1) Unlisted enclosed illuminating appliances installed outdoors shall be installed with clearances in any direction from combustible material of not less than 12 in. (300 mm).
(2) Unlisted enclosed illuminating appliances installed indoors shall be installed with clearances in any direction from combustible material of not less than 18 in. (460 mm).

10.14.2.2 Open-Flame Type. Clearance shall comply with the following:

(1) Unlisted open-flame illuminating appliances installed outdoors shall have clearances from combustible material not less than that specified in Table 10.14.2.2. The distance from ground level to the base of the burner shall be a minimum of 7 ft (2.1 m) where installed within 2 ft (0.6 m) of walkways. Lesser clearances shall be permitted to be used where acceptable to the authority having jurisdiction.
(2) Unlisted open-flame illuminating appliances installed outdoors shall be equipped with a limiting orifice or other limiting devices that maintain a flame height consistent with the clearance from combustible material, as given in Table 10.14.2.2.

(3) Appliances designed for flame heights in excess of 30 in. (760 mm) shall be approved. Such appliances shall be equipped with a safety shutoff device or automatic ignition.
(4) Clearances to combustible material from unlisted open-flame illuminating appliances shall be approved.

Δ **10.14.3 Installation on Buildings.** Illuminating appliances designed for installation on a wall or ceiling shall be securely attached to substantial structures in such a manner that they are not dependent on the gas piping for support.

10.14.4 Installation on Posts. Illuminating appliances designed for installation on a post shall be securely and rigidly attached to a post. Posts shall be rigidly installed. The strength and rigidity of posts greater than 3 ft (0.9 m) in height shall be at least equivalent to that of a 2½ in. (64 mm) diameter post constructed of 0.064 in. (1.6 mm) thick steel or a 1 in. Schedule 40 steel pipe. Posts 3 ft (0.9 m) or less in height shall not be smaller than a ¾ in. Schedule 40 steel pipe. Drain openings shall be provided near the base of posts where water collecting inside the posts is possible.

10.14.5 Appliance Pressure Regulators. Where an appliance pressure regulator is not supplied with an illuminating appliance and the service line is not equipped with a service pressure regulator, an appliance pressure regulator shall be installed in the line serving one or more illuminating appliances.

10.15 Incinerators, Commercial-Industrial. Commercial-industrial-type incinerators shall be constructed and installed in accordance with NFPA 82.

10.16 Infrared Heaters.

N **10.16.1 Application.** Infrared heaters having an input rating of 400,000 Btu/hr or less shall be listed in accordance with ANSI Z83.19/CSA 2.35, *Gas-Fired High Intensity Infrared Heaters,* or ANSI Z83.20/CSA 2.34, *Gas-Fired Tubular and Low-Intensity Infrared Heaters.*

10.16.2 Support. Suspended-type infrared heaters shall be fixed in position independent of gas and electric supply lines. Hangers and brackets shall be of noncombustible material. Heaters subject to vibration shall be provided with vibration-isolating hangers.

Table 10.14.2.2 Clearances for Unlisted Outdoor Open-Flame Illuminating Appliances

Flame Height Above Burner Head (in.)	Minimum Clearance from Combustible Material (ft)*	
	Horizontal	Vertical
12	2	6
18	3	8
24	3	10
30	4	12

For SI units, 1 in. = 25.4 mm, 1 ft = 0.305 m.
*Measured from the nearest portion of the burner head.

10.16.3 Clearance. The installation of infrared heaters shall meet the following clearance requirements:

(1) Listed heaters shall be installed with clearances from combustible material in accordance the manufacturer's installation instructions.
(2) Unlisted heaters shall be installed in accordance with clearances from combustible material acceptable to the authority having jurisdiction.
(3) In locations used for the storage of combustible materials, signs shall be posted to specify the maximum permissible stacking height to maintain required clearances from the heater to the combustibles.

10.16.4 Combustion and Ventilation Air.

10.16.4.1 Where unvented infrared heaters are used, natural or mechanical means shall be provided to supply and exhaust at least 4 ft^3/min/1000 Btu/hr (0.38 m^3/min/kW) input of installed heaters.

10.16.4.2 Exhaust openings for removing flue products shall be above the level of the heaters.

Δ **10.16.5 Installation in Commercial Garages and Aircraft Hangars.** Overhead heaters installed in garages for more than three motor vehicles or in aircraft hangars shall be listed and shall be installed in accordance with 9.1.11 and 9.1.12.

10.17 Open-Top Broiler Units.

10.17.1 Application. Open-top broiler units shall be listed in accordance with ANSI Z83.11/CSA 1.8, *Gas Food Service Equipment,* or ANSI Z21.1/CSA 1.1, *Household Cooking Gas Appliances,* and installed in accordance with the manufacturer's installation instructions.

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10.17.2 Protection Above Domestic Units. Domestic open-top broiler units shall be provided with a metal ventilating hood not less than 0.0122 in. (0.3 mm) thick with a clearance of not less than ¼ in. (6 mm) between the hood and the underside of combustible material or metal cabinets. A clearance of at least 24 in. (610 mm) shall be maintained between the cooking top and the combustible material or metal cabinet, and the hood shall be at least as wide as the open-top broiler unit and centered over the unit. Domestic open-top broiler units incorporating an integral exhaust system and listed for use without a ventilating hood shall not be required to be provided with a ventilating hood if installed in accordance with 10.13.3.1(1).

10.17.3 Commercial Units. Commercial open-top broiler units shall be provided with ventilation in accordance with NFPA 96.

10.18 Outdoor Cooking Appliances. Outdoor cooking appliances shall be listed in accordance with ANSI Z83.11/CSA 1.8, *Gas Food Service Equipment,* ANSI Z21.58/CSA 1.6, *Outdoor Cooking Gas Appliances,* or ANSI Z21.89/CSA 1.18, *Outdoor Cooking Specialty Gas Appliances,* and installed in accordance with the manufacturer's installation instructions.

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10.19 Pool Heaters.

N **10.19.1 Application.** Pool heaters shall be listed in accordance with ANSI Z21.56/CSA 4.7, *Gas-Fired Pool Heaters.*

10.19.2 Location. A pool heater shall be located or protected so as to minimize accidental contact of hot surfaces by persons.

Δ **10.19.3 Clearance.** The installation of pool heaters shall meet the following requirements:

(1) The clearances shall not interfere with combustion air, draft hood or vent terminal clearance and relief, and accessibility for servicing.
(2) A pool heater shall be installed in accordance with the manufacturer's installation instructions.

10.19.4 Temperature or Pressure Limiting Devices. Where a pool heater is provided with overtemperature protection only and is installed with any device in the discharge line of the heater that can restrict the flow of water from the heater to the pool (such as a check valve, shutoff valve, therapeutic pool valving, or flow nozzles), a pressure relief valve shall be installed either in the heater or between the heater and the restrictive device.

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10.19.5 Bypass Valves. Where an integral bypass system is not provided as a part of the pool heater, a bypass line and valve shall be installed between the inlet and outlet piping for use in adjusting the flow of water through the heater.

10.19.6 Venting. A pool heater listed for outdoor installation shall be installed with the venting means supplied by the manufacturer and in accordance with the manufacturer's instructions.

10.20 Refrigerators.

N **10.20.1 Application.** Refrigerators shall be listed in accordance with ANSI Z21.19/CSA 1.4, *Refrigerators Using Gas Fuel.*

10.20.2 Clearance. Refrigerators shall be provided with clearances for ventilation at the top and back in accordance with the manufacturers' instructions. Where such instructions are not available, at least 2 in. (50 mm) shall be provided between the back of the refrigerator and the wall and at least 12 in. (300 mm) above the top.

10.20.3 Venting or Ventilating Kits Approved for Use with a Refrigerator. Where an accessory kit is used for conveying air for burner combustion or unit cooling to the refrigerator from areas outside the room in which it is located, or for conveying combustion products diluted with air containing waste heat from the refrigerator to areas outside the room in which it is located, the kit shall be installed in accordance with the refrigerator manufacturer's instructions.

10.21 Room Heaters.

N **10.21.1 Application.** Room heaters shall be listed in accordance with 10.21.1.1 or 10.21.1.2.

N **10.21.1.1 Vented Room Heaters.** Vented room heaters shall be listed in accordance with ANSI Z21.86/CSA 2.32, *Vented Gas-Fired Space Heating Appliances,* or ANSI Z21.88/CSA 2.33, *Vented Gas Fireplace Heaters.*

N **10.21.1.2 Unvented Room Heaters.** Unvented room heaters shall be listed in accordance with ANSI Z21.11.2, *Gas-Fired Room Heaters—Volume II, Unvented Room Heaters.*

Δ **10.21.2* Prohibited Installations.** Unvented room heaters shall not be installed in bathrooms or bedrooms.

Exception No. 1: Where approved, one listed wall-mounted, unvented room heater equipped with an oxygen depletion safety shutoff system shall be permitted to be installed in a bathroom, provided that the input rating does not exceed 6000 Btu/hr (1760 W/hr) and combustion and ventilation air is provided as specified in 10.1.2.

Exception No. 2: Where approved, one listed wall-mounted unvented room heater equipped with an oxygen depletion safety shutoff system shall be permitted to be installed in a bedroom, provided that the input rating does not exceed 10,000 Btu/hr (2930 W/hr) and combustion and ventilation air is provided as specified in 10.1.2.

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10.21.3 Installations in Institutions. Room heaters shall not be installed in the following occupancies:

(1) Residential board and care
(2) Health care

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10.21.4 Wall-Mounted Room Heaters. Wall-mounted room heaters shall not be installed in or attached to walls of combustible material unless listed for such installation.

10.22 Stationary Gas Engines. The installation of gas engines shall conform to NFPA 37.

10.22.1 Stationary gas engines shall not be rigidly connected to the gas supply piping.

10.23 Gas-Fired Toilets.

10.23.1 Clearance. A listed gas-fired toilet shall be installed in accordance with the manufacturer's installation instructions, provided that the clearance is in any case sufficient to afford ready accessibility for use, cleanout, and necessary servicing.

10.23.2 Installation on Combustible Floors. Listed gas-fired toilets installed on combustible floors shall be listed for such installation.

10.23.3 Installation. Vents or vent connectors that are capable of being contacted during casual use of the room in which the toilet is installed shall be protected or shielded to prevent such contact.

10.24 Unit Heaters.

N **10.24.1 Application.** Unit heaters shall be listed in accordance with ANSI Z83.8/CSA 2.6, *Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, and Gas-Fired Duct Furnaces,* and installed in accordance with the manufacturer's installation instructions.

10.24.2 Support. Suspended-type unit heaters shall be safely and adequately supported, with due consideration given to their weight and vibration characteristics. Hangers and brackets shall be of noncombustible material.

Δ **10.24.3 Clearance for Suspended-Type Unit Heaters.** Suspended-type unit heaters shall meet the following requirements:

(1) Unit heaters shall be installed with clearances from combustible material of not less than 18 in. (460 mm) at the sides, 12 in. (300 mm) at the bottom, and 6 in. (150 mm) above the top where the unit heater has an internal draft hood, or 1 in. (25 mm) above the top of the sloping side of a vertical draft hood. A unit heater listed for reduced clearances shall be installed in accordance with the manufacturer's installation instructions.
(2) Clearances for servicing shall be in accordance with the manufacturers' installation instructions.

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10.24.4 Combustion and Circulating Air. Combustion and circulating air shall be provided in accordance with Section 9.3.

10.24.5 Ductwork. A unit heater shall not be attached to a warm air duct system unless listed and marked for such installation.

Δ **10.24.6 Installation in Commercial Garages and Aircraft Hangars.** Unit heaters installed in garages for more than three motor vehicles or in aircraft hangars shall be installed in accordance with 9.1.11 and 9.1.12.

10.25 Wall Furnaces.

N **10.25.1 Application.** Wall furnaces shall be listed in accordance with ANSI Z21.86/CSA 2.32, *Vented Gas-Fired Space Heating Appliances.*

10.25.2 Installation.

10.25.2.1 Wall furnaces shall be installed in accordance with the manufacturer's installation instructions. Wall furnaces installed in or attached to combustible material shall be listed for such installation.

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10.25.2.2 Vented wall furnaces connected to a Type B-W gas vent system listed only for a single story shall be installed only in single-story buildings or the top story of multistory buildings. Vented wall furnaces connected to a Type B-W gas vent system listed for installation in multistory buildings shall be permitted to be installed in single-story or multistory buildings. Type B-W gas vents shall be attached directly to a solid header plate that serves as a firestop at that point and that shall be permitted to be an integral part of the vented wall furnace, as illustrated in Figure 10.25.2.2. The stud space in which the vented wall furnace is installed shall be ventilated at the first ceiling level by installation of the ceiling plate spacers furnished with the gas vent. Firestop spacers shall be installed at each subsequent ceiling or floor level penetrated by the vent.

10.25.2.3 Direct vent wall furnaces shall be installed with the combustion air intake terminal outdoors.

10.25.2.4 Panels, grilles, and access doors that are required to be removed for normal servicing operations shall not be attached to the building. *(For additional information on the venting of wall furnaces, see Chapter 12.)*

10.25.3 Location. Wall furnaces shall be located so as not to cause a hazard to walls, floors, curtains, furniture, or doors. Wall furnaces installed between bathrooms and adjoining rooms shall not circulate air from bathrooms to other parts of the building.

10.25.4 Combustion and Circulating Air. Combustion and circulating air shall be provided in accordance with Section 9.3.

10.26 Water Heaters.

N **10.26.1 Application.** Water heaters shall be listed in accordance with ANSI Z21.10.1/CSA 4.1, *Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less,* or ANSI Z21.10.3/CSA 4.3, *Gas Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating or Instantaneous,* and shall be installed in accordance with the manufacturer's installation instructions.

10.26.2 Location. Water heater installations in bedrooms and bathrooms shall comply with one of the following:

(1) Water heater shall be installed in a closet equipped with a weather-stripped door with no openings and with a self-closing device. All combustion air shall be obtained from the outdoors in accordance with 9.3.3.

