Committee Input No. 64-NFPA 54-2024 [Section No. 1.1.1.1]

~~1.1.1.1~~ –

~~This code is a safety code that shall apply to the installation of fuel gas piping systems, appliances, equipment, and related accessories as shown in 1.1.1.1(A) through 1.1.1.1(F).~~

~~(A) * –~~

~~Coverage of piping systems shall extend from the point of delivery to the appliance connections. For other than undiluted liquefied petroleum gas (LP-Gas) systems, the point of delivery shall be the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where no meter is provided. For undiluted LP-Gas systems, the point of delivery shall be considered to be the outlet of the final pressure regulator, exclusive of line gas regulators where no meter is installed. Where a meter is installed, the point of delivery shall be the outlet of the meter.~~

~~(B)~~ –

~~This code shall apply to natural gas systems operating at a pressure of 125 psi (862 kPa) or less.~~

~~(C)~~ –

~~This code shall apply to LP-Gas systems operating at a pressure of 50 psi (345 kPa) or less.~~

~~(D)~~ –

~~This code shall apply to gas–air mixture systems operating within the flammable range at a pressure of 10 psi (69 kPa) or less.~~

~~(E)~~ –

~~Requirements for piping systems shall include design, materials, components, fabrication, assembly, installation, testing, inspection, purging, operation, and maintenance.~~

~~(F)~~ –

~~Requirements for appliances, equipment, and related accessories shall include installation, combustion air, ventilation air, and venting.~~

See Attached Word Document for proposed reorganization of the application section

Supplemental Information

File Name	Description	Approved
54-2024_1.1.1.1_Renumber_For_CI.docx		

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Wed Sep 25 13:06:04 EDT 2024

Committee Statement

Committee Statement: The technical committee is looking at rewording the application section of the code to remove the lettered list and match the non-application section of the code in a numbered list format.

Response Message:	CI-64-NFPA 54-2024

1.1.1.1

This code ~~is a safety code that~~ shall apply to the following ~~installation of fuel gas piping systems, appliances, equipment, and related accessories as shown in 1.1.1.1(A) through 1.1.1.1(F)~~.

1. Natural gas systems operating at a pressure of 125 psi (862 kPa) or less from the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where no meter is provided to the appliance connection.
2. LP-Gas systems operating at a pressure of 50 psi (345 kPa) or less from the outlet of the final pressure regulator, exclusive of line gas regulators where no meter is installed or the outlet of the meter where a meter is installed to the appliance connection
3. Gas–air mixture systems operating within the flammable range at a pressure of 10 psi (69 kPa) or less from the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where no meter is provided to the appliance connection.
4. Design, materials, components, fabrication, assembly, installation, testing, inspection, purging, operation, and maintenance of piping systems
5. Appliances, equipment, and related accessories including installation, combustion air, ventilation air, and venting

~~**(A)***~~

~~Coverage of piping systems shall extend from the point of delivery to the appliance connections. For other than undiluted liquefied petroleum gas (LP-Gas) systems, the point of delivery shall be the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where no meter is provided. For undiluted LP-Gas systems, the point of delivery shall be considered to be the outlet of the final pressure regulator, exclusive of line gas regulators where no meter is installed. Where a meter is installed, the point of delivery shall be the outlet of the meter.~~

~~**(B)**~~

~~This code shall apply to natural gas systems operating at a pressure of 125 psi (862 kPa) or less.~~

~~**(C)**~~

~~This code shall apply to LP-Gas systems operating at a pressure of 50 psi (345 kPa) or less.~~

~~**(D)**~~

~~This code shall apply to gas–air mixture systems operating within the flammable range at a pressure of 10 psi (69 kPa) or less.~~

~~**(E)**~~

~~Requirements for piping systems shall include design, materials, components, fabrication, assembly, installation, testing, inspection, purging, operation, and maintenance.~~

~~**(F)**~~

~~Requirements for appliances, equipment, and related accessories shall include installation, combustion air, ventilation air, and venting.~~

Committee Input No. 49-NFPA 54-2024 [Section No. 1.1.1.2]

1.1.1.2

This code shall not apply to the following items:

(1) Portable LP-Gas appliances and equipment of all types that are not connected to a fixed fuel piping system

(2) Installation of appliances such as brooders, dehydrators, dryers, and irrigation equipment used for agricultural purposes

(3) Raw material (i.e., feedstock) applications except for piping to special atmosphere generators

(4) Oxygen–fuel gas cutting and welding systems

(5) Industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen, and nitrogen

(6) Petroleum refineries, pipeline compressor or pumping stations, loading terminals, compounding plants, refinery tank farms, and natural gas processing plants

(7) Large integrated chemical plants or portions of such plants where flammable or combustible liquids or gases are produced by chemical reactions or used in chemical reactions

(8) LP-Gas installations at utility gas plants

(9) * Liquefied natural gas (LNG) systems

(10) ~~Fuel gas piping in electric utility power plants~~

(11) Proprietary items of equipment, apparatus, or instruments such as gas generating sets, compressors, and calorimeters

(12) LP-Gas equipment for vaporization, gas mixing, and gas manufacturing

(13) LP-Gas piping for buildings under construction or renovations that is not to become part of the permanent building piping system — that is, temporary fixed piping for building heat

(14) Installation of LP-Gas systems for railroad switch heating

(15) Installation of LP-Gas and compressed natural gas (CNG) systems on vehicles

(16) Gas piping, meters, gas pressure regulators, and other appurtenances used by the serving gas supplier in distribution of gas, other than undiluted LP-Gas

(17) Building design and construction, except as specified herein

(18) Fuel gas systems on recreational vehicles manufactured in accordance with NFPA 1192

(19) Fuel gas systems using hydrogen as a fuel

(20) Construction of appliances

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Fri Sep 20 12:09:27 EDT 2024

Committee Statement

Committee Statement:	Fuel gas utilization under 125 psig, is the same in electric utility power plants as it is in other facilities and there is no reason to exclude these facilities however the technical committee is unsure if this change would create unintended enforcement of this code. The technical committee is looking for input from electric utility power plants on this requirement.
Response Message:	CI-49-NFPA 54-2024

Public Input No. 19-NFPA 54-2024 [Section No. 1.1.1.2]

Committee Input No. 54-NFPA 54-2024 [Section No. 2.4]

2.4 References for Extracts in Mandatory Sections.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment,* 2020 edition.

NFPA 70®, *National Electrical Code®*,~~2023~~ 2026 edition.

NFPA 88A, *Standard for Parking Structures,*~~2023~~ 2027 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems,*~~2024~~ 2027 edition.

NFPA *101®*, *Life Safety Code®*,~~2021~~ 2027 edition.

NFPA 5000®, *Building Construction and Safety Code®*,~~2021~~ 2027 edition.

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Mon Sep 23 16:14:18 EDT 2024

Committee Statement

Committee Statement: These documents are currently in cycle but are expected to finish their Second Draft stage prior to this standard's Second Draft meeting. At the Second Draft stage, the Technical Committee will review the extracts from these documents and will update extracted text as needed.

Response Message: CI-54-NFPA 54-2024

Committee Input No. 67-NFPA 54-2024 [Section No. 4.2]

4.2 Interruption of Service.

4.2.1 Notification of Interrupted Service.

~~When the gas supply is to be turned off, it shall be the duty of the qualified agency to notify all affected users.~~ **4.3.1.1**

In cases of emergency, affected users shall be notified as soon as possible of the actions taken by the qualified agency.

4.2.1.2

Where two or more users are served from the same supply system, precautions shall be exercised to ensure that service only to the proper user is turned off.

~~*Exception: In cases of emergency, affected users shall be notified as soon as possible of the actions taken by the qualified agency.*~~

4.2.2 Work Interruptions.

When interruptions in work occur while repairs or alterations are being made to an existing piping system, the system shall be left in a safe condition.

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Wed Sep 25 13:25:19 EDT 2024

Committee Statement

Committee Statement: The technical committee is looking at revising the exception to incorporate it into a requirement in accordance with the NFPA Manual of Style.

Response Message: CI-67-NFPA 54-2024

Committee Input No. 65-NFPA 54-2024 [Section No. 4.3.1]

4.3.1 Potential Ignition Sources.

Where work is being performed on piping that contains or has contained gas, the following shall apply:

(1) Provisions for electrical continuity shall be made before alterations are made in a metallic piping system.

(2) Smoking, open flames, lanterns, welding, or other sources of ignition shall not be permitted.

(3) A metallic electrical bond shall be installed around the location of cuts in metallic gas pipes made by means other than cutting torches.

(4) Where cutting torches, welding, or other sources of ignition are to be used, it shall be determined that all sources of gas or gas–air mixtures have been secured and that all flammable gas or liquids have been cleared from the area.

(5) Piping shall be purged as required in Section 8.3 before welding or cutting with a torch is attempted.

(6) Artificial illumination shall be restricted to listed safety-type flashlights and safety lamps. ~~Electric~~

(7) Electrical switches shall not be turned on or turned off.

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Wed Sep 25 13:16:34 EDT 2024

Committee Statement

Committee Statement: The technical committee is looking at breaking out the list further to meet the NFPA Manual of Style.

Response Message: CI-65-NFPA 54-2024

Committee Input No. 66-NFPA 54-2024 [Section No. 4.5]

4.5 Engineering Methods.

Where an engineering method is used to calculate flow of air or gas, or to determine the size of gas pipe or a gas vent, the authority having jurisdiction shall be permitted to require submittal of any or all of the following:

(1) Calculations, including documentation that the method used is published and recognized as being valid for the calculations provided

(2) The name of any software used, input and output developed, and documentation that the software is recognized as being valid for the calculations provided

(3) * The name of the person that performed the calculation or design, along with their qualifications to perform the calculation or design

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Wed Sep 25 13:20:14 EDT 2024

Committee Statement

Committee Statement: A comma is being added for editorial purposes.

Response Message: CI-66-NFPA 54-2024

Committee Input No. 69-NFPA 54-2024 [Chapter 5]

Chapter 5 Gas Piping System Design, Materials, and Components [See attached Word document for proposed changes]

5.1 Piping Plan.

5.1.1 Installation of Piping System.

5.1.1.1

Where required by the authority having jurisdiction, a piping sketch or plan shall be prepared before proceeding with the installation.

5.1.1.2

The plan in 5.1.1.1 shall show the proposed location of piping, the size of different branches, the various load demands, the location of the point of delivery, the location of isolation valves, and accommodations for meeting the safe purging requirements as required in Chapter 8.

5.1.2 Addition to Existing System.

5.1.2.1

When additional appliances are being connected to a gas piping system, the existing piping shall be checked to determine whether it has adequate capacity.

5.1.2.2

If the capacity of the system is determined to be inadequate for the additional appliances, one or more of the following modifications shall be made to provide required minimum gas pressures to each appliance:

(1) The existing system is enlarged as required.

(2) Separate gas piping of adequate capacity is provided.

(3) The gas pressure is increased within the limitations of the existing piping system and connected appliances.

5.2 Interconnections Between Gas Piping Systems.

5.2.1 Interconnections Supplying Separate Users.

Where two or more meters, or two or more service regulators where meters are not provided, are located on the same premises and supply separate users, the gas piping systems shall not be interconnected on the outlet side of the meters or service regulators.

5.2.2 Interconnections for Standby Fuels.

5.2.2.1

Where a supplementary gas for standby use is connected downstream from a meter or a service regulator where a meter is not provided, equipment to prevent backflow shall be installed.

5.2.2.2

A three-way valve installed to admit the standby supply and at the same time shut off the regular supply shall be permitted to be used for this purpose.

5.3 Sizing of Gas Piping Systems.

5.3.1* General Considerations.

Gas piping systems shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance.

5.3.2* Maximum Gas Demand.

5.3.2.1*

The volumetric flow rate of gas to be provided shall be the sum of the maximum input of the appliances served.

5.3.2.2

The volumetric flow rate of gas to be provided shall be adjusted for altitude where the installation is above 2,000 ft (609.6 m).

5.3.2.3

The total connected hourly load shall be used as the basis for piping sizing, assuming all appliances are operating at full capacity simultaneously.

Exception: Sizing shall be permitted to be based upon established load diversity factors.

5.3.3* Sizing Methods.

Gas piping shall be sized in accordance with one of the following:

(1) Pipe sizing tables or sizing equations in Chapter 6

(2) Sizing tables included in a listed piping system manufacturer's installation instructions

(3) Engineering methods

5.3.4 Allowable Pressure Drop.

The design pressure loss in a piping system from the point of delivery to the inlet connection of all appliances served shall be such that the supply pressure at each appliance inlet is greater than or equal to the minimum pressure required by the appliance.

5.4 Operating Pressure.

5.4.1 Piping System Operating Pressure Limitations.

The maximum operating pressure for any piping system shall not exceed 125 psi (862 kPa).

5.4.2 Flammable Gas–Air Mixtures.

The maximum operating pressure for piping systems for gas–air mixtures within the flammable range shall be 10 psi (69 kPa).

5.4.3 LP-Gas Piping Systems.

The maximum operating pressure for LP-Gas piping systems shall be 20 psi (140 kPa), except as provided in 5.4.4(8).

5.4.4 Maximum Operating Pressure in Buildings.

The maximum operating pressure for any piping systems located inside buildings shall not exceed 5 psi (34 kPa) unless one or more of the following conditions are met:

(1) * The piping joints are welded or brazed.

(2) The piping is joined by fittings listed to CSA/ANSI LC 4/CSA 6.32, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems*, and installed according to the manufacturer's installation instructions.

(3) The piping joints are flanged and all pipe-to-flange connections are made by welding or brazing.

(4) The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.

(5) The piping is located inside buildings or separate areas of buildings used exclusively for one of the following:

(6) Industrial processing or heating

(7) Research

(8) Warehousing

(9) Boiler or mechanical rooms

(10) The piping is a temporary installation for buildings under construction.

(11) The piping serves appliances or equipment used for agricultural purposes.

(12) The piping system is an LP-Gas piping system with an operating pressure greater than 20 psi (138 kPa) and complies with NFPA 58.

5.4.5 LP-Gas Systems Operating Below −5°F (−21°C).

LP-Gas systems designed to operate below −5°F (−21°C) or with butane or a propane-butane mix shall be designed to either accommodate liquid LP-Gas or to prevent LP-Gas vapor from condensing back into a liquid.

5.5 Piping Materials and Joining Methods.

5.5.1 General.

5.5.1.1 Acceptable Materials.

Materials used for piping systems shall either comply with the requirements of this chapter or be acceptable to the authority having jurisdiction.

5.5.1.2 Used Materials.

Pipe, fittings, valves, or other materials shall not be used again unless they are free of foreign materials and have been ascertained to be adequate for the service intended.

5.5.2 Metallic Pipe.

5.5.2.1 Cast Iron.

Cast-iron pipe shall not be used.

5.5.2.2 Steel, Stainless Steel, and Wrought Iron.

Steel, stainless steel, and wrought-iron pipe shall be at least Schedule 10 and shall comply with the dimensional standards of ANSI/ASME B36.10M, *Welded and Seamless Wrought Steel Pipe,* and one of the following:

(1) ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless*

(2) ASTM A106, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*

(3) ASTM A312, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*

5.5.2.3* Copper and Copper Alloy.

Copper and copper alloy pipe shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 scf of gas (0.7 mg/100 L).

5.5.2.4 Threaded Copper, Copper Alloy, and Aluminum.

Threaded copper, copper alloy, or aluminum alloy pipe shall not be used with gases corrosive to such material.

5.5.2.5 Aluminum Alloy.

Aluminum alloy pipe shall comply with ASTM B241, *Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube* (except that the use of alloy 5456 is prohibited), and shall be marked at each end of each length indicating compliance. Aluminum alloy pipe shall be coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water, detergents, or sewage.

5.5.2.6 Aluminum Installation.

Aluminum alloy pipe shall not be used in exterior locations or underground.

5.5.3 Metallic Tubing.

5.5.3.1

Tubing shall not be used with gases corrosive to the tubing material

5.5.3.2 Steel.

Steel tubing shall comply with ASTM A254, *Standard Specification for Copper-Brazed Steel Tubing*.

5.5.3.3 Stainless Steel.

Stainless steel tubing shall comply with one of the following:

(1) ASTM A268, *Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service*

(2) ASTM A269, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*

5.5.3.4* Copper and Copper Alloy.

Copper and copper alloy tubing shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 scf of gas (0.7 mg/100 L). Copper tubing shall comply with standard Type K or Type L of ASTM B88, *Standard Specification for Seamless Copper Water Tube,* or ASTM B280, *Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*.

5.5.3.5 Aluminum.

Aluminum alloy tubing shall comply with ASTM B210, *Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes,* or ASTM B241*, Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.* Aluminum alloy tubing shall be coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water, detergent, or sewage. Aluminum alloy tubing shall not be used in exterior locations or underground.

5.5.3.6 Corrugated Stainless Steel.

Corrugated stainless steel tubing shall be listed in accordance with CSA/ANSI LC 1/CSA 6.26, *Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing.*

5.5.4 Plastic Pipe, Tubing, and Fittings.

5.5.4.1 Standard and Marking.

5.5.4.1.1

Polyethylene plastic pipe, tubing, and fittings used to supply fuel gas shall conform to ASTM D2513, *Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.* Pipe to be used shall be marked "gas" and "ASTM D2513."

5.5.4.1.2

Polyamide pipe, tubing, and fittings shall be identified in and conform to ASTM F2945, *Standard Specification for Polyamide 11 Gas Pressure Pipe, Tubing, and Fittings*. Pipe to be used shall be marked "gas" and "ASTM F2945."

5.5.4.1.3

Polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) plastic pipe, tubing, and fittings shall not be used to supply fuel gas.

5.5.4.2* Regulator Vent Piping.

Plastic pipe and fittings used to connect regulator vents to remote vent terminations shall be PVC conforming to UL 651, *Schedule 40 and 80 Rigid PVC Conduit and Fittings*. PVC vent piping shall not be installed indoors.

5.5.4.3 Anodeless Risers.

Anodeless risers shall comply with the following:

(1) Factory-assembled anodeless risers shall be recommended by the manufacturer for the gas used and shall be leak tested by the manufacturer in accordance with written procedures.

(2) Service head adapters and field-assembled anodeless risers incorporating service head adapters shall be recommended by the manufacturer for the gas used and shall be design-certified to meet the requirements of Category I of ASTM D2513, *Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings,* and 49 CFR 192.281(e). The manufacturer shall provide the user qualified installation instructions as prescribed by 49 CFR 192.283(b).

(3) The use of plastic pipe, tubing, and fittings in undiluted LP-Gas piping systems shall be in accordance with NFPA 58.

5.5.5 Workmanship and Defects.

Gas pipe, tubing, and fittings at the time of installation shall meet the following requirements:

(1) Gas pipe, tubing, and fittings shall be clear and free from cutting burrs and visible defects in structure or threading.

(2) Gas pipe, tubing, and fittings shall be thoroughly cleaned to remove chip, scale, and debris.

(3) Visible defects in pipe, tubing, and fittings shall not be repaired.

(4) Pipe, tubing, and fittings with visible defects shall be replaced.

5.5.6 Metallic Pipe Threads.

5.5.6.1 Specifications for Pipe Threads.

Metallic pipe and fitting threads shall be taper pipe threads and shall comply with ANSI/ASME B1.20.1, *Pipe Threads, General Purpose, Inch.*

5.5.6.2 Damaged Threads.

5.5.6.2.1

Pipe with threads that are stripped, chipped, corroded, or otherwise damaged shall not be used.

5.5.6.2.2

Where a weld opens during the operation of cutting or threading, that portion of the pipe shall not be used.

5.5.6.3 Number of Threads.

Field threading of metallic pipe shall be in accordance with Table 5.5.6.3.

Table 5.5.6.3 Specifications for Threading Metallic Pipe

Iron Pipe Size (in.)	Approximate Length of Threaded Portion (in.)	Approximate No. of Threads to Be Cut
½	¾	10
¾	¾	10
1	⅞	10
1¼	1	11
1½	1	11
2	1	11
2½	1½	12
3	1½	12
4	1⅝	13

For SI units, 1 in. = 25.4 mm.

5.5.6.4* Thread Joint Sealing.

5.5.6.4.1

Threaded joints shall be made using a thread joint sealing material.

5.5.6.4.2

Thread joint sealing materials shall be compatible with the pipe and fitting material on which the compounds are used.

5.5.6.4.3

Thread joint sealing materials shall be non-hardening and shall be resistant to the chemical constituents of the gases to be conducted through the piping.

5.5.7 Metallic Piping Joints and Fittings.

The type of piping joint used shall conform to the following:

(1) Be suitable for the pressure and temperature conditions

(2) Be selected giving consideration to joint tightness and mechanical strength under the service conditions

(3) Be able to sustain the maximum end forces inclusive of temperature expansion or contraction, vibration, fatigue, internal pressure, or the weight of the pipe and its contents

5.5.7.1* Pipe Joints.

Schedule 40 and heavier pipe joints shall be threaded, flanged, brazed, welded, or assembled with press-connect fittings listed to ANSI LC 4/CSA 6.32, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems*.

(A)

Pipe lighter than Schedule 40 shall be connected using press-connect fittings, flanges, brazing, or welding.

(B)

Where nonferrous pipe is brazed, the brazing materials shall have a melting point in excess of 1000°F (538°C).

(C)

Brazing alloys shall not contain more than 0.05 percent phosphorus.

5.5.7.2 Copper Tubing Joints.

Copper tubing joints shall be assembled with approved gas tubing fittings, shall be brazed with a material having a melting point in excess of 1000°F (538°C), or shall be assembled with press-connect fittings listed to ANSI LC 4/CSA 6.32, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems*. Brazing alloys shall not contain more than 0.05 percent phosphorus.

5.5.7.3 Stainless Steel Tubing Joints.

Stainless steel joints shall be welded, assembled with approved tubing fittings, brazed with a material having a melting point in excess of 1000°F (538°C), or assembled with press-connect fittings listed to ANSI LC 4/CSA 6.32, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems*. Brazing alloys and fluxes shall be recommended by the manufacturer for use on stainless steel alloys.

5.5.7.4 Flared Joints.

Flared joints shall be used only in systems constructed from nonferrous pipe and tubing where experience or tests have demonstrated that the joint is suitable for the conditions and where provisions are made in the design to prevent separation of the joints.

5.5.7.5 Metallic Pipe Fittings.

Metallic fittings shall comply with the following:

(1) Threaded fittings in sizes larger than 4 in. (100 mm) shall not be used.

(2) Fittings used with steel, stainless steel, or wrought-iron pipe shall be steel, stainless steel, copper alloy, malleable iron, or cast iron.

(3) Fittings used with copper or copper alloy pipe shall be copper or copper alloy.

(4) Fittings used with aluminum alloy pipe shall be aluminum alloy.

(5) *Cast-Iron Fittings.* Cast-iron fittings shall comply with the following:

(6) Flanges shall be permitted.

(7) Bushings shall not be used.

(8) Fittings shall not be used in systems containing flammable gas–air mixtures.

(9) Fittings in sizes 4 in. (100 mm) and larger shall not be used indoors unless approved.

(10) Fittings in sizes 6 in. (150 mm) and larger shall not be used unless approved.

(11) *Aluminum Alloy Fittings.* Threads shall not form the joint seal.

(12) *Zinc–Aluminum Alloy Fittings.* Fittings shall not be used in systems containing flammable gas–air mixtures.

(13) *Special Fittings.* Fittings such as couplings, proprietary-type joints, saddle tees, gland-type compression fittings, and flared, flareless, or compression-type tubing fittings shall be as follows:

(14) Used within the fitting manufacturer's pressure–temperature recommendations

(15) Used within the service conditions anticipated with respect to vibration, fatigue, thermal expansion, or contraction

(16) Acceptable to the authority having jurisdiction

(17) When pipe fittings are drilled and tapped in the field, the operation shall be in accordance with the following:

(18) The operation shall be performed on systems having operating pressures of 5 psi (34 kPa) or less.

(19) The operation shall be performed by the gas supplier or their designated representative.

(20) The drilling and tapping operation shall be performed in accordance with written procedures prepared by the gas supplier.

(21) The fittings shall be located outdoors.

(22) The tapped fitting assembly shall be inspected and proven to be free of leaks.

5.5.8 Plastic Piping Joints and Fittings.

Plastic pipe, tubing, and fittings shall be joined in accordance with the manufacturers' instructions. The following shall be observed when making such joints:

(1) The joint shall be designed and installed so that the longitudinal pullout resistance of the joint will be at least equal to the tensile strength of the plastic piping material.

(2) Heat fusion joints shall be made in accordance with qualified procedures that have been established and proven by test to produce gastight joints at least as strong as the pipe or tubing being joined. Joints shall be made with the joining method recommended by the pipe manufacturer. Polyethylene heat fusion fittings shall be marked "ASTM D2513." Polyamide heat fusion fittings shall be marked "ASTM F2945."

(3) Where compression-type mechanical joints are used, the gasket material in the fitting shall be compatible with the plastic piping and with the gas distributed by the system. An internal tubular rigid stiffener shall be used in conjunction with the fitting. The stiffener shall be flush with the end of the pipe or tubing and shall extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. Split tubular stiffeners shall not be used.

(4) Plastic piping joints and fittings for use in LP-Gas piping systems shall be in accordance with NFPA 58.

5.5.9 Flanges.

5.5.9.1 Flange Specifications.

5.5.9.1.1

Cast iron flanges shall be in accordance with ANSI/ASME B16.1, *Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250*.

5.5.9.1.2

Steel flanges shall be in accordance with the following: ANSI/ASME B16.5, *Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard*, or ANSI/ASME B16.47, *Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric/Inch Standard*.

5.5.9.1.3

Nonferrous flanges shall be in accordance with ANSI/ASME B16.24, *Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500,* except listed components using aluminum flange connections constructed in accordance with the dimensional specifications of ANSI/ASME B16.5, *Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard*, or ANSI/ASME B16.1, *Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250*.

5.5.9.1.4

Ductile iron flanges shall be in accordance with ANSI/ASME B16.42, *Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300*.

5.5.9.2 Dissimilar Flange Connections.

Raised-face flanges shall not be joined to flat-faced cast iron, ductile iron or non-ferrous material flanges.

5.5.9.3 Flange Facings.

Standard facings shall be permitted for use under this code. Where 150 psi (1034 kPa) steel flanges are bolted to Class 125 cast-iron flanges, the raised face on the steel flange shall be removed.

5.5.9.4 Lapped Flanges.

Lapped flanges shall be used only aboveground or in exposed locations accessible for inspection.

5.5.10 Flange Gaskets.

The material for gaskets shall be capable of withstanding the design temperature and pressure of the piping system and the chemical constituents of the gas being conducted without change to its chemical and physical properties. The effects of fire exposure to the joint shall be considered in choosing the material.

5.5.10.1

Acceptable materials shall include the following:

(1) Metal (plain or corrugated)

(2) Composition

(3) Aluminum “O” rings

(4) Spiral-wound metal gaskets

(5) Rubber-faced phenolic

(6) Elastomeric

5.5.10.2 Gasket Specifications.

5.5.10.2.1

Metallic flange gaskets shall be in accordance with ANSI/ASME B16.20, *Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound and Jacketed*.

5.5.10.2.2

Non-metallic flange gaskets shall be in accordance with ANSI/ASME B16.21, *Nonmetallic Flat Gaskets for Pipe Flanges*.

5.5.10.3

Full-face flange gaskets shall be used with all non-steel flanges.

5.5.10.4

When a flanged joint is separated, the gasket shall be replaced.

5.5.10.5*

When flanges are separated and before gaskets are replaced, the following shall be met:

(1) Flange faces shall be cleaned.

(2) Flange surfaces shall be inspected for pitting, corrosion, and other surface defects.

(3) Flanges that contain pitting, corrosion, and other surface defects on faces shall be repaired or replaced.

5.6* Gas Meters.

5.6.1 Capacity.

Gas meters shall be selected for the maximum expected pressure and permissible pressure drop.

5.6.2 Location.

5.6.2.1

Gas meters shall be located in ventilated spaces readily accessible for examination, reading, replacement, or necessary maintenance.

5.6.2.2*

Gas meters shall not be placed where they will be subjected to damage.

5.6.2.3

Gas meters shall not be located where they will be subjected to extreme temperatures or sudden extreme changes in temperature or in areas where they are subjected to temperatures beyond those recommended by the manufacturer.

5.6.3 Supports.

5.6.3.1

Gas meters shall be supported or connected to rigid piping so as not to exert a strain on the meters.

5.6.3.2

Where flexible connectors are used to connect a gas meter to downstream piping at manufactured homes in manufactured-home parks and mobile homes in mobile-home parks, the meter shall be supported by a post or bracket placed in a firm footing or by other means providing equivalent support.

5.6.4 Meter Protection.

Meters shall be protected against overpressure, back pressure, and vacuum.

5.6.5 Identification.

Gas piping at multiple meter installations shall be marked by a metal tag or other permanent means designating the building or the part of the building being supplied and attached by the installing agency.

5.7* Gas Pressure Regulators.

5.7.1 Where Required.

A line pressure regulator shall be installed where the gas supply pressure exceeds the maximum allowable inlet pressure of the appliance served.

5.7.2 Listing.

Line pressure regulators shall be listed in accordance with ANSI Z21.80/CSA 6.22, *Line Pressure Regulators*, where the outlet pressure is set to 2 psi or less.

5.7.3 Location.

The gas pressure regulator shall be accessible for servicing.

5.7.4 Regulator Protection.

Pressure regulators shall be protected against physical damage.

5.7.5 Regulator Vents.

Regulator vents shall be in accordance with Section 5.14.

5.7.6 Identification.

Line pressure regulators at multiple regulator installations shall be marked by a metal tag or other permanent means designating the building or the part of the building being supplied.

5.7.7 Regulator Removal.

A union shall be installed either upstream or downstream of a regulator with threaded pipe connections.

5.8 Overpressure Protection.

5.8.1 Where Required.

Where the serving gas supplier delivers gas at a pressure greater than 2 psi (14 kPa) for piping systems serving appliances designed to operate at a gas pressure of 14 in. w.c. (3.4 kPa)or less, overpressure protection devices shall be installed. Piping systems serving equipment designed to operate at inlet pressures greater than 14 in. w.c. (3.4 kPa) shall be equipped with overpressure protection devices as required by the appliance manufacturer’s installation instructions.

5.8.2 Pressure Limitation Requirements.

5.8.2.1

Where piping systems serving appliances designed to operate with a gas supply pressure of 14 in. w.c. (3.4 kPa) or less are required to be equipped with overpressure protection by 5.8.1, each overpressure protection device shall be adjusted to limit the gas pressure to each connected appliance to 2 psi (14 kPa) or less upon a failure of the line pressure regulator.

5.8.2.2

Where piping systems serving appliances designed to operate with a gas supply pressure greater than 14 in. w.c. (3.4 kPa) are required to be equipped with overpressure protection by 5.8.1, each overpressure protection device shall be adjusted to limit the gas pressure to each connected appliance as required by the appliance manufacturer's installation instructions.

5.8.2.3

Each overpressure protection device installed to meet the requirements of this section shall be capable of limiting the pressure to its connected appliance(s) as required by this section independently of any other pressure control equipment in the piping system.

5.8.2.4

Each gas piping system for which an overpressure protection device is required by this section shall be designed and installed so that a failure of the primary pressure control device(s) is detectable.

5.8.2.5

If a pressure relief valve is used to meet the requirements of this section, it shall have a flow capacity such that the pressure in the protected system is maintained at or below the limits specified in 5.8.2.1 under the following conditions:

(1) The line pressure regulator for which the relief valve is providing overpressure protection has failed wide open.

(2) The gas pressure at the inlet of the line pressure regulator for which the relief valve is providing overpressure protection is not less than the regulator's normal operating inlet pressure.

5.8.3 Overpressure Protection Devices.

5.8.3.1

Overpressure protection devices shall be one of the following:

(1) Pressure relief valve

(2) Monitor regulator

(3) Series regulator installed upstream from the line regulator and set to continuously limit the pressure on the inlet of the line regulator

(4) Automatic shutoff device installed in series with the line pressure regulator and designed so that it will remain closed until manually reset

5.8.3.2

The devices in 5.8.3.1 shall be installed either as an integral part of the service or line pressure regulator or as separate units. Where separate overpressure protection devices are installed, they shall comply with 5.8.4 through 5.8.9.