(2) Water heater shall be of the direct vent type.

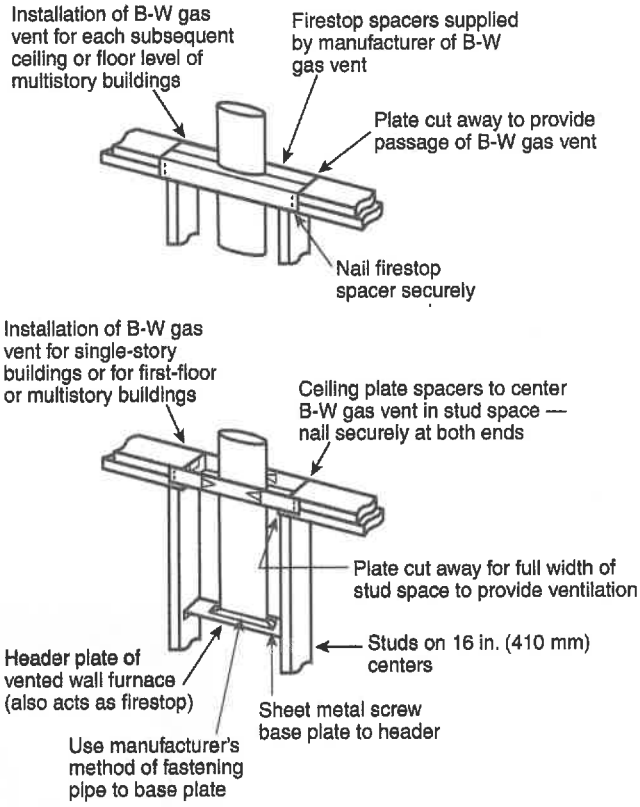

FIGURE 10.25.2.2 Installation of Type B-W Gas Vents for Vented Wall Furnaces.

10.26.3 Clearance. 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 the manufacturer's installation instructions.

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10.26.4 Pressure Relief Devices. A water heater installation shall be provided with overpressure protection by means of a device listed in accordance with ANSI Z21.22/CSA 4.4, *Relief Valves for Hot Water Supply Systems,* and installed in accordance with the manufacturer's installation instructions. The pressure setting of the device shall exceed the water service pressure and shall not exceed the maximum pressure rating of the water heater.

10.26.5 Temperature Limiting Devices. 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 manufacturer's installation instructions.

Δ **10.26.6 Temperature, Pressure, and Vacuum Relief Devices.** Temperature, pressure, and vacuum relief devices, or combinations thereof, and automatic gas shutoff devices shall be installed in accordance with 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 Btu discharge

capacity or the rated steam relief capacity of the device shall not be less than the input rating of the water heater.

10.26.7 Automatic Instantaneous Type: Cold Water Supply. The water supply to an automatic instantaneous water heater that is equipped with a water flow–actuated control shall be such as to provide sufficient pressure to properly operate the control when water is drawn from the highest faucet served by the heater.

10.26.8* Antisiphon Devices. Means acceptable to the authority having jurisdiction shall be provided to prevent siphoning in any water heater or any tank to which a circulating water heater that incorporates a cold water inlet tube is attached.

10.27 Compressed Natural Gas (CNG) Vehicular Fuel Systems. The installation of compressed natural gas (CNG) fueling (dispensing) systems shall be in accordance with NFPA 52. Residential CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.1, *Residential Fueling Appliances*, and installed in accordance to the appliance manufacturer's installation instructions. Non-residential CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.2, *Vehicle Fueling Appliances (VFA)*, and installed in accordance with the appliance manufacturer's installation instructions.

10.28 Appliances for Installation in Manufactured Housing. Appliances installed in manufactured housing after the initial sale shall be listed for installation in manufactured housing, or approved, and shall be installed in accordance with the requirements of this code and the manufacturers' installation instructions. Appliances installed in the living space of manufactured housing shall be in accordance with the requirements of Section 9.3.

10.29 Fuel Cell Power Plants. Fuel cell power plants with a power output of less than 50 kW shall be listed in accordance with ANSI/CSA FC 1, *Fuel Cell Technologies — Part 3-100: Stationary Fuel Cell Power Systems — Safety*, and installed in accordance with the manufacturer's instructions. Fuel cell power plants with a power output of greater than 50 kW shall be installed in accordance with NFPA 853.

10.30 Outdoor Open Flame Decorative Appliances. Permanently fixed in place outdoor open flame decorative appliances shall be installed in accordance with 10.30.1 through 10.30.2.

10.30.1 Application. Outdoor open flame decorative appliances shall be listed in accordance with ANSI Z21.97/CSA 2.41, *Outdoor Decorative Gas Appliances*, and shall be installed in accordance with the manufacturer's installation instructions.

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10.30.2 Connection to Piping System. The connection to the gas piping system shall be in accordance with 9.6.1(1), 9.6.1(2), 9.6.1(4), or 9.6.1(5).

N **10.31 Outdoor Infrared Heaters.** Outdoor infrared heaters for residential and commercial applications shall be listed in accordance with ANSI Z83.26/CSA 2.27, *Gas-Fired Outdoor Infrared Patio Heaters*, and shall be installed in accordance with the manufacturer's installation instructions.

Chapter 11 Procedures to Be Followed to Place Appliance in Operation

11.1 Adjusting the Burner Input.

11.1.1* Adjusting Input. The input rate of the burner shall be adjusted to the proper value in accordance with the appliance manufacturer's instructions. Firing at a rate in excess of the nameplate rating shall be prohibited.

11.1.1.1 The input rate can be adjusted by either changing the size of a fixed orifice, changing the adjustment of an adjustable orifice, or readjusting the appliance's gas pressure regulator outlet pressure (where a regulator is provided in the appliance).

11.1.1.2 The input rate shall be determined by one of the following:

(1) Checking burner input by using a gas meter
(2) Checking burner input by using manifold pressure and orifice size

11.1.1.3 Overfiring shall be prohibited.

11.1.2 High Altitude. Gas input ratings of appliances shall be used for elevations up to 2000 ft (600 m). The input ratings of appliances operating at elevations above 2000 ft (600 m) shall be reduced in accordance with one of the following methods:

(1) At the rate of 4 percent for each 1000 ft (300 m) above sea level before selecting appropriately sized appliance
(2) As permitted by the authority having jurisdiction
(3) In accordance with the manufacturer's installation instructions

11.2* Primary Air Adjustment. The primary air for injection (Bunsen)-type burners shall be adjusted for proper flame characteristics in accordance with the appliance manufacturer's instructions. After setting the primary air, the adjustment means shall be secured in position.

Δ **11.3 Safety Shutoff Devices.** Where a safety shutoff device is provided, it shall be checked for proper operation and adjustment in accordance with the appliance manufacturer's instructions. Where the device does not turn off the gas supply in the event of pilot outage or other ignition malfunction, the device shall be serviced or replaced with a new device.

11.4 Automatic Ignition. Appliances supplied with means for automatic ignition shall be checked for operation within the parameters provided by the manufacturer. Any adjustments made shall be in accordance with the manufacturer's installation instructions.

11.5 Protective Devices. Where required by the manufacturer's installation instructions, all protective devices furnished with the appliance, such as a limit control, fan control to blower, temperature and pressure relief valve, low-water cutoff device, or manual operating features, shall be checked for operation within the parameters provided by the manufacturer. Any adjustments made shall be in accordance with the manufacturer's installation instructions.

11.6* Checking the Draft. Draft hood–equipped appliances shall be checked to verify that there is no draft hood spillage after 5 minutes of main burner operation.

11.7 Operating Instructions. Operating instructions shall be furnished and shall be left in a prominent position near the appliance for use by the consumer.

Chapter 12 Venting of Appliances

12.1* Minimum Safe Performance. Venting systems shall be designed and constructed to convey all flue and vent gases to the outdoors.

12.2 General.

12.2.1 Installation. Listed chimneys and vents shall be installed in accordance with Chapter 12 and the manufacturers' installation instructions.

12.3 Specification for Venting.

12.3.1 Connection to Venting Systems. Except as permitted in 12.3.2 through 12.3.6, all appliances shall be connected to venting systems.

12.3.2 Appliances Not Required to Be Vented. The following appliances shall not be required to be vented:

(1) Listed ranges
(2) Built-in domestic cooking units listed and marked for optional venting
(3) Listed hot plates
(4) Listed Type 1 clothes dryers exhausted in accordance with Section 10.4
(5) 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 36 in. (910 mm) vertically and 6 in. (150 mm) horizontally from any surface other than the appliance.]
(6) Listed refrigerators
(7) Counter appliances
(8) Room heaters listed for unvented use
(9) Direct gas–fired make-up air heaters
(10) Other appliances listed for unvented use and not provided with flue collars
(11) Specialized appliances of limited input such as laboratory burners or gas lights

12.3.2.1 Where any or all of the appliances in 12.3.2(5) through 12.3.2(11) are installed so the aggregate input rating exceeds 20 Btu/hr/ft^3 (207 W/m^3) 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 20 Btu/hr/ft^3 (207 W/m^3).

12.3.2.2 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.

12.3.3* 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.

12.3.4 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.

Δ 12.3.5 Direct Vent Appliances.

***N* 12.3.5.1** Listed direct vent appliances shall be installed in accordance with the manufacturer's installation instructions.

***N* 12.3.5.2** Through-the-wall vent terminations for listed direct vent appliances shall be in accordance with 12.9.1.

Δ 12.3.6 Appliances with Integral Vents. Appliances incorporating integral venting means shall be installed in accordance with 12.9.1.

Δ 12.3.7 Incinerators. Incinerators shall be vented in accordance with NFPA 82.

12.4 Design and Construction.

12.4.1 Appliance Draft Requirements. A venting system shall satisfy the draft requirements of the appliance in accordance with the manufacturer's instructions.

12.4.2 Design and Construction. Appliances required to be vented shall be connected to a venting system designed and installed in accordance with the provisions of Sections 12.5 through 12.16.

12.4.3 Mechanical Draft Systems.

12.4.3.1 Mechanical draft systems shall be listed in accordance with UL 378, *Draft Equipment*, and installed in accordance with both the appliance and the mechanical draft system manufacturer's installation instructions.

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

12.4.3.3 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.

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

12.4.3.5 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.

• 12.4.4* Ventilating Hoods and Exhaust Systems.

12.4.4.1 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.

12.4.5 Circulating Air Ducts, Above-Ceiling Air-Handling Spaces, and Furnace Plenums.

12.4.5.1 Venting systems shall not extend into or pass through any fabricated air duct or furnace plenum.

12.4.5.2 Where a venting system passes through an above-ceiling air space or other nonducted 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.

12.5 Type of Venting System to Be Used.

12.5.1 The type of venting system to be used shall be in accordance with Table 12.5.1.

Δ **12.5.2 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, *Venting Systems for Gas-Burning Appliances, Categories II, III, and IV.*

Δ **12.5.3 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, *Venting Systems for Gas-Burning Appliances, Categories II, III, and IV,* shall be installed in accordance with the vent manufacturer's installation instructions. Where primer is required, it shall be of a contrasting color.

Δ **12.5.4 Special Gas Vents.** Special gas vents shall be listed and labeled in accordance with UL 1738, *Venting Systems for Gas-Burning Appliances, Categories II, III, and IV,* and installed in accordance with the special gas vent manufacturer's installation instructions.

12.6 Masonry, Metal, and Factory-Built Chimneys.

12.6.1 Listing or Construction.

Δ **12.6.1.1** Factory-built chimneys shall be listed in accordance with UL 103, *Chimneys, Factory-Built, Residential Type and Building Heating Appliances;* UL 959, *Medium Heat Appliance Factory-Built Chimneys;* or UL 2561, *1400 Degree Fahrenheit Factory-Built Chimneys.* Factory-built chimneys used to vent appliances that operate at positive vent pressure shall be listed for such application.

12.6.1.2 Metal chimneys shall be built and installed in accordance with NFPA 211.

Δ **Table 12.5.1 Type of Venting System to Be Used**

Appliances	Type of Venting System	Location of Requirements
Listed Category I appliances	Type B gas vent	12.7
Listed appliances equipped with draft hood	Chimney	12.6
Appliances listed for use with Type B gas vent	Single-wall metal pipe	12.8
	Listed chimney lining system for gas venting	12.6.1.3
	Special gas vent listed for these appliances	12.5.4
Listed vented wall furnaces	Type B-W gas vent	12.7, 10.25
Category II, Category III, and Category IV appliances	As specified or furnished by manufacturers of listed appliances	12.5.2, 12.5.4
Incinerators	In accordance with NFPA 82	
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	12.6
Listed combination gas- and oil-burning appliances	Type L vent Chimney	12.7 12.6
Decorative appliance in vented fireplace	Chimney	10.6.3
Gas-fired toilets	Single-wall metal pipe	12.8, 10.23.3
Direct vent appliances		12.3.5
Appliances with integral vents		12.3.6

Δ **12.6.1.3*** 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, *Chimney Liners*
(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."

12.6.2 Termination.

12.6.2.1* A chimney for residential-type or low-heat appliances shall extend at least 3 ft (0.9 m) above the highest point where it passes through a roof of a building and at least 2 ft (0.6 m) higher than any portion of a building within a horizontal distance of 10 ft (3 m).

12.6.2.2 A chimney for medium-heat appliances shall extend at least 10 ft (3 m) higher than any portion of any building within 25 ft (7.6 m).

12.6.2.3 A chimney shall extend at least 5 ft (1.5 m) above the highest connected appliance draft hood outlet or flue collar.

12.6.2.4 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 manufacturers' installation instructions.

12.6.3 Size of Chimneys.

Δ **12.6.3.1** 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 Chapter 13.
(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.

12.6.4 Inspection of Chimneys.

12.6.4.1 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.

Δ **12.6.4.2** Chimneys shall be lined in accordance with NFPA 211.

12.6.4.3 Cleanouts shall be examined and where they do not remain tightly closed when not in use, they shall be repaired or replaced.

12.6.4.4 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.

12.6.5 Chimney Serving Appliances Burning Other Fuels.

12.6.5.1 An appliance shall not be connected to a chimney flue serving a separate appliance designed to burn solid fuel.

12.6.5.2 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.

12.6.5.3* 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.

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

12.6.6 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.

12.6.7 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 6 in. (150 mm) below the lower edge of the lowest chimney inlet opening.

12.6.8 Space Surrounding Lining or Vent.

12.6.8.1 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.

Exception: The insertion of another liner or vent within the chimney as provided in this code and the liner or vent manufacturer's instructions.

12.6.8.2 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.

Exception: Direct vent appliances designed for installation in a solid fuel–burning fireplace where installed in accordance with the manufacturer's installation instructions.

Δ **12.6.9 Insulation Shield.** Where a factory-built chimney passes through insulated assemblies, an insulation shield constructed of steel having a minimum thickness of 0.0187 in. (0.4712 mm) (nominal 26 gage) shall be installed to provide clearance between the chimney and the insulation material. The clearance shall not be less than the clearance to combustibles specified by the chimney manufacturer's installation instructions. Where chimneys pass through attic space, the shield shall terminate not less than 2 in. (51 mm) above the insulation materials and shall be secured in place to prevent displacement.

12.7 Gas Vents.

Δ **12.7.1 Materials.** Type B and Type BW gas vents shall be listed in accordance with UL 441, *Gas Vents*. Vents for listed combination gas- and oil-burning appliances shall be listed in accordance with UL 641, *Type L Low-Temperature Venting Systems*.

12.7.2 Installation. 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.

12.7.3 Gas Vent Termination. 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 12 in. (300 mm) or less in size and located not less than 8 ft (2.4 m) from a vertical wall or similar obstruction shall terminate above the roof in accordance with Figure 12.7.3 and Table 12.7.3.
   (b) Gas vents that are over 12 in. (300 mm) in size or are located less than 8 ft (2.4 m) from a vertical wall or similar obstruction shall terminate not less than 2 ft (0.6 m) above the highest point where they pass through the roof and not less than 2 ft (0.6 m) above any portion of a building within 10 ft (3.0 m) horizontally.
   (c) Industrial appliances as provided in 12.3.4.
   (d) Direct vent systems as provided in 12.3.5.
   (e) Appliances with integral vents as provided in 12.3.6.
   (f) Mechanical draft systems as provided in 12.4.3.
   (g) Ventilating hoods and exhaust systems as provided in 12.4.4.
(2) A Type B or a Type L gas vent shall terminate at least 5 ft (1.5 m) in vertical height above the highest connected appliance draft hood or flue collar.
(3) A Type B-W gas vent shall terminate at least 12 ft (3.7 m) 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 12.3.5 and 12.4.3.
(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 3 ft (0.9 m) above a forced air inlet located within 10 ft (3.0 m).

12.7.4 Size of Gas Vents. Venting systems shall be sized and constructed in accordance with 12.7.4.1 through 12.7.4.3 and the appliance manufacturer's instructions.

Table 12.7.3 Roof Slope Heights

Roof Slope	*H* (minimum) ft	*H* (minimum) m
Flat to 6/12	1.0	0.30
Over 6/12 to 7/12	1.25	0.38
Over 7/12 to 8/12	1.5	0.46
Over 8/12 to 9/12	2.0	0.61
Over 9/12 to 10/12	2.5	0.76
Over 10/12 to 11/12	3.25	0.99
Over 11/12 to 12/12	4.0	1.22
Over 12/12 to 14/12	5.0	1.52
Over 14/12 to 16/12	6.0	1.83
Over 16/12 to 18/12	7.0	2.13
Over 18/12 to 20/12	7.5	2.27
Over 20/12 to 21/12	8.0	2.44

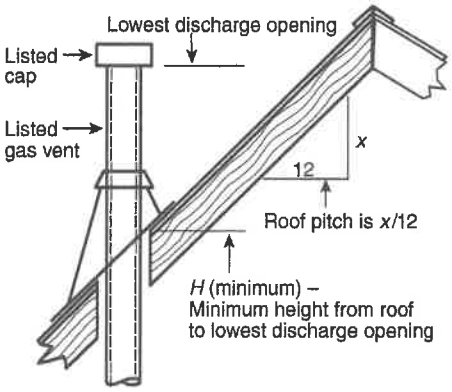

FIGURE 12.7.3 Termination Locations for Gas Vents with Listed Caps 12 in. (300 mm) or Less in Size at Least 8 ft (2.4 m) from a Vertical Wall.

Δ **12.7.4.1* 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 Chapter 13.
(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 Chapter 13 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.

12.7.4.2 Vent Offsets. Type B and Type L vents sized in accordance with 12.7.4.1(3) or 12.7.4.1(4) shall extend in a generally vertical direction with offsets not exceeding 45 degrees, except that a vent system having not more than one 60 degree offset shall be permitted. Any angle greater than 45 degrees 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.

12.7.4.3 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.

Δ **12.7.4.4 Sizing.** Chimney venting systems using mechanical draft shall be sized in accordance with engineering methods.

12.7.5 Gas Vents Serving Appliances on More than One Floor.

Δ **12.7.5.1** 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.

12.7.5.2* 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.

12.7.5.3 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 13.2(a), 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.

12.7.6 Support of Gas Vents. Gas vents shall be supported and spaced in accordance with the manufacturer's installation instructions.

12.7.7 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 authority having jurisdiction shall determine whether its area constitutes such a locality.

12.8 Single-Wall Metal Pipe.

12.8.1 Construction. Single-wall metal pipe shall be constructed of galvanized sheet steel not less than 0.0304 in. (0.7 mm) thick or of other approved, noncombustible, corrosion-resistant material.

12.8.2* 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).

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

(1) Single-wall metal pipe shall terminate at least 5 ft (1.5 m) in vertical height above the highest connected appliance draft hood outlet or flue collar.
(2) Single-wall metal pipe shall extend at least 2 ft (0.6 m) above the highest point where it passes through a roof of a building and at least 2 ft (0.6 m) higher than any portion of a building within a horizontal distance of 10 ft (3 m).
(3) An approved cap or roof assembly shall be attached to the terminus of a single-wall metal pipe.

12.8.4 Installation with Appliances Permitted by 12.5.1.

12.8.4.1* Prohibited Use. Single-wall metal pipe shall not be used as a vent in dwellings and residential occupancies.

12.8.4.2 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.

12.8.4.3 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.

12.8.4.4 Minimum clearances from single-wall metal pipe to combustible material shall be in accordance with Table 12.8.4.4. Reduced clearances from single-wall metal pipe to combustible material shall be as specified for vent connectors in Table 10.2.4.

Table 12.8.4.4 Clearances for Connectors

Appliance	Minimum Distance from Combustible Material			
	Listed Type B Gas Vent Material	Listed Type L Vent Material	Single-Wall Metal Pipe	Factory-Built Chimney Sections
Listed appliance with draft hoods and appliance listed for use with Type B gas vents	As listed	As listed	6 in.	As listed
Residential boilers and furnaces with listed gas conversion burner and with draft hood	6 in.	6 in.	9 in.	As listed
Residential appliances listed for use with Type L vents	Not permitted	As listed	9 in.	As listed
Listed gas-fired toilets	Not permitted	As listed	As listed	As listed
Unlisted residential appliances with draft hood	Not permitted	6 in.	9 in.	As listed
Residential and low-heat appliances other than those above	Not permitted	9 in.	18 in.	As listed
Medium-heat appliance	Not permitted	Not permitted	36 in.	As listed

For SI units, 1 in. = 25.4 mm.

Note: 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.

12.8.4.5 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 18 in. (460 mm) above and 6 in. (150 mm) 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 12.8.4.6.

12.8.4.6 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 4 in. (100 mm) larger in diameter than the metal pipe. Where there is a run of not less than 6 ft (1.8 m) of metal pipe in the opening between the draft hood outlet and the thimble, the thimble shall be a minimum of 2 in. (50 mm) larger in diameter than the metal pipe.

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

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

Exception: 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.

12.8.5 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 Chapter 13.

(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 2 in. (50 mm).

(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.

12.8.6 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.

12.8.7 Marking. Single-wall metal pipe shall comply with the marking provisions of 12.7.7.

12.9 Through-the-Wall Vent Termination.

Δ **12.9.1** The clearance for through-the-wall direct vent and nondirect vent terminals shall be in accordance with Table 12.9.1 and Figure 12.9.1.

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

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12.9.2 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.

12.9.3 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 10 ft (3 m) horizontally from an operable opening in an adjacent building.

Exception: This shall not apply to vent terminals that are 2 ft (0.6 m) or more above or 25 ft (7.6 m) or more below operable openings.

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N **Table 12.9.1 Through the Wall Vent Terminal Clearances**

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 in.	12 in.
B	Clearance to window or door that is openable	6 in. Appliances ≤ 10,000 Btu/hr 9 in. Appliances > 10,000 Btu/hr ≤ 50,000 Btu/hr 12 in. Appliances > 50,000 Btu/hr ≤ 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	4 ft below or to side of opening or 1 ft above opening
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 ft (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 manufacturer	
F	Clearance to outside corner of building	None unless otherwise specified by the appliance manufacturer	
G	Clearance to inside corner of building	None unless otherwise specified by the appliance manufacturer	
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 ft horizontally from inlet or 3 ft 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 ft 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 in. 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.	

For SI units, 1 in. = 25.4 mm, 1 ft = 0.3 m, 1 Btu/hr = 0.293 W.

12.10 Condensation Drain.

Δ **12.10.1** Provision shall be made to collect and dispose of condensate from venting systems serving Category II and Category IV appliances and noncategorized condensing appliances.

12.10.2 Drains for condensate shall be installed in accordance with the appliance and vent manufacturers' installation instructions.

12.11 Vent Connectors for Category I Appliances.

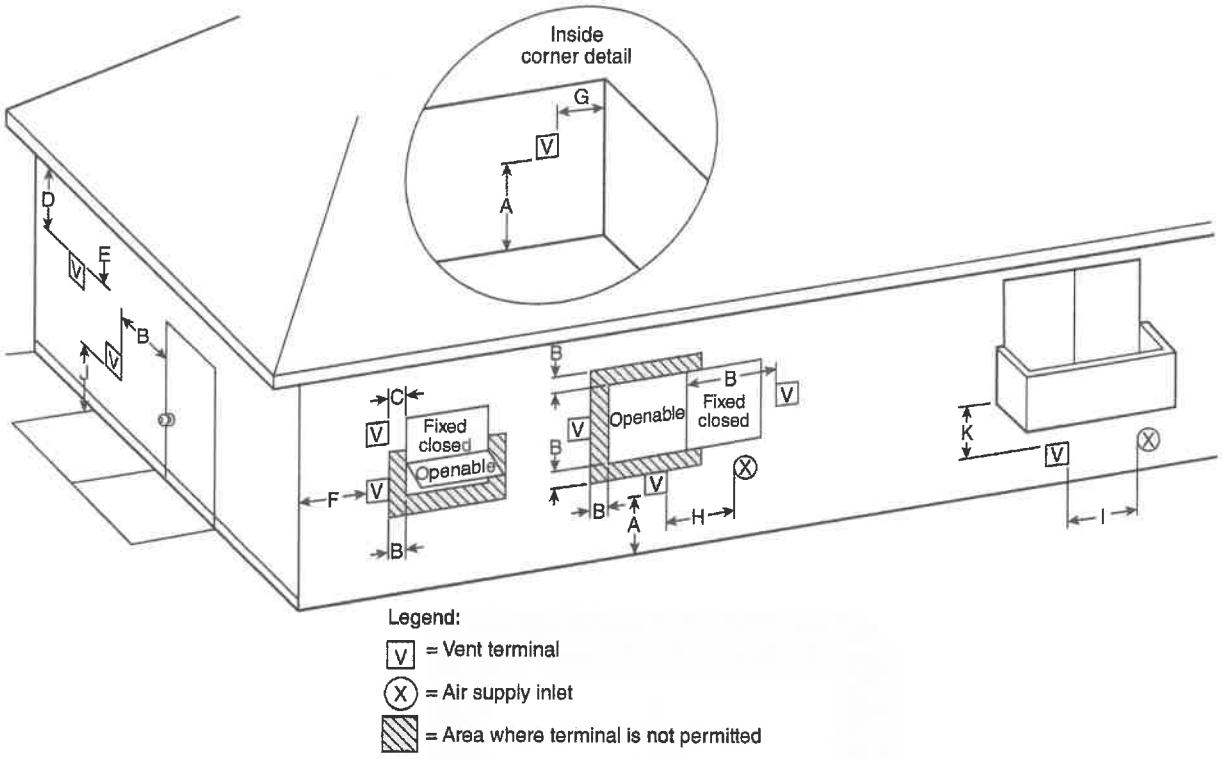
12.11.1 Where Required. A vent connector shall be used to connect an appliance to a gas vent, chimney, or single-wall metal pipe, except where the gas vent, chimney, or single-wall metal pipe is directly connected to the appliance.

12.11.2 Materials.

12.11.2.1 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.

12.11.2.2 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.

Exception: 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.



N **FIGURE 12.9.1 Through the Wall Vent Terminal Clearances.**

12.11.2.3 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 in. (0.46 mm) thick
   (c) Aluminum (1100 or 3003 alloy or equivalent) sheet not less than 0.027 in. (0.69 mm) thick
   (d) Stainless steel sheet not less than 0.012 in. (0.31 mm) thick
   (e) Smooth interior wall metal pipe having resistance to heat and corrosion equal to or greater than that of 12.11.2.3(1)(b), 12.11.2.3(1)(c), or 12.11.2.3(1)(d)
   (f) A listed vent connector
(2) Vent connectors shall not be covered with insulation.

Exception: Listed insulated vent connectors shall be installed in accordance with the manufacturer's installation instructions.

12.11.2.4 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 12.11.2.4. Factory-built chimney sections shall be joined together in accordance with the chimney manufacturer's instructions.