5.8.4 Construction and Installation.

All overpressure protection devices shall meet the following requirements:

(1) Be constructed of materials so that the operation of the device is not impaired by corrosion of external parts by the atmosphere or of internal parts by the gas.

(2) Be designed and installed so they can be operated to determine whether the valve is free. The devices shall also be designed and installed so they can be tested to determine the pressure at which they operate and be examined for leakage when in the closed position.

5.8.5 External Control Piping.

External control piping shall be designed and installed so that damage to the control piping of one device does not render both the regulator and the overpressure protective device inoperative.

5.8.6 Setting.

Each pressure limiting or pressure relieving device shall be set so that the gas pressure supplied to the connected appliance(s) does not exceed the limits specified in 5.8.2.1 and 5.8.2.2.

5.8.7 Unauthorized Operation.

Where unauthorized operation of any shutoff valve could render a pressure relieving valve or pressure limiting device inoperative, one of the following shall be accomplished:

(1) The valve shall be locked in the open position. Instruct authorized personnel in the importance of leaving the shutoff valve open and of being present while the shutoff valve is closed so that it can be locked in the open position before leaving the premises.

(2) Duplicate relief valves shall be installed, each having adequate capacity to protect the system, and arrange the isolating valves or three-way valve so that only one relief valve can be rendered inoperative at a time.

5.8.8 Vents.

5.8.8.1

The discharge stacks, vents, or outlet parts of all pressure relieving and pressure limiting devices shall be located so that gas is safely discharged to the outdoors. Discharge stacks or vents shall be designed to prevent the entry of water, insects, or other foreign material that could cause blockage.

5.8.8.2

The discharge stack or vent line shall be at least the same size as the outlet of the pressure-relieving device.

5.8.9 Size of Fittings, Pipe, and Openings.

The fittings, pipe, and openings located between the system to be protected and the pressure relieving device shall be sized to prevent reduction of relief capacity.

5.9 Back Pressure Protection.

5.9.1 Where to Install.

5.9.1.1

Protective devices shall be installed as close to the equipment as practical where the design of equipment connected is such that air, oxygen, or standby gases could be forced into the gas supply system.

5.9.1.2

Gas and air combustion mixers incorporating double diaphragm “zero” or “atmosphere” governors or regulators shall require no further protection unless connected directly to compressed air or oxygen at pressures of 5 psi (34 kPa) or more.

5.9.2 Protective Devices.

Protective devices shall include but not be limited to the following:

(1) Check valves

(2) Three-way valves (of the type that completely closes one side before starting to open the other side)

(3) Reverse flow indicators controlling positive shutoff valves

(4) Normally closed air-actuated positive shutoff pressure regulators

5.10* Low-Pressure Protection.

A protective device shall be installed between the meter and the appliance or equipment if the operation of the appliance or equipment is such that it could produce a vacuum or a dangerous reduction in gas pressure at the meter. Such protective devices include, but are not limited to, mechanical, diaphragm-operated, or electrically operated low-pressure shutoff valves.

5.11 Shutoff Valves.

Shutoff valves shall be selected in accordance with Table 5.11. Shutoff valves of size 1 in. (25 mm) National Pipe Thread and smaller shall be listed and labeled. Where used outdoors, such use shall be in accordance with the manufacturer's recommendation.

Table 5.11 Manual Gas Valve Standards

Shutoff Valve Application	Valve Meeting the Following Standards	
Appliance shutoff valve up to ½ psi	ANSI Z21.15/CSA 9.1	
	ANSI/ASME B16.44	
	-	ANSI/ASME B16.33 marked 125 G
	-	ANSI LC 4/CSA 6.32
Valve up to ½ psi	ANSI/ASME B16.44	
	-	ANSI/ASME B16.33 marked 125 G
	-	ANSI LC 4/CSA 6.32
Valve up to 2 psi	ANSI/ASME B16.44 labeled 2G	
	-	ANSI/ASME B16.33 marked 125 G
	-	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.44 labeled 2G or labeled 5G
	-	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G
Valve up to 5 psi	ANSI/ASME B16.44 labeled 5G	
	-	ANSI/ASME B16.33
	-	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.44 marked 5G
	-	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G
Valve up to 125 psi	ANSI/ASME B16.33 marked 125 G	
	-	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G

For SI units, 1 psi gauge = 6.895 kPa.

5.12 Excess Flow Valve(s).

Where automatic excess flow valves are installed, they shall be listed in accordance with ANSI Z21.93/CSA 6.30, *Excess Flow Valves for Natural and LP-Gas with Pressures Up to 5 psig*, and shall be sized and installed in accordance with the manufacturers' instructions.

5.13 Expansion and Flexibility.

5.13.1 Design.

Piping systems shall be designed to prevent failure from thermal expansion or contraction.

5.13.2 Special Local Conditions.

Where local conditions include earthquake, tornado, unstable ground, or flood hazards, special consideration shall be given to increased strength and flexibility of piping supports and connections.

5.14 Pressure Regulator and Pressure Control Venting.

The venting of the atmospheric side of diaphragms in line-pressure regulators and gas-pressure-limit controls shall be in accordance with all of the following:

(1) An independent vent pipe to the outdoors, sized in accordance with the device manufacturer's instructions, shall be provided where the location of a device is such that a discharge of fuel gas will cause a hazard.

(2) Independent vents for multiple regulators shall not be required where the vents are connected to a common manifold designed in accordance with engineering methods to minimize backpressure in the event of diaphragm failure and such design is approved.

(3) A regulator and vent limiting means combination listed in accordance with ANSI Z21.80/CSA 6.22, *Line Pressure Regulators,* shall not be required to be vented to the outdoors.

(4) A listed gas appliance regulator factory equipped with a vent limiting device shall not be required to be vented to the outdoors.

(5) A listed gas pressure limit control that is factory equipped with a vent limiting device and in accordance with UL 353, *Limit Controls,* or UL 60730-2-6, *Automatic Electrical Controls for Household and Similar Use, Part 2,* shall not be required to be vented to the outdoors.

(6) Materials for vent piping shall be in accordance with Section 5.5.

(7) The vent terminus shall be designed to prevent the entry of water, insects, and other foreign matter that could cause blockage.

(8) Vent piping shall be installed to minimize static loads and bending moments placed on the regulators and gas pressure control devices.

(9) Vents shall terminate not less than 3 ft (0.9 m) from a possible source of ignition.

(10) At locations where a vent termination could be submerged during floods or snow accumulations, one of the following shall apply:

(a) An antiflood-type breather vent fitting shall be installed.

(b) The vent terminal shall be located above the height of the expected flood waters or snow.

(11) Vent piping from pressure regulators and gas pressure controls shall not be connected to a common manifold that serves a bleed line from a diaphragm-type gas valve.

Supplemental Information

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Chapter 5 Gas Piping System Design, Materials, and Components
5.1.2 Addition to Existing System.
5.1.2.1

When additional appliances are being connected to a gas piping system, the existing piping shall be checked to determine whether it has the required ~~adequate~~ capacity.

5.1.2.2

If ~~the capacity of~~ the system does not have the capacity to supply ~~is determined to be inadequate for~~ the additional appliances, one or more of the following modifications shall be made to provide required minimum gas pressures to each appliance:

(1) The existing system is enlarged as required.

(2) Additional~~Separate~~ gas piping ~~of adequate capacity~~ is provided.

(3) The gas pressure is increased within the limitations of the existing piping system and connected appliances.

5.2.2* Interconnections for Standby Fuels.
~~5.2.2.1~~

Where a supplementary gas for standby use is connected downstream from a meter or a service regulator where a meter is not provided, equipment to prevent backflow shall be installed.

A.5.2.2.~~2~~

A three-way valve installed to admit the standby supply and at the same time shut off the regular supply shall be permitted to be used to prevent backflow. ~~for this purpose.~~

5.3 Sizing of Gas Piping Systems.
5.3.1* General Considerations.

Gas piping systems shall be of such size and so installed as to provide a supply of gas ~~sufficient~~ to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance.

5.3.2.3

The total connected hourly load shall be used as the basis for piping sizing, assuming all appliances are operating at full capacity simultaneously, except where established load diversity factors are used. ~~as permitted in 5.3.2.4~~.

5.3.2.4~~Exception:~~ Sizing shall be permitted to be based upon established load diversity factors.

5.5 Piping Materials and Joining Methods.
5.5.1 General.
5.5.1.1 Acceptable Materials.

Materials used for piping systems shall either comply with the requirements of this chapter or be approved ~~acceptable to the authority having jurisdiction~~.

5.5.1.2 Used Materials.

Pipe, fittings, valves, or other materials shall not be used again unless they are free of foreign materials and have been approved~~ascertained to be adequate~~ for the service intended.

5.5.2.2 Steel, Stainless Steel, and Wrought Iron.

5.5.2.2.1
Steel, stainless steel, and wrought-iron pipe shall be at least Schedule 10.

5.5.2.2.2
Steel, stainless steel, and wrought-iron pipe ~~and~~ shall comply with the dimensional standards of ANSI/ASME B36.10M, *Welded and Seamless Wrought Steel Pipe,* and one of the following:

(1) ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless*

(2) ASTM A106, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*

(3) ASTM A312, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*

5.5.2.5 Aluminum Alloy.

5.5.2.5.1
Aluminum alloy pipe shall comply with ASTM B241, *Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube*, ~~(~~except ~~that the use of alloy 5456 is prohibited)~~as provided in 5.5.2.5.2.

5.5.2.5.2
Alloy 5456, in accordance with ASTM B241, *Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube,* shall be prohibited.

5.5.2.5.3
Aluminum alloy pipe ~~, and~~ shall be marked at each end of each length indicating compliance.

5.5.2.5.4
Aluminum alloy pipe shall be coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water, detergents, or sewage.

5.5.3 Metallic Tubing.
5.5.3.1 Compatibility.

Tubing shall not be used with gases corrosive to the tubing material.

5.5.3.4* Copper and Copper Alloy.

5.5.3.4.1
Copper and copper alloy tubing shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 scf of gas (0.7 mg/100 L).

5.5.3.4.2
Copper tubing shall comply with standard Type K or Type L of ASTM B88, *Standard Specification for Seamless Copper Water Tube,* or ASTM B280, *Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*.

5.5.3.5 Aluminum.

5.5.3.5.1
Aluminum alloy tubing shall comply with ASTM B210, *Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes,* or ASTM B241*, Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.*

5.5.3.5.2
Aluminum alloy tubing shall be coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water, detergent, or sewage.

5.5.3.5.3
Aluminum alloy tubing shall not be used in exterior locations or underground.

5.5.4 Plastic Pipe, Tubing, and Fittings.
5.5.4.1 Standard and Marking.
5.5.4.1.1

Polyethylene plastic pipe, tubing, and fittings used to supply fuel gas shall conform to ASTM D2513, *Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings*.~~ Pipe to be used shall~~ and be marked "gas" and "ASTM D2513."

5.5.4.1.2

Polyamide pipe, tubing, and fittings shall be identified in and conform to ASTM F2945, *Standard Specification for Polyamide 11 Gas Pressure Pipe, Tubing, and Fittings*~~. , Pipe to be used shall~~and be marked "gas" and "ASTM F2945."

5.5.4.2* Regulator Vent Piping.

5.5.4.2.1
Plastic pipe and fittings used to connect regulator vents to remote vent terminations shall be PVC conforming to UL 651, *Schedule 40 and 80 Rigid PVC Conduit and Fittings*.

5.5.4.2.2
PVC vent piping shall not be installed indoors.

5.5.4.3 Anodeless Risers.

Anodeless risers shall comply with all of the following:

(1) ~~(1)~~ Factory-assembled anodeless risers shall be recommended by the manufacturer for the gas used.
~~(1)~~(2) Factory-assembled anodeless risers~~and~~ shall be leak tested by the manufacturer in accordance with written procedures.
(3) ~~(2)~~ Service head adapters and field-assembled anodeless risers incorporating service head adapters shall be recommended by the manufacturer for the gas used.
(4) Service head adapters and field-assembled anodeless risers incorporating service head adapters~~and~~ shall be design-certified to meet the requirements of Category I of ASTM D2513, *Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings,* and 49 CFR 192.281(e).
~~(2)~~(5) The manufacturer shall provide the user qualified installation instructions as prescribed by 49 CFR 192.283(b).

(~~3~~6) The use of plastic pipe, tubing, and fittings in undiluted LP-Gas piping systems shall be in accordance with NFPA 58.

5.5.5 Workmanship and Defects.

Gas pipe, tubing, and fittings at the time of installation shall meet all of the following requirements:

(1) Gas pipe, tubing, and fittings shall be clear and free from cutting burrs and visible defects in structure or threading.

(2) Gas pipe, tubing, and fittings shall be ~~thoroughly~~ cleaned to remove chip, scale, and debris.

(3) Visible defects in pipe, tubing, and fittings shall not be repaired.

(4) Pipe, tubing, and fittings with visible defects shall be replaced.

5.5.6 Metallic Pipe Threads.
5.5.6.1 Specifications for Pipe Threads.

Metallic pipe and fitting threads shall be tapered pipe threads ~~and shall~~ that comply with ANSI/ASME B1.20.1, *Pipe Threads, General Purpose, Inch.*

5.5.6.4.3

Thread joint sealing materials shall be non-hardening and ~~shall be~~ resistant to the chemical constituents of the gases to be conducted through the piping.

5.5.7 Metallic Piping Joints and Fittings.

The type of piping joint used shall ~~conform to~~comply with all of the following:

(1) Be suitable for the pressure and temperature conditions

(2) Be selected ~~giving consideration to~~considering joint tightness and mechanical strength under the service conditions

(3) Be able to sustain the maximum end forces inclusive of temperature expansion or contraction, vibration, fatigue, internal pressure, or the weight of the pipe and its contents

~~(A)~~ 5.5.7.1.1

Pipe lighter than Schedule 40 shall be connected using press-connect fittings, flanges, brazing, or welding.

~~(B)~~ 5.5.7.1.2

Where nonferrous pipe is brazed, the brazing materials shall have a melting point in excess of 1000°F (538°C) and ~~Brazing alloys shall not~~ containing not more than 0.05 percent phosphorus.

5.5.7.2 Copper Tubing Joints.

5.5.7.2.1
Copper tubing joints shall be in accordance with any of the following:

(1) ~~assembled~~ Assembled with approved gas tubing fittings
(2) ~~, shall be b~~Brazed with a material having a melting point in excess of 1000°F (538°C) and containing not more than 0.05 percent phosphorus.
(3) ~~, or shall be a~~Assembled with press-connect fittings listed to ANSI LC 4/CSA 6.32, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems*~~.~~

~~5.5.7.2.2~~
~~Brazing alloys shall not contain more than 0.05 percent phosphorus.~~

5.5.7.3 Stainless Steel Tubing Joints.

5.5.7.3.1
Stainless steel joints shall be in accordance with any of the following:

(1) Welded
(2) ~~, a~~Assembled with approved tubing fittings
(3) ~~, b~~Brazed with a material having a melting point in excess of 1000°F (538°C)
(4) ~~, or a~~Assembled with press-connect fittings listed to ANSI LC 4/CSA 6.32, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems*~~.~~

5.5.7.3.2
Brazing alloys and fluxes ~~shall be recommended by the manufacturer~~ for use on stainless steel alloys shall be recommended by the manufacturer.

5.5.7.5 Metallic Pipe Fittings.

Metallic fittings shall comply with all of the following:

(1) Threaded fittings in sizes larger than 4 in. (100 mm) shall not be used.

(2) Fittings used with steel, stainless steel, or wrought-iron pipe shall be steel, stainless steel, copper alloy, malleable iron, or cast iron.

(3) Fittings used with copper or copper alloy pipe shall be copper or copper alloy.

(4) Fittings used with aluminum alloy pipe shall be aluminum alloy.

(5) *Cast-Iron Fittings.* Cast-iron fittings shall comply with the following:

(a) Flanges shall be permitted.

(b) Bushings shall not be used.

(c) Fittings shall not be used in systems containing flammable gas–air mixtures.

(d) Fittings in sizes 4 in. (100 mm) and larger shall not be used indoors unless approved.

(e) Fittings in sizes 6 in. (150 mm) and larger shall not be used unless approved.

(6) *Aluminum Alloy Fittings.* Threads shall not form the joint seal.

(7) *Zinc–Aluminum Alloy Fittings.* Fittings shall not be used in systems containing flammable gas–air mixtures.

(8) *Special Fittings.* Fittings such as couplings, proprietary-type joints, saddle tees, gland-type compression fittings, and flared, flareless, or compression-type tubing fittings shall be as follows:

(a) Used within the fitting manufacturer's pressure–temperature recommendations

(b) Used within the service conditions anticipated with respect to vibration, fatigue, thermal expansion, or contraction

(c) Acceptable to the authority having jurisdiction

(9) When pipe fittings are drilled and tapped in the field, the operation shall be in accordance with the following:

(a) The operation shall be performed on systems having operating pressures of 5 psi (34 kPa) or less.

(b) The operation shall be performed by the gas supplier or their designated representative.

(c) The drilling and tapping operation shall be performed in accordance with written procedures prepared by the gas supplier.

(d) The fittings shall be located outdoors.

(e) The tapped fitting assembly shall be inspected and proven to be free of leaks.

5.5.9.1.2

Steel flanges shall be in accordance with ~~the following:~~ ANSI/ASME B16.5, *Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard*, or ANSI/ASME B16.47, *Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric/Inch Standard*.

5.5.9.3* Flange Facings.

A.5.5.9.3.~~1~~
Standard facings ~~shall be~~are permitted for use under this code.

~~5.5.9.3.2~~
Where 150 psi (1034 kPa) steel flanges are bolted to Class 125 cast-iron flanges, the raised face on the steel flange shall be removed.

5.5.10 Flange Gaskets.

5.5.10.1*
The material for gaskets shall be capable of withstanding the design temperature and pressure of the piping system and the chemical constituents of the gas being conducted without change to its chemical and physical properties.

5.5.10.1.1
The effects of fire exposure to the joint shall be considered in choosing the material.

A.5.5.10.1

Acceptable materials can~~shall~~ include the following:

(1) Metal (plain or corrugated)

(2) Composition

(3) Aluminum "O" rings

(4) Spiral-wound metal gaskets

(5) Rubber-faced phenolic

(6) Elastomeric

5.5.10.2.2

Non-metallic flange gaskets shall be in accordance with ANSI/ASME B16.21, *Nonmetallic Flat Gaskets for Pipe Flanges*.

5.5.10.3

Full-face flange gaskets shall be used with all non-steel flanges.

5.8 Overpressure Protection.
5.8.1 Where Required.

Where the serving gas supplier delivers gas at a pressure greater than 2 psi (14 kPa) for piping systems serving appliances designed to operate at a gas pressure of 14 in. w.c. (3.4 kPa)or less, overpressure protection devices shall be installed. Piping systems serving equipment designed to operate at inlet pressures greater than 14 in. w.c. (3.4 kPa) shall be equipped with overpressure protection devices as required by the appliance manufacturer's installation instructions.

5.8.3.2

The devices in 5.8.3.1 shall be installed either as an integral part of the service or line pressure regulator or as separate units.

5.8.3.3
Where separate overpressure protection devices are installed, they shall comply with 5.8.4 through 5.8.9.

5.8.4 Construction and Installation.

~~5.8.4.1~~
All overpressure protection devices shall meet the following requirements:

(1) Be constructed of materials so that the operation of the device is not impaired by corrosion of external parts by the atmosphere or of internal parts by the gas~~.~~

(2) Be designed and installed so they can be operated to determine whether the valve is free~~.~~

(3) ~~The devices shall also b~~Be designed and installed so they can be tested to determine the pressure at which they operate and be examined for leakage when in the closed position~~.~~

~~5.8.4.2~~

5.8.6 Setting.

Each ~~pressure~~ pressure-limiting or ~~pressure~~ pressure-relieving device shall be set so that the gas pressure supplied to the connected appliance(s) does not exceed the limits specified in 5.8.2.1 and 5.8.2.2.

5.8.8 Vents.
5.8.8.1

The discharge stacks, vents, or outlet parts of all ~~pressure~~ pressure-relieving and ~~pressure~~ pressure-limiting devices shall be located so that gas is safely discharged to the outdoors.

5.8.8.2
Discharge stacks or vents shall be designed to prevent the entry of water, insects, or other foreign material that could cause blockage.

5.8.8.~~2~~ 3

The discharge stack or vent line shall be at least the same size as the outlet of the pressure-relieving device.

5.8.9 Size of Fittings, Pipe, and Openings.

The fittings, pipe, and openings located between the system to be protected and the ~~pressure~~ pressure-relieving device shall be sized to prevent reduction of relief capacity.

5.9.2 Protective Devices.

Protective devices shall include, but not be limited to, the following:

(1) Check valves

(2) Three-way valves (of the type that completely closes one side before starting to open the other side)

Commented [AI1]: See word document 5.8.1

(3) Reverse flow indicators controlling positive shutoff valves

(4) Normally closed air-actuated positive shutoff pressure regulators

5.11 Shutoff Valves.

5.11.1
Shutoff valves shall be selected in accordance with Table 5.11.1.

5.11.2
Shutoff valves of size 1 in. (25 mm) National Pipe Thread and smaller shall be listed and labeled.

5.11.3
Where shut-off valves are used outdoors, such use shall be in accordance with the manufacturer's recommendation.

Table 5.11.1 Manual Gas Valve Standards

Shutoff Valve Application	Valve Meeting the Following Standards
Appliance shutoff valve up to 1/2 psi	ANSI Z21.15/CSA 9.1
	ANSI/ASME B16.44
	ANSI/ASME B16.33 marked 125 G
	ANSI LC 4/CSA 6.32
Valve up to 1/2 psi	ANSI/ASME B16.44
	ANSI/ASME B16.33 marked 125 G
	ANSI LC 4/CSA 6.32
Valve up to 2 psi	ANSI/ASME B16.44 labeled 2G
	ANSI/ASME B16.33 marked 125 G
	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.44 labeled 2G or labeled 5G
	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G
Valve up to 5 psi	ANSI/ASME B16.44 labeled 5G
	ANSI/ASME B16.33
	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.44 marked 5G
	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G
Valve up to 125 psi	ANSI/ASME B16.33 marked 125 G
	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G

For SI units, 1 psi gauge = 6.895 kPa.

5.12 Excess Flow Valve(s).

5.12.1
Where automatic excess flow valves are installed, they shall be listed in accordance with ANSI Z21.93/CSA 6.30, *Excess Flow Valves for Natural and LP-Gas with Pressures Up to 5 psig*.

5.12.2
~~, and~~Excess flow valves shall be sized and installed in accordance with the manufacturers' instructions.

5.13.2 Special Local Conditions.

Where local conditions include earthquakes, tornados, unstable ground, or flood hazards, special consideration shall be given to increased strength and flexibility of piping supports and connections.

Committee Input No. 68-NFPA 54-2024 [Section No. 5.8.1]

5.8.1 Where Required.

5.8.1.1

Where the serving gas supplier delivers gas at a pressure greater than 2 psi (14 kPa) for piping systems serving appliances designed to operate at a gas pressure of 14 in. w.c. (3.4 kPa)or less, overpressure protection devices shall be installed. ~~Piping~~

5.8.1.2

Where the serving gas supplier delivers gas at a pressure greater than 2 psi (14 kPa) for piping systems serving equipment designed to operate at inlet pressures greater than 14 in. w.c. (3.4 kPa) shall be equipped with overpressure protection devices as required by the appliance manufacturer's installation instructions.

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Wed Sep 25 13:39:30 EDT 2024

Committee Statement

Committee Statement: The technical committee is looking at breaking out the section to comply with the NFPA Manual of Style.

Response Message: CI-68-NFPA 54-2024

Committee Input No. 82-NFPA 54-2024 [Chapter 6]

Chapter 6 Pipe Sizing

6.1* Pipe Sizing Methods.

Where the pipe size is to be determined using any of the methods in 6.1.2 through 6.1.4, the diameter of each pipe segment shall be obtained from the pipe sizing tables in Section 6.2, Section 6.3, the sizing tables included in a listed piping system manufacturer's installation instructions, or from the sizing equations in Section 6.4.

6.1.1 US to SI Conversions.

For SI units, the following shall apply: 1 ft^3 = 0.028 m^3, 1 ft = 0.305 m, 1 in. w.c. = 0.249 kPa, 1 psi = 6.894 kPa, 1000 Btu/hr = 0.293 kW.

6.1.2* Longest Length Method.

The pipe size of each section of gas piping shall be determined using the longest length of piping from the point of delivery to the most remote outlet and the load of the section.

6.1.3* Branch Length Method.

Pipe shall be sized as follows:

(1) Pipe size of each section of the longest pipe run from the point of delivery to the most remote outlet shall be determined using the longest run of piping and the load of the section.

(2) The pipe size of each section of branch piping not previously sized shall be determined using the length of piping from the point of delivery to the most remote outlet in each branch and the load of the section.

6.1.4 Hybrid Pressure.

The pipe size for each section of higher pressure gas piping shall be determined using the longest length of piping from the point of delivery to the most remote line pressure regulator. The pipe size from the line pressure regulator to each outlet shall be determined using the length of piping from the regulator to the most remote outlet served by the regulator.

6.2 Sizing Natural Gas Piping Systems.

Sizing of piping systems shall be in accordance with 6.2.1 or 6.2.2.

6.2.1

Table 6.2.1(a) through Table 6.2.1(x) shall be used in conjunction with one of the methods described in 6.1.2 through 6.1.4 for piping materials other than non-corrugated stainless steel tubing.

Table 6.2.1(a) Schedule 40 Metallic Pipe

Gas:	
Inlet Pressure:	
Pressure Drop:	
Specific Gravity:	

	Pipe Size (in.)											
Nominal:	½	¾	1	1¼	1½	2	2½	3	4	5	6	8
Actual ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026	5.047	6.065	7.981
Length (ft)	Capacity in Cubic Feet of Gas per Hour											
10	131	273	514	1,060	1,580	3,050	4,860	8,580	17,500	31,700	51,300	105,000
20	90	188	353	726	1,090	2,090	3,340	5,900	12,000	21,800	35,300	72,400
30	72	151	284	583	873	1,680	2,680	4,740	9,660	17,500	28,300	58,200
40	62	129	243	499	747	1,440	2,290	4,050	8,270	15,000	24,200	49,800
50	55	114	215	442	662	1,280	2,030	3,590	7,330	13,300	21,500	44,100
60	50	104	195	400	600	1,160	1,840	3,260	6,640	12,000	19,500	40,000
70	46	95	179	368	552	1,060	1,690	3,000	6,110	11,100	17,900	36,800
80	42	89	167	343	514	989	1,580	2,790	5,680	10,300	16,700	34,200
90	40	83	157	322	482	928	1,480	2,610	5,330	9,650	15,600	32,100
100	38	79	148	304	455	877	1,400	2,470	5,040	9,110	14,800	30,300
125	33	70	131	269	403	777	1,240	2,190	4,460	8,080	13,100	26,900
150	30	63	119	244	366	704	1,120	1,980	4,050	7,320	11,900	24,300
175	28	58	109	224	336	648	1,030	1,820	3,720	6,730	10,900	22,400
200	26	54	102	209	313	602	960	1,700	3,460	6,260	10,100	20,800
250	23	48	90	185	277	534	851	1,500	3,070	5,550	8,990	18,500
300	21	43	82	168	251	484	771	1,360	2,780	5,030	8,150	16,700
350	19	40	75	154	231	445	709	1,250	2,560	4,630	7,490	15,400
400	18	37	70	143	215	414	660	1,170	2,380	4,310	6,970	14,300
450	17	35	66	135	202	389	619	1,090	2,230	4,040	6,540	13,400
500	16	33	62	127	191	367	585	1,030	2,110	3,820	6,180	12,700
550	15	31	59	121	181	349	556	982	2,000	3,620	5,870	12,100
600	14	30	56	115	173	333	530	937	1,910	3,460	5,600	11,500
650	14	29	54	110	165	318	508	897	1,830	3,310	5,360	11,000
700	13	27	52	106	159	306	488	862	1,760	3,180	5,150	10,600
750	13	26	50	102	153	295	470	830	1,690	3,060	4,960	10,200
800	12	26	48	99	148	285	454	802	1,640	2,960	4,790	9,840
850	12	25	46	95	143	275	439	776	1,580	2,860	4,640	9,530
900	11	24	45	93	139	267	426	752	1,530	2,780	4,500	9,240

950	11	23	44	90	135	259	413	731	1,490	2,700	4,370	8,970
1,000	11	23	43	87	131	252	402	711	1,450	2,620	4,250	8,720
1,100	10	21	40	83	124	240	382	675	1,380	2,490	4,030	8,290
1,200	NA	20	39	79	119	229	364	644	1,310	2,380	3,850	7,910
1,300	NA	20	37	76	114	219	349	617	1,260	2,280	3,680	7,570
1,400	NA	19	35	73	109	210	335	592	1,210	2,190	3,540	7,270
1,500	NA	18	34	70	105	203	323	571	1,160	2,110	3,410	7,010
1,600	NA	18	33	68	102	196	312	551	1,120	2,030	3,290	6,770
1,700	NA	17	32	66	98	189	302	533	1,090	1,970	3,190	6,550
1,800	NA	16	31	64	95	184	293	517	1,050	1,910	3,090	6,350
1,900	NA	16	30	62	93	178	284	502	1,020	1,850	3,000	6,170
2,000	NA	16	29	60	90	173	276	488	1,000	1,800	2,920	6,000

NA: A flow of less than 10 cfh.

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(b) Schedule 40 Metallic Pipe

-	-	-	-	-	-	-	-	-	-	-	**Gas:**	
-	-	-	-	-	-	-	-	-	-	-	**Inlet Pressure:**	
-	-	-	-	-	-	-	-	-	-	-	**Pressure Drop:**	
-	-	-	-	-	-	-	-	-	-	-	**Specific Gravity:**	
-	**Pipe Size (in.)**											
Nominal:	½	¾	**1**	**1¼**	**1½**	**2**	**2½**	**3**	**4**	**5**	**6**	**8**
Actual ID:	**0.622**	**0.824**	**1.049**	**1.380**	**1.610**	**2.067**	**2.469**	**3.068**	**4.026**	**5.047**	**6.065**	**7.981**
Length (ft)	**Capacity in Cubic Feet of Gas per Hour**											
10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100	41,800	67,600	139,000
20	118	247	466	957	1,430	2,760	4,400	7,780	15,900	28,700	46,500	95,500
30	95	199	374	768	1,150	2,220	3,530	6,250	12,700	23,000	37,300	76,700
40	81	170	320	657	985	1,900	3,020	5,350	10,900	19,700	31,900	65,600
50	72	151	284	583	873	1,680	2,680	4,740	9,660	17,500	28,300	58,200
60	65	137	257	528	791	1,520	2,430	4,290	8,760	15,800	25,600	52,700
70	60	126	237	486	728	1,400	2,230	3,950	8,050	14,600	23,600	48,500
80	56	117	220	452	677	1,300	2,080	3,670	7,490	13,600	22,000	45,100
90	52	110	207	424	635	1,220	1,950	3,450	7,030	12,700	20,600	42,300
100	50	104	195	400	600	1,160	1,840	3,260	6,640	12,000	19,500	40,000
125	44	92	173	355	532	1,020	1,630	2,890	5,890	10,600	17,200	35,400
150	40	83	157	322	482	928	1,480	2,610	5,330	9,650	15,600	32,100
175	37	77	144	296	443	854	1,360	2,410	4,910	8,880	14,400	29,500
200	34	71	134	275	412	794	1,270	2,240	4,560	8,260	13,400	27,500
250	30	63	119	244	366	704	1,120	1,980	4,050	7,320	11,900	24,300
300	27	57	108	221	331	638	1,020	1,800	3,670	6,630	10,700	22,100

350	25	53	99	203	305	587	935	1,650	3,370	6,100	9,880	20,300
400	23	49	92	189	283	546	870	1,540	3,140	5,680	9,190	18,900
450	22	46	86	177	266	512	816	1,440	2,940	5,330	8,620	17,700
500	21	43	82	168	251	484	771	1,360	2,780	5,030	8,150	16,700
550	20	41	78	159	239	459	732	1,290	2,640	4,780	7,740	15,900
600	19	39	74	152	228	438	699	1,240	2,520	4,560	7,380	15,200
650	18	38	71	145	218	420	669	1,180	2,410	4,360	7,070	14,500
700	17	36	68	140	209	403	643	1,140	2,320	4,190	6,790	14,000
750	17	35	66	135	202	389	619	1,090	2,230	4,040	6,540	13,400
800	16	34	63	130	195	375	598	1,060	2,160	3,900	6,320	13,000
850	16	33	61	126	189	363	579	1,020	2,090	3,780	6,110	12,600
900	15	32	59	122	183	352	561	992	2,020	3,660	5,930	12,200
950	15	31	58	118	178	342	545	963	1,960	3,550	5,760	11,800
1,000	14	30	56	115	173	333	530	937	1,910	3,460	5,600	11,500
1,100	14	28	53	109	164	316	503	890	1,810	3,280	5,320	10,900
1,200	13	27	51	104	156	301	480	849	1,730	3,130	5,070	10,400
1,300	12	26	49	100	150	289	460	813	1,660	3,000	4,860	9,980
1,400	12	25	47	96	144	277	442	781	1,590	2,880	4,670	9,590
1,500	11	24	45	93	139	267	426	752	1,530	2,780	4,500	9,240
1,600	11	23	44	89	134	258	411	727	1,480	2,680	4,340	8,920
1,700	11	22	42	86	130	250	398	703	1,430	2,590	4,200	8,630
1,800	10	22	41	84	126	242	386	682	1,390	2,520	4,070	8,370
1,900	10	21	40	81	122	235	375	662	1,350	2,440	3,960	8,130
2,000	NA	20	39	79	119	229	364	644	1,310	2,380	3,850	7,910

NA: A flow of less than 10 cfh.

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(c) Schedule 40 Metallic Pipe

Gas:	**Natural**
Inlet Pressure:	**Less than 2 psi**
Pressure Drop:	**3.0 in. w.c.**
Specific Gravity:	**0.60**

INTENDED USE: Initial supply pressure of 8.0 in. w.c. or greater

	Pipe Size (in.)								
Nominal:	½	¾	**1**	**1¼**	**1½**	**2**	**2 ½**	**3**	**4**
Actual ID:	**0.622**	**0.824**	**1.049**	**1.380**	**1.610**	**2.067**	**2.469**	**3.068**	**4.026**
Length (ft)	**Capacity in Thousands of Btu per Hour**								
10	454	949	1,790	3,670	5,500	10,600	16,900	29,800	60,800
20	312	652	1,230	2,520	3,780	7,280	11,600	20,500	41,800
30	250	524	986	2,030	3,030	5,840	9,310	16,500	33,600
40	214	448	844	1,730	2,600	5,000	7,970	14,100	28,700
50	190	397	748	1,540	2,300	4,430	7,060	12,500	25,500
60	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100
70	158	331	624	1,280	1,920	3,690	5,890	10,400	21,200

						Gas:	Natural		
						Inlet Pressure:	Less than 2 psi		
						Pressure Drop:	3.0 in. w.c.		
						Specific Gravity:	0.60		
INTENDED USE: Initial supply pressure of 8.0 in. w.c. or greater									
	Pipe Size (in.)								
Nominal:	½	¾	1	1¼	1½	2	2 ½	3	4
Actual ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Thousands of Btu per Hour								
80	147	308	580	1,190	1,790	3,440	5,480	9,690	19,800
90	138	289	544	1,120	1,670	3,230	5,140	9,090	18,500
100	131	273	514	1,060	1,580	3,050	4,860	8,580	17,500
125	116	242	456	936	1,400	2,700	4,300	7,610	15,500
150	105	219	413	848	1,270	2,450	3,900	6,890	14,100
175	96	202	380	780	1,170	2,250	3,590	6,340	12,900
200	90	188	353	726	1,090	2,090	3,340	5,900	12,000
250	80	166	313	643	964	1,860	2,960	5,230	10,700
300	72	151	284	583	873	1,680	2,680	4,740	9,660
350	66	139	261	536	803	1,550	2,470	4,360	8,890
400	62	129	243	499	747	1,440	2,290	4,050	8,270
450	58	121	228	468	701	1,350	2,150	3,800	7,760
500	55	114	215	442	662	1,280	2,030	3,590	7,330
550	52	109	204	420	629	1,210	1,930	3,410	6,960
600	50	104	195	400	600	1,160	1,840	3,260	6,640
650	47	99	187	384	575	1,110	1,760	3,120	6,360
700	46	95	179	368	552	1,060	1,690	3,000	6,110
750	44	92	173	355	532	1,020	1,630	2,890	5,890
800	42	89	167	343	514	989	1,580	2,790	5,680
850	41	86	162	332	497	957	1,530	2,700	5,500
900	40	83	157	322	482	928	1,480	2,610	5,330
950	39	81	152	312	468	901	1,440	2,540	5,180
1000	38	79	148	304	455	877	1,400	2,470	5,040
1100	36	75	141	289	432	833	1,330	2,350	4,780
1200	34	71	134	275	412	794	1,270	2,240	4,560
1300	33	68	128	264	395	761	1,210	2,140	4,370
1400	31	65	123	253	379	731	1,160	2,060	4,200
1500	30	63	119	244	366	704	1,120	1,980	4,050
1600	29	61	115	236	353	680	1,080	1,920	3,910
1700	28	59	111	228	342	658	1,050	1,850	3,780
1800	27	57	108	221	331	638	1,020	1,800	3,670
1900	27	56	105	215	322	619	987	1,750	3,560
2000	26	54	102	209	313	602	960	1,700	3,460

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(d) Schedule 40 Metallic Pipe

						Gas:	Natural		
						Inlet Pressure:	Less than 2 psi		
						Pressure Drop:	6.0 in. w.c.		
						Specific Gravity:	0.6		
INTENDED USE: Initial supply pressure of 11.0 in. w.c. or greater									
	Pipe Size (in.)								
Nominal:	½	¾	1	1¼	1½	2	2½	3	4
Actual ID:	**0.622**	**0.824**	**1.049**	**1.38**	**1.61**	**2.067**	**2.469**	**3.068**	**4.026**
Length (ft)	**Capacity in Cubic Feet of Gas per Hour**								
10	660	1,380	2,600	5,340	8,000	15,400	24,600	43,400	88,500
20	454	949	1,790	3,670	5,500	10,600	16,900	29,800	60,800
30	364	762	1,440	2,950	4,410	8,500	13,600	24,000	48,900
40	312	652	1,230	2,520	3,780	7,280	11,600	20,500	41,800
50	276	578	1,090	2,240	3,350	6,450	10,300	18,200	37,100
60	250	524	986	2,030	3,030	5,840	9,310	16,500	33,600
70	230	482	907	1,860	2,790	5,380	8,570	15,100	30,900
80	214	448	844	1,730	2,600	5,000	7,970	14,100	28,700
90	201	420	792	1,630	2,440	4,690	7,480	13,200	27,000
100	190	397	748	1,540	2,300	4,430	7,060	12,500	25,500
125	168	352	663	1,360	2,040	3,930	6,260	11,100	22,600
150	153	319	601	1,230	1,850	3,560	5,670	10,000	20,500
175	140	293	553	1,140	1,700	3,270	5,220	9,230	18,800
200	131	273	514	1,056	1,580	3,050	4,860	8,580	17,500
250	116	242	456	936	1,400	2,700	4,300	7,610	15,500
300	105	219	413	848	1,270	2,450	3,900	6,890	14,100
350	96	202	380	780	1,170	2,250	3,590	6,340	12,900
400	90	188	353	726	1,090	2,090	3,340	5,900	12,000
450	84	176	332	681	1,020	1,960	3,130	5,540	11,300
500	80	166	313	643	964	1,860	2,960	5,230	10,700
550	76	158	297	611	915	1,760	2,810	4,970	10,100
600	72	151	284	583	873	1,680	2,680	4,740	9,660
650	69	144	272	558	836	1,610	2,570	4,540	9,250
700	66	139	261	536	803	1,550	2,470	4,360	8,890
750	64	134	252	516	774	1,490	2,380	4,200	8,560
800	62	129	243	499	747	1,440	2,290	4,050	8,270
850	60	125	235	483	723	1,390	2,220	3,920	8,000
900	58	121	228	468	701	1,350	2,150	3,800	7,760
950	56	118	221	454	681	1,310	2,090	3,690	7,540
1,000	55	114	215	442	662	1,280	2,030	3,590	7,330
1,100	52	109	204	420	629	1,210	1,930	3,410	6,960
1,200	50	104	195	400	600	1,160	1,840	3,260	6,640
1,300	47	99	187	384	575	1,110	1,760	3,120	6,360

1,400	46	95	179	368	552	1,060	1,690	3,000	6,110
1,500	44	92	173	355	532	1,020	1,630	2,890	5,890
1,600	42	89	167	343	514	989	1,580	2,790	5,680
1,700	41	86	162	332	497	957	1,530	2,700	5,500
1,800	40	83	157	322	482	928	1,480	2,610	5,330
1,900	39	81	152	312	468	901	1,440	2,540	5,180
2,000	38	79	148	304	455	877	1,400	2,470	5,040

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(e) Schedule 40 Metallic Pipe

						Gas:	**Natural**		
						Inlet Pressure:	**2.0 psi**		
						Pressure Drop:	**1.0 psi**		
						Specific Gravity:	**0.60**		
	Pipe Size (in.)								
Nominal:	½	¾	**1**	**1¼**	**1½**	**2**	**2½**	**3**	**4**
Actual ID:	**0.622**	**0.824**	**1.049**	**1.380**	**1.610**	**2.067**	**2.469**	**3.068**	**4.026**
Length (ft)	**Capacity in Cubic Feet of Gas per Hour**								
10	1,510	3,040	5,560	11,400	17,100	32,900	52,500	92,800	189,000
20	1,070	2,150	3,930	8,070	12,100	23,300	37,100	65,600	134,000
30	869	1,760	3,210	6,590	9,880	19,000	30,300	53,600	109,000
40	753	1,520	2,780	5,710	8,550	16,500	26,300	46,400	94,700
50	673	1,360	2,490	5,110	7,650	14,700	23,500	41,500	84,700
60	615	1,240	2,270	4,660	6,980	13,500	21,400	37,900	77,300
70	569	1,150	2,100	4,320	6,470	12,500	19,900	35,100	71,600
80	532	1,080	1,970	4,040	6,050	11,700	18,600	32,800	67,000
90	502	1,010	1,850	3,810	5,700	11,000	17,500	30,900	63,100
100	462	934	1,710	3,510	5,260	10,100	16,100	28,500	58,200
125	414	836	1,530	3,140	4,700	9,060	14,400	25,500	52,100
150	372	751	1,370	2,820	4,220	8,130	13,000	22,900	46,700
175	344	695	1,270	2,601	3,910	7,530	12,000	21,200	43,300
200	318	642	1,170	2,410	3,610	6,960	11,100	19,600	40,000
250	279	583	1,040	2,140	3,210	6,180	9,850	17,400	35,500
300	253	528	945	1,940	2,910	5,600	8,920	15,800	32,200
350	232	486	869	1,790	2,670	5,150	8,210	14,500	29,600
400	216	452	809	1,660	2,490	4,790	7,640	13,500	27,500
450	203	424	759	1,560	2,330	4,500	7,170	12,700	25,800
500	192	401	717	1,470	2,210	4,250	6,770	12,000	24,400
550	182	381	681	1,400	2,090	4,030	6,430	11,400	23,200
600	174	363	650	1,330	2,000	3,850	6,130	10,800	22,100
650	166	348	622	1,280	1,910	3,680	5,870	10,400	21,200
700	160	334	598	1,230	1,840	3,540	5,640	9,970	20,300
750	154	322	576	1,180	1,770	3,410	5,440	9,610	19,600
800	149	311	556	1,140	1,710	3,290	5,250	9,280	18,900

						Gas:	Natural		
						Inlet Pressure:	2.0 psi		
						Pressure Drop:	1.0 psi		
						Specific Gravity:	0.60		
	Pipe Size (in.)								
Nominal:	½	¾	1	1¼	1½	2	2½	3	4
Actual ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Cubic Feet of Gas per Hour								
850	144	301	538	1,100	1,650	3,190	5,080	8,980	18,300
900	139	292	522	1,070	1,600	3,090	4,930	8,710	17,800
950	135	283	507	1,040	1,560	3,000	4,780	8,460	17,200
1,000	132	275	493	1,010	1,520	2,920	4,650	8,220	16,800
1,100	125	262	468	960	1,440	2,770	4,420	7,810	15,900
1,200	119	250	446	917	1,370	2,640	4,220	7,450	15,200
1,300	114	239	427	878	1,320	2,530	4,040	7,140	14,600
1,400	110	230	411	843	1,260	2,430	3,880	6,860	14,000
1,500	106	221	396	812	1,220	2,340	3,740	6,600	13,500
1,600	102	214	382	784	1,180	2,260	3,610	6,380	13,000
1,700	99	207	370	759	1,140	2,190	3,490	6,170	12,600
1,800	96	200	358	736	1,100	2,120	3,390	5,980	12,200
1,900	93	195	348	715	1,070	2,060	3,290	5,810	11,900
2,000	91	189	339	695	1,040	2,010	3,200	5,650	11,500

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(f) Schedule 40 Metallic Pipe

						Gas:	Natural		
						Inlet Pressure:	3.0 psi		
						Pressure Drop:	2.0 psi		
						Specific Gravity:	0.60		
	Pipe Size (in.)								
Nominal:	½	¾	1	1¼	1½	2	2½	3	4
Actual ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Cubic Feet of Gas per Hour								
10	2,350	4,920	9,270	19,000	28,500	54,900	87,500	155,000	316,000
20	1,620	3,380	6,370	13,100	19,600	37,700	60,100	106,000	217,000
30	1,300	2,720	5,110	10,500	15,700	30,300	48,300	85,400	174,000
40	1,110	2,320	4,380	8,990	13,500	25,900	41,300	73,100	149,000
50	985	2,060	3,880	7,970	11,900	23,000	36,600	64,800	132,000
60	892	1,870	3,520	7,220	10,800	20,800	33,200	58,700	120,000
70	821	1,720	3,230	6,640	9,950	19,200	30,500	54,000	110,000
80	764	1,600	3,010	6,180	9,260	17,800	28,400	50,200	102,000
90	717	1,500	2,820	5,800	8,680	16,700	26,700	47,100	96,100
100	677	1,420	2,670	5,470	8,200	15,800	25,200	44,500	90,800

						Gas:	Natural		
						Inlet Pressure:	3.0 psi		
						Pressure Drop:	2.0 psi		
						Specific Gravity:	0.60		
	Pipe Size (in.)								
Nominal:	½	¾	1	1¼	1½	2	2½	3	4
Actual ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Cubic Feet of Gas per Hour								
125	600	1,250	2,360	4,850	7,270	14,000	22,300	39,500	80,500
150	544	1,140	2,140	4,400	6,590	12,700	20,200	35,700	72,900
175	500	1,050	1,970	4,040	6,060	11,700	18,600	32,900	67,100
200	465	973	1,830	3,760	5,640	10,900	17,300	30,600	62,400
250	412	862	1,620	3,330	5,000	9,620	15,300	27,100	55,300
300	374	781	1,470	3,020	4,530	8,720	13,900	24,600	50,100
350	344	719	1,350	2,780	4,170	8,020	12,800	22,600	46,100
400	320	669	1,260	2,590	3,870	7,460	11,900	21,000	42,900
450	300	627	1,180	2,430	3,640	7,000	11,200	19,700	40,200
500	283	593	1,120	2,290	3,430	6,610	10,500	18,600	38,000
550	269	563	1,060	2,180	3,260	6,280	10,000	17,700	36,100
600	257	537	1,010	2,080	3,110	5,990	9,550	16,900	34,400
650	246	514	969	1,990	2,980	5,740	9,150	16,200	33,000
700	236	494	931	1,910	2,860	5,510	8,790	15,500	31,700
750	228	476	897	1,840	2,760	5,310	8,470	15,000	30,500
800	220	460	866	1,780	2,660	5,130	8,180	14,500	29,500
850	213	445	838	1,720	2,580	4,960	7,910	14,000	28,500
900	206	431	812	1,670	2,500	4,810	7,670	13,600	27,700
950	200	419	789	1,620	2,430	4,670	7,450	13,200	26,900
1,000	195	407	767	1,580	2,360	4,550	7,240	12,800	26,100
1,100	185	387	729	1,500	2,240	4,320	6,890	12,200	24,800
1,200	177	369	695	1,430	2,140	4,120	6,570	11,600	23,700
1,300	169	353	666	1,370	2,050	3,940	6,290	11,100	22,700
1,400	162	340	640	1,310	1,970	3,790	6,040	10,700	21,800
1,500	156	327	616	1,270	1,900	3,650	5,820	10,300	21,000
1,600	151	316	595	1,220	1,830	3,530	5,620	10,000	20,300
1,700	146	306	576	1,180	1,770	3,410	5,440	9,610	19,600
1,800	142	296	558	1,150	1,720	3,310	5,270	9,320	19,000
1,900	138	288	542	1,110	1,670	3,210	5,120	9,050	18,400
2,000	134	280	527	1,080	1,620	3,120	4,980	8,800	18,000

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(g) Schedule 40 Metallic Pipe

						Gas:	Natural		
						Inlet Pressure:	5.0 psi		
						Pressure Drop:	3.5 psi		
						Specific Gravity:	0.60		
	Pipe Size (in.)								
Nominal:	½	¾	1	1¼	1½	2	2½	3	4
Actual ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Cubic Feet of Gas per Hour								
10	3,190	6,430	11,800	24,200	36,200	69,700	111,000	196,000	401,000
20	2,250	4,550	8,320	17,100	25,600	49,300	78,600	139,000	283,000
30	1,840	3,720	6,790	14,000	20,900	40,300	64,200	113,000	231,000
40	1,590	3,220	5,880	12,100	18,100	34,900	55,600	98,200	200,000
50	1,430	2,880	5,260	10,800	16,200	31,200	49,700	87,900	179,000
60	1,300	2,630	4,800	9,860	14,800	28,500	45,400	80,200	164,000
70	1,200	2,430	4,450	9,130	13,700	26,400	42,000	74,300	151,000
80	1,150	2,330	4,260	8,540	12,800	24,700	39,300	69,500	142,000
90	1,060	2,150	3,920	8,050	12,100	23,200	37,000	65,500	134,000
100	979	1,980	3,620	7,430	11,100	21,400	34,200	60,400	123,000
125	876	1,770	3,240	6,640	9,950	19,200	30,600	54,000	110,000
150	786	1,590	2,910	5,960	8,940	17,200	27,400	48,500	98,900
175	728	1,470	2,690	5,520	8,270	15,900	25,400	44,900	91,600
200	673	1,360	2,490	5,100	7,650	14,700	23,500	41,500	84,700
250	558	1,170	2,200	4,510	6,760	13,000	20,800	36,700	74,900
300	506	1,060	1,990	4,090	6,130	11,800	18,800	33,300	67,800
350	465	973	1,830	3,760	5,640	10,900	17,300	30,600	62,400
400	433	905	1,710	3,500	5,250	10,100	16,100	28,500	58,100
450	406	849	1,600	3,290	4,920	9,480	15,100	26,700	54,500
500	384	802	1,510	3,100	4,650	8,950	14,300	25,200	51,500
550	364	762	1,440	2,950	4,420	8,500	13,600	24,000	48,900
600	348	727	1,370	2,810	4,210	8,110	12,900	22,900	46,600
650	333	696	1,310	2,690	4,030	7,770	12,400	21,900	44,600
700	320	669	1,260	2,590	3,880	7,460	11,900	21,000	42,900
750	308	644	1,210	2,490	3,730	7,190	11,500	20,300	41,300
800	298	622	1,170	2,410	3,610	6,940	11,100	19,600	39,900
850	288	602	1,130	2,330	3,490	6,720	10,700	18,900	38,600
900	279	584	1,100	2,260	3,380	6,520	10,400	18,400	37,400
950	271	567	1,070	2,190	3,290	6,330	10,100	17,800	36,400
1,000	264	551	1,040	2,130	3,200	6,150	9,810	17,300	35,400
1,100	250	524	987	2,030	3,030	5,840	9,320	16,500	33,600
1,200	239	500	941	1,930	2,900	5,580	8,890	15,700	32,000
1,300	229	478	901	1,850	2,770	5,340	8,510	15,000	30,700
1,400	220	460	866	1,780	2,660	5,130	8,180	14,500	29,500
1,500	212	443	834	1,710	2,570	4,940	7,880	13,900	28,400
1,600	205	428	806	1,650	2,480	4,770	7,610	13,400	27,400

						Gas:	Natural		
						Inlet Pressure:	5.0 psi		
						Pressure Drop:	3.5 psi		
						Specific Gravity:	0.60		
	Pipe Size (in.)								
Nominal:	½	¾	1	1¼	1½	2	2½	3	4
Actual ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Cubic Feet of Gas per Hour								
1,700	198	414	780	1,600	2,400	4,620	7,360	13,000	26,500
1,800	192	401	756	1,550	2,330	4,480	7,140	12,600	25,700
1,900	186	390	734	1,510	2,260	4,350	6,930	12,300	25,000
2,000	181	379	714	1,470	2,200	4,230	6,740	11,900	24,300

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(h) Semirigid Copper Tubing

								Gas:	Natural	
								Inlet Pressure:	Less than 2 psi	
								Pressure Drop:	0.3 in. w.c.	
								Specific Gravity:	0.60	
		Tube Size (in.)								
Nominal:	K & L:	¼	⅜	½	⅝	¾	1	1¼	1½	2
	ACR:	⅜	½	⅝	¾	⅞	1⅛	1⅜	—	—
Outside:		0.375	0.500	0.625	0.750	0.875	1.125	1.375	1.625	2.125
Inside:*		0.305	0.402	0.527	0.652	0.745	0.995	1.245	1.481	1.959
Length (ft)		Capacity in Cubic Feet of Gas per Hour								
10		20	42	85	148	210	448	806	1,270	2,650
20		14	29	58	102	144	308	554	873	1,820
30		11	23	47	82	116	247	445	701	1,460
40		10	20	40	70	99	211	381	600	1,250
50		NA	17	35	62	88	187	337	532	1,110
60		NA	16	32	56	79	170	306	482	1,000
70		NA	14	29	52	73	156	281	443	924
80		NA	13	27	48	68	145	262	413	859
90		NA	13	26	45	64	136	245	387	806
100		NA	12	24	43	60	129	232	366	761
125		NA	11	22	38	53	114	206	324	675
150		NA	10	20	34	48	103	186	294	612
175		NA	NA	18	31	45	95	171	270	563
200		NA	NA	17	29	41	89	159	251	523

250	NA	NA	15	26	37	78	141	223	464
300	NA	NA	13	23	33	71	128	202	420
350	NA	NA	12	22	31	65	118	186	387
400	NA	NA	11	20	28	61	110	173	360
450	NA	NA	11	19	27	57	103	162	338
500	NA	NA	10	18	25	54	97	153	319
550	NA	NA	NA	17	24	51	92	145	303
600	NA	NA	NA	16	23	49	88	139	289
650	NA	NA	NA	15	22	47	84	133	277
700	NA	NA	NA	15	21	45	81	128	266
750	NA	NA	NA	14	20	43	78	123	256
800	NA	NA	NA	14	20	42	75	119	247
850	NA	NA	NA	13	19	40	73	115	239
900	NA	NA	NA	13	18	39	71	111	232
950	NA	NA	NA	13	18	38	69	108	225
1,000	NA	NA	NA	12	17	37	67	105	219
1,100	NA	NA	NA	12	16	35	63	100	208
1,200	NA	NA	NA	11	16	34	60	95	199
1,300	NA	NA	NA	11	15	32	58	91	190
1,400	NA	NA	NA	10	14	31	56	88	183
1,500	NA	NA	NA	NA	14	30	54	84	176
1,600	NA	NA	NA	NA	13	29	52	82	170
1,700	NA	NA	NA	NA	13	28	50	79	164
1,800	NA	NA	NA	NA	13	27	49	77	159
1,900	NA	NA	NA	NA	12	26	47	74	155
2,000	NA	NA	NA	NA	12	25	46	72	151

NA: A flow of less than 10 cfh.

Note: All table entries are rounded to 3 significant digits.

*Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.

Table 6.2.1(i) Semirigid Copper Tubing

								Gas:	**Natural**	
								Inlet Pressure:	**Less than 2 psi**	
								Pressure Drop:	**0.5 in. w.c.**	
								Specific Gravity:	**0.60**	
		Tube Size (in.)								
Nominal:	**K & L:**	¼	⅜	½	⅝	¾	**1**	**1¼**	**1½**	**2**
	ACR:	⅜	½	⅝	¾	⅞	**1⅛**	**1⅜**	**—**	**—**
Outside:		**0.375**	**0.500**	**0.625**	**0.750**	**0.875**	**1.125**	**1.375**	**1.625**	**2.125**
Inside:*		**0.305**	**0.402**	**0.527**	**0.652**	**0.745**	**0.995**	**1.245**	**1.481**	**1.959**
Length (ft)		**Capacity in Cubic Feet of Gas per Hour**								
10		27	55	111	195	276	590	1,060	1,680	3,490

20	18	38	77	134	190	406	730	1,150	2,400
30	15	30	61	107	152	326	586	925	1,930
40	13	26	53	92	131	279	502	791	1,650
50	11	23	47	82	116	247	445	701	1,460
60	10	21	42	74	105	224	403	635	1,320
70	NA	19	39	68	96	206	371	585	1,220
80	NA	18	36	63	90	192	345	544	1,130
90	NA	17	34	59	84	180	324	510	1,060
100	NA	16	32	56	79	170	306	482	1,000
125	NA	14	28	50	70	151	271	427	890
150	NA	13	26	45	64	136	245	387	806
175	NA	12	24	41	59	125	226	356	742
200	NA	11	22	39	55	117	210	331	690
250	NA	NA	20	34	48	103	186	294	612
300	NA	NA	18	31	44	94	169	266	554
350	NA	NA	16	28	40	86	155	245	510
400	NA	NA	15	26	38	80	144	228	474
450	NA	NA	14	25	35	75	135	214	445
500	NA	NA	13	23	33	71	128	202	420
550	NA	NA	13	22	32	68	122	192	399
600	NA	NA	12	21	30	64	116	183	381
650	NA	NA	12	20	29	62	111	175	365
700	NA	NA	11	20	28	59	107	168	350
750	NA	NA	11	19	27	57	103	162	338
800	NA	NA	10	18	26	55	99	156	326
850	NA	NA	10	18	25	53	96	151	315
900	NA	NA	NA	17	24	52	93	147	306
950	NA	NA	NA	17	24	50	90	143	297
1,000	NA	NA	NA	16	23	49	88	139	289
1,100	NA	NA	NA	15	22	46	84	132	274
1,200	NA	NA	NA	15	21	44	80	126	262
1,300	NA	NA	NA	14	20	42	76	120	251
1,400	NA	NA	NA	13	19	41	73	116	241
1,500	NA	NA	NA	13	18	39	71	111	232
1,600	NA	NA	NA	13	18	38	68	108	224
1,700	NA	NA	NA	12	17	37	66	104	217
1,800	NA	NA	NA	12	17	36	64	101	210
1,900	NA	NA	NA	11	16	35	62	98	204
2,000	NA	NA	NA	11	16	34	60	95	199

NA: A flow of less than 10 cfh.

Note: All table entries are rounded to 3 significant digits.

*Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.

Table 6.2.1(j) Semirigid Copper Tubing

Gas:	Natural
Inlet Pressure:	Less than 2 psi
Pressure Drop:	1.0 in. w.c.
Specific Gravity:	0.60

INTENDED USE: Tube Sizing Between House Line Regulator and the Appliance.

Nominal:		Tube Size (in.)								
	K & L:	¼	⅜	½	⅝	¾	1	1¼	1½	2
	ACR:	⅜	½	⅝	¾	⅞	1⅛	1⅜	—	—
Outside:		0.375	0.500	0.625	0.750	0.875	1.125	1.375	1.625	2.125
Inside:*		0.305	0.402	0.527	0.652	0.745	0.995	1.245	1.481	1.959
Length (ft)		Capacity in Cubic Feet of Gas per Hour								
10		39	80	162	283	402	859	1,550	2,440	5,080
20		27	55	111	195	276	590	1,060	1,680	3,490
30		21	44	89	156	222	474	853	1,350	2,800
40		18	38	77	134	190	406	730	1,150	2,400
50		16	33	68	119	168	359	647	1,020	2,130
60		15	30	61	107	152	326	586	925	1,930
70		13	28	57	99	140	300	539	851	1,770
80		13	26	53	92	131	279	502	791	1,650
90		12	24	49	86	122	262	471	742	1,550
100		11	23	47	82	116	247	445	701	1,460
125		NA	20	41	72	103	219	394	622	1,290
150		NA	18	37	65	93	198	357	563	1,170
175		NA	17	34	60	85	183	329	518	1,080
200		NA	16	32	56	79	170	306	482	1,000
250		NA	14	28	50	70	151	271	427	890
300		NA	13	26	45	64	136	245	387	806
350		NA	12	24	41	59	125	226	356	742
400		NA	11	22	39	55	117	210	331	690
450		NA	10	21	36	51	110	197	311	647
500		NA	NA	20	34	48	103	186	294	612
550		NA	NA	19	32	46	98	177	279	581
600		NA	NA	18	31	44	94	169	266	554
650		NA	NA	17	30	42	90	162	255	531
700		NA	NA	16	28	40	86	155	245	510
750		NA	NA	16	27	39	83	150	236	491
800		NA	NA	15	26	38	80	144	228	474
850		NA	NA	15	26	36	78	140	220	459
900		NA	NA	14	25	35	75	135	214	445
950		NA	NA	14	24	34	73	132	207	432
1,000		NA	NA	13	23	33	71	128	202	420
1,100		NA	NA	13	22	32	68	122	192	399
1,200		NA	NA	12	21	30	64	116	183	381

1,300	NA	NA	12	20	29	62	111	175	365
1,400	NA	NA	11	20	28	59	107	168	350
1,500	NA	NA	11	19	27	57	103	162	338
1,600	NA	NA	10	18	26	55	99	156	326
1,700	NA	NA	10	18	25	53	96	151	315
1,800	NA	NA	NA	17	24	52	93	147	306
1,900	NA	NA	NA	17	24	50	90	143	297
2,000	NA	NA	NA	16	23	49	88	139	289

NA: A flow of less than 10 cfh.

Note: All table entries are rounded to 3 significant digits.

*Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.

Table 6.2.1(k) Semirigid Copper Tubing

							Gas:	**Natural**	
							Inlet Pressure:	**Less than 2.0 psi**	
							Pressure Drop:	**17.0 in. w.c.**	
							Specific Gravity:	**0.60**	
		Tube Size (in.)							
Nominal:	**K & L:**	¼	⅜	½	⅝	¾	**1**	**1¼**	**1½**	**2**
	ACR:	⅜	½	⅝	¾	⅞	**1⅛**	**1⅜**	—	—
Outside:		**0.375**	**0.500**	**0.625**	**0.750**	**0.875**	**1.125**	**1.375**	**1.625**	**2.125**
Inside:*		**0.305**	**0.402**	**0.527**	**0.652**	**0.745**	**0.995**	**1.245**	**1.481**	**1.959**
Length (ft)		**Capacity in Cubic Feet of Gas per Hour**								
10		190	391	796	1,390	1,970	4,220	7,590	12,000	24,900
20		130	269	547	956	1,360	2,900	5,220	8,230	17,100
30		105	216	439	768	1,090	2,330	4,190	6,610	13,800
40		90	185	376	657	932	1,990	3,590	5,650	11,800
50		79	164	333	582	826	1,770	3,180	5,010	10,400
60		72	148	302	528	749	1,600	2,880	4,540	9,460
70		66	137	278	486	689	1,470	2,650	4,180	8,700
80		62	127	258	452	641	1,370	2,460	3,890	8,090
90		58	119	243	424	601	1,280	2,310	3,650	7,590
100		55	113	229	400	568	1,210	2,180	3,440	7,170
125		48	100	203	355	503	1,080	1,940	3,050	6,360
150		44	90	184	321	456	974	1,750	2,770	5,760
175		40	83	169	296	420	896	1,610	2,540	5,300
200		38	77	157	275	390	834	1,500	2,370	4,930
250		33	69	140	244	346	739	1,330	2,100	4,370
300		30	62	126	221	313	670	1,210	1,900	3,960
350		28	57	116	203	288	616	1,110	1,750	3,640
400		26	53	108	189	268	573	1,030	1,630	3,390
450		24	50	102	177	252	538	968	1,530	3,180
500		23	47	96	168	238	508	914	1,440	3,000

550	22	45	91	159	226	482	868	1,370	2,850
600	21	43	87	152	215	460	829	1,310	2,720
650	20	41	83	145	206	441	793	1,250	2,610
700	19	39	80	140	198	423	762	1,200	2,500
750	18	38	77	135	191	408	734	1,160	2,410
800	18	37	74	130	184	394	709	1,120	2,330
850	17	35	72	126	178	381	686	1,080	2,250
900	17	34	70	122	173	370	665	1,050	2,180
950	16	33	68	118	168	359	646	1,020	2,120
1,000	16	32	66	115	163	349	628	991	2,060
1,100	15	31	63	109	155	332	597	941	1,960
1,200	14	29	60	104	148	316	569	898	1,870
1,300	14	28	57	100	142	303	545	860	1,790
1,400	13	27	55	96	136	291	524	826	1,720
1,500	13	26	53	93	131	280	505	796	1,660
1,600	12	25	51	89	127	271	487	768	1,600
1,700	12	24	49	86	123	262	472	744	1,550
1,800	11	24	48	84	119	254	457	721	1,500
1,900	11	23	47	81	115	247	444	700	1,460
2,000	11	22	45	79	112	240	432	681	1,420

Note: All table entries are rounded to 3 significant digits.

*Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.

Table 6.2.1(l) Semirigid Copper Tubing

								Gas:	**Natural**	
								Inlet Pressure:	**2.0 psi**	
								Pressure Drop:	**1.0 psi**	
								Specific Gravity:	**0.60**	
		Tube Size (in.)								
Nominal:	**K & L:**	¼	⅜	½	⅝	¾	**1**	**1¼**	**1½**	**2**
	ACR:	⅜	½	⅝	¾	⅞	**1⅛**	**1⅜**	**—**	**—**
Outside:		**0.375**	**0.500**	**0.625**	**0.750**	**0.875**	**1.125**	**1.375**	**1.625**	**2.125**
Inside:*		**0.305**	**0.402**	**0.527**	**0.652**	**0.745**	**0.995**	**1.245**	**1.481**	**1.959**
Length (ft)		**Capacity in Cubic Feet of Gas per Hour**								
10		245	506	1,030	1,800	2,550	5,450	9,820	15,500	32,200
20		169	348	708	1,240	1,760	3,750	6,750	10,600	22,200
30		135	279	568	993	1,410	3,010	5,420	8,550	17,800
40		116	239	486	850	1,210	2,580	4,640	7,310	15,200
50		103	212	431	754	1,070	2,280	4,110	6,480	13,500
60		93	192	391	683	969	2,070	3,730	5,870	12,200
70		86	177	359	628	891	1,900	3,430	5,400	11,300
80		80	164	334	584	829	1,770	3,190	5,030	10,500
90		75	154	314	548	778	1,660	2,990	4,720	9,820

100	71	146	296	518	735	1,570	2,830	4,450	9,280
125	63	129	263	459	651	1,390	2,500	3,950	8,220
150	57	117	238	416	590	1,260	2,270	3,580	7,450
175	52	108	219	383	543	1,160	2,090	3,290	6,850
200	49	100	204	356	505	1,080	1,940	3,060	6,380
250	43	89	181	315	448	956	1,720	2,710	5,650
300	39	80	164	286	406	866	1,560	2,460	5,120
350	36	74	150	263	373	797	1,430	2,260	4,710
400	33	69	140	245	347	741	1,330	2,100	4,380
450	31	65	131	230	326	696	1,250	1,970	4,110
500	30	61	124	217	308	657	1,180	1,870	3,880
550	28	58	118	206	292	624	1,120	1,770	3,690
600	27	55	112	196	279	595	1,070	1,690	3,520
650	26	53	108	188	267	570	1,030	1,620	3,370
700	25	51	103	181	256	548	986	1,550	3,240
750	24	49	100	174	247	528	950	1,500	3,120
800	23	47	96	168	239	510	917	1,450	3,010
850	22	46	93	163	231	493	888	1,400	2,920
900	22	44	90	158	224	478	861	1,360	2,830
950	21	43	88	153	217	464	836	1,320	2,740
1,000	20	42	85	149	211	452	813	1,280	2,670
1,100	19	40	81	142	201	429	772	1,220	2,540
1,200	18	38	77	135	192	409	737	1,160	2,420
1,300	18	36	74	129	183	392	705	1,110	2,320
1,400	17	35	71	124	176	376	678	1,070	2,230
1,500	16	34	68	120	170	363	653	1,030	2,140
1,600	16	33	66	116	164	350	630	994	2,070
1,700	15	31	64	112	159	339	610	962	2,000
1,800	15	30	62	108	154	329	592	933	1,940
1,900	14	30	60	105	149	319	575	906	1,890
2,000	14	29	59	102	145	310	559	881	1,830

Note: All table entries are rounded to 3 significant digits.

*Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.

Table 6.2.1(m) Semirigid Copper Tubing

Gas:	Natural
Inlet Pressure:	2.0 psi
Pressure Drop:	1.5 psi
Specific Gravity:	0.60

INTENDED USE: Pipe Sizing Between Point of Delivery and the House Line Regulator. Total Load Supplied by a Single House Line Regulator Not Exceeding 150 Cubic Feet per Hour.*

Nominal:	Tube Size (in.)								
K & L:	¼	⅜	½	⅝	¾	1	1¼	1½	2
ACR:	⅜	½	⅝	¾	⅞	1⅛	1⅜	—	—
Outside:	0.375	0.500	0.625	0.750	0.875	1.125	1.375	1.625	2.125
Inside:†	0.305	0.402	0.527	0.652	0.745	0.995	1.245	1.481	1.959
Length (ft)	Capacity in Cubic Feet of Gas per Hour								
10	303	625	1,270	2,220	3,150	6,740	12,100	19,100	39,800
20	208	430	874	1,530	2,170	4,630	8,330	13,100	27,400
30	167	345	702	1,230	1,740	3,720	6,690	10,600	22,000
40	143	295	601	1,050	1,490	3,180	5,730	9,030	18,800
50	127	262	532	931	1,320	2,820	5,080	8,000	16,700
60	115	237	482	843	1,200	2,560	4,600	7,250	15,100
70	106	218	444	776	1,100	2,350	4,230	6,670	13,900
80	98	203	413	722	1,020	2,190	3,940	6,210	12,900
90	92	190	387	677	961	2,050	3,690	5,820	12,100
100	87	180	366	640	907	1,940	3,490	5,500	11,500
125	77	159	324	567	804	1,720	3,090	4,880	10,200
150	70	144	294	514	729	1,560	2,800	4,420	9,200
175	64	133	270	472	670	1,430	2,580	4,060	8,460
200	60	124	252	440	624	1,330	2,400	3,780	7,870
250	53	110	223	390	553	1,180	2,130	3,350	6,980
300	48	99	202	353	501	1,070	1,930	3,040	6,320
350	44	91	186	325	461	984	1,770	2,790	5,820
400	41	85	173	302	429	916	1,650	2,600	5,410
450	39	80	162	283	402	859	1,550	2,440	5,080
500	36	75	153	268	380	811	1,460	2,300	4,800
550	35	72	146	254	361	771	1,390	2,190	4,560
600	33	68	139	243	344	735	1,320	2,090	4,350
650	32	65	133	232	330	704	1,270	2,000	4,160
700	30	63	128	223	317	676	1,220	1,920	4,000
750	29	60	123	215	305	652	1,170	1,850	3,850
800	28	58	119	208	295	629	1,130	1,790	3,720
850	27	57	115	201	285	609	1,100	1,730	3,600
900	27	55	111	195	276	590	1,060	1,680	3,490
950	26	53	108	189	268	573	1,030	1,630	3,390
1,000	25	52	105	184	261	558	1,000	1,580	3,300

1,100	24	49	100	175	248	530	954	1,500	3,130
1,200	23	47	95	167	237	505	910	1,430	2,990
1,300	22	45	91	160	227	484	871	1,370	2,860
1,400	21	43	88	153	218	465	837	1,320	2,750
1,500	20	42	85	148	210	448	806	1,270	2,650
1,600	19	40	82	143	202	432	779	1,230	2,560
1,700	19	39	79	138	196	419	753	1,190	2,470
1,800	18	38	77	134	190	406	731	1,150	2,400
1,900	18	37	74	130	184	394	709	1,120	2,330
2,000	17	36	72	126	179	383	690	1,090	2,270

Note: All table entries are rounded to 3 significant digits.

*When this table is used to size the tubing upstream of a line pressure regulator, the pipe or tubing downstream of the line pressure regulator shall be sized using a pressure drop no greater than 1 in. w.c.

†Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.

Table 6.2.1(n) Semirigid Copper Tubing

								Gas:	**Natural**	
								Inlet Pressure:	**5.0 psi**	
								Pressure Drop:	**3.5 psi**	
								Specific Gravity:	**0.60**	
		Tube Size (in.)								
Nominal:	**K & L:**	¼	⅜	½	⅝	¾	**1**	**1¼**	**1½**	**2**
	ACR:	⅜	½	⅝	¾	⅞	**1⅛**	**1⅜**	—	—
Outside:		**0.375**	**0.500**	**0.625**	**0.750**	**0.875**	**1.125**	**1.375**	**1.625**	**2.125**
Inside:*		**0.305**	**0.402**	**0.527**	**0.652**	**0.745**	**0.995**	**1.245**	**1.481**	**1.959**
Length (ft)		**Capacity in Cubic Feet of Gas per Hour**								
10		511	1,050	2,140	3,750	5,320	11,400	20,400	32,200	67,100
20		351	724	1,470	2,580	3,650	7,800	14,000	22,200	46,100
30		282	582	1,180	2,070	2,930	6,270	11,300	17,800	37,000
40		241	498	1,010	1,770	2,510	5,360	9,660	15,200	31,700
50		214	441	898	1,570	2,230	4,750	8,560	13,500	28,100
60		194	400	813	1,420	2,020	4,310	7,750	12,200	25,500
70		178	368	748	1,310	1,860	3,960	7,130	11,200	23,400
80		166	342	696	1,220	1,730	3,690	6,640	10,500	21,800
90		156	321	653	1,140	1,620	3,460	6,230	9,820	20,400
100		147	303	617	1,080	1,530	3,270	5,880	9,270	19,300
125		130	269	547	955	1,360	2,900	5,210	8,220	17,100
150		118	243	495	866	1,230	2,620	4,720	7,450	15,500
175		109	224	456	796	1,130	2,410	4,350	6,850	14,300
200		101	208	424	741	1,050	2,250	4,040	6,370	13,300
250		90	185	376	657	932	1,990	3,580	5,650	11,800
300		81	167	340	595	844	1,800	3,250	5,120	10,700

350	75	154	313	547	777	1,660	2,990	4,710	9,810
400	69	143	291	509	722	1,540	2,780	4,380	9,120
450	65	134	273	478	678	1,450	2,610	4,110	8,560
500	62	127	258	451	640	1,370	2,460	3,880	8,090
550	58	121	245	429	608	1,300	2,340	3,690	7,680
600	56	115	234	409	580	1,240	2,230	3,520	7,330
650	53	110	224	392	556	1,190	2,140	3,370	7,020
700	51	106	215	376	534	1,140	2,050	3,240	6,740
750	49	102	207	362	514	1,100	1,980	3,120	6,490
800	48	98	200	350	497	1,060	1,910	3,010	6,270
850	46	95	194	339	481	1,030	1,850	2,910	6,070
900	45	92	188	328	466	1,000	1,790	2,820	5,880
950	43	90	182	319	452	967	1,740	2,740	5,710
1,000	42	87	177	310	440	940	1,690	2,670	5,560
1,100	40	83	169	295	418	893	1,610	2,530	5,280
1,200	38	79	161	281	399	852	1,530	2,420	5,040
1,300	37	76	154	269	382	816	1,470	2,320	4,820
1,400	35	73	148	259	367	784	1,410	2,220	4,630
1,500	34	70	143	249	353	755	1,360	2,140	4,460
1,600	33	68	138	241	341	729	1,310	2,070	4,310
1,700	32	65	133	233	330	705	1,270	2,000	4,170
1,800	31	63	129	226	320	684	1,230	1,940	4,040
1,900	30	62	125	219	311	664	1,200	1,890	3,930
2,000	29	60	122	213	302	646	1,160	1,830	3,820

Note: All table entries are rounded to 3 significant digits.

*Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.

Table 6.2.1(o) Corrugated Stainless Steel Tubing (CSST)

Gas:	**Natural**
Inlet Pressure:	**Less than 2 psi**
Pressure Drop:	**0.5 in. w.c.**
Specific Gravity:	**0.60**

	Tube Size (EHD)													
Flow Designation:	**13**	**15**	**18**	**19**	**23**	**25**	**30**	**31**	**37**	**39**	**46**	**48**	**60**	**62**
Length (ft)	**Capacity in Cubic Feet of Gas per Hour**													
5	46	63	115	134	225	270	471	546	895	1,037	1,790	2,070	3,660	4,140
10	32	44	82	95	161	192	330	383	639	746	1,260	1,470	2,600	2,930
15	25	35	66	77	132	157	267	310	524	615	1,030	1,200	2,140	2,400
20	22	31	58	67	116	137	231	269	456	536	888	1,050	1,850	2,080
25	19	27	52	60	104	122	206	240	409	482	793	936	1,660	1,860

														Gas:	Natural
														Inlet Pressure:	Less than 2 psi
														Pressure Drop:	0.5 in. w.c.
														Specific Gravity:	0.60

	Tube Size (EHD)													
Flow Designation:	13	15	18	19	23	25	30	31	37	39	46	48	60	62
Length (ft)	Capacity in Cubic Feet of Gas per Hour													
30	18	25	47	55	96	112	188	218	374	442	723	856	1,520	1,700
40	15	21	41	47	83	97	162	188	325	386	625	742	1,320	1,470
50	13	19	37	42	75	87	144	168	292	347	559	665	1,180	1,320
60	12	17	34	38	68	80	131	153	267	318	509	608	1,080	1,200
70	11	16	31	36	63	74	121	141	248	295	471	563	1,000	1,110
80	10	15	29	33	60	69	113	132	232	277	440	527	940	1,040
90	10	14	28	32	57	65	107	125	219	262	415	498	887	983
100	9	13	26	30	54	62	101	118	208	249	393	472	843	933
150	7	10	20	23	42	48	78	91	171	205	320	387	691	762
200	6	9	18	21	38	44	71	82	148	179	277	336	600	661
250	5	8	16	19	34	39	63	74	133	161	247	301	538	591
300	5	7	15	17	32	36	57	67	95	148	226	275	492	540

EHD: Equivalent hydraulic diameter. A measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.

Notes:

(1) Table includes losses for four 90 degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fittings shall be increased by an equivalent length of tubing to the following equation: $L = 1.3n$, where L is additional length (ft) of tubing and n is the number of additional fittings and/or bends.

(2) All table entries are rounded to 3 significant digits.

Table 6.2.1(p) Corrugated Stainless Steel Tubing (CSST)

														Gas:	Natural
														Inlet Pressure:	Less than 2 psi
														Pressure Drop:	3.0 in. w.c.
														Specific Gravity:	0.60

INTENDED USE: Initial Supply Pressure of 8.0 in. w.c. or Greater.

	Tube Size (EHD)													
Flow Designation:	13	15	18	19	23	25	30	31	37	39	46	48	60	62
Length (ft)	Capacity in Cubic Feet of Gas per Hour													
5	120	160	277	327	529	649	1,180	1,370	2,140	2423	4,430	5,010	8,800	10,100

10	83	112	197	231	380	462	828	958	1,530	1740	3,200	3,560	6,270	7,160
15	67	90	161	189	313	379	673	778	1,250	1433	2,540	2,910	5,140	5,850
20	57	78	140	164	273	329	580	672	1,090	1249	2,200	2,530	4,460	5,070
25	51	69	125	147	245	295	518	599	978	1123	1,960	2,270	4,000	4,540
30	46	63	115	134	225	270	471	546	895	1029	1,790	2,070	3,660	4,140
40	39	54	100	116	196	234	407	471	778	897	1,550	1,800	3,180	3,590
50	35	48	89	104	176	210	363	421	698	806	1,380	1,610	2,850	3,210
60	32	44	82	95	161	192	330	383	639	739	1,260	1,470	2,600	2,930
70	29	41	76	88	150	178	306	355	593	686	1,170	1,360	2,420	2,720
80	27	38	71	82	141	167	285	331	555	644	1,090	1,280	2,260	2,540
90	26	36	67	77	133	157	268	311	524	609	1,030	1,200	2,140	2,400
100	24	34	63	73	126	149	254	295	498	579	974	1,140	2,030	2,280
150	19	27	52	60	104	122	206	240	409	477	793	936	1,660	1,860
200	17	23	45	52	91	106	178	207	355	415	686	812	1,440	1,610
250	15	21	40	46	82	95	159	184	319	373	613	728	1,290	1,440
300	13	19	37	42	75	87	144	168	234	342	559	665	1,180	1,320

EHD: Equivalent hydraulic diameter. A measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.

Notes:

(1) Table includes losses for four 90 degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fittings shall be increased by an equivalent length of tubing to the following equation: $L = 1.3n$, where L is additional length (ft) of tubing and n is the number of additional fittings and/or bends.

(2) All table entries are rounded to 3 significant digits.

Table 6.2.1(q) Corrugated Stainless Steel Tubing (CSST)

Gas:	**Natural**
Inlet Pressure:	**Less than 2 psi**
Pressure Drop:	**6.0 in. w.c.**
Specific Gravity:	**0.60**

INTENDED USE: Initial Supply Pressure of 11.0 in. w.c. or Greater.

	Tube Size (EHD)													
Flow Designation:	**13**	**15**	**18**	**19**	**23**	**25**	**30**	**31**	**37**	**39**	**46**	**48**	**60**	**62**
Length (ft)	**Capacity in Cubic Feet of Gas per Hour**													
5	173	229	389	461	737	911	1,690	1,950	3,000	3375	6,280	7,050	12,400	14,260
10	120	160	277	327	529	649	1,180	1,370	2,140	2423	4,430	5,010	8,800	10,100
15	96	130	227	267	436	532	960	1,110	1,760	1996	3,610	4,100	7,210	8,260
20	83	112	197	231	380	462	828	958	1,530	1740	3,120	3,560	6,270	7,160
25	74	99	176	207	342	414	739	855	1,370	1564	2,790	3,190	5,620	6,400
30	67	90	161	189	313	379	673	778	1,250	1433	2,540	2,910	5,140	5,850
40	57	78	140	164	273	329	580	672	1,090	1249	2,200	2,530	4,460	5,070
50	51	69	125	147	245	295	518	599	978	1123	1,960	2,270	4,000	4,540

60	46	63	115	134	225	270	471	546	895	1029	1,790	2,070	3,660	4,140
70	42	58	106	124	209	250	435	505	830	956	1,660	1,920	3,390	3,840
80	39	54	100	116	196	234	407	471	778	897	1,550	1,800	3,180	3,590
90	37	51	94	109	185	221	383	444	735	848	1,460	1,700	3,000	3,390
100	35	48	89	104	176	210	363	421	698	806	1,380	1,610	2,850	3,210
150	28	39	73	85	145	172	294	342	573	664	1,130	1,320	2,340	2,630
200	24	34	63	73	126	149	254	295	498	579	974	1,140	2,030	2,280
250	21	30	57	66	114	134	226	263	447	520	870	1,020	1,820	2,040
300	19	27	52	60	104	122	206	240	409	477	793	936	1,660	1,860

EHD: Equivalent hydraulic diameter. A measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.

Notes:

(1) Table includes losses for four 90 degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fittings shall be increased by an equivalent length of tubing to the following equation: $L = 1.3n$, where L is additional length (ft) of tubing and n is the number of additional fittings and/or bends.

(2) All table entries are rounded to 3 significant digits.

Table 6.2.1(r) Corrugated Stainless Steel Tubing (CSST)

											Gas:	**Natural**		
											Inlet Pressure:	**2.0 psi**		
											Pressure Drop:	**1.0 psi**		
											Specific Gravity:	**0.60**		
	Tube Size (EHD)													
Flow Designation:	**13**	**15**	**18**	**19**	**23**	**25**	**30**	**31**	**37**	**39**	**46**	**48**	**60**	**62**
Length (ft)	**Capacity in Cubic Feet of Gas per Hour**													
10	270	353	587	700	1,100	1,370	2,590	2,990	4,510	5,037	9,600	10,700	18,600	21,600
25	166	220	374	444	709	876	1,620	1,870	2,890	3,258	6,040	6,780	11,900	13,700
30	151	200	342	405	650	801	1,480	1,700	2,640	2,987	5,510	6,200	10,900	12,500
40	129	172	297	351	567	696	1,270	1,470	2,300	2,605	4,760	5,380	9,440	10,900
50	115	154	266	314	510	624	1,140	1,310	2,060	2,343	4,260	4,820	8,470	9,720
75	93	124	218	257	420	512	922	1,070	1,690	1,932	3,470	3,950	6,940	7,940
80	89	120	211	249	407	496	892	1,030	1,640	1,874	3,360	3,820	6,730	7,690
100	79	107	189	222	366	445	795	920	1,470	1,685	3,000	3,420	6,030	6,880
150	64	87	155	182	302	364	646	748	1,210	1,389	2,440	2,800	4,940	5,620
200	55	75	135	157	263	317	557	645	1,050	1,212	2,110	2,430	4,290	4,870
250	49	67	121	141	236	284	497	576	941	1,090	1,890	2,180	3,850	4,360
300	44	61	110	129	217	260	453	525	862	999	1,720	1,990	3,520	3,980
400	38	52	96	111	189	225	390	453	749	871	1,490	1,730	3,060	3,450
500	34	46	86	100	170	202	348	404	552	783	1,330	1,550	2,740	3,090

EHD: Equivalent hydraulic diameter. A measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.

Notes:

(1) Table does not include effect of pressure drop across the line regulator. Where regulator loss exceeds ¾ psi, do not use this table. Consult with regulator manufacturer for pressure drops and capacity factors. Pressure drops across a regulator may vary with flow rate.

(2) CAUTION: Capacities shown in table may exceed maximum capacity for a selected regulator. Consult with regulator or tubing manufacturer for guidance.

(3) Table includes losses for four 90 degree bends and two end fittings. Tubing runs with larger number of bends and/or fittings shall be increased by an equivalent length of tubing according to the following equation: $L = 1.3n$, where L is additional length (ft) of tubing and n is the number of additional fittings and/or bends.

(4) All table entries are rounded to 3 significant digits.

Table 6.2.1(s) Corrugated Stainless Steel Tubing (CSST)

Gas:	**Natural**
Inlet Pressure:	**5.0 psi**
Pressure Drop:	**3.5 psi**
Specific Gravity:	**0.60**

	Tube Size (EHD)													
Flow Designation:	**13**	**15**	**18**	**19**	**23**	**25**	**30**	**31**	**37**	**39**	**46**	**48**	**60**	
Length (ft)	**Capacity in Cubic Feet of Gas per Hour**													
10	523	674	1,080	1,300	2,000	2,530	4,920	5,660	8,300	9,140	18,100	19,800	34,400	40
25	322	420	691	827	1,290	1,620	3,080	3,540	5,310	5,911	11,400	12,600	22,000	25
30	292	382	632	755	1,180	1,480	2,800	3,230	4,860	5,420	10,400	11,500	20,100	23
40	251	329	549	654	1,030	1,280	2,420	2,790	4,230	4,727	8,970	10,000	17,400	20
50	223	293	492	586	926	1,150	2,160	2,490	3,790	4,251	8,020	8,930	15,600	18
75	180	238	403	479	763	944	1,750	2,020	3,110	3,506	6,530	7,320	12,800	14
80	174	230	391	463	740	915	1,690	1,960	3,020	3,400	6,320	7,090	12,400	14
100	154	205	350	415	665	820	1,510	1,740	2,710	3,057	5,650	6,350	11,100	12
150	124	166	287	339	548	672	1,230	1,420	2,220	2,521	4,600	5,200	9,130	10
200	107	143	249	294	478	584	1,060	1,220	1,930	2,199	3,980	4,510	7,930	9,
250	95	128	223	263	430	524	945	1,090	1,730	1,977	3,550	4,040	7,110	8,
300	86	116	204	240	394	479	860	995	1,590	1,813	3,240	3,690	6,500	7,
400	74	100	177	208	343	416	742	858	1,380	1,581	2,800	3,210	5,650	6,
500	66	89	159	186	309	373	662	766	1,040	1,422	2,500	2,870	5,060	5,

EHD: Equivalent hydraulic diameter. A measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.

Notes:

(1) Table does not include effect of pressure drop across line regulator. Where regulator loss exceeds 1 psi, do not use this table. Consult with regulator manufacturer for pressure drops and capacity factors. Pressure drop across regulator may vary with the flow rate.

(2) CAUTION: Capacities shown in table may exceed maximum capacity of selected regulator. Consult with tubing manufacturer for guidance.

(3) Table includes losses for four 90 degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fittings shall be increased by an equivalent length of tubing to the

following equation: $L = 1.3n$, where L is additional length (ft) of tubing and n is the number of additional fittings and/or bends.

(4) All table entries are rounded to 3 significant digits.

Table 6.2.1(t) Polyethylene Plastic Pipe

			Gas:	**Natural**				
			Inlet Pressure:	**Less than 2 psi**				
			Pressure Drop:	**0.3 in. w.c.**				
			Specific Gravity:	**0.60**				
	Pipe Size (in.)							
Nominal OD:	½	¾	**1**	**1¼**	**1½**	**2**	**3**	**4**
Designation:	**SDR 9.3**	**SDR 11**	**SDR 11**	**SDR 10**	**SDR 11**	**SDR 11**	**SDR 11**	**SDR 11**
Actual ID:	**0.660**	**0.860**	**1.077**	**1.328**	**1.554**	**1.943**	**2.864**	**3.682**
Length (ft)	**Capacity in Cubic Feet of Gas per Hour**							
10	153	305	551	955	1,440	2,590	7,170	13,900
20	105	210	379	656	991	1,780	4,920	9,520
30	84	169	304	527	796	1,430	3,950	7,640
40	72	144	260	451	681	1,220	3,380	6,540
50	64	128	231	400	604	1,080	3,000	5,800
60	58	116	209	362	547	983	2,720	5,250
70	53	107	192	333	503	904	2,500	4,830
80	50	99	179	310	468	841	2,330	4,500
90	46	93	168	291	439	789	2,180	4,220
100	44	88	159	275	415	745	2,060	3,990
125	39	78	141	243	368	661	1,830	3,530
150	35	71	127	221	333	598	1,660	3,200
175	32	65	117	203	306	551	1,520	2,940
200	30	60	109	189	285	512	1,420	2,740
250	27	54	97	167	253	454	1,260	2,430
300	24	48	88	152	229	411	1,140	2,200
350	22	45	81	139	211	378	1,050	2,020
400	21	42	75	130	196	352	974	1,880
450	19	39	70	122	184	330	914	1,770
500	18	37	66	115	174	312	863	1,670

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(u) Polyethylene Plastic Pipe

						Gas:	Natural	
						Inlet Pressure:	Less than 2 psi	
						Pressure Drop:	0.5 in. w.c.	
						Specific Gravity:	0.60	
	Pipe Size (in.)							
Nominal OD:	½	¾	1	1¼	1½	2	3	4
Designation:	SDR 9.3	SDR 11	SDR 11	SDR 10	SDR 11	SDR 11	SDR 11	SDR 11
Actual ID:	0.660	0.860	1.077	1.328	1.554	1.943	2.864	3.682
Length (ft)	Capacity in Cubic Feet of Gas per Hour							
10	201	403	726	1,260	1,900	3,410	9,450	18,260
20	138	277	499	865	1,310	2,350	6,490	12,550
30	111	222	401	695	1,050	1,880	5,210	10,080
40	95	190	343	594	898	1,610	4,460	8,630
50	84	169	304	527	796	1,430	3,950	7,640
60	76	153	276	477	721	1,300	3,580	6,930
70	70	140	254	439	663	1,190	3,300	6,370
80	65	131	236	409	617	1,110	3,070	5,930
90	61	123	221	383	579	1,040	2,880	5,560
100	58	116	209	362	547	983	2,720	5,250
125	51	103	185	321	485	871	2,410	4,660
150	46	93	168	291	439	789	2,180	4,220
175	43	86	154	268	404	726	2,010	3,880
200	40	80	144	249	376	675	1,870	3,610
250	35	71	127	221	333	598	1,660	3,200
300	32	64	115	200	302	542	1,500	2,900
350	29	59	106	184	278	499	1,380	2,670
400	27	55	99	171	258	464	1,280	2,480
450	26	51	93	160	242	435	1,200	2,330
500	24	48	88	152	229	411	1,140	2,200

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(v) Polyethylene Plastic Pipe

						Gas:	Natural	
						Inlet Pressure:	2.0 psi	
						Pressure Drop:	1.0 psi	
						Specific Gravity:	0.60	
	Pipe Size (in.)							
Nominal OD:	½	¾	1	1¼	1½	2	3	3
Designation:	SDR 9.3	SDR 11	SDR 11	SDR 10	SDR 11	SDR 11	SDR 11	SDR 11
Actual ID:	0.660	0.860	1.077	1.328	1.554	1.943	2.864	3.682
Length (ft)	Capacity in Cubic Feet of Gas per Hour							
10	1,860	3,720	6,710	11,600	17,600	31,600	87,300	169,000

			Gas:	Natural				
			Inlet Pressure:	2.0 psi				
			Pressure Drop:	1.0 psi				
			Specific Gravity:	0.60				
	Pipe Size (in.)							
Nominal OD:	½	¾	1	1¼	1½	2	3	3
Designation:	SDR 9.3	SDR 11	SDR 11	SDR 10	SDR 11	SDR 11	SDR 11	SDR 11
Actual ID:	0.660	0.860	1.077	1.328	1.554	1.943	2.864	3.682
Length (ft)	Capacity in Cubic Feet of Gas per Hour							
20	1,280	2,560	4,610	7,990	12,100	21,700	60,000	116,000
30	1,030	2,050	3,710	6,420	9,690	17,400	48,200	93,200
40	878	1,760	3,170	5,490	8,300	14,900	41,200	79,700
50	778	1,560	2,810	4,870	7,350	13,200	36,600	70,700
60	705	1,410	2,550	4,410	6,660	12,000	33,100	64,000
70	649	1,300	2,340	4,060	6,130	11,000	30,500	58,900
80	603	1,210	2,180	3,780	5,700	10,200	28,300	54,800
90	566	1,130	2,050	3,540	5,350	9,610	26,600	51,400
100	535	1,070	1,930	3,350	5,050	9,080	25,100	48,600
125	474	949	1,710	2,970	4,480	8,050	22,300	43,000
150	429	860	1,550	2,690	4,060	7,290	20,200	39,000
175	395	791	1,430	2,470	3,730	6,710	18,600	35,900
200	368	736	1,330	2,300	3,470	6,240	17,300	33,400
250	326	652	1,180	2,040	3,080	5,530	15,300	29,600
300	295	591	1,070	1,850	2,790	5,010	13,900	26,800
350	272	544	981	1,700	2,570	4,610	12,800	24,700
400	253	506	913	1,580	2,390	4,290	11,900	22,900
450	237	475	856	1,480	2,240	4,020	11,100	21,500
500	224	448	809	1,400	2,120	3,800	10,500	20,300
550	213	426	768	1,330	2,010	3,610	9,990	19,300
600	203	406	733	1,270	1,920	3,440	9,530	18,400
650	194	389	702	1,220	1,840	3,300	9,130	17,600
700	187	374	674	1,170	1,760	3,170	8,770	16,900
750	180	360	649	1,130	1,700	3,050	8,450	16,300
800	174	348	627	1,090	1,640	2,950	8,160	15,800
850	168	336	607	1,050	1,590	2,850	7,890	15,300
900	163	326	588	1,020	1,540	2,770	7,650	14,800
950	158	317	572	990	1,500	2,690	7,430	14,400
1,000	154	308	556	963	1,450	2,610	7,230	14,000
1,100	146	293	528	915	1,380	2,480	6,870	13,300
1,200	139	279	504	873	1,320	2,370	6,550	12,700
1,300	134	267	482	836	1,260	2,270	6,270	12,100
1,400	128	257	463	803	1,210	2,180	6,030	11,600
1,500	124	247	446	773	1,170	2,100	5,810	11,200

			Gas:	Natural				
			Inlet Pressure:	2.0 psi				
			Pressure Drop:	1.0 psi				
			Specific Gravity:	0.60				
	Pipe Size (in.)							
Nominal OD:	½	¾	1	1¼	1½	2	3	3
Designation:	SDR 9.3	SDR 11	SDR 11	SDR 10	SDR 11	SDR 11	SDR 11	SDR 11
Actual ID:	0.660	0.860	1.077	1.328	1.554	1.943	2.864	3.682
Length (ft)	Capacity in Cubic Feet of Gas per Hour							
1,600	119	239	431	747	1,130	2,030	5,610	10,800
1,700	115	231	417	723	1,090	1,960	5,430	10,500
1,800	112	224	404	701	1,060	1,900	5,260	10,200
1,900	109	218	393	680	1,030	1,850	5,110	9,900
2,000	106	212	382	662	1,000	1,800	4,970	9,600

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(w) Polyethylene Plastic Tubing

	Gas:	Natural
	Inlet Pressure:	Less than 2.0 psi
	Pressure Drop:	0.3 in. w.c.
	Specific Gravity:	0.60
	Plastic Tubing Size (CTS) (in.)	
Nominal OD:	½	1
Designation:	SDR 7	SDR 11
Actual ID:	0.445	0.927
Length (ft)	Capacity in Cubic Feet of Gas per Hour	
10	54	372
20	37	256
30	30	205
40	26	176
50	23	156
60	21	141
70	19	130
80	18	121
90	17	113
100	16	107
125	14	95
150	13	86
175	12	79
200	11	74
225	10	69
250	NA	65

	Gas:	Natural
	Inlet Pressure:	Less than 2.0 psi
	Pressure Drop:	0.3 in. w.c.
	Specific Gravity:	0.60
	Plastic Tubing Size (CTS) (in.)	
Nominal OD:	½	1
Designation:	SDR 7	SDR 11
Actual ID:	0.445	0.927
Length (ft)	Capacity in Cubic Feet of Gas per Hour	
275	NA	62
300	NA	59
350	NA	54
400	NA	51
450	NA	47
500	NA	45

CTS: Copper tube size.