12.11.2.5 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 12.11.2.5 and shall comply with the following:

(1) A steel vent connector for an appliance with a vent gas temperature in excess of 1000°F (538°C) 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 2½ in. (64 mm) thick for a vent connector having a diameter or greatest cross-sectional dimension of 18 in. (460 mm) or less.
(3) The lining shall be at least 4½ in. (110 mm) thick laid on the 4½ in. (110 mm) bed for a vent connector having a diameter or greatest cross-sectional dimension greater than 18 in. (460 mm).
(4) Where factory-built chimney sections are installed, they shall be joined together in accordance with the chimney manufacturer's instructions.

Table 12.11.2.4 Minimum Thickness for Galvanized Steel Vent Connectors for Low-Heat Appliances

Diameter of Connector (in.)	Minimum Thickness (in.)
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

For SI units, 1 in. = 25.4 mm, 1 in.^{2} = 645 mm^2.

Table 12.11.2.5 Minimum Thickness for Steel Vent Connectors for Medium-Heat Appliances

Vent Connector Size		Minimum Thickness (in.)
Diameter (in.)	Area (in.^{2})	
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	Larger than 254	0.123

For SI units, 1 in. = 25.4 mm, 1 in.^{2} = 645 mm^2.

12.11.3* Size of Vent Connector.

Δ **12.11.3.1** 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 Chapter 13 or engineering methods.

Δ **12.11.3.2** 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 1 ft (0.3 m) rise.

Δ **12.11.3.3** Where two or more appliances are connected to a common vent or chimney, each vent connector shall be sized in accordance with Chapter 13 or engineering methods.

12.11.3.4 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.

Δ **12.11.3.5** 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 Chapter 13 or engineering methods.

12.11.3.6 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.

12.11.3.7 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.

12.11.4 Two or More Appliances Connected to a Single Vent.

12.11.4.1 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 or less relative to the vertical.

12.11.4.2 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.

12.11.4.3 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.

12.11.5 Clearance. Minimum clearances from vent connectors to combustible material shall be in accordance with Table 12.8.4.4.

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 10.2.4.

12.11.6 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) Sheet metal screws
(2) Vent connectors of listed vent material assembled and connected to flue collars or draft hood outlets in accordance with the manufacturers' instructions
(3) Other approved means

N **12.11.7 Connector Junctions.** Where vent connectors are joined together, the connection shall be made with a manufactured tee or wye fitting.

12.11.8 Slope. A vent connector shall be installed without any dips or sags and shall slope upward toward the vent or chimney at least ¼ in./ft (20 mm/m).

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

12.11.9* Length of Vent Connector.

12.11.9.1 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.

12.11.9.2 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.

12.11.10 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.

Δ **12.11.11 Chimney Connection.**

N **12.11.11.1** Where entering a flue in a masonry or metal chimney, the vent connector shall be installed above the extreme bottom to avoid stoppage.

N **12.11.11.2** 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.

N **12.11.11.3** 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.

12.11.12 Inspection. The entire length of a vent connector shall be readily accessible for inspection, cleaning, and replacement.

12.11.13 Fireplaces. A vent connector shall not be connected to a chimney flue serving a fireplace unless the fireplace flue opening is permanently sealed.

12.11.14 Passage Through Ceilings, Floors, or Walls.

12.11.14.1 Single-wall metal pipe connectors shall not pass through any wall, floor, or ceiling except as permitted by 12.8.4.2 and 12.8.4.6.

12.11.14.2 Vent connectors for medium-heat appliances shall not pass through walls or partitions constructed of combustible material.

12.12 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 Section 12.5.

12.13 Draft Hoods and Draft Controls.

12.13.1 Appliances Requiring Draft Hoods. Vented appliances shall be installed with draft hoods.

Exception: 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 400,000 Btu/hr (117 kW); appliances equipped with blast, power, or pressure burners that are not listed for use with draft hoods; and appliances designed for forced venting.

12.13.2 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.

12.13.2.1 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.

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12.13.3 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.

12.13.4* 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.

12.13.5 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.

12.13.6 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.

12.13.7 Clearance. A draft hood shall be located so that its relief opening is not less than 6 in. (150 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.

Δ **12.14 Manually Operated Dampers.**

N **12.14.1** 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.

N **12.14.2*** Balancing baffles shall be mechanically locked in the desired position before placing the appliance in service.

N **12.14.3** Balancing baffles shall be listed in accordance with UL 378, *Draft Equipment.*

Δ **12.15 Automatically Operated Vent Dampers.** An automatically operated vent damper shall be listed.

Δ **12.16 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 13.1.1 or 13.2.1 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 Section 12.1 and 12.4.1 is obtained

Chapter 13 Sizing of Category I Venting Systems

13.1 Additional Requirements to Single Appliance Vent. This section shall apply where Table 13.1(a) through Table 13.1(f) are used to size single appliance venting systems. Subsections 13.1.1 through 13.1.18 apply to Table 13.1(a) through Table 13.1(f).

Table 13.1(a) Type B Double-Wall Gas Vent

		Number of Appliances:	Single
		Appliance Type:	Category I
		Appliance Vent Connection:	Connected Directly to Vent

		Vent Diameter — *D* (in.)																					
		3			4			5			6			7			8			9			
		Appliance Input Rating in Thousands of Btu per Hour																					
Height *H* (ft)	Lateral *L* (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	0	78	46	0	152	86	0	251	141	0	375	205	0	524	285	0	698	370	0	897	470
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	321	217	53	425	285	68	543	370
	4	21	49	34	30	94	64	39	153	103	50	227	153	66	316	211	79	419	279	93	536	362
	6	25	46	32	36	91	61	47	149	100	59	223	149	78	310	205	93	413	273	110	530	354
8	0	0	84	50	0	165	94	0	276	155	0	415	235	0	583	320	0	780	415	0	1006	537
	2	12	57	40	16	109	75	25	178	120	28	263	180	42	365	247	50	483	322	60	619	418
	5	23	53	38	32	103	71	42	171	115	53	255	173	70	356	237	83	473	313	99	607	407
	8	28	49	35	39	98	66	51	164	109	64	247	165	84	347	227	99	463	303	117	596	396
10	0	0	88	53	0	175	100	0	295	166	0	447	255	0	631	345	0	847	450	0	1096	585
	2	12	61	42	17	118	81	23	194	129	26	289	195	40	402	273	48	533	355	57	684	457
	5	23	57	40	32	113	77	41	187	124	52	280	188	68	392	263	81	522	346	95	671	446
	10	30	51	36	41	104	70	54	176	115	67	267	175	88	376	245	104	504	330	122	651	427
15	0	0	94	58	0	191	112	0	327	187	0	502	285	0	716	390	0	970	525	0	1263	682
	2	11	69	48	15	136	93	20	226	150	22	339	225	38	475	316	45	633	414	53	815	544
	5	22	65	45	30	130	87	39	219	142	49	330	217	64	463	300	76	620	403	90	800	529
	10	29	59	41	40	121	82	51	206	135	64	315	208	84	445	288	99	600	386	116	777	507
	15	35	53	37	48	112	76	61	195	128	76	301	198	98	429	275	115	580	373	134	755	491
20	0	0	97	61	0	202	119	0	349	202	0	540	307	0	776	430	0	1057	575	0	1384	752
	2	10	75	51	14	149	100	18	250	166	20	377	249	33	531	346	41	711	470	50	917	612
	5	21	71	48	29	143	96	38	242	160	47	367	241	62	519	337	73	697	460	86	902	599
	10	28	64	44	38	133	89	50	229	150	62	351	228	81	499	321	95	675	443	112	877	576
	15	34	58	40	46	124	84	59	217	142	73	337	217	94	481	308	111	654	427	129	853	557
	20	48	52	35	55	116	78	69	206	134	84	322	206	107	464	295	125	634	410	145	830	537
30	0	0	100	64	0	213	128	0	374	220	0	587	336	0	853	475	0	1173	650	0	1548	855
	2	9	81	56	13	166	112	14	283	185	18	432	280	27	613	394	33	826	535	42	1072	700
	5	21	77	54	28	160	108	36	275	176	45	421	273	58	600	385	69	811	524	82	1055	688
	10	27	70	50	37	150	102	48	262	171	59	405	261	77	580	371	91	788	507	107	1028	668
	15	33	64	NA	44	141	96	57	249	163	70	389	249	90	560	357	105	765	490	124	1002	648
	20	56	58	NA	53	132	90	66	237	154	80	374	237	102	542	343	119	743	473	139	977	628
	30	NA	NA	NA	73	113	NA	88	214	NA	104	346	219	131	507	321	149	702	444	171	929	594
50	0	0	101	67	0	216	134	0	397	232	0	633	363	0	932	518	0	1297	708	0	1730	952
	2	8	86	61	11	183	122	14	320	206	15	497	314	22	715	445	26	975	615	33	1276	813
	5	20	82	NA	27	177	119	35	312	200	43	487	308	55	702	438	65	960	605	77	1259	798
	10	26	76	NA	35	168	114	45	299	190	56	471	298	73	681	426	86	935	589	101	1230	773
	15	59	70	NA	42	158	NA	54	287	180	66	455	288	85	662	413	100	911	572	117	1203	747
	20	NA	NA	NA	50	149	NA	63	275	169	76	440	278	97	642	401	113	888	556	131	1176	722
	30	NA	NA	NA	69	131	NA	84	250	NA	99	410	259	123	605	376	141	844	522	161	1125	670
100	0	NA	NA	NA	0	218	NA	0	407	NA	0	665	400	0	997	560	0	1411	770	0	1908	1040
	2	NA	NA	NA	10	194	NA	12	354	NA	13	566	375	18	831	510	21	1155	700	25	1536	935
	5	NA	NA	NA	26	189	NA	33	347	NA	40	557	369	52	820	504	60	1141	692	71	1519	926
	10	NA	NA	NA	33	182	NA	43	335	NA	53	542	361	68	801	493	80	1118	679	94	1492	910
	15	NA	NA	NA	40	174	NA	50	321	NA	62	528	353	80	782	482	93	1095	666	109	1465	895
	20	NA	NA	NA	47	166	NA	59	311	NA	71	513	344	90	763	471	105	1073	653	122	1438	880
	30	NA	NA	NA	NA	NA	NA	78	290	NA	92	483	NA	115	726	449	131	1029	627	149	1387	849
	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	147	428	NA	180	651	405	197	944	575	217	1288	787

Table 13.1(a) ***Continued***

		Number of Appliances:	Single
		Appliance Type:	Category I
		Appliance Vent Connection:	Connected Directly to Vent