NA: A flow of less than 10 cfh.

Note: All table entries are rounded to 3 significant digits.

Table 6.2.1(x) Polyethylene Plastic Tubing

	Gas:	Natural
	Inlet Pressure:	Less than 2.0 psi
	Pressure Drop:	0.5 in. w.c.
	Specific Gravity:	0.60
	Plastic Tubing Size (CTS) (in.)	
Nominal OD:	½	1
Designation:	SDR 7	SDR 11
Actual ID:	0.445	0.927
Length (ft)	Capacity in Cubic Feet of Gas per Hour	
10	72	490
20	49	337
30	39	271
40	34	232
50	30	205
60	27	186
70	25	171
80	23	159
90	22	149
100	21	141
125	18	125
150	17	113
175	15	104

	Gas:	Natural
	Inlet Pressure:	Less than 2.0 psi
	Pressure Drop:	0.5 in. w.c.
	Specific Gravity:	0.60
	Plastic Tubing Size (CTS) (in.)	
Nominal OD:	½	1
Designation:	SDR 7	SDR 11
Actual ID:	0.445	0.927
Length (ft)	Capacity in Cubic Feet of Gas per Hour	
200	14	97
225	13	91
250	12	86
275	11	82
300	11	78
350	10	72
400	NA	67
450	NA	63
500	NA	59

CTS: Copper tube size.

NA: A flow of less than 10 cfh.

Note: All table entries are rounded to 3 significant digits.

6.2.2

Section 6.4 shall be used in conjunction with one of the methods described in 6.1.2 through 6.1.4 for non-corrugated stainless steel tubing.

6.3 Sizing Propane Piping Systems.

Sizing of piping systems shall be in accordance with 6.3.1 or 6.3.2.

6.3.1

Table 6.3.1(a) through Table 6.3.1(m)shall be used in conjunction with one of the methods described in 6.1.2 through 6.1.4 for piping materials other than non-corrugated stainless steel tubing.

Table 6.3.1(a) Schedule 40 Metallic Pipe

Gas:	Undiluted Propane
Inlet Pressure:	10.0 psi
Pressure Drop:	1.0 psi
Specific Gravity:	1.50

INTENDED USE: Pipe Sizing Between First-Stage (High-Pressure) Regulator and Second-Stage (Low-Pressure) Regulator.

	Pipe Size (in.)								
Nominal Inside:	½	¾	1	1¼	1½	2	2 ½	3	4
Actual:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Thousands of Btu per Hour								
10	3,320	6,950	13,100	26,900	40,300	77,600	124,000	219,000	446,000
20	2,280	4,780	9,000	18,500	27,700	53,300	85,000	150,000	306,000
30	1,830	3,840	7,220	14,800	22,200	42,800	68,200	121,000	246,000
40	1,570	3,280	6,180	12,700	19,000	36,600	58,400	103,000	211,000
50	1,390	2,910	5,480	11,300	16,900	32,500	51,700	91,500	187,000
60	1,260	2,640	4,970	10,200	15,300	29,400	46,900	82,900	169,000
70	1,160	2,430	4,570	9,380	14,100	27,100	43,100	76,300	156,000
80	1,080	2,260	4,250	8,730	13,100	25,200	40,100	70,900	145,000
90	1,010	2,120	3,990	8,190	12,300	23,600	37,700	66,600	136,000
100	956	2,000	3,770	7,730	11,600	22,300	35,600	62,900	128,000
125	848	1,770	3,340	6,850	10,300	19,800	31,500	55,700	114,000
150	768	1,610	3,020	6,210	9,300	17,900	28,600	50,500	103,000
175	706	1,480	2,780	5,710	8,560	16,500	26,300	46,500	94,700
200	657	1,370	2,590	5,320	7,960	15,300	24,400	43,200	88,100
250	582	1,220	2,290	4,710	7,060	13,600	21,700	38,300	78,100
300	528	1,100	2,080	4,270	6,400	12,300	19,600	34,700	70,800
350	486	1,020	1,910	3,930	5,880	11,300	18,100	31,900	65,100
400	452	945	1,780	3,650	5,470	10,500	16,800	29,700	60,600
450	424	886	1,670	3,430	5,140	9,890	15,800	27,900	56,800
500	400	837	1,580	3,240	4,850	9,340	14,900	26,300	53,700
550	380	795	1,500	3,070	4,610	8,870	14,100	25,000	51,000
600	363	759	1,430	2,930	4,400	8,460	13,500	23,900	48,600
650	347	726	1,370	2,810	4,210	8,110	12,900	22,800	46,600
700	334	698	1,310	2,700	4,040	7,790	12,400	21,900	44,800
750	321	672	1,270	2,600	3,900	7,500	12,000	21,100	43,100
800	310	649	1,220	2,510	3,760	7,240	11,500	20,400	41,600
850	300	628	1,180	2,430	3,640	7,010	11,200	19,800	40,300
900	291	609	1,150	2,360	3,530	6,800	10,800	19,200	39,100

950	283	592	1,110	2,290	3,430	6,600	10,500	18,600	37,900
1,000	275	575	1,080	2,230	3,330	6,420	10,200	18,100	36,900
1,100	261	546	1,030	2,110	3,170	6,100	9,720	17,200	35,000
1,200	249	521	982	2,020	3,020	5,820	9,270	16,400	33,400
1,300	239	499	940	1,930	2,890	5,570	8,880	15,700	32,000
1,400	229	480	903	1,850	2,780	5,350	8,530	15,100	30,800
1,500	221	462	870	1,790	2,680	5,160	8,220	14,500	29,600
1,600	213	446	840	1,730	2,590	4,980	7,940	14,000	28,600
1,700	206	432	813	1,670	2,500	4,820	7,680	13,600	27,700
1,800	200	419	789	1,620	2,430	4,670	7,450	13,200	26,900
1,900	194	407	766	1,570	2,360	4,540	7,230	12,800	26,100
2,000	189	395	745	1,530	2,290	4,410	7,030	12,400	25,400

Note: All table entries are rounded to 3 significant digits.

Table 6.3.1(b) Schedule 40 Metallic Pipe

Gas:	**Undiluted Propane**
Inlet Pressure:	**10.0 psi**
Pressure Drop:	**3.0 psi**
Specific Gravity:	**1.50**

INTENDED USE: Pipe Sizing Between First-Stage (High-Pressure) Regulator and Second-Stage (Low-Pressure) Regulator.

	Pipe Size (in.)								
Nominal Inside:	½	¾	**1**	**1¼**	**1½**	**2**	**2½**	**3**	**4**
Actual:	**0.622**	**0.824**	**1.049**	**1.380**	**1.610**	**2.067**	**2.469**	**3.068**	**4.026**
Length (ft)	**Capacity in Thousands of Btu per Hour**								
10	5,890	12,300	23,200	47,600	71,300	137,000	219,000	387,000	789,000
20	4,050	8,460	15,900	32,700	49,000	94,400	150,000	266,000	543,000
30	3,250	6,790	12,800	26,300	39,400	75,800	121,000	214,000	436,000
40	2,780	5,810	11,000	22,500	33,700	64,900	103,000	183,000	373,000
50	2,460	5,150	9,710	19,900	29,900	57,500	91,600	162,000	330,000
60	2,230	4,670	8,790	18,100	27,100	52,100	83,000	147,000	299,000
70	2,050	4,300	8,090	16,600	24,900	47,900	76,400	135,000	275,000
80	1,910	4,000	7,530	15,500	23,200	44,600	71,100	126,000	256,000
90	1,790	3,750	7,060	14,500	21,700	41,800	66,700	118,000	240,000
100	1,690	3,540	6,670	13,700	20,500	39,500	63,000	111,000	227,000
125	1,500	3,140	5,910	12,100	18,200	35,000	55,800	98,700	201,000
150	1,360	2,840	5,360	11,000	16,500	31,700	50,600	89,400	182,000
175	1,250	2,620	4,930	10,100	15,200	29,200	46,500	82,300	167,800
200	1,160	2,430	4,580	9,410	14,100	27,200	43,300	76,500	156,100
250	1,030	2,160	4,060	8,340	12,500	24,100	38,400	67,800	138,400
300	935	1,950	3,680	7,560	11,300	21,800	34,800	61,500	125,400
350	860	1,800	3,390	6,950	10,400	20,100	32,000	56,500	115,300
400	800	1,670	3,150	6,470	9,690	18,700	29,800	52,600	107,300

450	751	1,570	2,960	6,070	9,090	17,500	27,900	49,400	100,700
500	709	1,480	2,790	5,730	8,590	16,500	26,400	46,600	95,100
550	673	1,410	2,650	5,450	8,160	15,700	25,000	44,300	90,300
600	642	1,340	2,530	5,200	7,780	15,000	23,900	42,200	86,200
650	615	1,290	2,420	4,980	7,450	14,400	22,900	40,500	82,500
700	591	1,240	2,330	4,780	7,160	13,800	22,000	38,900	79,300
750	569	1,190	2,240	4,600	6,900	13,300	21,200	37,400	76,400
800	550	1,150	2,170	4,450	6,660	12,800	20,500	36,200	73,700
850	532	1,110	2,100	4,300	6,450	12,400	19,800	35,000	71,400
900	516	1,080	2,030	4,170	6,250	12,000	19,200	33,900	69,200
950	501	1,050	1,970	4,050	6,070	11,700	18,600	32,900	67,200
1,000	487	1,020	1,920	3,940	5,900	11,400	18,100	32,000	65,400
1,100	463	968	1,820	3,740	5,610	10,800	17,200	30,400	62,100
1,200	442	923	1,740	3,570	5,350	10,300	16,400	29,000	59,200
1,300	423	884	1,670	3,420	5,120	9,870	15,700	27,800	56,700
1,400	406	849	1,600	3,280	4,920	9,480	15,100	26,700	54,500
1,500	391	818	1,540	3,160	4,740	9,130	14,600	25,700	52,500
1,600	378	790	1,490	3,060	4,580	8,820	14,100	24,800	50,700
1,700	366	765	1,440	2,960	4,430	8,530	13,600	24,000	49,000
1,800	355	741	1,400	2,870	4,300	8,270	13,200	23,300	47,600
1,900	344	720	1,360	2,780	4,170	8,040	12,800	22,600	46,200
2,000	335	700	1,320	2,710	4,060	7,820	12,500	22,000	44,900

Note: All table entries are rounded to 3 significant digits.

Table 6.3.1(c) Schedule 40 Metallic Pipe

Gas:	**Undiluted Propane**
Inlet Pressure:	**2.0 psi**
Pressure Drop:	**1.0 psi**
Specific Gravity:	**1.50**

INTENDED USE: Pipe Sizing Between 2 psig Service and Line Pressure Regulator.

	Pipe Size (in.)								
Nominal:	½	¾	**1**	**1¼**	**1½**	**2**	**2 ½**	**3**	**4**
Actual ID:	**0.622**	**0.824**	**1.049**	**1.380**	**1.610**	**2.067**	**2.469**	**3.068**	**4.026**
Length (ft)	**Capacity in Thousands of Btu per Hour**								
10	2,680	5,590	10,500	21,600	32,400	62,400	99,500	176,000	359,000
20	1,840	3,850	7,240	14,900	22,300	42,900	68,400	121,000	247,000
30	1,480	3,090	5,820	11,900	17,900	34,500	54,900	97,100	198,000
40	1,260	2,640	4,980	10,200	15,300	29,500	47,000	83,100	170,000
50	1,120	2,340	4,410	9,060	13,600	26,100	41,700	73,700	150,000
60	1,010	2,120	4,000	8,210	12,300	23,700	37,700	66,700	136,000
70	934	1,950	3,680	7,550	11,300	21,800	34,700	61,400	125,000
80	869	1,820	3,420	7,020	10,500	20,300	32,300	57,100	116,000
90	815	1,700	3,210	6,590	9,880	19,000	30,300	53,600	109,000
100	770	1,610	3,030	6,230	9,330	18,000	28,600	50,600	103,000

						Gas:	Undiluted Propane		
						Inlet Pressure:	2.0 psi		
						Pressure Drop:	1.0 psi		
						Specific Gravity:	1.50		
INTENDED USE: Pipe Sizing Between 2 psig Service and Line Pressure Regulator.									
	Pipe Size (in.)								
Nominal:	½	¾	1	1¼	1½	2	2 ½	3	4
Actual ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Thousands of Btu per Hour								
125	682	1,430	2,690	5,520	8,270	15,900	25,400	44,900	91,500
150	618	1,290	2,440	5,000	7,490	14,400	23,000	40,700	82,900
175	569	1,190	2,240	4,600	6,890	13,300	21,200	37,400	76,300
200	529	1,110	2,080	4,280	6,410	12,300	19,700	34,800	71,000
250	469	981	1,850	3,790	5,680	10,900	17,400	30,800	62,900
300	425	889	1,670	3,440	5,150	9,920	15,800	27,900	57,000
350	391	817	1,540	3,160	4,740	9,120	14,500	25,700	52,400
400	364	760	1,430	2,940	4,410	8,490	13,500	23,900	48,800
450	341	714	1,340	2,760	4,130	7,960	12,700	22,400	45,800
500	322	674	1,270	2,610	3,910	7,520	12,000	21,200	43,200
550	306	640	1,210	2,480	3,710	7,140	11,400	20,100	41,100
600	292	611	1,150	2,360	3,540	6,820	10,900	19,200	39,200
650	280	585	1,100	2,260	3,390	6,530	10,400	18,400	37,500
700	269	562	1,060	2,170	3,260	6,270	9,990	17,700	36,000
750	259	541	1,020	2,090	3,140	6,040	9,630	17,000	34,700
800	250	523	985	2,020	3,030	5,830	9,300	16,400	33,500
850	242	506	953	1,960	2,930	5,640	9,000	15,900	32,400
900	235	490	924	1,900	2,840	5,470	8,720	15,400	31,500
950	228	476	897	1,840	2,760	5,310	8,470	15,000	30,500
1,000	222	463	873	1,790	2,680	5,170	8,240	14,600	29,700
1,100	210	440	829	1,700	2,550	4,910	7,830	13,800	28,200
1,200	201	420	791	1,620	2,430	4,680	7,470	13,200	26,900
1,300	192	402	757	1,550	2,330	4,490	7,150	12,600	25,800
1,400	185	386	727	1,490	2,240	4,310	6,870	12,100	24,800
1,500	178	372	701	1,440	2,160	4,150	6,620	11,700	23,900
1,600	172	359	677	1,390	2,080	4,010	6,390	11,300	23,000
1,700	166	348	655	1,340	2,010	3,880	6,180	10,900	22,300
1,800	161	337	635	1,300	1,950	3,760	6,000	10,600	21,600
1,900	157	327	617	1,270	1,900	3,650	5,820	10,300	21,000
2,000	152	318	600	1,230	1,840	3,550	5,660	10,000	20,400

Note: All table entries are rounded to 3 significant digits.

Table 6.3.1(d) Schedule 40 Metallic Pipe

						Gas:	Undiluted Propane		
						Inlet Pressure:	11.0 in. w.c.		
						Pressure Drop:	0.5 in. w.c.		
						Specific Gravity:	1.50		

INTENDED USE: Pipe Sizing Between Single- or Second-Stage (Low-Pressure) Regulator and Appliance.

	Pipe Size (in.)								
Nominal Inside:	½	¾	1	1¼	1½	2	2 ½	3	4
Actual:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
Length (ft)	Capacity in Thousands of Btu per Hour								
10	291	608	1,150	2,350	3,520	6,790	10,800	19,100	39,000
20	200	418	787	1,620	2,420	4,660	7,430	13,100	26,800
30	160	336	632	1,300	1,940	3,750	5,970	10,600	21,500
40	137	287	541	1,110	1,660	3,210	5,110	9,030	18,400
50	122	255	480	985	1,480	2,840	4,530	8,000	16,300
60	110	231	434	892	1,340	2,570	4,100	7,250	14,800
70	101	212	400	821	1,230	2,370	3,770	6,670	13,600
80	94	197	372	763	1,140	2,200	3,510	6,210	12,700
90	89	185	349	716	1,070	2,070	3,290	5,820	11,900
100	84	175	330	677	1,010	1,950	3,110	5,500	11,200
125	74	155	292	600	899	1,730	2,760	4,880	9,950
150	67	140	265	543	814	1,570	2,500	4,420	9,010
175	62	129	243	500	749	1,440	2,300	4,060	8,290
200	58	120	227	465	697	1,340	2,140	3,780	7,710
250	51	107	201	412	618	1,190	1,900	3,350	6,840
300	46	97	182	373	560	1,080	1,720	3,040	6,190
350	42	89	167	344	515	991	1,580	2,790	5,700
400	40	83	156	320	479	922	1,470	2,600	5,300
450	37	78	146	300	449	865	1,380	2,440	4,970
500	35	73	138	283	424	817	1,300	2,300	4,700
550	33	70	131	269	403	776	1,240	2,190	4,460
600	32	66	125	257	385	741	1,180	2,090	4,260
650	30	64	120	246	368	709	1,130	2,000	4,080
700	29	61	115	236	354	681	1,090	1,920	3,920
750	28	59	111	227	341	656	1,050	1,850	3,770
800	27	57	107	220	329	634	1,010	1,790	3,640
850	26	55	104	213	319	613	978	1,730	3,530
900	25	53	100	206	309	595	948	1,680	3,420
950	25	52	97	200	300	578	921	1,630	3,320
1,000	24	50	95	195	292	562	895	1,580	3,230
1,100	23	48	90	185	277	534	850	1,500	3,070
1,200	22	46	86	176	264	509	811	1,430	2,930

1,300	21	44	82	169	253	487	777	1,370	2,800
1,400	20	42	79	162	243	468	746	1,320	2,690
1,500	19	40	76	156	234	451	719	1,270	2,590
1,600	19	39	74	151	226	436	694	1,230	2,500
1,700	18	38	71	146	219	422	672	1,190	2,420
1,800	18	37	69	142	212	409	652	1,150	2,350
1,900	17	36	67	138	206	397	633	1120	2280
2,000	17	35	65	134	200	386	615	1090	2220

Note: All table entries are rounded to 3 significant digits.

Table 6.3.1(e) Semirigid Copper Tubing

Gas:	**Undiluted Propane**
Inlet Pressure:	**10.0 psi**
Pressure Drop:	**1.0 psi**
Specific Gravity:	**1.50**

INTENDED USE: Tube Sizing Between First-Stage (High-Pressure) Regulator and Second-Stage (Low-Pressure) Regulator.

		Tube Size (in.)								
Nominal:	**K & L:**	¼	⅜	½	⅝	¾	1	1¼	1½	2
	ACR:	⅜	½	⅝	¾	⅞	1⅛	1⅜	—	—
Outside:		**0.375**	**0.500**	**0.625**	**0.750**	**0.875**	**1.125**	**1.375**	**1.625**	**2.125**
Inside:*		**0.305**	**0.402**	**0.527**	**0.652**	**0.745**	**0.995**	**1.245**	**1.481**	**1.959**
Length (ft)		**Capacity in Thousands of Btu per Hour**								
10		513	1,060	2,150	3,760	5,330	11,400	20,500	32,300	67,400
20		352	727	1,480	2,580	3,670	7,830	14,100	22,200	46,300
30		283	584	1,190	2,080	2,940	6,290	11,300	17,900	37,200
40		242	500	1,020	1,780	2,520	5,380	9,690	15,300	31,800
50		215	443	901	1,570	2,230	4,770	8,590	13,500	28,200
60		194	401	816	1,430	2,020	4,320	7,780	12,300	25,600
70		179	369	751	1,310	1,860	3,980	7,160	11,300	23,500
80		166	343	699	1,220	1,730	3,700	6,660	10,500	21,900
90		156	322	655	1,150	1,630	3,470	6,250	9,850	20,500
100		147	304	619	1,080	1,540	3,280	5,900	9,310	19,400
125		131	270	549	959	1,360	2,910	5,230	8,250	17,200
150		118	244	497	869	1,230	2,630	4,740	7,470	15,600
175		109	225	457	799	1,130	2,420	4,360	6,880	14,300
200		101	209	426	744	1,060	2,250	4,060	6,400	13,300
250		90	185	377	659	935	2,000	3,600	5,670	11,800
300		81	168	342	597	847	1,810	3,260	5,140	10,700
350		75	155	314	549	779	1,660	3,000	4,730	9,840
400		70	144	292	511	725	1,550	2,790	4,400	9,160

450	65	135	274	480	680	1,450	2,620	4,130	8,590
500	62	127	259	453	643	1,370	2,470	3,900	8,120
550	59	121	246	430	610	1,300	2,350	3,700	7,710
600	56	115	235	410	582	1,240	2,240	3,530	7,350
650	54	111	225	393	558	1,190	2,140	3,380	7,040
700	51	106	216	378	536	1,140	2,060	3,250	6,770
750	50	102	208	364	516	1,100	1,980	3,130	6,520
800	48	99	201	351	498	1,060	1,920	3,020	6,290
850	46	96	195	340	482	1,030	1,850	2,920	6,090
900	45	93	189	330	468	1,000	1,800	2,840	5,910
950	44	90	183	320	454	970	1,750	2,750	5,730
1,000	42	88	178	311	442	944	1,700	2,680	5,580
1,100	40	83	169	296	420	896	1,610	2,540	5,300
1,200	38	79	161	282	400	855	1,540	2,430	5,050
1,300	37	76	155	270	383	819	1,470	2,320	4,840
1,400	35	73	148	260	368	787	1,420	2,230	4,650
1,500	34	70	143	250	355	758	1,360	2,150	4,480
1,600	33	68	138	241	343	732	1,320	2,080	4,330
1,700	32	66	134	234	331	708	1,270	2,010	4,190
1,800	31	64	130	227	321	687	1,240	1,950	4,060
1,900	30	62	126	220	312	667	1,200	1,890	3,940
2,000	29	60	122	214	304	648	1,170	1,840	3,830

Note: All table entries are rounded to 3 significant digits.

*Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.

Table 6.3.1(f) Semirigid Copper Tubing

Gas:	Undiluted Propane
Inlet Pressure:	11.0 in. w.c.
Pressure Drop:	0.5 in. w.c.
Specific Gravity:	1.50

INTENDED USE: Tube Sizing Between Single- or Second-Stage (Low-Pressure) Regulator and Appliance.

		Tube Size (in.)								
Nominal:	K & L:	¼	⅜	½	⅝	¾	1	1¼	1½	2
	ACR:	⅜	½	⅝	¾	⅞	1⅛	1⅜	—	—
Outside:		0.375	0.500	0.625	0.750	0.875	1.125	1.375	1.625	2.125
Inside:*		0.305	0.402	0.527	0.652	0.745	0.995	1.245	1.481	1.959
Length (ft)		Capacity in Thousands of Btu per Hour								
10		45	93	188	329	467	997	1,800	2,830	5,890
20		31	64	129	226	321	685	1,230	1,950	4,050

30	25	51	104	182	258	550	991	1,560	3,250
40	21	44	89	155	220	471	848	1,340	2,780
50	19	39	79	138	195	417	752	1,180	2,470
60	17	35	71	125	177	378	681	1,070	2,240
70	16	32	66	115	163	348	626	988	2,060
80	15	30	61	107	152	324	583	919	1,910
90	14	28	57	100	142	304	547	862	1,800
100	13	27	54	95	134	287	517	814	1,700
125	11	24	48	84	119	254	458	722	1,500
150	10	21	44	76	108	230	415	654	1,360
175	NA	20	40	70	99	212	382	602	1,250
200	NA	18	37	65	92	197	355	560	1,170
250	NA	16	33	58	82	175	315	496	1,030
300	NA	15	30	52	74	158	285	449	936
350	NA	14	28	48	68	146	262	414	861
400	NA	13	26	45	63	136	244	385	801
450	NA	12	24	42	60	127	229	361	752
500	NA	11	23	40	56	120	216	341	710
550	NA	11	22	38	53	114	205	324	674
600	NA	10	21	36	51	109	196	309	643
650	NA	NA	20	34	49	104	188	296	616
700	NA	NA	19	33	47	100	180	284	592
750	NA	NA	18	32	45	96	174	274	570
800	NA	NA	18	31	44	93	168	264	551
850	NA	NA	17	30	42	90	162	256	533
900	NA	NA	17	29	41	87	157	248	517
950	NA	NA	16	28	40	85	153	241	502
1,000	NA	NA	16	27	39	83	149	234	488
1,100	NA	NA	15	26	37	78	141	223	464
1,200	NA	NA	14	25	35	75	135	212	442
1,300	NA	NA	14	24	34	72	129	203	423
1,400	NA	NA	13	23	32	69	124	195	407
1,500	NA	NA	13	22	31	66	119	188	392
1,600	NA	NA	12	21	30	64	115	182	378
1,700	NA	NA	12	20	29	62	112	176	366
1,800	NA	NA	11	20	28	60	108	170	355
1,900	NA	NA	11	19	27	58	105	166	345
2,000	NA	NA	11	19	27	57	102	161	335

NA: A flow of less than 10,000 Btu/hr.

Note: All table entries are rounded to 3 significant digits.

*Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.

Table 6.3.1(g) Semirigid Copper Tubing

								Gas:	Undiluted Propane	
								Inlet Pressure:	2.0 psi	
								Pressure Drop:	1.0 psi	
								Specific Gravity:	1.50	

INTENDED USE: Tube Sizing Between 2 psig Service and Line Pressure Regulator.

		Tube Size (in.)								
Nominal:	K & L:	¼	⅜	½	⅝	¾	1	1¼	1½	2
	ACR:	⅜	½	⅝	¾	⅞	1⅛	1⅜	—	—
Outside:		0.375	0.500	0.625	0.750	0.875	1.125	1.375	1.625	2.125
Inside:*		0.305	0.402	0.527	0.652	0.745	0.995	1.245	1.481	1.959
Length (ft)		Capacity in Thousands of Btu per Hour								
10		413	852	1,730	3,030	4,300	9,170	16,500	26,000	54,200
20		284	585	1,190	2,080	2,950	6,310	11,400	17,900	37,300
30		228	470	956	1,670	2,370	5,060	9,120	14,400	29,900
40		195	402	818	1,430	2,030	4,330	7,800	12,300	25,600
50		173	356	725	1,270	1,800	3,840	6,920	10,900	22,700
60		157	323	657	1,150	1,630	3,480	6,270	9,880	20,600
70		144	297	605	1,060	1,500	3,200	5,760	9,090	18,900
80		134	276	562	983	1,390	2,980	5,360	8,450	17,600
90		126	259	528	922	1,310	2,790	5,030	7,930	16,500
100		119	245	498	871	1,240	2,640	4,750	7,490	15,600
125		105	217	442	772	1,100	2,340	4,210	6,640	13,800
150		95	197	400	700	992	2,120	3,820	6,020	12,500
175		88	181	368	644	913	1,950	3,510	5,540	11,500
200		82	168	343	599	849	1,810	3,270	5,150	10,700
250		72	149	304	531	753	1,610	2,900	4,560	9,510
300		66	135	275	481	682	1,460	2,620	4,140	8,610
350		60	124	253	442	628	1,340	2,410	3,800	7,920
400		56	116	235	411	584	1,250	2,250	3,540	7,370
450		53	109	221	386	548	1,170	2,110	3,320	6,920
500		50	103	209	365	517	1,110	1,990	3,140	6,530
550		47	97	198	346	491	1,050	1,890	2,980	6,210
600		45	93	189	330	469	1,000	1,800	2,840	5,920
650		43	89	181	316	449	959	1,730	2,720	5,670
700		41	86	174	304	431	921	1,660	2,620	5,450
750		40	82	168	293	415	888	1,600	2,520	5,250
800		39	80	162	283	401	857	1,540	2,430	5,070
850		37	77	157	274	388	829	1,490	2,350	4,900
900		36	75	152	265	376	804	1,450	2,280	4,750
950		35	72	147	258	366	781	1,410	2,220	4,620
1,000		34	71	143	251	356	760	1,370	2,160	4,490

1,100	32	67	136	238	338	721	1,300	2,050	4,270
1,200	31	64	130	227	322	688	1,240	1,950	4,070
1,300	30	61	124	217	309	659	1,190	1,870	3,900
1,400	28	59	120	209	296	633	1,140	1,800	3,740
1,500	27	57	115	201	286	610	1,100	1,730	3,610
1,600	26	55	111	194	276	589	1,060	1,670	3,480
1,700	26	53	108	188	267	570	1,030	1,620	3,370
1,800	25	51	104	182	259	553	1,000	1,570	3,270
1,900	24	50	101	177	251	537	966	1,520	3,170
2,000	23	48	99	172	244	522	940	1,480	3,090

Note: All table entries are rounded to 3 significant digits.

*Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.

Table 6.3.1(h) Corrugated Stainless Steel Tubing (CSST)

Gas:	**Undiluted Propane**
Inlet Pressure:	**11.0 in. w.c.**
Pressure Drop:	**0.5 in. w.c.**
Specific Gravity:	**1.50**

INTENDED USE: CSST Sizing Between Single- or Second-Stage (Low-Pressure) Regulator and Appliance Shutoff Valve.

	Tube Size (EHD)													
Flow Designation:	**13**	**15**	**18**	**19**	**23**	**25**	**30**	**31**	**37**	**39**	**46**	**48**	**60**	**62**
Length (ft)	**Capacity in Thousands of Btu per Hour**													
5	72	99	181	211	355	426	744	863	1,420	1,638	2,830	3,270	5,780	6,550
10	50	69	129	150	254	303	521	605	971	1,179	1,990	2,320	4,110	4,640
15	39	55	104	121	208	248	422	490	775	972	1,620	1,900	3,370	3,790
20	34	49	91	106	183	216	365	425	661	847	1,400	1,650	2,930	3,290
25	30	42	82	94	164	192	325	379	583	762	1,250	1,480	2,630	2,940
30	28	39	74	87	151	177	297	344	528	698	1,140	1,350	2,400	2,680
40	23	33	64	74	131	153	256	297	449	610	988	1,170	2,090	2,330
50	20	30	58	66	118	137	227	265	397	548	884	1,050	1,870	2,080
60	19	26	53	60	107	126	207	241	359	502	805	961	1,710	1,900
70	17	25	49	57	99	117	191	222	330	466	745	890	1,590	1,760
80	15	23	45	52	94	109	178	208	307	438	696	833	1,490	1,650
90	15	22	44	50	90	102	169	197	286	414	656	787	1,400	1,550
100	14	20	41	47	85	98	159	186	270	393	621	746	1,330	1,480
150	11	15	31	36	66	75	123	143	217	324	506	611	1,090	1,210
200	9	14	28	33	60	69	112	129	183	283	438	531	948	1,050
250	8	12	25	30	53	61	99	117	163	254	390	476	850	934
300	8	11	23	26	50	57	90	107	147	234	357	434	777	854

EHD: Equivalent hydraulic diameter. A measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.

Notes:

(1) Table includes losses for four 90 degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fitting shall be increased by an equivalent length of tubing to the following equation: $L = 1.3n$, where L is additional length (ft) of tubing and n is the number of additional fittings and/or bends.

(2) All table entries are rounded to 3 significant digits.

Table 6.3.1(i) Corrugated Stainless Steel Tubing (CSST)

Gas:	**Undiluted Propane**
Inlet Pressure:	**2.0 psi**
Pressure Drop:	**1.0 psi**
Specific Gravity:	**1.50**

INTENDED USE: CSST Sizing Between 2 psig Service and Line Pressure Regulator.

	Tube Size (EHD)													
Flow Designation:	**13**	**15**	**18**	**19**	**23**	**25**	**30**	**31**	**37**	**39**	**46**	**48**	**60**	**62**
Length (ft)	**Capacity in Thousands of Btu per Hour**													
10	426	558	927	1,110	1,740	2,170	4,100	4,720	7,130	7,958	15,200	16,800	29,400	34,2
25	262	347	591	701	1,120	1,380	2,560	2,950	4,560	5,147	9,550	10,700	18,800	21,7
30	238	316	540	640	1,030	1,270	2,330	2,690	4,180	4,719	8,710	9,790	17,200	19,8
40	203	271	469	554	896	1,100	2,010	2,320	3,630	4,116	7,530	8,500	14,900	17,2
50	181	243	420	496	806	986	1,790	2,070	3,260	3,702	6,730	7,610	13,400	15,4
75	147	196	344	406	663	809	1,460	1,690	2,680	3,053	5,480	6,230	11,000	12,6
80	140	189	333	393	643	768	1,410	1,630	2,590	2,961	5,300	6,040	10,600	12,2
100	124	169	298	350	578	703	1,260	1,450	2,330	2,662	4,740	5,410	9,530	10,9
150	101	137	245	287	477	575	1,020	1,180	1,910	2,195	3,860	4,430	7,810	8,89
200	86	118	213	248	415	501	880	1,020	1,660	1,915	3,340	3,840	6,780	7,71
250	77	105	191	222	373	448	785	910	1,490	1,722	2,980	3,440	6,080	6,90
300	69	96	173	203	343	411	716	829	1,360	1,578	2,720	3,150	5,560	6,30
400	60	82	151	175	298	355	616	716	1,160	1,376	2,350	2,730	4,830	5,46
500	53	72	135	158	268	319	550	638	1,030	1,237	2,100	2,450	4,330	4,88

EHD: Equivalent hydraulic diameter. A measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.

Notes:

(1) Table does not include effect of pressure drop across the line regulator. Where regulator loss exceeds ½ psi (based on 13 in. w.c. outlet pressure), do not use this table. Consult with regulator manufacturer for pressure drops and capacity factors. Pressure drops across a regulator may vary with flow rate.

(2) CAUTION: Capacities shown in table may exceed maximum capacity for a selected regulator. Consult with regulator or tubing manufacturer for guidance.

(3) Table includes losses for four 90 degree bends and two end fittings. Tubing runs with larger number of bends and/or fittings shall be increased by an equivalent length of tubing according

to the following equation: $L = 1.3n$, where L is additional length (ft) of tubing and n is the number of additional fittings and/or bends.

(4) All table entries are rounded to 3 significant digits.

Table 6.3.1(j) Corrugated Stainless Steel Tubing (CSST)

												Gas:	Undi Prop
												Inlet Pressure:	5.0 p
												Pressure Drop:	3.5 p
												Specific Gravity:	1.50
	Tube Size (EHD)												
Flow Designation:	13	15	18	19	23	25	30	31	37	39	46	48	60
Length (ft)	Capacity in Thousands of Btu per Hour												
10	826	1,070	1,710	2,060	3,150	4,000	7,830	8,950	13,100	14,441	28,600	31,200	54,40
25	509	664	1,090	1,310	2,040	2,550	4,860	5,600	8,400	9,339	18,000	19,900	34,70
30	461	603	999	1,190	1,870	2,340	4,430	5,100	7,680	8,564	16,400	18,200	31,70
40	396	520	867	1,030	1,630	2,030	3,820	4,400	6,680	7,469	14,200	15,800	27,60
50	352	463	777	926	1,460	1,820	3,410	3,930	5,990	6,717	12,700	14,100	24,70
75	284	376	637	757	1,210	1,490	2,770	3,190	4,920	5,539	10,300	11,600	20,30
80	275	363	618	731	1,170	1,450	2,680	3,090	4,770	5,372	9,990	11,200	19,60
100	243	324	553	656	1,050	1,300	2,390	2,760	4,280	4,830	8,930	10,000	17,60
150	196	262	453	535	866	1,060	1,940	2,240	3,510	3,983	7,270	8,210	14,40
200	169	226	393	464	755	923	1,680	1,930	3,050	3,474	6,290	7,130	12,50
250	150	202	352	415	679	828	1,490	1,730	2,740	3,124	5,620	6,390	11,20
300	136	183	322	379	622	757	1,360	1,570	2,510	2,865	5,120	5,840	10,30
400	117	158	279	328	542	657	1,170	1,360	2,180	2,498	4,430	5,070	8,92(
500	104	140	251	294	488	589	1,050	1,210	1,950	2,247	3,960	4,540	8,00(

EHD: Equivalent hydraulic diameter. A measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.

Notes:

(1) Table does not include effect of pressure drop across the line regulator. Where regulator loss exceeds ½ psi (based on 13 in. w.c. outlet pressure), do not use this table. Consult with regulator manufacturer for pressure drops and capacity factors. Pressure drops across a regulator may vary with flow rate.

(2) CAUTION: Capacities shown in table may exceed maximum capacity for a selected regulator. Consult with regulator or tubing manufacturer for guidance.

(3) Table includes losses for four 90 degree bends and two end fittings. Tubing runs with larger number of bends and/or fittings shall be increased by an equivalent length of tubing according to the following equation: $L = 1.3n$, where L is additional length (ft) of tubing and n is the number of additional fittings and/or bends.

(4) All table entries are rounded to 3 significant digits.

Table 6.3.1(k) Polyethylene Plastic Pipe

					Gas:	Undiluted Propane		
					Inlet Pressure:	11.0 in. w.c.		
					Pressure Drop:	0.5 in. w.c.		
					Specific Gravity:	1.50		
INTENDED USE: PE Pipe Sizing Between Integral Second-Stage Regulator at Tank or Second-Stage (Low-Pressure) Regulator and Building.								
	Pipe Size (in.)							
Nominal OD:	½	¾	1	1¼	1½	2	3	4
Designation:	SDR 9.3	SDR 11	SDR 11	SDR 10	SDR 11	SDR 11	SDR 11	SDR 11
Actual ID:	0.660	0.860	1.077	1.328	1.554	1.943	2.864	3.682
Length (ft)	Capacity in Thousands of Btu per Hour							
10	340	680	1,230	2,130	3,210	5,770	16,000	30,900
20	233	468	844	1,460	2,210	3,970	11,000	21,200
30	187	375	677	1,170	1,770	3,180	8,810	17,000
40	160	321	580	1,000	1,520	2,730	7,540	14,600
50	142	285	514	890	1,340	2,420	6,680	12,900
60	129	258	466	807	1,220	2,190	6,050	11,700
70	119	237	428	742	1,120	2,010	5,570	10,800
80	110	221	398	690	1,040	1,870	5,180	10,000
90	103	207	374	648	978	1,760	4,860	9,400
100	98	196	353	612	924	1,660	4,590	8,900
125	87	173	313	542	819	1,470	4,070	7,900
150	78	157	284	491	742	1,330	3,690	7,130
175	72	145	261	452	683	1,230	3,390	6,560
200	67	135	243	420	635	1,140	3,160	6,100
250	60	119	215	373	563	1,010	2,800	5,410
300	54	108	195	338	510	916	2,530	4,900
350	50	99	179	311	469	843	2,330	4,510
400	46	92	167	289	436	784	2,170	4,190
450	43	87	157	271	409	736	2,040	3,930
500	41	82	148	256	387	695	1,920	3,720

Note: All table entries are rounded to 3 significant digits.

Table 6.3.1(I) Polyethylene Plastic Pipe

						Gas:	Undiluted Propane	
						Inlet Pressure:	2.0 psi	
						Pressure Drop:	1.0 psi	
						Specific Gravity:	1.50	

INTENDED USE: PE Pipe Sizing Between 2 psi Service Regulator and Line Pressure Regulator.

	Pipe Size (in.)							
Nominal OD:	½	¾	1	1¼	1½	2	3	4
Designation:	SDR 9.3	SDR 11	SDR 11	SDR 10	SDR 11	SDR 11	SDR 11	SDR 11
Actual ID:	0.660	0.860	1.077	1.328	1.554	1.943	2.864	3.682
Length (ft)	Capacity in Thousands of Btu per Hour							
10	3,130	6,260	11,300	19,600	29,500	53,100	147,000	284,000
20	2,150	4,300	7,760	13,400	20,300	36,500	101,000	195,000
30	1,730	3,450	6,230	10,800	16,300	29,300	81,100	157,000
40	1,480	2,960	5,330	9,240	14,000	25,100	69,400	134,100
50	1,310	2,620	4,730	8,190	12,400	22,200	61,500	119,000
60	1,190	2,370	4,280	7,420	11,200	20,100	55,700	108,000
70	1,090	2,180	3,940	6,830	10,300	18,500	51,300	99,100
80	1,010	2,030	3,670	6,350	9,590	17,200	47,700	92,200
90	952	1,910	3,440	5,960	9,000	16,200	44,700	86,500
100	899	1,800	3,250	5,630	8,500	15,300	42,300	81,700
125	797	1,600	2,880	4,990	7,530	13,500	37,500	72,400
150	722	1,450	2,610	4,520	6,830	12,300	33,900	65,600
175	664	1,330	2,400	4,160	6,280	11,300	31,200	60,300
200	618	1,240	2,230	3,870	5,840	10,500	29,000	56,100
250	548	1,100	1,980	3,430	5,180	9,300	25,700	49,800
300	496	994	1,790	3,110	4,690	8,430	23,300	45,100
350	457	914	1,650	2,860	4,320	7,760	21,500	41,500
400	425	851	1,530	2,660	4,020	7,220	12,000	38,600
450	399	798	1,440	2,500	3,770	6,770	18,700	36,200
500	377	754	1,360	2,360	3,560	6,390	17,700	34,200
550	358	716	1,290	2,240	3,380	6,070	16,800	32,500
600	341	683	1,230	2,140	3,220	5,790	16,000	31,000
650	327	654	1,180	2,040	3,090	5,550	15,400	29,700
700	314	628	1,130	1,960	2,970	5,330	14,700	28,500
750	302	605	1,090	1,890	2,860	5,140	14,200	27,500
800	292	585	1,050	1,830	2,760	4,960	13,700	26,500
850	283	566	1,020	1,770	2,670	4,800	13,300	25,700
900	274	549	990	1,710	2,590	4,650	12,900	24,900
950	266	533	961	1,670	2,520	4,520	12,500	24,200
1,000	259	518	935	1,620	2,450	4,400	12,200	23,500
1,100	246	492	888	1,540	2,320	4,170	11,500	22,300

1,200	234	470	847	1,470	2,220	3,980	11,000	21,300
1,300	225	450	811	1,410	2,120	3,810	10,600	20,400
1,400	216	432	779	1,350	2,040	3,660	10,100	19,600
1,500	208	416	751	1,300	1,960	3,530	9,760	18,900
1,600	201	402	725	1,260	1,900	3,410	9,430	18,200
1,700	194	389	702	1,220	1,840	3,300	9,130	17,600
1,800	188	377	680	1,180	1,780	3,200	8,850	17,100
1,900	183	366	661	1,140	1,730	3,110	8,590	16,600
2,000	178	356	643	1,110	1,680	3,020	8,360	16,200

Note: All table entries are rounded to 3 significant digits.

Table 6.3.1(m) Polyethylene Plastic Tubing

	Gas:	**Undiluted Propane**
	Inlet Pressure:	**11.0 in. w.c.**
	Pressure Drop:	**0.5 in. w.c.**
	Specific Gravity:	**1.50**

INTENDED USE: Sizing Between Integral 2-Stage Regulator at Tank or Second-Stage (Low-Pressure Regulator) and the Building.

Plastic Tubing Size (CTS) (in.)		
Nominal OD:	½	**1**
Designation:	**SDR 7**	**SDR 11**
Actual ID:	**0.445**	**0.927**
Length (ft)	**Capacity in Thousands of Btu per Hour**	
10	121	828
20	83	569
30	67	457
40	57	391
50	51	347
60	46	314
70	42	289
80	39	269
90	37	252
100	35	238
125	31	211
150	28	191
175	26	176
200	24	164
225	22	154
250	21	145
275	20	138
300	19	132
350	18	121
400	16	113
450	15	106

500	15	100

CTS: Copper tube size.

Note: All table entries are rounded to 3 significant digits.

6.3.2

Section 6.4 shall be used in conjunction with one of the methods described in 6.1.2 through 6.1.4 for non-corrugated stainless steel tubing.

6.4 Sizing Equations.

The inside diameter of smooth wall pipe or tubing shall be determined by the sizing equations in 6.4.1 and 6.4.2 using the equivalent pipe length determined by the methods in 6.1.2 through 6.1.4.

6.4.1* Low-Pressure Gas Formula.

Less than 1.5 psi (10.3 kPa):

$$D = \frac{Q^{0.381}}{19.17\left(\frac{\Delta H}{Cr \times L}\right)^{0.206}} \quad \textbf{[6.4.1]}$$

where:

D = inside diameter of pipe (in.)

Q = input rate appliance(s) (cubic feet per hour at 60°F and 30 in. mercury column)

ΔH = pressure drop [in. w.c. (27.7 in. H_2O = 1 psi)]

L = equivalent length of pipe (ft)

See Table 6.4.2 for values of *Cr*.

6.4.2* High-Pressure Gas Formula.

1.5 psi (10.3 kPa) and above:

$$D = \frac{Q^{0.381}}{18.93\left[\frac{\left(P_1^2 - P_2^2\right) \cdot Y}{Cr \times L}\right]^{0.206}} \quad \textbf{[6.4.2]}$$

where:

D = inside diameter of pipe (in.)

Q = input rate appliance(s) (cubic feet per hour at 60°F and 30 in. mercury column)

P_1 = upstream pressure [psia (P_1 + 14.7)]

P_2 = downstream pressure [psia (P_2 + 14.7)]

L = equivalent length of pipe (ft)

See Table 6.4.2 for values of *Cr* and *Y*.

Table 6.4.2 ***Cr*** and ***Y*** for Natural Gas and Undiluted Propane at Standard Conditions

	Formula Factors	
Gas	*Cr*	*Y*
Natural gas	0.6094	0.9992
Undiluted propane	1.2462	0.9910

Submitter Information Verification

Committee: NFG-AAA

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Committee Statement

Committee Statement:	The technical committee is looking at revising chapter 6 to conform to the NFPA Manual of Style.
Response Message:	CI-82-NFPA 54-2024

Committee Input No. 71-NFPA 54-2024 [Chapter 7]

Chapter 7 Gas Piping Installation [See attached Word document for changes to chapter 7]

7.1 Installation of Underground Piping.

7.1.1 Clearances.

7.1.1.1

Underground gas piping shall be installed with sufficient clearance from any other underground structure to avoid contact therewith, to allow maintenance, and to protect against damage from proximity to other structures.

7.1.1.2

Underground plastic piping shall be installed with sufficient clearance or shall be insulated from any source of heat so as to prevent the heat from impairing the serviceability of the pipe.

7.1.2 Protection Against Damage.

Means shall be provided to prevent excessive stressing of the piping where vehicular traffic is heavy or soil conditions are unstable and settling of piping or foundation walls could occur. Piping shall be buried or covered in a manner so as to protect the piping from physical damage. Piping shall be protected from physical damage where it passes through flower beds, shrub beds, and other such cultivated areas where such damage is reasonably expected.

7.1.2.1 Cover Requirements.

Underground piping systems shall be installed with a minimum of 12 in. (300 mm) of cover.

(A)

The minimum cover shall be increased to 18 in. (460 mm) if external damage to the pipe or tubing from external forces is likely to result.

(B)*

Where a minimum of 12 in. (300 mm) of cover cannot be provided, the piping shall be installed in conduit.

7.1.2.2 Trenches.

The trench shall be graded so that the pipe has a firm, substantially continuous bearing on the bottom of the trench.

7.1.2.3 Backfilling.

Where flooding of the trench is done to consolidate the backfill, care shall be exercised to see that the pipe is not floated from its firm bearing on the trench bottom.

7.1.3* Corrosion Protection of Piping.

Steel pipe and steel tubing installed underground shall be installed in accordance with the 7.1.3.1 through 7.1.3.9.

7.1.3.1

Zinc coating (galvanizing) shall not be deemed adequate protection for underground gas piping.

7.1.3.2

Underground piping shall comply with one or more of the following unless approved technical justification is provided to demonstrate that protection is unnecessary:

(1) The piping shall be made of corrosion-resistant material that is suitable for the environment in which it will be installed.

(2) Pipe shall have a factory-applied, electrically insulating coating. Fittings and joints between sections of coated pipe shall be coated in accordance with the coating manufacturer's instructions.

(3) The piping shall have a cathodic protection system installed, and the system shall be maintained in accordance with 7.1.3.3 or 7.1.3.4.

7.1.3.3

Cathodic protection systems shall be monitored by testing and the results shall be documented. The test results shall demonstrate one of the following:

(1) A pipe-to-soil voltage of −0.85 volts or more negative is produced, with reference to a saturated copper-copper sulfate half cell

(2) A pipe-to-soil voltage of −0.78 volts or more negative is produced, with reference to a saturated KCl calomel half cell

(3) A pipe-to-soil voltage of −0.80 volts or more negative is produced, with reference to a silver-silver chloride half cell

(4) Compliance with a method described in Appendix D of Title 49 of the Code of Federal Regulations, Part 192

7.1.3.4

Sacrificial anodes shall be tested in accordance with the following:

(1) Upon installation of the cathodic protection system, except where prohibited by climatic conditions, in which case the testing shall be performed not later than 180 days after the installation of the system

(2) 12 to 18 months after the initial test

(3) Upon successful verification testing in accordance with (1) and (2), periodic follow-up testing shall be performed at intervals not to exceed 36 months

7.1.3.5

Systems failing a test shall be repaired not more than 180 days after the date of the failed testing. The testing schedule shall be restarted as required in 7.1.3.4(1) and 7.1.3.4(2), and the results shall comply with 7.1.3.3.

7.1.3.6

Impressed current cathodic protection systems shall be inspected and tested in accordance with the following schedule:

(1) The impressed current rectifier voltage output shall be checked at intervals not exceeding two months.

(2) The pipe-to-soil voltage shall be tested at least annually.

7.1.3.7

Documentation of the results of the two most recent tests shall be retained.

7.1.3.8

Where dissimilar metals are joined underground, an insulating coupling or fitting shall be used.

7.1.3.9

Steel risers, other than anodeless risers, connected to plastic piping shall be cathodically protected by means of a welded anode.

7.1.4* Protection Against Freezing.

Where the formation of hydrates or ice is known to occur, piping shall be protected against freezing.

7.1.5 Piping Through Foundation Wall.

Piping through a foundation wall shall comply with all of the following:

(1) Underground piping, where installed through the outer foundation or basement wall of a building, shall be encased in a protective sleeve or protected by an approved device or method.

(2) The spaces between the gas piping and the sleeve and between the sleeve and the wall shall be sealed to prevent entry of gas and water.

(3) Sealing materials shall be compatible with the piping and sleeve.

7.1.6 Piping Underground Beneath Buildings.

Where gas piping is installed underground beneath buildings, the piping shall be either of the following:

(1) Encased in an approved conduit designed to withstand the imposed loads and installed in accordance with 7.1.6.1 or 7.1.6.2

(2) A piping/encasement system listed for installation beneath buildings.

7.1.6.1 Conduit with One End Terminating Outdoors.

The conduit shall extend into an accessible portion of the building and, at the point where the conduit terminates in the building, the space between the conduit and the gas piping shall be sealed to prevent the possible entrance of any gas leakage. Where the end sealing is of a type that retains the full pressure of the pipe, the conduit shall be designed for the same pressure as the pipe. The conduit shall extend at least 4 in. (100 mm) outside the building, be vented outdoors above finished ground level, and be installed so as to prevent the entrance of water and insects.

7.1.6.2 Conduit with Both Ends Terminating Indoors.

Where the conduit originates and terminates within the same building, the conduit shall originate and terminate in an accessible portion of the building and shall not be sealed.

7.1.7 Plastic Piping.

7.1.7.1 Connection of Plastic Piping.

Plastic piping shall be installed outdoors, underground only.

Exception No. 1: Plastic piping shall be permitted to terminate aboveground where an anodeless riser is used.

Exception No. 2: Plastic piping shall be permitted to terminate with a wall head adapter aboveground in buildings, including basements, where the plastic piping is inserted in a piping material permitted for use in buildings.

7.1.7.2 Connections Between Metallic and Plastic Piping.

Connections made between metallic and plastic piping shall be made with fittings conforming to one of the following:

(1) ASTM D2513, *Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings*, Category I transition fittings

(2) ASTM F1973, *Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA 12) Fuel Gas Distribution Systems*

(3) ASTM F2509, *Standard Specification for Field-Assembled Anodeless Riser Kits for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing*

7.1.7.3 Tracer Wire.

An electrically continuous corrosion-resistant tracer shall be buried with the plastic pipe to facilitate locating.

7.1.7.3.1

The tracer shall be one of the following:

(1) A product specifically designed for that purpose

(2) Insulated copper conductor not less than 14 AWG

(3) Tracer wire listed and labeled in accordance with UL 2989, *Outline of Investigation for Tracer Wire*

7.1.7.3.2

Where tracer wire is used, access shall be provided from aboveground or one end of the tracer wire or tape shall be brought aboveground at a building wall or riser.

7.1.8

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

7.2 Installation of Aboveground Piping.

7.2.1

Piping installed aboveground shall comply with all of the following:

(1) Piping shall be securely supported and located where it will be protected from physical damage.

(2) Where passing through an exterior wall, the piping shall also be protected from corrosion by coating or wrapping with an inert material approved for such applications.

(3) The piping shall be sealed around its circumference at the point of the exterior penetration to prevent the entry of water, insects, and rodents.

(4) Where piping is encased in a protective pipe sleeve, the annular spaces between the gas piping and the sleeve and between the sleeve and the wall opening shall be sealed.

(5) Piping installed outdoors shall be elevated not less than 3½ in. (89 mm) above the ground.

(6) Sealing materials shall be compatible with the piping and sleeve.

7.2.2* Protective Coating.

Where piping is in contact with a material or an atmosphere corrosive to the piping system, the piping and fittings shall be coated with a corrosion-resistant material. Any such coating used on piping or components shall not be considered as adding strength to the system.

7.2.3 Building Structure.

7.2.3.1

The installation of gas piping shall not cause structural stresses within building components to exceed allowable design limits.

7.2.3.2

Approval shall be obtained before any beams or joists are cut or notched.

7.2.4 Gas Piping to Be Sloped.

Piping for other than dry gas conditions shall be sloped not less than ¼ in. in 15 ft (7 mm in 4.6 m) to prevent traps.

7.2.5* Prohibited Locations.

Gas piping inside any building shall not be installed in or through a clothes chute, chimney or gas vent, dumbwaiter, elevator shaft, or air duct, other than combustion air ducts.

7.2.6 Hangers, Supports, and Anchors.

7.2.6.1

Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers, or building structural components, suitable for the size of piping, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration. Piping shall be anchored to prevent undue strains on connected appliances and equipment and shall not be supported by other piping. Pipe hangers and supports shall conform to the requirements of ANSI/MSS SP-58, *Pipe Hangers and Supports — Materials, Design Manufacture, Selection, Application, and Installation.*

7.2.6.2

Spacings of supports in gas piping installations shall not be greater than shown in Table 7.2.6.2.

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.

7.2.6.3

Spacing of supports of CSST shall be in accordance with the CSST manufacturer’s instructions.

7.2.6.4

Supports, hangers, and anchors shall be installed so as not to interfere with the free expansion and contraction of the piping between anchors. All parts of the supporting system shall be designed and installed so they are not disengaged by movement of the supported piping.

7.2.6.5 Piping on Roofs.

7.2.6.5.1

Gas piping installed on the roof surfaces shall be supported in accordance with Table 7.2.6.2.

7.2.6.5.2

Gas piping shall be elevated not less than 3½ in. (89 mm) above the roof surface.

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 CSA/ANSI LC 1/CSA 6.26, *Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing*, or CSA/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.

Gas piping in nonindustrial occupancies shall not be embedded in concrete floor slabs unless in accordance with 7.3.5.2.1 through 7.3.5.2.5.

7.3.5.2.1

The installation shall be approved.

7.3.5.2.2

Embedded gas piping shall be surrounded with a minimum of 1½ in. (38 mm) of concrete.

7.3.5.2.3

Embedded gas piping shall not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors.

7.3.5.2.4

All piping, fittings, and risers shall be protected against corrosion in accordance with 7.2.2.

7.3.5.2.5

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.

7.8.1 Accessibility of Gas Valves.

7.8.1.1

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

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.

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.

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 belowgrade installations shall have adequate positive ventilation.

7.11.5.2 Electrical Requirements.

7.11.5.2.1

Where gas-mixing machines are installed in well-ventilated areas, the type of electrical equipment shall be in accordance with *NFPA 70* for unclassified areas unless other hazards require classification of the area.

7.11.5.2.2

Where gas-mixing machines are installed in small detached buildings or cutoff rooms, the small detached building or cutoff room shall be classified 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.

7.12.1.1

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.

7.12.1.2

Gas piping, other than CSST, shall be considered to be bonded where it is connected to one or more appliances that are connected to the equipment grounding conductor of the circuit supplying the appliance(s).

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*.

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.

7.12.3.1

CSST with an arc-resistant jacket or coating system shall be listed as arc-resistant in accordance with CSA/ANSI LC 1/CSA 6.26, *Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing*.

7.12.3.2

Arc-resistant jacketed CSST shall be electrically continuous and bonded to an effective ground fault current path.

7.12.3.3

Arc-resistant jacketed CSST shall be considered to be bonded where it is connected to one or more appliances that are connected to the equipment grounding conductor of the circuit supplying the appliance(s).

7.12.3.4

Where any CSST used in a piping system does not have an arc-resistant jacket or coating system, the bonding requirements of 7.12.2 shall apply.

7.12.4 Electrical Isolation.

7.12.4.1*

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

7.12.4.2

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

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

Electrically operated safety devices shall fail safe and shut off the flow of gas in the event of electrical power failure.

Supplemental Information

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Chapter 7 Gas Piping Installation

7.1 Installation of Underground Piping.

7.1.1 Clearances.

7.1.1.1

Underground gas piping shall be installed with ~~sufficient~~ clearance from any other underground structure to avoid contact therewith, to allow maintenance, and to protect against damage from proximity to other structures.

7.1.1.2

Underground plastic piping shall be installed with sufficient clearance or ~~shall be~~ insulated from any source of heat so as to prevent the heat from impairing the serviceability of the pipe.

7.1.2 Protection Against Damage.

7.1.2.1 Piping Protection.
Means shall be provided to prevent excessive stressing of the piping where vehicular traffic is heavy or soil conditions are unstable and settling of piping or foundation walls could occur.

7.1.2.1.1*
Piping shall be buried or covered in a manner so as to protect the piping from physical damage.

A.7.1.2.1.1~~2~~
Piping should~~all~~ be protected from physical damage where it passes through flower beds, shrub beds, and other such cultivated areas where such damage is reasonably expected.

7.1.2.~~1~~ 2 Cover Requirements.

Underground piping systems shall be installed with a minimum of 12 in. (300 mm) of cover.

~~(A)~~7.1.2.2.1
The minimum cover shall be increased to 18 in. (460 mm) where external forces can cause ~~if external~~ damage to the pipe or tubing ~~from external forces is likely to result~~.
~~(B)~~7.1.2.2.2*

Where a minimum of 12 in. (300 mm) of cover cannot be provided, the piping shall be installed in conduit.

7.1.2.~~2~~ 3 Trenches.

The trench shall be graded so that the pipe has a firm~~, substantially~~ continuous bearing on the bottom of the trench.

7.1.2.~~3~~ 4 Backfilling.

Where flooding of the trench is done to consolidate the backfill, care shall be exercised to see that the pipe is not floated from its firm bearing on the trench bottom.

7.1.3* Corrosion Protection of Piping.

Steel pipe and steel tubing installed underground shall be installed in accordance with ~~the~~ 7.1.3.1 through 7.1.3.9~~1~~3.

7.1.3.1

Zinc ~~coating~~ plated or ~~(~~galvanized pipe~~ing)~~ shall not be considered corrosion ~~deemed adequate~~ protection for underground gas piping.

7.1.3.2

Underground piping shall comply with one or more of the following unless approved technical justification is provided to demonstrate that protection is unnecessary:

(1) The piping shall be made of corrosion-resistant material that is suitable for the environment in which it will be installed.

(2) Pipe shall have a factory-applied, electrically insulating coating.

(3) Fittings and joints between sections of coated pipe shall be coated in accordance with the coating manufacturer's instructions.

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(~~3~~4) The piping shall have a cathodic protection system installed. (See 7.1.3.2.1)

~~(5) , and t~~The ~~cathodic protection system shall be maintained in accordance with 7.1.3.3 or through 7.1.3.4~~6~~.~~

7.1.3.2.1
The cathodic protection system shall be maintained in accordance with 7.1.3.3 through 7.1.3.6.

7.1.3.3

Cathodic protection systems shall be monitored by testing.

7.1.3.4
Testing results for cathodic protection systems~~and the results~~ shall be documented.

7.1.3.5
The documented test results for cathodic protection systems shall demonstrate one of the following:

(1) A pipe-to-soil voltage of −0.85 volts or more negative is produced, with reference to a saturated copper-copper sulfate half cell

(2) A pipe-to-soil voltage of −0.78 volts or more negative is produced, with reference to a saturated KCl calomel half cell

(3) A pipe-to-soil voltage of −0.80 volts or more negative is produced, with reference to a silver-silver chloride half cell

(4) Compliance with a method described in Appendix D of Title 49 of the Code of Federal Regulations, Part 192

7.1.3.~~4~~ 6

Sacrificial anodes shall be tested in accordance with the following:

(1) Upon installation of the cathodic protection system~~, except where prohibited by climatic conditions, in which case the testing shall be performed not later than 180 days after the installation of the system~~

(2) 12 to 18 months after the initial test

~~(3) Upon successful verification testing in accordance with 7.1.3.6(1) and 7.1.3.6(2), periodic follow-up testing shall be performed at intervals not to exceed 36 months.~~

7.1.3.6.1
Where prohibited by climatic conditions, sacrificial anode testing shall be performed not later than 180 days after the installation of the cathodic protection system.

7.1.3.6.2
Upon successful verification testing in accordance with 7.1.3.6(1) and 7.1.3.6(2), periodic follow-up cathodic protection system testing shall be performed at intervals not to exceed 36 months.

7.1.3.~~5~~ 7

~~c~~Cathodic protection s~~S~~ystems failing a test shall be repaired not more than 180 days after the date of the failed testing.