		Vent Diameter — D (in.)																							
		10			12			14			16			18			20			22			24		
		Appliance Input Rating in Thousands of Btu per Hour																							
Height H (ft)	Lateral L (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	0	1121	570	0	1645	850	0	2267	1170	0	2983	1530	0	3802	1960	0	4721	2430	0	5737	2950	0	6853	3520
	2	75	675	455	103	982	650	138	1346	890	178	1769	1170	225	2250	1480	296	2782	1850	360	3377	2220	426	4030	2670
	4	110	668	445	147	975	640	191	1338	880	242	1761	1160	300	2242	1475	390	2774	1835	469	3370	2215	555	4023	2660
	6	128	661	435	171	967	630	219	1330	870	276	1753	1150	341	2235	1470	437	2767	1820	523	3363	2210	618	4017	2650
8	0	0	1261	660	0	1858	970	0	2571	1320	0	3399	1740	0	4333	2220	0	5387	2750	0	6555	3360	0	7838	4010
	2	71	770	515	98	1124	745	130	1543	1020	168	2030	1340	212	2584	1700	278	3196	2110	336	3882	2560	401	4634	3050
	5	115	758	503	154	1110	733	199	1528	1010	251	2013	1330	311	2563	1685	398	3180	2090	476	3863	2545	562	4612	3040
	8	137	746	490	180	1097	720	231	1514	1000	289	2000	1320	354	2552	1670	450	3163	2070	537	3850	2530	630	4602	3030
10	0	0	1377	720	0	2036	1060	0	2825	1450	0	3742	1925	0	4782	2450	0	5955	3050	0	7254	3710	0	8682	4450
	2	68	852	560	93	1244	850	124	1713	1130	161	2256	1480	202	2868	1890	264	3556	2340	319	4322	2840	378	5153	3390
	5	112	839	547	149	1229	829	192	1696	1105	243	2238	1461	300	2849	1871	382	3536	2318	458	4301	2818	540	5132	3371
	10	142	817	525	187	1204	795	238	1669	1080	298	2209	1430	364	2818	1840	459	3504	2280	546	4268	2780	641	5099	3340
15	0	0	1596	840	0	2380	1240	0	3323	1720	0	4423	2270	0	5678	2900	0	7099	3620	0	8665	4410	0	10,393	5300
	2	63	1019	675	86	1495	985	114	2062	1350	147	2719	1770	186	3467	2260	239	4304	2800	290	5232	3410	346	6251	4080
	5	105	1003	660	140	1476	967	182	2041	1327	229	2696	1748	283	3442	2235	355	4278	2777	426	5204	3385	501	6222	4057
	10	135	977	635	177	1446	936	227	2009	1289	283	2659	1712	346	3402	2193	432	4234	2739	510	5159	3343	599	6175	4019
	15	155	953	610	202	1418	905	257	1976	1250	318	2623	1675	385	3368	2150	479	4192	2700	564	5115	3300	665	6129	3980
20	0	0	1756	930	0	2637	1350	0	3701	1900	0	4948	2520	0	6376	3250	0	7988	4060	0	9785	4980	0	11,753	6000
	2	59	1150	755	81	1694	1100	107	2343	1520	139	3097	2000	175	3955	2570	220	4916	3200	269	5983	3910	321	7154	4700
	5	101	1133	738	135	1674	1079	174	2320	1498	219	3071	1978	270	3926	2544	337	4885	3174	403	5950	3880	475	7119	4662
	10	130	1105	710	172	1641	1045	220	2282	1460	273	3029	1940	334	3880	2500	413	4835	3130	489	5896	3830	573	7063	4600
	15	150	1078	688	195	1609	1018	248	2245	1425	306	2988	1910	372	3835	2465	459	4786	3090	541	5844	3795	631	7007	4575
	20	167	1052	665	217	1578	990	273	2210	1390	335	2948	1880	404	3791	2430	495	4737	3050	585	5792	3760	689	6953	4550
30	0	0	1977	1060	0	3004	1550	0	4252	2170	0	5725	2920	0	7420	3770	0	9341	4750	0	11,483	5850	0	13,848	7060
	2	54	1351	865	74	2004	1310	98	2786	1800	127	3696	2380	159	4734	3050	199	5900	3810	241	7194	4650	285	8617	5600
	5	96	1332	851	127	1981	1289	164	2759	1775	206	3666	2350	252	4701	3020	312	5863	3783	373	7155	4622	439	8574	5552
	10	125	1301	829	164	1944	1254	209	2716	1733	259	3617	2300	316	4647	2970	386	5803	3739	456	7090	4574	535	8505	5471
	15	143	1272	807	187	1908	1220	237	2674	1692	292	3570	2250	354	4594	2920	431	5744	3695	507	7026	4527	590	8437	5391
	20	160	1243	784	207	1873	1185	260	2633	1650	319	3523	2200	384	4542	2870	467	5686	3650	548	6964	4480	639	8370	5310
	30	195	1189	745	246	1807	1130	305	2555	1585	369	3433	2130	440	4442	2785	540	5574	3565	635	6842	4375	739	8239	5225
50	0	0	2231	1195	0	3441	1825	0	4934	2550	0	6711	3440	0	8774	4460	0	11,129	5635	0	13,767	6940	0	16,694	8430
	2	41	1620	1010	66	2431	1513	86	3409	2125	113	4554	2840	141	5864	3670	171	7339	4630	209	8980	5695	251	10,788	6860
	5	90	1600	996	118	2406	1495	151	3380	2102	191	4520	2813	234	5826	3639	283	7295	4597	336	8933	5654	394	10,737	6818
	10	118	1567	972	154	2366	1466	196	3332	2064	243	4464	2767	295	5763	3585	355	7224	4542	419	8855	5585	491	10,652	6749
	15	136	1536	948	177	2327	1437	222	3285	2026	274	4409	2721	330	5701	3534	396	7155	4511	465	8779	5546	542	10,570	6710
	20	151	1505	924	195	2288	1408	244	3239	1987	300	4356	2675	361	5641	3481	433	7086	4479	506	8704	5506	586	10,488	6670
	30	183	1446	876	232	2214	1349	287	3150	1910	347	4253	2631	412	5523	3431	494	6953	4421	577	8557	5444	672	10,328	6603
100	0	0	2491	1310	0	3925	2050	0	5729	2950	0	7914	4050	0	10,485	5300	0	13,454	6700	0	16,817	8600	0	20,578	10,300
	2	30	1975	1170	44	3027	1820	72	4313	2550	95	5834	3500	120	7591	4600	138	9577	5800	169	11,803	7200	204	14,264	8800
	5	82	1955	1159	107	3002	1803	136	4282	2531	172	5797	3475	208	7548	4566	245	9528	5769	293	11,748	7162	341	14,204	8756
	10	108	1923	1142	142	2961	1775	180	4231	2500	223	5737	3434	268	7478	4509	318	9447	5717	374	11,658	7100	436	14,105	8683
	15	126	1892	1124	163	2920	1747	206	4182	2469	252	5678	3392	304	7409	4451	358	9367	5665	418	11,569	7037	487	14,007	8610
	20	141	1861	1107	181	2880	1719	226	4133	2438	277	5619	3351	330	7341	4394	387	9289	5613	452	11,482	6975	523	13,910	8537
	30	170	1802	1071	215	2803	1663	265	4037	2375	319	5505	3267	378	7209	4279	446	9136	5509	514	11,310	6850	592	13,720	8391
	50	241	1688	1000	292	2657	1550	350	3856	2250	415	5289	3100	486	6956	4050	572	8841	5300	659	10,979	6600	752	13,354	8100

For SI units, 1 in. = 25.4 mm, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW, 1 in.^{2} = 645 mm^2.
NA: Not applicable.

Table 13.1(b) Type B Double-Wall Vent

													Number of Appliances:			Single													
													Appliance Type:			Category I													
													Appliance Vent Connection:			Single-Wall Metal Connector													
		Vent Diameter — D (in.)																											
		3			4			5			6			7			8			9			10			12				
		Appliance Input Rating in Thousands of Btu per Hour																											
Height H (ft)	Lateral L (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT		
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max		
6	0	38	77	45	59	151	85	85	249	140	126	373	204	165	522	284	211	695	369	267	894	469	371	1118	569	537	1639	849		
	2	39	51	36	60	96	66	85	156	104	123	231	156	159	320	213	201	423	284	251	541	368	347	673	453	498	979	648		
	4	NA	NA	33	74	92	63	102	152	102	146	225	152	187	313	208	237	416	277	295	533	360	409	664	443	584	971	638		
	6	NA	NA	31	83	89	60	114	147	99	163	220	148	207	307	203	263	409	271	327	526	352	449	656	433	638	962	627		
8	0	37	83	50	58	164	93	83	273	154	123	412	234	161	580	319	206	777	414	258	1002	536	360	1257	658	521	1852	967		
	2	39	56	39	59	108	75	83	176	119	121	261	179	155	363	246	197	482	321	246	617	417	339	768	513	486	1120	743		
	5	NA	NA	37	77	102	69	107	168	114	151	252	171	193	352	235	245	470	311	305	604	404	418	754	500	598	1104	730		
	8	NA	NA	33	90	95	64	122	161	107	175	243	163	223	342	225	280	458	300	344	591	392	470	740	486	665	1089	715		
10	0	37	87	53	57	174	99	82	293	165	120	444	254	158	628	344	202	844	449	253	1093	584	351	1373	718	507	2031	1057		
	2	39	61	41	59	117	80	82	193	128	119	287	194	153	400	272	193	531	354	242	681	456	332	849	559	475	1242	848		
	5	52	56	39	76	111	76	105	185	122	148	277	186	190	388	261	241	518	344	299	667	443	409	834	544	584	1224	825		
	10	NA	NA	34	97	100	68	132	171	112	188	261	171	237	369	241	296	497	325	363	643	423	492	808	520	688	1194	788		
15	0	36	93	57	56	190	111	80	325	186	116	499	283	153	713	388	195	966	523	244	1259	681	336	1591	838	488	2374	1237		
	2	38	69	47	57	136	93	80	225	149	115	337	224	148	473	314	187	681	413	232	812	543	319	1015	673	457	1491	983		
	5	51	63	44	75	128	86	102	216	140	144	326	217	182	459	298	231	616	400	287	795	526	392	997	657	562	1469	963		
	10	NA	NA	39	95	116	79	128	201	131	182	308	203	228	438	284	284	592	381	349	768	501	470	966	628	664	1433	928		
	15	NA	NA	NA	NA	NA	72	158	186	124	220	290	192	272	418	269	334	568	367	404	742	484	540	937	601	750	1399	894		
20	0	35	96	60	54	200	118	78	346	201	114	537	306	149	772	428	190	1053	573	238	1379	750	326	1751	927	473	2631	1346		
	2	37	74	50	56	148	99	78	248	165	113	375	248	144	528	344	182	708	468	227	914	611	309	1146	754	443	1689	1098		
	5	50	68	47	73	140	94	100	239	158	141	363	239	178	514	334	224	692	457	279	896	596	381	1126	734	547	1665	1074		
	10	NA	NA	41	93	129	86	125	223	146	177	344	224	222	491	316	277	666	437	339	866	570	457	1092	702	646	1626	1037		
	15	NA	NA	NA	NA	NA	80	155	208	136	216	325	210	264	469	301	325	640	419	393	838	549	526	1060	677	730	1587	1005		
	20	NA	NA	NA	NA	NA	NA	186	192	126	254	306	196	309	448	285	374	616	400	448	810	526	592	1028	651	808	1550	973		
30	0	34	99	63	53	211	127	76	372	219	110	584	334	144	849	472	184	1168	647	229	1542	852	312	1971	1056	454	2996	1545		
	2	37	80	56	55	164	111	76	281	183	109	429	279	139	610	392	175	823	533	219	1069	698	296	1346	863	424	1999	1308		
	5	49	74	52	72	157	106	98	271	173	136	417	271	171	595	382	215	806	521	269	1049	684	366	1324	846	524	1971	1283		
	10	NA	NA	NA	91	144	98	122	255	168	171	397	257	213	570	367	265	777	501	327	1017	662	440	1287	821	620	1927	1243		
	15	NA	NA	NA	115	131	NA	151	239	157	208	377	242	255	547	349	312	750	481	379	985	638	507	1251	794	702	1884	1205		
	20	NA	NA	NA	NA	NA	NA	181	223	NA	246	357	228	298	524	333	360	723	461	433	955	615	570	1216	768	780	1841	1166		
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	389	477	305	461	670	426	541	895	574	704	1147	720	937	1759	1101		
50	0	33	99	66	51	213	133	73	394	230	105	629	361	138	928	515	176	1292	704	220	1724	948	295	2223	1189	428	3432	1818		
	2	36	84	61	53	181	121	73	318	205	104	495	312	133	712	448	168	971	613	209	1273	811	280	1615	1007	401	2426	1509		
	5	48	80	NA	70	174	117	94	308	198	131	482	305	164	696	435	204	953	602	257	1252	795	347	1591	991	496	2396	1490		
	10	NA	NA	NA	89	160	NA	118	292	186	162	461	292	203	671	420	253	923	583	313	1217	765	418	1551	963	589	2347	1455		
	15	NA	NA	NA	112	148	NA	145	275	174	199	441	280	244	646	405	299	894	562	363	1183	736	481	1512	934	668	2299	1421		
	20	NA	NA	NA	NA	NA	NA	176	257	NA	236	420	267	285	622	389	345	866	543	415	1150	708	544	1473	906	741	2251	1387		
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	315	376	NA	373	573	NA	442	809	502	521	1086	649	674	1399	848	892	2159	1318		
100	0	NA	NA	NA	49	214	NA	69	403	NA	100	659	395	131	991	555	166	1404	765	207	1900	1033	273	2479	1300	395	3912	2042		
	2	NA	NA	NA	51	192	NA	70	351	NA	98	563	373	125	828	508	158	1152	698	196	1532	933	259	1970	1168	371	3021	1817		
	5	NA	NA	NA	67	186	NA	90	342	NA	125	551	366	156	813	501	194	1134	688	240	1511	921	322	1945	1153	460	2990	1796		
	10	NA	NA	NA	85	175	NA	113	324	NA	153	532	354	191	789	486	238	1104	672	293	1477	902	389	1905	1133	547	2938	1763		
	15	NA	NA	NA	132	162	NA	138	310	NA	188	511	343	230	764	473	281	1075	656	342	1443	884	447	1865	1110	618	2888	1730		
	20	NA	NA	NA	NA	NA	NA	168	295	NA	224	487	NA	270	739	458	325	1046	639	391	1410	864	507	1825	1087	690	2838	1696		
	30	NA	NA	NA	NA	NA	NA	231	264	NA	301	448	NA	355	685	NA	418	988	NA	491	1343	824	631	1747	1041	834	2739	1627		
	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	540	584	NA	617	866	NA	711	1205	NA	895	1591	NA	1138	2547	1489		

For SI units, 1 in. = 25.4 mm, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW, 1 in.^{2} = 645 mm^2.
NA: Not applicable.

Table 13.1(c) Masonry Chimney

		Number of Appliances:	Single
		Appliance Type:	Category I
		Appliance Vent Connection:	Type B Double-Wall Connector