7.1.3.8
The cathodic protection system testing schedule shall be restarted as required in 7.1.3.~~4~~6(1) and 7.1.3.~~4~~6(2).

7.1.3.9
~~, and t~~The results of the cathodic protection system testing shall comply with 7.1.3.~~3~~5.

7.1.3.~~6~~ 10

Impressed current cathodic protection systems shall be inspected and tested in accordance with the following schedule:

(1) The impressed current rectifier voltage output shall be checked at intervals not exceeding two months.

(2) The pipe-to-soil voltage shall be tested at least annually.

7.1.3.~~7~~ 11

Documentation of the results of the two most recent tests shall be retained.

7.1.3.~~8~~ 12

Where dissimilar metals are joined underground, an insulating coupling or fitting shall be used.

7.1.3.~~9~~ 13

Steel risers, other than anodeless risers, connected to plastic piping shall be cathodically protected by means of a welded anode.

7.1.6 Piping Underground Beneath Buildings.

Where gas piping is installed underground beneath buildings, the piping shall be either of the following:

(1) Encased in an approved conduit designed to withstand the imposed loads and installed in accordance with 7.1.6.1 or 7.1.6.2

(2) A piping/encasement system listed for installation beneath buildings~~.~~

7.1.6.1 Conduit with One End Terminating Outdoors.

7.1.6.1.1
~~The~~ Where the conduit has one end that terminates indoors, the conduit shall extend into an accessible portion of the building.

7.1.6.1.2
~~, and, a~~At the point where the conduit terminates in the building, the space between the conduit and the gas piping shall be sealed to prevent the possible entrance of any gas leakage.

7.1.6.1.3
Where the end sealing is of a type that retains the full pressure of the pipe, the conduit shall be designed for the same pressure as the pipe.

7.1.6.1.4
The outdoor end of the conduit shall comply with all of the following:

(1) ~~extend~~ Extend at least 4 in. (100 mm) outside the building
(2) ~~, be~~ Be vented outdoors above finished ground level
~~(1)~~(3) ~~, and be~~ Be installed so as to prevent the entrance of water and insects~~.~~

7.1.6.2 Conduit with Both Ends Terminating Indoors.

7.1.6.2.1
Where the conduit originates and terminates within the same building, the conduit shall originate and terminate in an accessible portion of the building.

7.1.6.2.2
Where the conduit originates and terminates within the same building, the conduit ~~and~~ shall not be sealed.

7.1.7 Plastic Piping.
7.1.7.1 Connection of Plastic Piping.

Plastic piping shall be installed outdoors, underground only, except as provided in 7.1.7.1.1 and 7.1.7.1.2.

~~Exception No. 1:~~7.1.7.1.1
~~Plastic piping shall be permitted to terminate aboveground where an anodeless riser is used.~~

~~Exception No. 2:~~7.1.7.1.2
~~Plastic piping shall be permitted to terminate with a wall head adapter aboveground in buildings, including basements, where the plastic piping is inserted in a piping material permitted for use in buildings.~~

7.1.7.2 Connections Between Metallic and Plastic Piping.

Connections made between metallic and plastic piping shall be made with fittings conforming to one of the following:

(1) ASTM D2513, *Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings*, for Category I transition fittings

(2) ASTM F1973, *Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA 12) Fuel Gas Distribution Systems*

(3) ASTM F2509, *Standard Specification for Field-Assembled Anodeless Riser Kits for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing*

7.1.7.3.2

Where tracer wire is used, either of the following shall apply:

(1) ~~access~~ Access shall be provided from aboveground.
~~(1)~~(2) ~~or o~~One end of the tracer wire or tape shall be brought aboveground at a building wall or riser.

7.2 Installation of Aboveground Piping.
7.2.1

Piping installed aboveground shall comply with all of the following:

(1) Piping shall be ~~securely~~ supported and located where it will be protected from physical damage.

(2) Where passing through an exterior wall, the piping shall also be protected from corrosion by coating or wrapping with an inert material approved for such applications.

(3) The piping shall be sealed around its circumference at the point of the exterior penetration to prevent the entry of water, insects, and rodents.

(4) Where piping is encased in a protective pipe sleeve, the annular spaces between the gas piping and the sleeve and between the sleeve and the wall opening shall be sealed.

(5) Piping installed outdoors shall be elevated not less than 3½ in. (89 mm) above the ground.

(6) Sealing materials shall be compatible with the piping and sleeve.

7.2.2* Protective Coating.

7.2.2.1
Where piping is in contact with a material or an atmosphere corrosive to the piping system, the piping and fittings shall be coated with a corrosion-resistant material.

7.2.2.2
Any corrosion-resistant~~such~~ coating used on piping or components shall not be considered as adding strength to the system.

7.2.6 Hangers, Supports, and Anchors.
7.2.6.1

Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers, or building structural components, designed ~~suitable~~ for the ~~size of~~ piping, ~~of adequate strength and quality,~~ and located at intervals so as to prevent or damp out excessive vibration.

7.2.6.2
Piping shall be anchored to prevent undue strains on connected appliances and equipment.

7.2.6.3
~~and~~Piping shall not be supported by other piping.

7.2.6.4
Pipe hangers and supports shall conform to the requirements of ANSI/MSS SP-58, *Pipe Hangers and Supports — Materials, Design Manufacture, Selection, Application, and Installation.*

7.2.6.~~2~~ 5

Spacings of supports in gas piping installations shall not be greater than shown in Table 7.2.6.~~2~~5.

Table 7.2.6.~~2~~ 5 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)
1/2	6	1/2	4
3/4 or 1	8	5/8 or 3/4	6
1 1/4 or larger (horizontal)	10	7/8 or 1 (horizontal)	8
1 1/4 or larger (vertical)	Every floor level	1 or larger (vertical)	Every floor level

For SI units, 1 ft = 0.305 m.

7.2.6.~~3~~ 6

Spacing of supports of corrugated stainless steel tubing (CSST) shall be in accordance with the CSST manufacturer's instructions.

7.2.6.~~4~~ 7

Supports, hangers, and anchors shall be installed so as not to interfere with the free expansion and contraction of the piping between anchors.

7.2.6.8
All parts of the supporting system shall be designed and installed so they are not disengaged by movement of the supported piping.

7.2.6.5 Piping on Roofs.
7.2.6.5.1

Gas piping installed on the roof surfaces shall be supported in accordance with Table 7.2.6.~~2~~5.

7.3.4 Tubing in Partitions.

7.3.4.1
~~This provision~~Section 7.3.4 shall not apply to tubing that pierces walls, floors, or partitions.

7.3.4.2
Tubing installed vertically ~~and~~ or 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~~ shall be installed between the tubing and the finished wall and extend~~s~~ at least 4 in. (100 mm) beyond concealed penetrations of plates, firestops, wall studs, and ~~so on~~where fasteners could penetrate the tubing.

(2) The tubing ~~is~~ shall be installed in single runs.

(3) The tubing shall ~~and is~~ not be rigidly secured.

7.3.5 Piping in Floors in Industrial Occupancies.
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.

7.3.5.2

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~~6 Other Occupancies.

Gas piping in nonindustrial occupancies shall not be embedded in concrete floor slabs unless in accordance with 7.3.~~5.2~~6.1 through 7.3.~~5.2~~6.5.

7.3.~~5.2~~6.1

The installation of embedded gas piping shall be approved.

7.3.~~5.2~~6.2

Embedded gas piping shall be surrounded with a minimum of 1½ in. (38 mm) of concrete.

7.3.~~5.2~~6.3

Embedded gas piping shall not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors.

7.3.~~5.2~~6.4

All piping, fittings, and risers shall be protected against corrosion in accordance with 7.2.2.

7.3.~~5.2~~6.5

Piping shall not be embedded in concrete slabs containing quickset additives or cinder aggregate.

7.3.~~6~~ 7 Shutoff Valves in Tubing Systems.

Shutoff valves in tubing systems in concealed locations shall be ~~rigidly and securely~~ supported independently of the tubing.

7.4.1 Pressure Reduction.

7.4.1.1
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.

7.4.1.2
Regulator venting and downstream overpressure protection shall comply with 5.7.5 and Section 5.8.

7.4.1.3
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, either of the following shall apply:

a) ~~regulators~~ Regulators equipped with a vent limiting means shall be permitted to be vented into the chase.
~~a)~~b) 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.

7.4.3* Ventilation.

7.4.3.1
A chase shall be ventilated to the outdoors and only at the top.

7.4.3.2
The ventilation 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.

7.4.3.3

Where more than one fuel gas piping system is present, the free area for each system shall be calculated and the largest area used.

7.5.1 Metallic Pipe.

Metallic pipe bends shall comply with all of 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 all of the following:

(1) ~~(1)~~ The pipe shall not be damaged.
~~(1)~~(2) ~~, and t~~The internal diameter of the pipe shall not be effectively reduced.

(~~2~~3) Joints shall not be located in pipe bends.

(~~3~~4) The radius of the inner curve of such bends shall not be less than 25 times the inside diameter of the pipe.

(45) 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.

7.6.1.1
For other than dry gas conditions, a drip shall be provided at any point in the line of pipe where condensate could collect.

7.6.1.2
Where required by the authority having jurisdiction or the serving gas supplier, a drip shall also be provided at the outlet of the meter.

7.6.1.3
~~This~~ A 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.

7.6.2.1
All drips shall be installed only in such locations that they are readily accessible to permit cleaning or emptying.

7.6.2.2
A drip shall not be located where the condensate ~~is likely to~~can freeze.

7.7 Outlets.
7.7.1 Location and Installation.
7.7.1.1

The outlet fittings or piping shall be ~~securely~~ fastened to prevent movement ~~in place~~.

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~~ and 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 except as permitted in 7.7.2.3 and 7.7.2.4 ~~thereto~~.

7.7.2.2~~1.1~~
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, except as permitted in 7.7.2.3~~1.2~~ and 7.7.2.4~~1.3~~.

~~Exception No. 1:~~7.7.2.3~~1.2~~
~~-~~Laboratory appliances installed in accordance with 9.6.2(1) shall be permitted.

~~Exception No. 2:~~7.7.2.4~~1.3~~
~~-~~The use of a listed quick-disconnect device with integral shutoff or listed gas convenience outlet shall be permitted.

7.7.2.5~~2~~

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

7.8 Manual Gas Shutoff Valves.
7.8.2 Valves at Regulators.

7.8.2.1
An accessible gas shutoff valve shall be provided upstream of each gas pressure regulator.

7.8.2.2~~1~~
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.

7.8.3.1.1
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, a readily accessible~~n~~ individual shutoff valve for each apartment or tenant line shall be provided ~~at a convenient point of general accessibility~~.

7.8.3.1.2
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.

7.8.3.2.1
An exterior shutoff valve to permit turning off the gas supply to each building in an emergency shall be provided.

7.8.3.2.2
~~The e~~Emergency shutoff valves shall be ~~plainly~~ marked ~~as~~ "Emergency Shutoff Valve"~~such~~ and their locations posted as required by the authority having jurisdiction.

7.8.3.3 Shutoff Valve for Laboratories.

7.8.3.3.1
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.

7.8.3.3.2
The shutoff valve shall be accessible, located within the laboratory or adjacent to the laboratory's egress door, and identified.

7.12 Electrical Bonding and Grounding.
7.12.1 Pipe and Tubing Other than CSST.
7.12.1.1

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.

7.12.2.4
Any additional grounding electrodes installed to meet ~~this requirement~~7.12.2.3 shall be bonded to the electrical service grounding electrode system or, where provided, lightning protection grounding electrode system.

7.12.2.~~4~~ 5

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

7.12.2.~~5~~ 6

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

7.13 Electrical Circuits.

7.13.1
Electrical circuits shall not utilize gas piping or components as conductors, except as provided in 7.13.2.

~~Exception:~~7.13.2
~~-~~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.

Committee Input No. 63-NFPA 54-2024 [Sections 7.1.1, 7.1.2]

Sections 7.1.1, 7.1.2

7.1.1 ~~Clearances~~ Protection Against Damage .

7.1.1.1

Underground gas piping shall be installed with sufficient clearance from any other underground structure to avoid contact therewith, to allow maintenance, and to protect against damage from proximity to other structures.

7.1.1.2

Underground plastic piping shall be installed with sufficient clearance or shall be insulated from any source of heat so as to prevent the heat from impairing the serviceability of the pipe.

7.1.2 ~~Protection Against Damage~~ 1 . 3

Means shall be provided to prevent excessive stressing of the piping where vehicular traffic is heavy or soil conditions are unstable and settling of piping or foundation walls could occur. Piping shall be buried or covered in a manner so as to protect the piping from physical damage. Piping shall be protected from physical damage where it passes through flower beds, shrub beds, and other such cultivated areas where such damage is reasonably expected.

7.1.~~2~~ 1 .3. 1 Cover Requirements.

Underground piping systems shall be installed with a minimum of 12 in. (300 mm) of cover.

(A)

The minimum cover shall be increased to 18 in. (460 mm) if external damage to the pipe or tubing from external forces is likely to result.

(B)*

Where a minimum of 12 in. (300 mm) of cover cannot be provided, the piping shall be installed in conduit.

7.1.~~2~~ 1 .3. 2 Trenches.

The trench shall be graded so that the pipe has a firm, substantially continuous bearing on the bottom of the trench.

7.1.~~2~~ 1 .3.3 Backfilling.

Where flooding of the trench is done to consolidate the backfill, care shall be exercised to see that the pipe is not floated from its firm bearing on the trench bottom.

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Tue Sep 24 16:02:54 EDT 2024

Committee Statement

Committee Statement: The technical committee is looking at combining and renumbering these sections as they are all related to protecting underground pipe from various types of damage.

Response Message:	CI-63-NFPA 54-2024

Committee Input No. 72-NFPA 54-2024 [Chapter 8]

Chapter 8 Inspection, Testing, and Purging [See attached Word document for changes]

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.

8.1.1.4

Minor repairs and additions shall not be required to be pressure tested, provided that the work is inspected and connections are tested with a noncorrosive leak-detecting fluid or other approved leak-detecting methods.

8.1.1.5

Where new branches are installed to new appliance(s), only the newly installed branch(es) shall be required to be pressure tested.

8.1.1.6

Connections between the new piping and the existing piping shall be tested with a noncorrosive leak-detecting fluid or approved leak-detecting methods.

8.1.1.7

A piping system shall be tested as a complete unit or in sections.

8.1.1.8

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.

8.1.1.9

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.

8.1.1.10

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.

8.1.1.11*

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). 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 a listed combustible 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.

8.3.4 Abandoned Fuel Gas Piping.

Where fuel gas piping is removed from service for an indefinite time period, it shall be purged.

Supplemental Information

File Name	Description	Approved
54-2024_editorial_review_Chapter_8_V1_For_CI.docx		

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Wed Sep 25 14:18:42 EDT 2024

Committee Statement

Committee Statement: The technical committee is looking at revising chapter 8 to conform with the NFPA Manual of Style.

Response Message: CI-72-NFPA 54-2024

Chapter 8 Inspection, Testing, and Purging

8.1 Pressure Testing and Inspection.

8.1.1* General.

8.1.1.9

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.

8.1.2 Test Medium.

8.1.2.1
The test medium shall be air, nitrogen, carbon dioxide, or an inert gas.

8.1.2.2
Oxygen shall not be used as a test medium.

8.1.3.~~2~~ 3

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

8.1.3.~~3~~ 4

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.

8.1.3.5
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~~ 6

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~~ 7

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~~ 8

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.

8.1.4.2
The source of pressure shall be isolated before the pressure tests are made.

8.1.4.3
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~~ 4

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).

8.1.4.5
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~~6*

Test duration shall be not less than ½ hour for each 500 ft^3 (14 m^3) of pipe volume or fraction thereof.

Commented [AI1]: Sections not changing not shown here

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8.1.4.7
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.

8.1.4.8
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.

8.1.5.2
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~~ 3

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

8.1.5.~~3~~ 4

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.
8.2.3~~*~~ Leak Check.

8.2.3.1
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. *(See Annex C for a suggested method.)*

8.2.3.2
Where leakage is indicated, the gas supply shall be shut off until the necessary repairs have been made.

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.

~~*~~ Note: CSST EHD size of 62 is equivalent to 2 in. nominal size pipe or tubing.

8.3.1.1 Removal from Service.

8.3.1.1.1
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.

8.3.1.1.2
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.

8.3.1.2.1

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.

8.3.1.2.2
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.

8.3.1.3.1
The open end of a piping system being pressure vented or purged shall discharge directly to an outdoor location.

8.3.1.3.2
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.

8.3.1.4.1
Combustible gas indicators shall be listed and calibrated in accordance with the manufacturer's instructions.

8.3.1.4.2
Combustible gas indicators shall numerically display a volume scale from 0 percent to 100 percent in 1 percent or smaller increments.

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~~ discharged ~~to the~~ outdoors.

(2) The piping shall be purged with fuel gas and ~~shall~~ discharged ~~to the~~ indoors or outdoors through an appliance burner not located in a combustion chamber. *[See also, 8.3.2.1(3).]*

(3) ~~Such~~ The appliance burner in 8.3.2.1(2) shall be provided with a continuous source of ignition.

(~~3~~4) The piping shall be ~~both~~ purged with fuel gas and ~~shall~~ discharged ~~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~~ with the point of discharge ~~shall be~~ monitored with a listed combustible gas detector in accordance with 8.3.2.2. *[See also, 8.3.2.1(5).]*

(5) The ~~Purging~~ purging in 8.3.2.1(4) shall be stopped when fuel gas is detected.

(~~5~~6) The piping shall be purged by the gas supplier in accordance with written procedures.

8.3.2.2 Combustible Gas Detector.

8.3.2.2.1
Combustible gas detectors shall be listed and calibrated or tested in accordance with the manufacturer's instructions.

8.3.2.2.2

Combustible gas detectors shall be capable of indicating the presence of fuel gas.

Committee Input No. 73-NFPA 54-2024 [Chapter 9]

Chapter 9 Appliance, Equipment, and Accessory Installation [See attached Word document for changes to chapter 9]

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.

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

Where chemicals that generate corrosive or flammable products such as aerosol sprays are routinely used, one of the following shall apply to fired appliances where these chemicals can enter combustion air:

(1) Fired appliances shall be located in a mechanical room separate or partitioned off from other areas with provisions for combustion and dilution air from outdoors.

(2) The appliances shall be direct vent and installed 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 able 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 impairs 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 CSA/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.

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 Installation of Outdoor Appliances.

Appliances installed outdoors shall be listed for outdoor installation.

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.

9.2.1.1

All appliances shall be located with respect to building construction and other equipment so as to permit access to the appliance.

9.2.1.2

Clearances shall be maintained to permit servicing the appliance.

9.2.1.3

The passageway to and the servicing area adjacent to attic appliances shall be provided with flooring.

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).

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:

$$\text{Required Volume}_{other} \geq \frac{21\ \text{ft}^3}{ACH}\left(\frac{I_{other}}{1000\ \text{Btu/hr}}\right) \qquad \text{[9.3.2.2a]}$$

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

$$\text{Required Volume}_{fan} \geq \frac{15\ \text{ft}^3}{ACH}\left(\frac{I_{fan}}{1000\ \text{Btu/hr}}\right) \qquad \text{[9.3.2.2b]}$$

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:

(4) The ratio of the interior spaces shall be the available volume of all communicating spaces divided by the required volume.

(5) The outdoor size reduction factor shall be 1 minus the ratio of interior spaces.

(6) 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.

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. 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:

(2) An appliance shutoff valve shall be installed where the connector is attached to the building piping.

(3) The connector shall be of minimum length and shall not exceed 6 ft (1.8 m).

(4) The connector shall not be concealed and shall not extend from one room to another or pass through wall partitions, ceilings, or floors.

(5) *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:

(6) 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.

(7) 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.

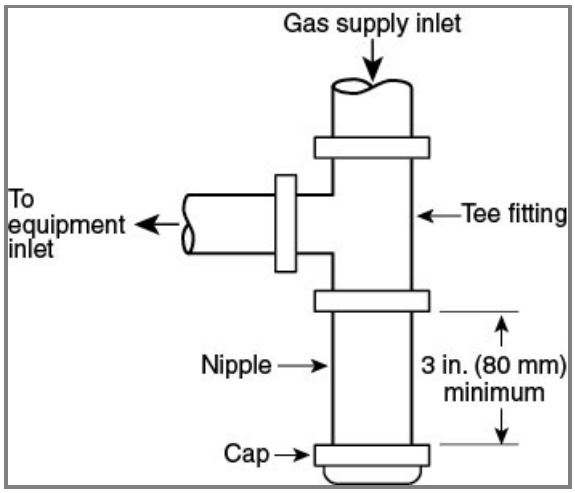
9.6.7 Gas Convenience Outlets.

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.

Figure 9.6.8 Method of Installing a Tee Fitting Sediment Trap.



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 provided 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.

Supplemental Information

File Name	Description	Approved

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Submitter Information Verification

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Committee Statement

Committee Statement: The technical committee is looking at revising chapter 9 to conform with the NFPA Manual of Style.

Response Message: CI-73-NFPA 54-2024

Chapter 9 Appliance, Equipment, and Accessory Installation

Commented [AI1]: Sections not changing not shown

9.1 General.

9.1.1.3

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

~~9.1.1.4~~
~~The unlisted appliance, equipment, or accessory and shall be recommended for the service by the manufacturer.~~

9.1.2 Added or Converted Appliances.

When additional or replacement appliances or equipment ~~is~~ are installed or an appliance is converted to gas from another fuel, the location in which the appliances or equipment ~~is~~ are to be operated shall be in accordance with the following~~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 the 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).

9.1.3.1
The appliance shall be connected to the fuel gas for which it was designed.

9.1.3.2
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.

9.1.3.3
Listed appliances shall not be converted unless permitted by, and in accordance with, the manufacturer's installation instructions.

9.1.5 Use of Air or Oxygen Under Pressure.

9.1.5.1*
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.
A.9.1.5.1
Means to prevent air or oxygen from entering the gas piping could be back pressure regulators or relief valves.

9.1.5.2
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 removal ~~safe disposal~~ shall be provided.

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.

9.1.8.3
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.

9.1.9.1
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.

9.1.9.2
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~~ flammable-~~vapor~~ vapor-ignition resistant.

9.1.10.2

~~Such a~~Appliances installed per ~~as stated in~~ 9.1.10.1 shall be located or protected so they are not subject to physical damage by a moving vehicle.

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.

(5) The terminus of the bleed line entering the combustion chamber shall be installed ~~securely held~~ in a fixed position relative to the pilot.

(6) For manufactured gas, the need for a flame arrester in the bleed line piping entering the combustion chamber shall be determined.

(~~5~~7) 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.

(8) Bleed lines shall not terminate in positive-pressure-type combustion chambers.

9.1.20* Installation Instructions.

9.1.20.1

The installer shall conform to the appliance and equipment manufacturers' recommendations in completing an installation.

9.1.20.2
The installer shall leave the manufacturers' installation, operating, and maintenance instructions on the premises.

9.1.22* Existing Appliances.

9.1.22.1
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 the following ~~9.1.22(1) through 9.1.22(6).~~ ~~follows~~:

(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.

9.1.22.2
Where the inspection in 9.1.22.1 identifies noncompliance with ~~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.
9.2.1.1

All appliances shall be located with respect to building construction and other equipment ~~so as~~ to permit access to the appliance.

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

A.9.2.2
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. (See also, NFPA 211.)

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.

9.3.1.2
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~~.~~, except as provided in 9.3.1.3.

~~Exception No. 1:~~9.3.1.3
~~This~~ The provision in 9.3.1.2 shall not apply to either ~~direct~~ direct-vent appliances ~~Exception No. 2:~~ or Type 1 clothes dryers that are provided with make-up air in accordance with 10.4.4.
~~Exception No. 2: Type 1 clothes dryers that are provided with make-up air in accordance with 10.4.4~~.

9.3.1.~~2~~ 4

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~~ 5

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

9.3.1.~~4~~ 6

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~~ 7

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.

9.3.2.1 Required Indoor Air Volume.
The required volume of indoor air shall be determined in accordance with the method in 9.3.2.~~1~~ 2 or 9.3.2.~~2~~3 *(see 9.3.2.1.1)*.

9.3.2.1.1
~~except that w~~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~~ 3 shall be used.

9.3.2.1.2
The total required volume shall be the sum of the required volume calculated for all appliances located within the space.

9.3.2.1.3
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~~4, ~~are~~ shall be considered a part of the required volume.

9.3.2.~~1~~2* Standard Method.

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

9.3.2.~~2~~3* Known Air Infiltration Rate Method.

Where the air infiltration rate of a structure is known, the minimum required volume shall be determined as follows:

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

$$\text{Required Volume}_{other} \geq \frac{21\ \text{ft}^3}{ACH}\left(\frac{I_{other}}{1000\ \text{Btu/hr}}\right)$$ **[9.3.2.~~2a~~3a]**

(2) For fan-assisted appliances, ~~calculate using~~ the following equation shall be used:

$$\text{Required Volume}_{fan} \geq \frac{15\ \text{ft}^3}{ACH}\left(\frac{I_{fan}}{1000\ \text{Btu/hr}}\right)$$ **[9.3.2.~~2b~~3b]**

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 9.3.2.2~~a~~ 3a and 9.3.2.2~~b~~3b.

9.3.2.3 ~~3~~ 4 Indoor Opening Size and Location.

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

(1) ~~(1)~~ *Combining spaces on the same story shall be in accordance with the following:~~.~~

a) 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).

b) One permanent opening shall commence within 12 in. (300 mm) of the top of the enclosure.

c) ~~and o~~One permanent opening shall commence within 12 in. (300 mm) of the bottom of the enclosure.

~~a)~~d) The minimum dimension of air openings shall not be less than 3 in. (80 mm).

(2) Where ~~Combining~~ combining spaces in different stories~~., The~~ 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), with a minimum dimension not less than 3 in. (80 mm), 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.

9.3.3.1.1
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.

9.3.3.1.2
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.

9.3.3.2.1
One permanent opening, commencing within 12 in. (300 mm) of the top of the enclosure, shall be provided.

9.3.3.2.2
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.

9.3.3.2.3

The opening shall either 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.

9.3.3.2.4
~~The openings in 9.3.3.2.3 and shall have a~~The minimum free area of the openings in 9.3.3.2.3 ~~shall be accordance with 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~~4.

(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.

(d) 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~~the required supply of combustion, ventilation, and dilution air determined using engineering methods.

9.3.8 Combustion Air Ducts.

Combustion air ducts shall comply with 9.3.8.1 through 9.3.8.~~8~~10~~1~~.

9.3.8.1

Ducts shall be constructed of galvanized steel or a material having equivalent corrosion resistance, strength, and rigidity, except as provided in 9.3.8.2.

~~Exception:~~9.3.8.2
~~-~~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~~ 3

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

9.3.8.~~3~~ 4

Ducts shall serve a single space.

9.3.8.~~4~~ 5

Ducts shall not serve both upper and lower combustion air openings where both such openings are used.

9.3.8.6
The separation between ducts serving upper and lower combustion air openings shall be maintained to the source of combustion air.

9.3.8.~~5~~ 7

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

9.3.8.~~6~~ 8

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

9.3.8.~~7~~ 9*

The remaining space surrounding a chimney liner, gas vent, special gas vent, or plastic piping installed within a masonry, metal, or ~~factory~~ factory-built chimney shall not be used to supply combustion air, ~~except as provided in 9.3.8.10~~.

A.9.3.8.~~9~~10
~~Exception: Direct~~ Direct-vent appliances designed for installation in a ~~solid~~ solid-fuel ~~-~~burning fireplace, where installed in accordance with the manufacturer's installation instructions are permitted. ~~, shall be permitted~~.

9.3.8.~~8~~ 10~~1~~

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.

9.4.2.3
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~~are provided on the exposed side.

9.4.2.~~3~~ ~~4~~5

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

9.4.2.~~4~~ ~~5~~6

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.

9.4.2.~~6~~7
~~Such~~ The platform(s) or walkway(s) ~~as stated~~required in 9.4.2.~~5~~6 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.

9.4.3.4
Scuttles and~~or~~ trapdoors shall be at least 22 in. × 24 in. (560 mm × 610 mm) in size.

9.4.3.5
Scuttles and~~or~~ trapdoors~~,~~ shall open ~~easily and safely~~ under all conditions, ~~especially~~ including snow.

9.4.3.6
Scuttles and~~or~~ trapdoors ~~, and~~ shall be constructed ~~so as~~ to permit access from the roof side unless deliberately locked on the inside.

9.4.3.7
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~~are provided on the exposed side.

9.4.3.~~8~~9
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~~ 10

Permanent lighting shall be provided at the roof access.

9.4.3.11
The switch for such lighting shall be located inside the building near the access means leading to the roof.

9.5.1.2

The passageway shall be unobstructed.

9.5.1.3
The passageway ~~and~~ shall have solid flooring not less than 24 in. (610 mm) wide from the entrance opening to the appliance.

9.5.3 Lighting and Convenience Outlet.

9.5.3.1
A permanent 120 V receptacle outlet and a luminaire shall be installed near the appliance.

9.5.3.2
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.

9.6.1.1.1
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.

9.6.1.1.2
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 Protection at Appliance Openings

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.

9.6.1.3.1
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.

9.6.1.3.2
~~Such~~ The connectors in 9.6.1.3.1 shall be listed in accordance with ANSI Z21.69/CSA 6.16, *Connectors for Movable Gas Appliances*.

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)~~9.6.1.5.1

The connector shall be installed in accordance with the tube heater installation instructions.

9.6.1.5.2
~~and~~ The connector shall be in the same room as the appliance.

~~(B)~~9.6.1.5.3

Only one connector shall be used per appliance.

9.6.2 Use of Nonmetallic Gas Hose Connectors.

Listed gas hose connectors shall be used ~~both~~ in accordance with the manufacturer's installation instructions and as follows:

(1) *Indoor.* Indoor gas hose connectors shall be ~~both~~ 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.

(c) The connector ~~and~~ shall not exceed 6 ft (1.8 m).

(~~c~~d) The connector shall ~~not~~ neither be concealed ~~and shall not~~nor 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 ~~both~~ 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) The appliance shutoff valve, listed quick-disconnect device, or listed gas convenience outlet~~This~~ connection shall be made only in the outdoor area where the appliance is to be used.

9.6.3* Laboratory Burners

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 recommended by the hose manufacturer ~~suitable and safe~~ for the ~~application~~conditions under which it can be used.

9.6.4.3

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

9.6.4.4

Where flexible connections are used, they shall be of the minimum practical length.

9.6.4.5
~~and~~Flexible connections shall not extend from one room to another or pass through any walls, partitions, ceilings, or floors.

9.6.4.6
Flexible connections shall not be used in any concealed location.

9.6.4.7
~~They~~ Flexible connections shall be protected against physical or thermal damage.

9.6.4.8
Flexible connections ~~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.

9.6.5.1
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.

9.6.5.2
Appliance shutoff valves and convenience outlets shall serve a single appliance only.

9.6.5.3
Appliance shutoff valves and convenience outlets ~~and~~ shall be installed in accordance with 9.6.5.~~1~~4.

9.6.5.~~1~~ 4

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~~ 5 ~~or~~ through 9.6.5.~~3~~7.

~~(A)~~ 9.6.5.4.1

Where a connector is used, the valve shall be installed upstream of the connector.

9.6.5.4.2
A union or flanged connection shall be provided downstream from the valve to permit removal of appliance controls.

~~(B)~~ 9.6.5.4.3

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~~ 5

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.

9.6.5.5.1~~6~~
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.

9.6.5.6~~3~~ ~~7~~

Where installed at a manifold, the appliance shutoff valve shall be located within 50 ft (15 m) of the appliance served.

9.6.5.7~~8~~
Where installed at a manifold, the appliance shutoff valve ~~and~~ shall be readily accessible and permanently identified.

9.6.5.7.1~~9~~
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.
9.6.7 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.

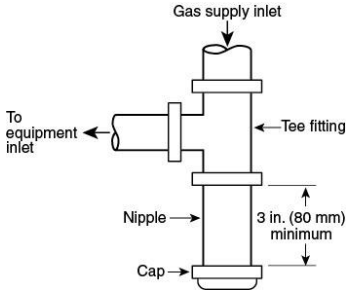
9.6.8 Sediment Trap.

9.6.8.1
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.