		Type B Double-Wall Connector Diameter — D (in.) To be used with chimney areas within the size limits at bottom																											
		3			4			5			6			7			8			9			10			12				
		Appliance Input Rating in Thousands of Btu per Hour																											
Height H (ft)	Lateral L (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT		
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max		
6	2	NA	NA	28	NA	NA	52	NA	NA	86	NA	NA	130	NA	NA	180	NA	NA	247	NA	NA	320	NA	NA	401	NA	NA	581		
	5	NA	NA	25	NA	NA	49	NA	NA	82	NA	NA	117	NA	NA	165	NA	NA	231	NA	NA	298	NA	NA	376	NA	NA	561		
8	2	NA	NA	29	NA	NA	55	NA	NA	93	NA	NA	145	NA	NA	198	NA	NA	266	84	590	350	100	728	446	139	1024	651		
	5	NA	NA	26	NA	NA	52	NA	NA	88	NA	NA	134	NA	NA	183	NA	NA	247	NA	NA	328	149	711	423	201	1007	640		
	8	NA	NA	24	NA	NA	48	NA	NA	83	NA	NA	127	NA	NA	175	NA	NA	239	NA	NA	318	173	695	410	231	990	623		
10	2	NA	NA	31	NA	NA	61	NA	NA	103	NA	NA	162	NA	NA	221	68	519	298	82	655	388	98	810	491	136	1144	724		
	5	NA	NA	28	NA	NA	57	NA	NA	96	NA	NA	148	NA	NA	204	NA	NA	277	124	638	365	146	791	466	196	1124	712		
	10	NA	NA	25	NA	NA	50	NA	NA	87	NA	NA	139	NA	NA	191	NA	NA	263	155	610	347	182	762	444	240	1093	668		
15	2	NA	NA	35	NA	NA	67	NA	NA	114	NA	NA	179	53	475	250	64	613	336	77	779	441	92	968	562	127	1376	841		
	5	NA	NA	35	NA	NA	62	NA	NA	107	NA	NA	164	NA	NA	231	99	594	313	118	759	416	139	946	533	186	1352	828		
	10	NA	NA	28	NA	NA	55	NA	NA	97	NA	NA	153	NA	NA	216	126	565	296	148	727	394	173	912	567	229	1315	777		
	15	NA	NA	NA	NA	NA	48	NA	NA	89	NA	NA	141	NA	NA	201	NA	NA	281	171	698	375	198	880	485	259	1280	742		
20	2	NA	NA	38	NA	NA	74	NA	NA	124	NA	NA	201	51	522	274	61	678	375	73	867	491	87	1083	627	121	1548	953		
	5	NA	NA	36	NA	NA	68	NA	NA	116	NA	NA	184	80	503	254	95	658	350	113	845	463	133	1059	597	179	1523	933		
	10	NA	NA	NA	NA	NA	60	NA	NA	107	NA	NA	172	NA	NA	237	122	627	332	143	811	440	167	1022	566	221	1482	879		
	15	NA	NA	NA	NA	NA	NA	NA	NA	97	NA	NA	159	NA	NA	220	NA	NA	314	165	780	418	191	987	541	251	1443	840		
	20	NA	NA	NA	NA	NA	NA	NA	NA	83	NA	NA	148	NA	NA	206	NA	NA	296	186	750	397	214	955	513	277	1406	807		
30	2	NA	NA	41	NA	NA	82	NA	NA	137	NA	NA	216	47	581	303	57	762	421	68	985	558	81	1240	717	111	1793	1112		
	5	NA	NA	NA	NA	NA	76	NA	NA	128	NA	NA	198	75	561	281	90	741	393	106	962	526	125	1216	683	169	1766	1094		
	10	NA	NA	NA	NA	NA	67	NA	NA	115	NA	NA	184	NA	NA	263	115	709	373	135	927	500	158	1176	648	210	1721	1025		
	15	NA	NA	NA	NA	NA	NA	NA	NA	107	NA	NA	171	NA	NA	243	NA	NA	353	156	893	476	181	1139	621	239	1679	981		
	20	NA	NA	NA	NA	NA	NA	NA	NA	91	NA	NA	159	NA	NA	227	NA	NA	332	176	860	450	203	1103	592	264	1638	940		
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	188	NA	NA	288	NA	NA	416	249	1035	555	318	1560	877		
50	2	NA	NA	NA	NA	NA	92	NA	NA	161	NA	NA	251	NA	NA	351	51	840	477	61	1106	633	72	1413	812	99	2080	1243		
	5	NA	NA	NA	NA	NA	NA	NA	NA	151	NA	NA	230	NA	NA	323	83	819	445	98	1083	596	116	1387	774	155	2052	1225		
	10	NA	NA	NA	NA	NA	NA	NA	NA	138	NA	NA	215	NA	NA	304	NA	NA	424	126	1047	567	147	1347	733	195	2006	1147		
	15	NA	NA	NA	NA	NA	NA	NA	NA	127	NA	NA	199	NA	NA	282	NA	NA	400	146	1010	539	170	1307	702	222	1961	1099		
	20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	185	NA	NA	264	NA	NA	376	165	977	511	190	1269	669	246	1916	1050		
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	327	NA	NA	468	233	1196	623	295	1832	984		
Minimum internal area of chimney (in.^{2})		12			19			28			38			50			63			78			95			132				
Maximum internal area of chimney (in.^{2})		Seven times the listed appliance categorized vent area, flue collar area, or draft hood outlet areas.																											

For SI units, 1 in. = 25.4 mm, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW, 1 in.^{2} = 645 mm^2.
NA: Not applicable.

Table 13.1(d) Masonry Chimney

																				Number of Appliances:			Single								
																				Appliance Type:			Category I								
																				Appliance Vent Connection:			Single-Wall Metal Connector								
		Single-Wall Metal Connector Diameter — *D* (in.) To be used with chimney areas within the size limits at bottom																													
		3			4			5			6			7			8			9			10			12					
		Appliance Input Rating in Thousands of Btu per Hour																													
Height *H* (ft)	Lateral *L* (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	2	NA	NA	28	NA	NA	52	NA	NA	86	NA	NA	130	NA	NA	180	NA	NA	247	NA	NA	319	NA	NA	400	NA	NA	580			
	5	NA	NA	25	NA	NA	48	NA	NA	81	NA	NA	116	NA	NA	164	NA	NA	230	NA	NA	297	NA	NA	375	NA	NA	560			
8	2	NA	NA	29	NA	NA	55	NA	NA	93	NA	NA	145	NA	NA	197	NA	NA	265	NA	NA	349	382	725	445	549	1021	650			
	5	NA	NA	26	NA	NA	51	NA	NA	87	NA	NA	133	NA	NA	182	NA	NA	246	NA	NA	327	NA	NA	422	673	1003	638			
	8	NA	NA	23	NA	NA	47	NA	NA	82	NA	NA	126	NA	NA	174	NA	NA	237	NA	NA	317	NA	NA	408	747	985	621			
10	2	NA	NA	31	NA	NA	61	NA	NA	102	NA	NA	161	NA	NA	220	216	518	297	271	654	387	373	808	490	536	1142	722			
	5	NA	NA	28	NA	NA	56	NA	NA	95	NA	NA	147	NA	NA	203	NA	NA	276	334	635	364	459	789	465	657	1121	710			
	10	NA	NA	24	NA	NA	49	NA	NA	86	NA	NA	137	NA	NA	189	NA	NA	261	NA	NA	345	547	758	441	771	1088	665			
15	2	NA	NA	35	NA	NA	67	NA	NA	113	NA	NA	178	166	473	249	211	611	335	264	776	440	362	965	560	520	1373	840			
	5	NA	NA	32	NA	NA	61	NA	NA	106	NA	NA	163	NA	NA	230	261	591	312	325	755	414	444	942	531	637	1348	825			
	10	NA	NA	27	NA	NA	54	NA	NA	96	NA	NA	151	NA	NA	214	NA	NA	294	392	722	392	531	907	504	749	1309	774			
	15	NA	NA	NA	NA	NA	46	NA	NA	87	NA	NA	138	NA	NA	198	NA	NA	278	452	692	372	606	873	481	841	1272	738			
20	2	NA	NA	38	NA	NA	73	NA	NA	123	NA	NA	200	163	520	273	206	675	374	258	864	490	252	1079	625	508	1544	950			
	5	NA	NA	35	NA	NA	67	NA	NA	115	NA	NA	183	NA	NA	252	255	655	348	317	842	461	493	1055	594	623	1518	930			
	10	NA	NA	NA	NA	NA	59	NA	NA	105	NA	NA	170	NA	NA	235	312	622	330	382	806	437	517	1016	562	733	1475	875			
	15	NA	NA	NA	NA	NA	NA	NA	NA	95	NA	NA	156	NA	NA	217	NA	NA	311	442	773	414	591	979	539	823	1434	835			
	20	NA	NA	NA	NA	NA	NA	NA	NA	80	NA	NA	144	NA	NA	202	NA	NA	292	NA	NA	392	663	944	510	911	1394	800			
30	2	NA	NA	41	NA	NA	81	NA	NA	136	NA	NA	215	158	578	302	200	759	420	249	982	556	340	1237	715	489	1789	1110			
	5	NA	NA	NA	NA	NA	75	NA	NA	127	NA	NA	196	NA	NA	279	245	737	391	306	958	524	417	1210	680	600	1760	1090			
	10	NA	NA	NA	NA	NA	66	NA	NA	113	NA	NA	182	NA	NA	260	300	703	370	370	920	496	500	1168	644	708	1713	1020			
	15	NA	NA	NA	NA	NA	NA	NA	NA	105	NA	NA	168	NA	NA	240	NA	NA	349	428	884	471	572	1128	615	798	1668	975			
	20	NA	NA	NA	NA	NA	NA	NA	NA	88	NA	NA	155	NA	NA	223	NA	NA	327	NA	NA	445	643	1089	585	883	1624	932			
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	182	NA	NA	281	NA	NA	408	NA	NA	544	1055	1539	865			
50	2	NA	NA	NA	NA	NA	91	NA	NA	160	NA	NA	250	NA	NA	350	191	837	475	238	1103	631	323	1408	810	463	2076	1240			
	5	NA	NA	NA	NA	NA	NA	NA	NA	149	NA	NA	228	NA	NA	321	NA	NA	442	293	1078	593	398	1381	770	571	2044	1220			
	10	NA	NA	NA	NA	NA	NA	NA	NA	136	NA	NA	212	NA	NA	301	NA	NA	420	355	1038	562	447	1337	728	674	1994	1140			
	15	NA	NA	NA	NA	NA	NA	NA	NA	124	NA	NA	195	NA	NA	278	NA	NA	395	NA	NA	533	546	1294	695	761	1945	1090			
	20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	180	NA	NA	258	NA	NA	370	NA	NA	504	616	1251	660	844	1898	1040			
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	318	NA	NA	458	NA	NA	610	1009	1805	970			
Minimum internal area of chimney (in.^{2})		12			19			28			38			50			63			78			95			132					
Maximum internal area of chimney (in.^{2})		Seven times the listed appliance categorized vent area, flue collar area, or draft hood outlet areas.																													

For SI units, 1 in. = 25.4 mm, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW, 1 in.^{2} = 645 mm^2.
NA: Not applicable.

Table 13.1(e) Single-Wall Metal Pipe or Type B Asbestos Cement Vent

		Number of Appliances:	Single						
		Appliance Type:	Draft Hood–Equipped						
		Appliance Vent Connection:	Connected Directly to Pipe or Vent						
Height *H* (ft)	Lateral *L* (ft)	Diameter — *D* (in.) To be used with chimney areas within the size limits at bottom							
		3	4	5	6	7	8	10	12
		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 in. = 25.4 mm, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW, 1 in.^{2} = 645 mm^2.
NA: Not applicable.

Table 13.1(f) Exterior Masonry Chimney

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* (ft)	Internal Area of Chimney (in.^{2})							
	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	NA	NA	393	334	0
50	NA	NA	NA	NA	NA	NA	NA	579
	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	NA	NA	NA	233	253	274	305
20	NA	NA	NA	NA	NA	307	330	362
30	NA	NA	NA	NA	NA	419	445	485
50	NA	NA	NA	NA	NA	NA	NA	763
	Local 99% winter design temperature: 17°F to 26°F							
6	NA	NA	NA	NA	NA	215	259	349
8	NA	NA	NA	NA	197	226	264	352
10	NA	NA	NA	NA	214	245	278	358
15	NA	NA	NA	NA	NA	296	331	398
20	NA	NA	NA	NA	NA	352	387	457
30	NA	NA	NA	NA	NA	NA	507	581
50	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	416
8	NA	NA	NA	NA	NA	NA	312	423
10	NA	NA	NA	NA	NA	289	331	430
15	NA	NA	NA	NA	NA	NA	393	485
20	NA	NA	NA	NA	NA	NA	450	547
30	NA	NA	NA	NA	NA	NA	NA	682
50	NA	NA	NA	NA	NA	NA	NA	972
	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 in. = 25.4 mm, 1 in.^{2} = 645 mm^2, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW, °C = (°F - 32)/1.8.
Note: See Figure F.2.4 for a map showing local 99 percent winter design temperatures in the United States.
NA: Not applicable.

13.1.1 Obstructions and Vent Dampers. Venting Table 13.1(a) through Table 13.1(f) 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.

13.1.2 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 10 ft (3 m).
(2) Vents for appliance draft hood outlets or flue collars 12 in. (300 mm) in diameter or smaller are not reduced more than one table size.
(3) Vents for appliance draft hood outlets or flue collars larger than 12 in. (300 mm) 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 × maximum table capacity).
(5) The draft hood outlet is greater than 4 in. (100 mm) in diameter. A 3 in. (80 mm) diameter vent shall not be connected to a 4 in. (100 mm) diameter draft hood outlet. This provision shall not apply to fan-assisted appliances.

13.1.3 Elbows. Single-appliance venting configurations with zero (0) lateral lengths in Table 13.1(a), Table 13.1(b), and Table 13.1(e) shall not have elbows in the venting system. Single-appliance venting with lateral lengths include two 90 degree elbows. For each additional elbow up to and including 45 degrees, the maximum capacity listed in the venting tables shall be reduced by 5 percent. For each additional elbow greater than 45 degrees up to and including 90 degrees, 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 13.1(a) through Table 13.1(e).

13.1.4 Zero Lateral. Zero (0) lateral (*L*) shall apply only to a straight vertical vent attached to a top outlet draft hood or flue collar.

13.1.5 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.

13.1.6 Two-Stage/Modulating Appliances. For appliances with more than one input rate, the minimum vent capacity (FAN Min) determined from the Chapter 13 tables 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.

13.1.7* Corrugated Chimney Liners. Listed corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Table 13.1(a) or Table 13.1(b) for Type B vents, with the maximum capacity reduced by 20 percent (0.80 × maximum capacity) and the minimum capacity as shown in Table 13.1(a) or Table 13.1(b). Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with 13.1.3. The 20 percent reduction for corrugated metallic chimney liner systems includes an allowance for one long radius 90-degree turn at the bottom of the liner.

13.1.8 Connection to Chimney Liners. Connections between chimney liners and listed double-wall connectors shall be made with listed adapters designed for such purpose.

Δ **13.1.9 Vertical Vent Upsizing/7 × 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.

13.1.10 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 manufacturers' installation instructions.

13.1.11 Chimneys and Vent Locations. Table 13.1(a) through Table 13.1(e) 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 ft (1.5 m) higher than required by Table 12.7.3, and where vents terminate in accordance with 12.7.3(1)(b), 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 R8 shall not be considered to be exposed to the outdoors. Table 13.1(c) in combination with Table 13.1(f) shall be used for clay tile–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 in./in. (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 13.1(c).
(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 13.1(f).

13.1.12 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.

13.1.13 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.

13.1.14 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.

13.1.15 Interpolation. Interpolation shall be permitted in calculating capacities for vent dimensions that fall between table entries.

13.1.16 Extrapolation. Extrapolation beyond the table entries shall not be permitted.

13.1.17 Sizing Vents Not Covered by Tables. Where a vent height is lower than 6 ft (1.8 m) or higher than shown in the Chapter 13 tables, an engineering method shall be used to calculate the vent capacity.

13.1.18 Height Entries. Where the actual height of a vent falls between entries in the height column of the applicable table in Table 13.1(a) through Table 13.1(f) 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

13.2 Additional Requirements to Multiple-Appliance Vent. This section shall apply where Table 13.2(a) through Table 13.2(i) are used to size multiple appliance venting systems. Subsections 13.2.1 through 13.2.30 apply to Table 13.2(a) through Table 13.2(i).

13.2.1 Obstructions and Vent Dampers. Venting Table 13.2(a) through Table 13.2(i) 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.

13.2.2 Vent Connector Maximum Length. The maximum vent connector horizontal length shall be 18 in./in. (18 mm/mm) of connector diameter as shown in Table 13.2.2, or as permitted by 13.2.3.

13.2.3 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 13.2.2 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 13.2.2. For example, the maximum length listed for a 4 in. (100 mm) connector is 6 ft (1.8 m). With a connector length greater than 6 ft (1.8 m) but not exceeding 12 ft (3.7 m), the maximum capacity must be reduced by 10 percent (0.90 × maximum vent connector capacity). With a connector length greater than 12 ft (3.7 m) but not exceeding 18 ft (5.5 m), the maximum capacity must be reduced by 20 percent (0.80 × 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 13.1(a) shall be used. For single-wall connectors, Table 13.1(b) 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.

13.2.4 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 × 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 in./in. (18 mm/mm) of common vent diameter (*D*).

13.2.5 Vent Offsets. Where the common vertical vent is offset, the maximum capacity of the common vent shall be reduced in accordance with 13.2.6 and the horizontal length of the common vent offset shall not exceed 18 in./in. (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 in./in. (18 mm/mm) of the common vent diameter.

13.2.6 Elbows in Vents. For each elbow up to and including 45 degrees 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 up to and including 90 degrees, the maximum common vent capacity listed in the venting tables shall be reduced by 10 percent.

13.2.7 Elbows in Connectors. The vent connector capacities listed in the common vent sizing tables include allowance for two 90 degree elbows. For each additional elbow up to and including 45 degrees, the maximum vent connector capacity listed in the venting tables shall be reduced by 5 percent. For each elbow greater than 45 degrees up to and including 90 degrees, the maximum vent connector capacity listed in the venting tables shall be reduced by 10 percent.

13.2.8 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.

Δ Table 13.2(a) Type B Double-Wall Vent

Number of Appliances:	Two or More
Appliance Type:	Category I
Appliance Vent Connection:	Type B Double-Wall Connector

Vent Connector Capacity

Vent Height *H* (ft)	Connector Rise *R* (ft)	Type B Double-Wall Vent and Connector Diameter — *D* (in.)																					
		3			4			5			6			7			8			9			10		
		Appliance Input Rating Limits in Thousands of Btu per Hour																					
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225	142	92	296	185	109	376	237	128	466	289
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253	168	95	333	220	112	424	282	131	526	345
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275	189	97	363	248	114	463	317	134	575	386
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243	148	100	320	194	118	408	248	138	507	303
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269	175	103	356	230	121	454	294	141	564	358
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290	198	105	384	258	123	492	330	143	612	402
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257	154	106	341	200	125	436	257	146	542	314
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282	182	109	374	238	128	479	305	149	596	372
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303	205	111	402	268	131	515	342	152	642	417
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298	163	110	389	214	134	493	273	162	609	333
	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320	193	112	419	253	137	532	323	165	658	394
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339	218	115	445	286	140	565	365	167	700	444
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334	171	107	436	224	131	552	285	158	681	347
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354	202	110	463	265	134	587	339	161	725	414
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371	228	113	486	300	137	618	383	164	764	466
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	991	182	103	512	238	125	649	305	151	802	372
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408	215	105	535	282	129	679	360	155	840	439
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423	242	108	555	317	132	706	405	158	874	494
50	1	19	71	36	30	133	64	43	216	101	57	349	145	78	477	197	97	627	257	120	797	330	144	984	403
	2	21	73	43	32	137	76	45	223	119	59	358	172	81	490	234	100	645	306	123	820	392	148	1014	478
	3	22	75	48	33	141	86	46	229	134	61	366	194	83	502	263	103	661	343	126	842	441	151	1043	538
100	1	18	82	37	28	158	66	40	262	104	53	442	150	73	611	204	91	810	266	112	1038	341	135	1285	417
	2	19	83	44	30	161	79	42	267	123	55	447	178	75	619	242	94	822	316	115	1054	405	139	1306	494
	3	20	84	50	31	163	89	44	272	138	57	452	200	78	627	272	97	834	355	118	1069	455	142	1327	555

Common Vent Capacity

Vent Height *H* (ft)	Type B Double-Wall Common Vent Diameter— *D* (in.)																							
	4			5			6			7			8			9			10					
	Combined Appliance Input Rating in Thousands of Btu per Hour																							
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT			
6	92	81	65	140	116	103	204	161	147	309	248	200	404	314	260	547	434	335	672	520	410			
8	101	90	73	155	129	114	224	178	163	339	275	223	444	348	290	602	480	378	740	577	465			
10	110	97	79	169	141	124	243	194	178	367	299	242	477	377	315	649	522	405	800	627	495			
15	125	112	91	195	164	144	283	228	206	427	352	280	556	444	365	753	612	465	924	733	565			
20	136	123	102	215	183	160	314	255	229	475	394	310	621	499	405	842	688	523	1035	826	640			
30	152	138	118	244	210	185	361	297	266	547	459	360	720	585	470	979	808	605	1209	975	740			
50	167	153	134	279	244	214	421	353	310	641	547	423	854	706	550	1164	977	705	1451	1188	860			
100	175	163	NA	311	277	NA	489	421	NA	751	658	479	1025	873	625	1408	1215	800	1784	1502	975			

Δ Table 13.2(a) *Continued*

Number of Appliances:	Two or More
Appliance Type:	Category I
Appliance Vent Connection:	Type B Double-Wall Connector

Vent Connector Capacity

Vent Height *H* (ft)	Connector Rise *R* (ft)	Type B Double-Wall Vent and Connector Diameter — *D* (in.)																					
		12			14			16			18			20			22			24				
		Appliance Input Rating Limits in Thousands of Btu per Hour																					
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	
6	2	174	764	496	223	1046	653	281	1371	853	346	1772	1080	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	180	897	616	230	1231	827	287	1617	1081	352	2069	1370	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
8	2	186	822	516	238	1126	696	298	1478	910	365	1920	1150	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	192	952	644	244	1307	884	305	1719	1150	372	2211	1460	471	2737	1800	560	3319	2180	662	3957	2590	
	6	198	1050	772	252	1445	1072	313	1902	1390	380	2434	1770	478	3018	2180	568	3665	2640	669	4373	3130	
10	2	196	870	536	249	1195	730	311	1570	955	379	2049	1205	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	201	997	664	256	1371	924	318	1804	1205	387	2332	1535	486	2887	1890	581	3502	2280	686	4175	2710	
	6	207	1095	792	263	1509	1118	325	1989	1455	395	2556	1865	494	3169	2290	589	3849	2760	694	4593	3270	
15	2	214	967	568	272	1334	790	336	1760	1030	408	2317	1305	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	221	1085	712	279	1499	1006	344	1978	1320	416	2579	1665	523	3197	2060	624	3881	2490	734	4631	2960	
	6	228	1181	856	286	1632	1222	351	2157	1610	424	2796	2025	533	3470	2510	634	4216	3030	743	5035	3600	
20	2	223	1051	596	291	1443	840	357	1911	1095	430	2533	1385	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	230	1162	748	298	1597	1064	365	2116	1395	438	2778	1765	554	3447	2180	661	4190	2630	772	5005	3130	
	6	237	1253	900	307	1726	1288	373	2287	1695	450	2984	2145	567	3708	2650	671	4511	3190	785	5392	3790	
30	2	216	1217	632	286	1664	910	367	2183	1190	461	2891	1540	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	223	1316	792	294	1802	1160	376	2366	1510	474	3110	1920	619	3840	2365	728	4861	2860	847	5606	3410	
	6	231	1400	952	303	1920	1410	384	2524	1830	485	3299	2340	632	4080	2875	741	4976	3480	860	5961	4150	
50	2	206	1479	689	273	2023	1007	350	2659	1315	435	3548	1665	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	213	1561	860	281	2139	1291	359	2814	1685	447	3730	2135	580	4601	2633	709	5569	3185	851	6633	3790	
	6	221	1631	1031	290	2242	1575	369	2951	2055	461	3893	2605	594	4808	3208	724	5826	3885	867	6943	4620	
100	2	192	1923	712	254	2644	1050	326	3490	1370	402	4707	1740	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	200	1984	888	263	2731	1346	336	3606	1760	414	4842	2220	523	5982	2750	639	7254	3330	769	8650	3950	
	6	208	2035	1064	272	2811	1642	346	3714	2150	426	4968	2700	539	6143	3350	654	7453	4070	786	8892	4810	

Common Vent Capacity

Vent Height *H* (ft)	Type B Double-Wall Common Vent Diameter — *D* (in.)																						
	12			14			16			18			20			22			24				
	Combined Appliance Input Rating in Thousands of Btu per Hour																						
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT		
6	900	696	588	1284	990	815	1735	1336	1065	2253	1732	1345	2838	2180	1660	3488	2677	1970	4206	3226	2390		
8	994	773	652	1423	1103	912	1927	1491	1190	2507	1936	1510	3162	2439	1860	3890	2998	2200	4695	3616	2680		
10	1076	841	712	1542	1200	995	2093	1625	1300	2727	2113	1645	3444	2665	2030	4241	3278	2400	5123	3957	2920		
15	1247	986	825	1794	1410	1158	2440	1910	1510	3184	2484	1910	4026	3133	2360	4971	3862	2790	6016	4670	3400		
20	1405	1116	916	2006	1588	1290	2722	2147	1690	3561	2798	2140	4548	3552	2640	5573	4352	3120	6749	5261	3800		
30	1658	1327	1025	2373	1892	1525	3220	2558	1990	4197	3326	2520	5303	4193	3110	6539	5157	3680	7940	6247	4480		
50	2024	1640	1280	2911	2347	1863	3964	3183	2430	5184	4149	3075	6567	5240	3800	8116	6458	4500	9837	7813	5475		
100	2569	2131	1670	3732	3076	2450	5125	4202	3200	6749	5509	4050	8597	6986	5000	10,681	8648	5920	13,004	10,499	7200		

For SI units, 1 in. = 25.4 mm, 1 in.^{2} = 645 mm^2, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW.

Table 13.2(b) Type B Double-Wall Vent

Number of Appliances:	Two or More
Appliance Type:	Category I
Appliance Vent Connection:	Single-Wall Metal Connector

Vent Connector Capacity

Vent Height *H* (ft)	Connector Rise *R* (ft)	Single-Wall Metal Vent Connector Diameter — *D* (in.)																							
		3			4			5			6			7			8			9			10		
		Appliance Input Rating Limits in Thousands of Btu per Hour																							
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	NA	NA	26	NA	NA	46	NA	NA	71	NA	NA	102	207	223	140	262	293	183	325	373	234	447	463	286
	2	NA	NA	31	NA	NA	55	NA	NA	85	168	182	123	215	251	167	271	331	219	334	422	281	458	524	344
	3	NA	NA	34	NA	NA	62	121	131	95	175	198	138	222	273	188	279	361	247	344	462	316	468	574	385
8	1	NA	NA	27	NA	NA	48	NA	NA	75	NA	NA	106	226	240	145	285	316	191	352	403	244	481	502	299
	2	NA	NA	32	NA	NA	57	125	126	89	184	193	127	234	266	173	293	353	228	360	450	292	492	560	355
	3	NA	NA	35	NA	NA	64	130	138	100	191	208	144	241	287	197	302	381	256	370	489	328	501	609	400
10	1	NA	NA	28	NA	NA	50	119	121	77	182	186	110	240	253	150	302	335	196	372	429	252	506	534	308
	2	NA	NA	33	84	85	59	124	134	91	189	203	132	248	278	183	311	369	235	381	473	302	517	589	368
	3	NA	NA	36	89	91	67	129	144	102	197	217	148	257	299	203	320	398	265	391	511	339	528	637	413
15	1	NA	NA	29	79	87	52	116	138	81	177	214	116	238	291	158	312	380	208	397	482	266	556	596	324
	2	NA	NA	34	83	94	62	121	150	97	185	230	138	246	314	189	321	411	248	407	522	317	568	646	387
	3	NA	NA	39	87	100	70	127	160	109	193	243	157	255	333	215	331	438	281	418	557	360	579	690	437
20	1	49	56	30	78	97	54	115	152	84	175	238	120	233	325	165	306	425	217	390	538	276	546	664	336
	2	52	59	36	82	103	64	120	163	101	182	252	144	243	346	197	317	453	259	400	574	331	558	709	403
	3	55	62	40	87	107	72	125	172	113	190	264	164	252	363	223	326	476	294	412	607	375	570	750	457
30	1	47	60	31	77	110	57	112	175	89	169	278	129	226	380	175	296	497	230	378	630	294	528	779	358
	2	51	62	37	81	115	67	117	185	106	177	290	152	236	397	208	307	521	274	389	662	349	541	819	425
	3	54	64	42	85	119	76	122	193	120	185	300	172	244	412	235	316	542	309	400	690	394	555	855	482
50	1	46	69	34	75	128	60	109	207	96	162	336	137	217	460	188	284	604	245	364	768	314	507	951	384
	2	49	71	40	79	132	72	114	215	113	170	345	164	226	473	223	294	623	293	376	793	375	520	983	458
	3	52	72	45	83	136	82	119	221	123	178	353	186	235	486	252	304	640	331	387	816	423	535	1013	518
100	1	45	79	34	71	150	61	104	249	98	153	424	140	205	585	192	269	774	249	345	993	321	476	1236	393
	2	48	80	41	75	153	73	110	255	115	160	428	167	212	593	228	279	788	299	358	1011	383	490	1259	469
	3	51	81	46	79	157	85	114	260	129	168	433	190	222	603	256	289	801	339	368	1027	431	506	1280	527

Common Vent Capacity

Vent Height *H* (ft)	Type B Double-Wall Vent Diameter — *D* (in.)																								
	4			5			6			7			8			9			10						
	Combined Appliance Input Rating in Thousands of Btu per Hour																								
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT				
6	NA	78	64	NA	113	99	200	158	144	304	244	196	398	310	257	541	429	332	665	515	407				
8	NA	87	71	NA	126	111	218	173	159	331	269	218	436	342	285	592	473	373	730	569	460				
10	NA	94	76	163	137	120	237	189	174	357	292	236	467	369	309	638	512	398	787	617	487				
15	121	108	88	189	159	140	275	221	200	416	343	274	544	434	357	738	599	456	905	718	553				
20	131	118	98	208	177	156	305	247	223	463	383	302	606	487	395	824	673	512	1013	808	626				
30	145	132	113	236	202	180	350	286	257	533	446	349	703	570	459	958	790	593	1183	952	723				
50	159	145	128	268	233	208	406	337	296	622	529	410	833	686	535	1139	954	689	1418	1157	838				
100	166	153	NA	297	263	NA	469	398	NA	726	633	464	999	846	606	1378	1185	780	1741	1459	948				

For SI units, 1 in. = 25.4 mm, 1 in.^{2} = 645 mm^2, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW.

Table 13.2(c) Masonry Chimney

Number of Appliances:	Two or More
Appliance Type:	Category I
Appliance Vent Connection:	Type B Double-Wall Connector

Vent Connector Capacity

Vent Height *H* (ft)	Connector Rise *R* (ft)	Type B Double-Wall Vent Connector Diameter — *D* (in.)																					
		3			4			5			6			7			8			9			10		
		Appliance Input Rating Limits in Thousands of Btu per Hour																					
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	24	33	21	39	62	40	52	106	67	65	194	101	87	274	141	104	370	201	124	479	253	145	599	319
	2	26	43	28	41	79	52	53	133	85	67	230	124	89	324	173	107	436	232	127	562	300	148	694	378
	3	27	49	34	42	92	61	55	155	97	69	262	143	91	369	203	109	491	270	129	633	349	151	795	439
8	1	24	39	22	39	72	41	55	117	69	71	213	105	94	304	148	113	414	210	134	539	267	156	682	335
	2	26	47	29	40	87	53	57	140	86	73	246	127	97	350	179	116	473	240	137	615	311	160	776	394
	3	27	52	34	42	97	62	59	159	98	75	269	145	99	383	206	119	517	276	139	672	358	163	848	452
10	1	24	42	22	38	80	42	55	130	71	74	232	108	101	324	153	120	444	216	142	582	277	165	739	348
	2	26	50	29	40	93	54	57	153	87	76	261	129	103	366	184	123	498	247	145	652	321	168	825	407
	3	27	55	35	41	105	63	58	170	100	78	284	148	106	397	209	126	540	281	147	705	366	171	893	463
15	1	24	48	23	38	93	44	54	154	74	72	277	114	100	384	164	125	511	229	153	658	297	184	824	375
	2	25	55	31	39	105	55	56	174	89	74	299	134	103	419	192	128	558	260	156	718	339	187	900	432
	3	26	59	35	41	115	64	57	189	102	76	319	153	105	448	215	131	597	292	159	760	382	190	960	486
20	1	24	52	24	37	102	46	53	172	77	71	313	119	98	437	173	123	584	239	150	752	312	180	943	397
	2	25	58	31	39	114	56	55	190	91	73	335	138	101	467	199	126	625	270	153	805	354	184	1011	452
	3	26	63	35	40	123	65	57	204	104	75	353	157	104	493	222	129	661	301	156	851	396	187	1067	505
30	1	24	54	25	37	111	48	52	192	82	69	357	127	96	504	187	119	680	255	145	883	337	175	1115	432
	2	25	60	32	38	122	58	54	208	95	72	376	145	99	531	209	122	715	287	149	928	378	179	1171	484
	3	26	64	36	40	131	66	56	221	107	74	392	163	101	554	233	125	746	317	152	968	418	182	1220	535
50	1	23	51	25	36	116	51	51	209	89	67	405	143	92	582	213	115	798	294	140	1049	392	168	1334	506
	2	24	59	32	37	127	61	53	225	102	70	421	161	95	604	235	118	827	326	143	1085	433	172	1379	558
	3	26	64	36	39	135	69	55	237	115	72	435	180	98	624	260	121	854	357	147	1118	474	176	1421	611
100	1	23	46	24	35	108	50	49	208	92	65	428	155	88	640	237	109	907	334	134	1222	454	161	1589	596
	2	24	53	31	37	120	60	51	224	105	67	444	174	92	660	260	113	933	368	138	1259	497	165	1626	651
	3	25	59	35	38	130	68	53	237	118	69	458	193	94	679	285	116	956	399	141	1282	540	169	1661	705

Common Vent Capacity

Vent Height *H* (ft)	Minimum Internal Area of Masonry Chimney Flue (in.^{2})																							
	12			19			28			38			50			63			78			113		
	Combined Appliance Input Rating in Thousands of Btu per Hour																							
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +FAN	NAT +NAT
6	NA	74	25	NA	119	46	NA	178	71	NA	257	103	NA	351	143	NA	458	188	NA	582	246	1041	853	NA
8	NA	80	28	NA	130	53	NA	193	82	NA	279	119	NA	384	163	NA	501	218	724	636	278	1144	937	408
10	NA	84	31	NA	138	56	NA	207	90	NA	299	131	NA	409	177	606	538	236	776	686	302	1226	1010	454
15	NA	NA	36	NA	152	67	NA	233	106	NA	334	152	523	467	212	682	611	283	874	781	365	1374	1156	546
20	NA	NA	41	NA	NA	75	NA	250	122	NA	368	172	565	508	243	742	668	325	955	858	419	1513	1286	648
30	NA	NA	NA	NA	NA	NA	NA	270	137	NA	404	198	615	564	278	816	747	381	1062	969	496	1702	1473	749
50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	620	328	879	831	461	1165	1089	606	1905	1692	922
100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	348	NA	NA	499	NA	NA	669	2053	1921	1058

For SI units, 1 in. = 25.4 mm, 1 in.^{2} = 645 mm^2, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW.

Δ Table 13.2(d) Masonry Chimney

Number of Appliances:	Two or More
Appliance Type:	Category I
Appliance Vent Connection:	Single-Wall Metal Connector

Vent Connector Capacity

Vent Height *H* (ft)	Connector Rise *R* (ft)	Single-Wall Metal Vent Connector Diameter — *D* (in.)																					
		3			4			5			6			7			8			9			10		
		Appliance Input Rating Limits in Thousands of Btu per Hour																					
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	NA	NA	21	NA	NA	39	NA	NA	66	179	191	100	231	271	140	292	366	200	362	474	252	499	594	316
	2	NA	NA	28	NA	NA	52	NA	NA	84	186	227	123	239	321	172	301	432	231	373	557	299	509	696	376
	3	NA	NA	34	NA	NA	61	134	153	97	193	258	142	247	365	202	309	491	269	381	634	348	519	793	437
8	1	NA	NA	21	NA	NA	40	NA	NA	68	195	208	103	250	298	146	313	407	207	387	530	263	529	672	331
	2	NA	NA	28	NA	NA	52	137	139	85	202	240	125	258	343	177	323	465	238	397	607	309	540	766	391
	3	NA	NA	34	NA	NA	62	143	156	98	210	264	145	266	376	205	332	509	274	407	663	356	551	838	450
10	1	NA	NA	22	NA	NA	41	130	151	70	202	225	106	267	316	151	333	434	213	410	571	273	558	727	343
	2	NA	NA	29	NA	NA	53	136	150	86	210	255	128	276	358	181	343	489	244	420	640	317	569	813	403
	3	NA	NA	34	97	102	62	143	166	99	217	277	147	284	389	207	352	530	279	430	694	363	580	880	459
15	1	NA	NA	23	NA	NA	43	129	151	73	199	271	112	268	376	161	349	502	225	445	646	291	623	808	366
	2	NA	NA	30	92	103	54	135	170	88	207	295	132	277	411	189	359	548	256	456	706	334	634	884	424
	3	NA	NA	34	96	112	63	141	185	101	215	315	151	286	439	213	368	586	289	466	755	378	646	945	479
20	1	NA	NA	23	87	99	45	128	167	76	197	303	117	265	425	169	345	569	235	439	734	306	614	921	387
	2	NA	NA	30	91	111	55	134	185	90	205	325	136	274	455	195	355	610	266	450	787	348	627	986	443
	3	NA	NA	35	96	119	64	140	199	103	213	343	154	282	481	219	365	644	298	461	831	391	639	1042	496
30	1	NA	NA	24	86	108	47	126	187	80	193	347	124	259	492	183	338	665	250	430	864	330	600	1089	421
	2	NA	NA	31	91	119	57	132	203	93	201	366	142	269	518	205	348	699	282	442	908	372	613	1145	473
	3	NA	NA	35	95	127	65	138	216	105	209	381	160	277	540	229	358	729	312	452	946	412	626	1193	524
50	1	NA	NA	24	85	113	50	124	204	87	188	392	139	252	567	208	328	778	287	417	1022	383	582	1302	492
	2	NA	NA	31	89	123	60	130	218	100	196	408	158	262	588	230	339	806	320	429	1058	425	596	1346	545
	3	NA	NA	35	94	131	68	136	231	112	205	422	176	271	607	255	349	831	351	440	1090	466	610	1386	597
100	1	NA	NA	23	84	104	49	122	200	89	182	410	151	243	617	232	315	875	328	402	1181	444	560	1537	580
	2	NA	NA	30	88	115	59	127	215	102	190	425	169	253	636	254	326	899	361	415	1210	488	575	1570	634
	3	NA	NA	34	93	124	67	133	228	115	199	438	188	262	654	279	337	921	392	427	1238	529	589	1604	687

Common Vent Capacity

Vent Height *H* (ft)	Minimum Internal Area of Masonry Chimney Flue (in.²)																							
	12			19			28			38			50			63			78			113		
	Combined Appliance Input Rating in Thousands of Btu per Hour																							
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +FAN	NAT +NAT
6	NA	NA	25	NA	118	45	NA	176	71	NA	255	102	NA	348	142	NA	455	187	NA	579	245	NA	846	NA
8	NA	NA	28	NA	128	52	NA	190	81	NA	276	118	NA	380	162	NA	497	217	NA	633	277	1136	928	405
10	NA	NA	31	NA	136	56	NA	205	89	NA	295	129	NA	405	175	NA	532	234	771	680	300	1216	1000	450
15	NA	NA	36	NA	NA	66	NA	230	105	NA	335	150	NA	400	210	677	602	280	866	772	360	1359	1139	540
20	NA	NA	NA	NA	NA	74	NA	247	120	NA	362	170	NA	503	240	765	661	321	947	849	415	1495	1264	640
30	NA	NA	NA	NA	NA	NA	NA	NA	135	NA	398	195	NA	558	275	808	739	377	1052	957	490	1682	1447	740
50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	612	325	NA	821	456	1152	1076	600	1879	1672	910
100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	494	NA	NA	663	2006	1885	1046

For SI units, 1 in. = 25.4 mm, 1 in.^{2} = 645 mm^2, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW.

Table 13.2(e) Single-Wall Metal Pipe or Type B Asbestos Cement Vent

				Number of Appliances:	Two or More		
				Appliance Type:	Draft Hood–Equipped		
				Appliance Vent Connection:	Direct to Pipe or Vent		
Vent Connector Capacity							
Total Vent Height *H* (ft)	**Connector Rise *R* (ft)**	**Vent Connector Diameter — *D* (in.)**					
		3	**4**	**5**	**6**	**7**	**8**
		Maximum Appliance Input Rating in Thousands of Btu per Hour					
6–8	1	21	40	68	102	146	205
	2	28	53	86	124	178	235
	3	34	61	98	147	204	275
15	1	23	44	77	117	179	240
	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
Common Vent Capacity							
Total Vent Height *H* (ft)		**Common Vent Diameter — *D* (in.)**					
		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 in. = 25.4 mm, 1 in.^{2} = 645 mm^2, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW.
Note: See Figure F.1(f) and Section 13.2.

Table 13.2(f) Exterior Masonry Chimney

					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* (ft)	Internal Area of Chimney (in.^{2})							
	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

For SI units, 1 in. = 25.4 mm, 1 in.^{2} = 645 mm^2, 1 ft = 0.305 m, 1000 Btu/hr = 0.293 kW.

13.2.9 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.

13.2.10 Tee and Wye Sizing. 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.

13.2.11 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.

13.2.12 Connector Rise. The connector rise (*R*) for each appliance connector shall be measured from the draft hood outlet or flue collar to the centerline where the vent gas streams come together.

13.2.13 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.

13.2.14 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.

13.2.15 Multistory Lowest Vent and Vent Connector Sizing. 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 13.1(a) or Table 13.1(b) for available total height (*H*) up to the lowest interconnection.

13.2.16 Multistory 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.

13.2.17 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 from vertical.
(2) The horizontal length of the offset shall not exceed 18 in./in. (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 × maximum common vent capacity).
(4) A multistory common vent shall not be reduced in size above the offset.

Δ **13.2.18 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.

Δ **13.2.19 Two-Stage/Modulating Appliances.**

N **13.2.19.1** 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.

N **13.2.19.2** 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.

13.2.20* Corrugated Chimney Liners. Listed corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Table 13.2(a) or Table 13.2(b) for Type B vents, with the maximum capacity reduced by 20 percent (0.80 × maximum capacity) and the minimum capacity as shown in Table 13.2(a) or Table 13.2(b). Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with 13.2.5 and 13.2.6. The 20 percent reduction for corrugated metallic chimney liner systems includes an allowance for one long radius 90-degree turn at the bottom of the liner.