9.6.8.2
The sediment trap shall be either a tee fitting with a capped nipple in the bottom outlet, as illustrated in Figure 9.6.8.2, or another device recognized as a~~n effective~~ sediment trap.

9.6.8.3
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 with a sediment trap.

Figure 9.6.8.2 Method of Installing a Tee Fitting Sediment Trap.



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.

Committee Input No. 74-NFPA 54-2024 [Section No. 9.4.1]

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.

9.4.1.2

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 to service the appliance .

9.4.1.~~2~~ – 3

Roofs on which appliances are to be installed shall be either capable of supporting the additional load or ~~shall be~~ reinforced to support the additional load.

9.4.1.~~3~~ – 4

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

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Wed Sep 25 15:22:48 EDT 2024

Committee Statement

Committee Statement: The technical committee is looking at revising the multiple requirements in one section into multiple sections to comply with the NFPA Manual of Style.

Response Message: CI-74-NFPA 54-2024

Committee Input No. 75-NFPA 54-2024 [Section No. 9.6.1]

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 methods :

(1) Rigid metallic pipe and fittings.

(2) Semirigid metallic tubing and metallic fittings~~. Aluminum~~ , except aluminum alloy tubing ~~shall not be used~~ in exterior locations.

(3) A connector for gas appliances ~~listed~~ in accordance with ~~ANSI Z21~~ 9 ~~.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.~~

~~A connector~~

(4) 1.1.

(5) One connector per appliance 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.~~

(6) 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.~~ 9.6.1.2

(7) Listed nonmetallic gas hose connectors in accordance with 9.6.2.

(8) Unlisted gas hose connectors for use in laboratories and educational facilities in accordance with 9.6.3.

9.6.1.1 – Gas Connectors

Gas connectors for appliances and equipment shall meet the following requirements:

1. Be listed to ANSI Z21.24/CSA 6.10, Connectors for Gas Appliances

2. Be used in accordance with the manufacturer's installation instructions

3. Be in the same room as the appliance

4. Be limited to one per appliance

9.6.1.2 CSST used as a Connector

CSST used as a connector for appliances and equipment shall meet the following requirements:

1. Be installed in accordance with the manufacturer's installation instructions

2. Be not directly routed into a metallic appliance enclosure where the appliance is connected to a metallic vent that terminates above a roofline

3. Be connected to appliances fixed in place

9.6.1.3 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~~ – 4

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~~ – 5 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~~ – 6 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~~ 7 * 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.

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Wed Sep 25 15:34:32 EDT 2024

Committee Statement

Committee Statement:	The technical committee is looking at revising the list requirements so that all items in the list are structured similarly and requirements are moving to their own lines per the NFPA Manual of Style.
Response Message:	CI-75-NFPA 54-2024

Committee Input No. 78-NFPA 54-2024 [Chapter 10]

Chapter 10 Installation of Specific Appliances [See attached Word document for changes to chapter 10]

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.

10.2 Air-Conditioning Appliances.

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, *Gas-Fired, Work Activated 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.

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.

Table 10.2.4 Reduction of Clearances with Specified Forms of 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.
Type of protection applied to and covering all surfaces of combustible material within the distance specified as the required clearance with no protection	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	18	12	9	6	6	4	5	3	3	3

face with ventilated air space										
(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.

10.2.5 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.

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*.

10.3 Central Heating Boilers and Furnaces.

10.3.1 Application.

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 CSA/ANSI Z21.47/CSA 2.3, *Gas-Fired Central Furnaces*

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

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.

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.

Table 10.3.3.2 Clearances to Combustible Material for Unlisted Furnaces and Boilers

Appliance	Minimum Clearance (in.)					
	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

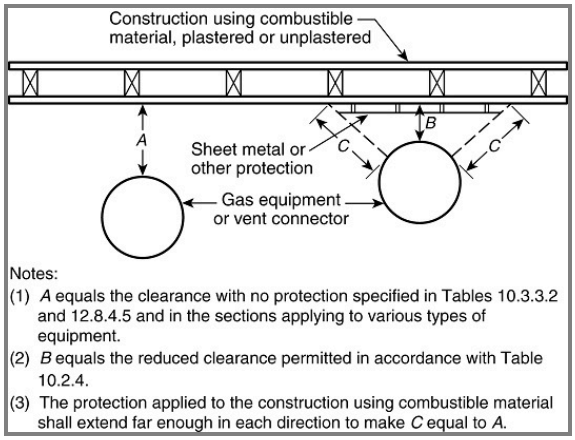
For SI units, 1 in. = 25.4 mm.

Note: See Section 10.3 for additional requirements for central heating boilers and furnaces.

10.3.3.3

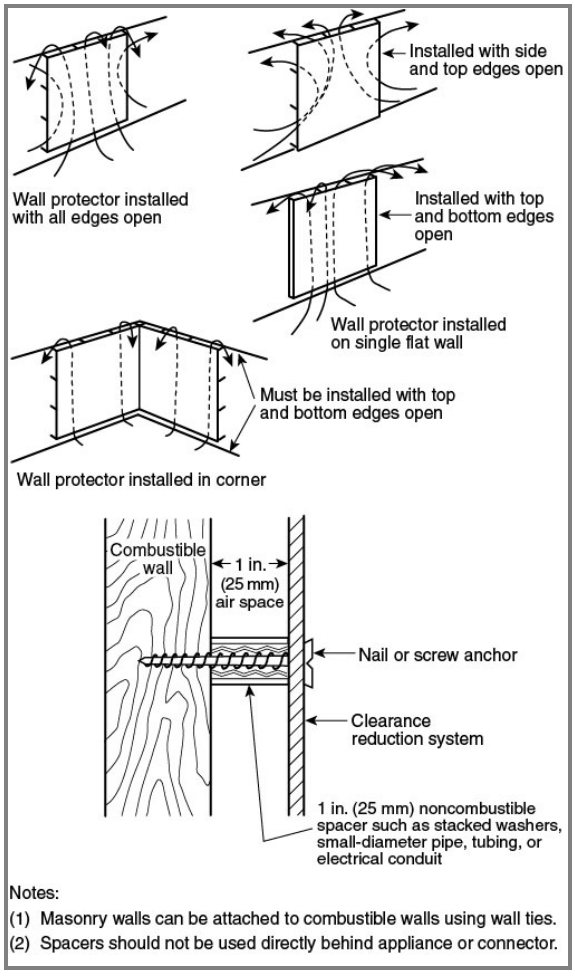
Central heating furnaces and low-pressure boilers shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material or appliance is protected as described in Table 10.2.4 and Figure 10.3.3.3(a) through Figure 10.3.3.3(c), and such reduction is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

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



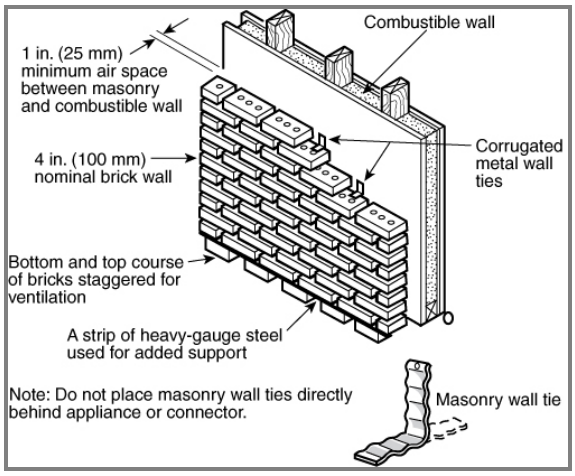
Notes:
(1) *A* equals the clearance with no protection specified in Tables 10.3.3.2 and 12.8.4.5 and in the sections applying to various types of equipment.
(2) *B* equals the reduced clearance permitted in accordance with Table 10.2.4.
(3) The protection applied to the construction using combustible material shall extend far enough in each direction to make *C* equal to *A*.

Figure 10.3.3.3(b) Wall Protector Clearance Reduction System.



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

Figure 10.3.3.3(c) Masonry Clearance Reduction System.



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. 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.

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.

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.

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*.

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.

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.

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.

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.

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*.

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.

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.

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.

10.7.1 Application.

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

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.

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.

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.

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.

10.8.5.1

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

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.

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.

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.

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.

10.9 Duct Furnaces.

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*.

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.

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.

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.

10.10.1 Application.

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

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.

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 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.

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.

10.11.2.1*

Floor-mounted food service appliances shall be installed at least 6 in. (150 mm) from combustible material with at least a 2 in. (50 mm) clearance provided between a draft hood and combustible material.

10.11.2.2

Floor-mounted food service appliances listed for installation at lesser clearances shall be installed in accordance with the manufacturer’s installation instructions.

10.11.2.3

Appliances designed and marked “For use only in noncombustible locations.” shall not be installed elsewhere.

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 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.

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.

10.12.3 Clearance for Appliances.

10.12.3.1

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.

10.12.3.2

The clearance between a food service counter appliance draft hood and combustible material shall be at least 2 in. (50 mm).

10.12.3.3

Food service counter appliances listed for installation at lesser clearances shall be installed in accordance with the manufacturer's installation instructions.

10.13 Household Cooking Appliances.

10.13.1 Application.

Household cooking appliances shall be listed in accordance with CSA/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.

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.

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.

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.

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.

10.14.3 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.

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.

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.

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 CSA/ANSI Z21.1/CSA 1.1, *Household Cooking Gas Appliances,* and installed in accordance with the manufacturer's installation instructions.

10.17.2 Protection Above Domestic Units.

10.17.2.1

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.

10.17.2.2

A clearance of at least 24 in. (610 mm) shall be maintained between the cooking top and the combustible material or metal cabinet.

10.17.2.3

The hood shall be at least as wide as the open-top broiler unit and centered over the unit.

10.17.2.4

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.

10.19 Pool Heaters.

10.19.1 Application.

Pool heaters shall be listed in accordance with CSA/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.

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.

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.

10.20.1 Application.

Refrigerators shall be listed in accordance with CSA/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.

10.21.1 Application.

Room heaters shall be listed in accordance with 10.21.1.1 or 10.21.1.2.

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 CSA/ANSI Z21.88/CSA 2.33, *Vented Gas Fireplace Heaters*.

10.21.1.2 Unvented Room Heaters.

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

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.

10.21.3 Installations in Institutions.

Room heaters shall not be installed in the following occupancies:

(1) Residential board and care

(2) Health care

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.

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.

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.

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.

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.

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.

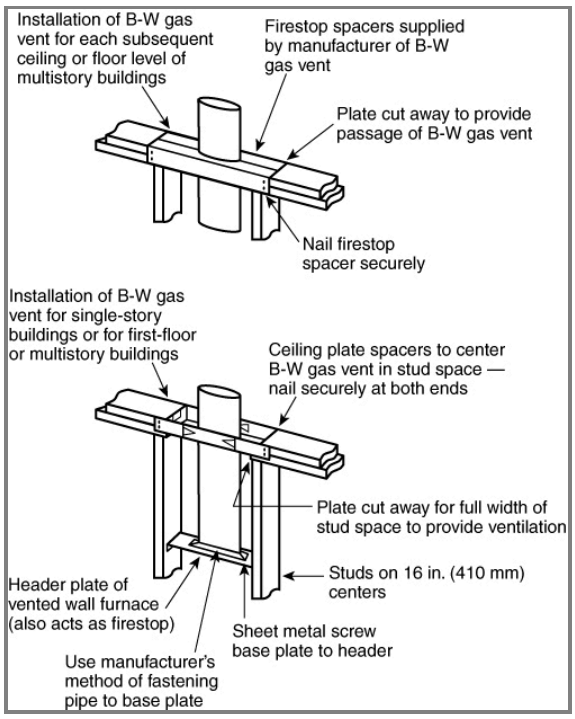
10.25.2.1

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.

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.

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



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.

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.

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.

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.

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

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.

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).

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.

Supplemental Information

File Name	Description	Approved
54-2024_editorial_review_Chapter_10_V1_Reviewed_For_CI.docx		

Submitter Information Verification

Committee: NFG-AAA

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Committee Statement

Committee Statement: The technical committee is considering changes to chapter 10 in order to conform with the NFPA Manual of Style.

Response Message: CI-78-NFPA 54-2024

Chapter 10 Installation of Specific Appliances

10.1 General.

10.1.1* Application.

10.1.1.1
Appliances shall be installed in accordance with the manufacturers' installation instructions and, as elsewhere specified in this chapter, as applicable to the appliance.

10.1.1.2
Unlisted appliances shall be installed as specified in this chapter as applicable to the appliances.

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 10.3.8.45.

10.2.3 Connection of ~~Gas~~ Gas-Engine~~—~~-Powered Air Conditioners.

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

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—n~~. N~~o clearance is necessary beyond this distance.

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	18	12	9	6	6	4	5	3	3	3

Commented [AI1]: Sections not changing are not shown

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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)
batts reinforced with wire on rear face with ventilated air space										
(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: See 10.2.4.1 through 10.2.4.13~~5~~. All clearances and thicknesses are minimums; larger clearances and thicknesses are acceptable.

~~(1)~~10.2.4.1
~~–~~Reduction of clearances from combustible materials shall not interfere with combustion air, draft hood clearance and relief, and accessibility of servicing.

~~(2)~~ 10.2.4.2
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)~~ 10.2.4.3
Spacers and ties shall be of noncombustible material *(see 10.2.4.4)*.

10.2.4.4
No spacer or tie shall be used directly opposite the appliance or connector.

~~(4)~~ 10.2.4.5
Where all clearance reduction systems use a ventilated air space~~, adequate provision for~~ air circulation shall be provided as described in Table 10.2.4.

~~(5)~~ 10.2.4.6
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)~~ 10.2.4.7
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.

10.2.4.8
~~To provide adequate air circulation, w~~Where a wall protector is installed on a single flat wall away from corners, the bottom and top edges, or only the side and top edges, or all edges shall be left open.

~~(7)~~ 10.2.4.9
Mineral wool batts (blanket or board) shall have ~~both~~ a minimum density of 8 lb/ft^3 (128 kg/m^3) and a minimum melting point of 1500°F (816°C).

~~(8)~~ 10.2.4.10
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)~~ 10.2.4.11
At least 1 in. (25 mm) shall be between the appliance and the protector.

10.2.4.12
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)~~ 10.2.4.13~~5~~
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 10.3.8.45.

10.3.2 Location.

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

(1) ~~(1)~~ Central heating furnaces and low-pressure boilers shall be installed in a closet in accordance with the following:
a) The closet is equipped with a weather-stripped door with no openings, and with a self-closing device.
~~a)~~b) All combustion air ~~shall be~~is obtained from the outdoors in accordance with 9.3.3.

(2) Central heating furnaces and low-pressure boilers shall be of the ~~direct~~ direct-vent type.

10.3.3.4

Front clearance shall allow ~~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 central heating furnaces and low-pressure boilers~~these appliances~~ shall not interfere with combustion air, draft hood clearance and relief, and accessibility for servicing.

10.3.3.7 Supply Air Duct- Listed Furnace

~~10.3.3.7.1~~
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.

10.3.3.7.1~~2~~
~~Clearance~~ The clearance in 10.3.3.7.~~1~~ shall not be required beyond the 3 ft (0.9 m) distance.

10.3.3.8 Supply Air Duct- Unlisted Furnace

~~10.3.3.8.1~~
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.

10.3.3.8.2
~~Clearance~~ The clearance in 10.3.3.8~~.1~~ shall not be required beyond the 6 ft (1.8 m) distance.

10.3.4 ~~Assembly and~~ Installation.

10.3.4.1
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:~~10.3.4.2
~~-~~Appliances listed for installation on a combustible floor shall not be required to comply with 10.3.4.1.

10.3.4.3
~~Exception No. 2:~~ A central heating boiler or furnace ~~I~~installation on a floor protected in an approved manner shall not be required to comply with 10.3.4.1.

10.3.5 Temperature~~-~~ or ~~Pressure~~ Pressure-Limiting Devices.

10.3.5.1
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.

10.3.5.2
Safety limit controls shall not be used as operating controls.

10.3.6 Low-Water Cutoff.

10.3.6.1
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.

10.3.6.2
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~~ flow-sensing device arranged to shut down the boiler when the flow rate is less than required ~~inadequate~~ to protect the boiler against overheating.

10.3.7* Steam Safety and ~~Pressure~~ Pressure-Relief Valves.

10.3.7.1
Steam and hot water boilers shall be equipped, respectively, with listed or approved steam safety or ~~pressure~~ pressure-relief valves of the required~~appropriate~~ discharge capacity in accordance with the manufacturer's instructions and conforming with ASME requirements.

10.3.7.2
A shutoff valve shall not be placed between the relief valve and the boiler or on discharge pipes between such valves and the atmosphere.

10.3.7.~~1~~ 3

Relief valves shall be piped to discharge near the floor.

10.3.7.~~2~~ 4

The entire discharge~~d~~ piping shall be at least the same size as the relief valve discharge piping.

10.3.7.~~3~~ 5

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

10.3.8.4
The method of connecting supply and return ducts shall facilitate the required ~~proper~~ circulation of air.

10.3.8.~~4~~ 5

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.

10.3.8.6
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~~ forced-air furnace where circulation of cooled air is provided by the furnace blower, unless the blower has ~~sufficient~~ the required 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.

(4) 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~~5) Means shall be provided ~~both~~ for the 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.

10.4.2 Clearance.

10.4.2.1
The installation of Type I clothes dryers shall comply with the following requirements:

(1) ~~(1) Type 1 c~~Clothes dryers shall be installed with a minimum clearance of 6 in. (150 mm) from adjacent combustible material.
(2) Clothes dryers listed for installation at reduced clearances shall be installed in accordance with the manufacturer's installation instructions.
~~(1)~~(3) ~~Type 1 c~~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.~~

10.4.2.2
The installation of Type 2 clothes dryers shall comply with the following requirements:

(1) ~~(2) Type 2 c~~Clothes dryers shall be installed with clearances of not less than those shown on the marking plate and in the manufacturer's instructions.
(2) ~~Type 2 c~~Clothes dryers designed and marked "For use only in noncombustible locations" shall not be installed elsewhere.

10.4.5.4
Transition ducts used to connect the dryer to the exhaust duct shall be ~~both~~ listed and labeled in accordance with UL 2158A, *Clothes Dryer Transition Ducts*, and installed in accordance with the clothes dryer manufacturer's installation instructions.

10.4.6.3
Exhaust~~Such~~ ducts for Type 2 clothes dryers 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~~ 4

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

10.4.6.~~4~~ 5

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

10.4.6.~~5~~ 6

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.

10.6.3 Installation.

10.6.3.1
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.

10.6.3.2
~~These appliances in 10.6.3.1~~ A decorative appliance for installation in a vented fireplace shall not be thermostatically controlled.

10.6.3.~~1~~ 3

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

10.6.3.~~2~~ 4

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

10.7.2* Prohibited Installations.

10.7.2.1
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.

10.7.2.2
~~Exception: Direct~~ Direct-vent gas fireplaces shall not be required to comply with 10.7.2.1.

10.7.3 Installation.

The installation of vented gas fireplaces shall comply with the following requirements:

(1) ~~(1)~~ Vented gas fireplaces shall be installed in accordance with the manufacturer's installation instructions.

~~(1)~~(2) ~~and w~~Where installed in or attached to combustible material, the vented gas fireplace shall be ~~specifically~~ listed for such installation.

(~~2~~3) Panels, grilles, and access doors that are required to be removed for normal servicing operations shall not be attached to the building.

(~~3~~4) ~~Direct~~ Direct-vent gas fireplaces shall be installed with the vent air intake terminal in the outdoors and in accordance with the manufacturer's instructions.

10.8 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*.

10.8.2.2

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

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~~4.

10.8.5.3
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.

10.8.5.~~3~~ 4

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.

10.8.6.1
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.

~~10.8.6.2~~
~~Means shall be employed on these lines, reliefs, or bleeds~~ and be designed to prevent water from entering and to prevent blockage from insects and foreign matter.

10.8.6.~~2~~3
An atmospheric vent line shall not be required to be provided on a valve train component equipped with a listed vent limiter.

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.

10.8.7.3
Where motorized dampers or closable louvers are used, they shall be proved to be in their open position prior to main burner operation.

10.9.2 Clearances.

10.9.2.1
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.

10.9.2.2
Duct furnace clearances ~~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.

10.9.5 Location of Draft Hood and Controls.

10.9.5.1

The controls, combustion air inlet, and draft hoods for duct furnaces shall be located outside the ducts.

10.9.5.2
The draft hood shall be located in the same enclosure from which combustion air is taken.

10.9.6 Circulating Air.

10.9.6.1
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.

10.9.6.2
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, except as provided by 10.9.7.2.

10.9.7.2
~~Exception:~~ A duct furnace shall be permitted to be installed in conjunction with a refrigeration coil ~~W~~where the blower has ~~sufficient~~ the required capacity to overcome the external static resistance imposed by the duct system, the furnace, and the cooling coil and the air throughput is necessary for heating or cooling, whichever is greater.

10.9.7.~~2~~ 3

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.

10.9.7.4
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, except as provided by 10.9.7.5.

10.9.7.5
~~Exception:~~ Where the duct furnace has been ~~specifically~~ listed for downstream installation, 10.9.7.4 shall not apply.

10.9.7.~~3~~6*

Where a duct furnace is installed downstream of an evaporative cooler or air washer, the heat exchanger shall be constructed of corrosion-resistant materials.

10.9.7.7
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.

10.10.5 Placement.

The following ~~provisions~~shall 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.* Floor furnaces installed near walls and corners shall be in accordance with the following:~~

(3) 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.

(4) A distance of at least 18 in. (460 mm) from two adjoining sides of the floor furnace register to walls shall be provided with the remaining sides being at least 6 in. (150 mm) from a wall. ~~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.~~

(53) ~~*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.

10.10.8 Clearance.

10.10.8.1
The lowest portion of the floor furnace shall have at least a 6 in. (150 mm) clearance from the ~~general~~ ground level.

10.10.8.2
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.

10.10.8.3
Where these clearances in 10.10.8.1 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.

10.10.8.4
A 12 in. (300 mm) clearance shall be provided on all sides except the control side.

10.10.8.5
~~, which~~The control side shall have an 18 in. (460 mm) clearance.

10.10.10 Seepage Pan.

10.10.10.1
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 corrosion-resistant ~~suitable~~ material shall be used, unless ~~adequate~~ drainage is provided or the appliance is sealed by the manufacturer to meet this condition.

10.10.10.2
A copper pan shall be made of not less than 16 oz/ft^2 (4.9 kg/m^2) sheet copper.

10.10.10.2.1
The ~~copper~~ pan shall be anchored in place to prevent floating.

10.10.10.2.2
~~, and t~~The walls of the ~~copper~~ pan 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~~ and 18 in. (460 mm) ~~clearance~~on the control side.

10.10.12 Upper Floor Installations.

10.10.12.1
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.

10.10.12.2
In ~~such~~ the installations in 10.10.12.1, the floor furnace shall be enclosed completely (i.e., 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.

10.10.13.1
Floor furnaces installed in the first or ground floors of buildings shall not be required to be enclosed.

10.10.13.2
~~unless~~Where the basements of ~~these~~ buildings have been converted to apartments or sleeping quarters, ~~in which case~~ the floor furnace shall be enclosed as specified in 10.10.12.

10.10.13.3
The enclosure required by 10.10.13.2 ~~for upper floor installations and~~ shall project into a nonhabitable space.

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) ~~(1)~~ The appliance shall be installed in accordance with 10.11.4.

~~(1)~~(2) 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.

(3) ~~(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, the following shall apply:

a) ~~i~~The appliance~~t~~ shall be permitted to be installed on combustible floors, provided the floor under the appliance is protected with not less than 3/8 in. (9.5 mm) insulating millboard covered with sheet metal not less than 0.0195 in. (0.5 mm) thick.

~~a)~~b) 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, the following shall apply:

(a) ~~i~~The appliance 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.

(b) ~~Such m~~Masonry courses as described in 10.11.3.2(3)(a) 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 3/16 in. (4.8 mm) in thickness.

10.11.4.2

~~Such~~The construction ~~as~~ described in 10.11.4.1 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.

10.11.5.1
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.

10.11.5.2
Reduced combustible material clearances ~~are~~ shall be permitted where protected in accordance with Table 10.2.4.

10.11.6 Use with Casters.

Floor-mounted appliances with casters shall be both 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.

10.11.8* 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.

10.13.3 Clearances.

10.13.3.1
Floor-mounted household cooking appliances, where installed on combustible floors, shall be set on their own bases or legs.

10.13.3.2
Floor-mounted household cooking appliances ~~and~~ shall not interfere with combustion air, accessibility for operation, and servicing.

10.13.3.~~1~~3* Vertical Clearance Above Cooking Top.

10.13.3.3.1
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.

10.13.3.3.2
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 1/4 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 1/4 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.

10.14.2 Clearances for Unlisted Appliances.
10.14.2.1 Enclosed ~~-~~ Type.

Clearance for enclosed-type illuminating appliances 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 for open-flame-type illuminating appliances shall comply with the following:

(1) ~~(1)~~ Unlisted open-flame illuminating appliances installed outdoors shall have clearances in accordance with the following:
a) ~~f~~Clearance from combustible material shall not be less than that specified in Table 10.14.2.2.
b) 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.
~~a)~~c) 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 maintains 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.

(4) Appliances designed for flame heights in excess of 30 in. (760 mm) ~~Such appliances~~ shall be equipped with a safety shutoff device or automatic ignition.

(~~4~~5) Clearances to combustible material from unlisted open-flame illuminating appliances shall be approved.

10.14.4 Installation on Posts.

10.14.4.1
Illuminating appliances designed for installation on a post shall be ~~securely and rigidly~~ attached to a ~~rigid~~ post in accordance with the manufacturer's instructions.

~~10.14.4.2~~

~~Posts Rigid posts shall be rigidly installed.~~

10.14.4.~~2~~3
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~~NPS (25 DN) Schedule 40 steel pipe.

10.14.4.~~3~~4
Posts 3 ft (0.9 m) or less in height shall not be smaller than a ¾ in. NPS (20 DN)~~-~~ Schedule 40 steel pipe.

10.14.4.~~4~~5
Drain openings shall be provided near the base of posts where water collecting inside the posts is possible.

10.16.2 Support.

10.16.2.1
Suspended-type infrared heaters shall be fixed in position independent of gas and electric supply lines.

10.16.2.2
Hangers and brackets for infrared heaters shall be of noncombustible material.

10.16.2.3
~~Heaters~~ Infrared heaters subject to vibration shall be provided with vibration-isolating hangers.

10.16.3 Clearance.

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

(1) Listed infrared heaters shall be installed with clearances from combustible material in accordance with the manufacturer's installation instructions.

(2) Unlisted infrared 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 infrared heater to the combustibles.

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 ~~both~~ 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 CSA/ANSI Z21.1/CSA 1.1, *Household Cooking Gas Appliances,* and installed in accordance with the manufacturer's installation instructions.

10.17.2.3

The hood shall be at least as wide as the open-top broiler unit and centered over the unit.

10.17.2.4

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~~3.2(1).

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.

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~~ 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~~ pressure-relief valve shall be installed either in the heater or between the heater and the restrictive device.

10.20.2 Clearance.

10.20.2.1
Refrigerators shall be ~~provided~~ installed with clearances for ventilation at the top and back in accordance with the manufacturers' instructions.

10.20.2.2
Where manufacturers'~~such~~ instructions are not available, clearance shall be provided of 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.

10.21.2* Prohibited Installations.

Unvented room heaters shall not be installed in bathrooms or bedrooms, except as provided in 10.21.2.1 and 10.21.2.2.

~~Exception No. 1:~~10.21.2.1
~~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.~~

10.21.2.2
~~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.

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.

10.22.1
The installation of gas engines shall conform to NFPA 37.

10.22.~~1~~ 2

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 following:

1. manufacturer's installation instructions~~,~~
2. clearance for use ~~provided that the clearance is in any case sufficient to affords~~ ready ~~accessibility for~~ use,
3. clearance for cleanout

~~2.4. , and necessary~~ clearance for servicing~~.~~

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.
10.24.3 Clearance for Suspended-Type Unit Heaters.

Suspended-type unit heaters shall meet the following requirements:

(1) ~~(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.

~~(1)~~(2) A unit heater listed for reduced clearances shall be installed in accordance with the manufacturer's installation instructions.

(~~2~~3) Clearances for servicing shall be in accordance with the manufacturers' installation instructions.

10.25.2.2
Wall furnaces installed in or attached to combustible material shall be listed for such installation.

10.25.2.~~2~~ 3

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.

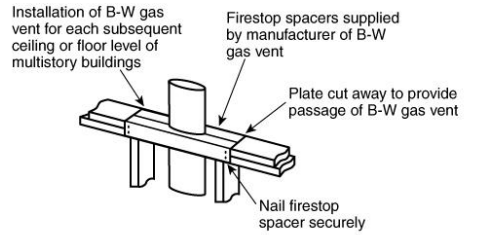
10.25.2.4
Vented wall furnaces connected to a Type B-W gas vent system listed for installation in multistory buildings shall be permitted to be installed in single-story or multistory buildings.

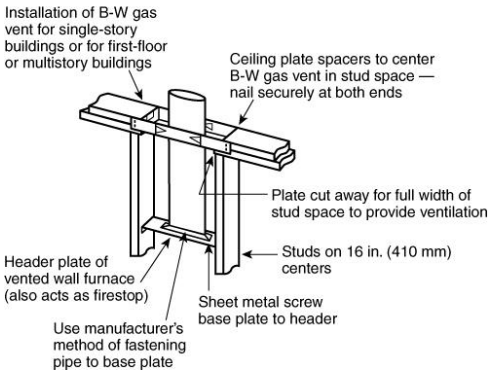
10.25.2.5
Type B-W gas vents shall be attached directly to a solid header plate that serves as a firestop at that point and ~~that shall be~~ permitted to be an integral part of the vented wall furnace, as illustrated in Figure 10.25.2.~~2~~5.

10.25.2.6
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.

10.25.2.7
Firestop spacers shall be installed at each subsequent ceiling or floor level penetrated by the vent.

Figure 10.25.2.~~2~~ 5 Installation of Type B-W Gas Vents for Vented Wall Furnaces.





10.25.2.~~3~~ 8

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

10.25.2.~~4~~ 9

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.

10.25.3.1
Wall furnaces shall be located so as not to cause a hazard to walls, floors, curtains, furniture, or doors.

10.25.3.2
Wall furnaces installed between bathrooms and adjoining rooms shall not circulate air from bathrooms to other parts of the building.

10.26 Water Heaters.
10.26.2 Installation in Bedrooms and Bathrooms~~Location~~.

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

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

(2) ~~Water~~ The water heater shall be of the ~~direct~~ direct-vent type.

10.26.3 Clearance.

10.26.3.1
The clearances shall not be such as to interfere with combustion air, draft hood clearance and relief, and accessibility for servicing.

10.26.3.2
Listed water heaters shall be installed in accordance with the manufacturer's installation instructions.

10.26.4 ~~Pressure~~ Pressure- Relief Devices.

10.26.4.1
A water heater installation shall be ~~both~~ 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.

10.26.4.2
The pressure setting of the device shall exceed the water service pressure *(see 10.26.4.3).*

10.26.4.3
The pressure setting of the device ~~and~~ shall not exceed the maximum pressure rating of the water heater.

10.26.5 ~~Temperature~~ Temperature- Limiting Devices.

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

10.26.6 Temperature, Pressure, and Vacuum Relief Devices.

10.26.6.1
Temperature-, pressure-, and ~~vacuum~~ vacuum- relief devices, or combinations thereof, and automatic ~~gas~~ gas- shutoff devices shall be installed in accordance with the manufacturer's installation instructions.

10.26.6.2
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.

10.26.6.3
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 the required~~sufficient~~ pressure to ~~properly~~ operate the control when water is drawn from the highest faucet served by the heater.

10.27 Compressed Natural Gas (CNG) Vehicular Fuel Systems.

10.27.1
The installation of compressed natural gas (CNG) fueling (~~i.e.,~~ dispensing) systems shall be in accordance with NFPA 52.

10.27.2
Residential CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.1, *Residential Fueling Appliances*, and installed in accordance with~~to~~ the appliance manufacturer's installation instructions.

10.27.3
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.

10.28.1
Appliances installed in manufactured housing after the initial sale shall be listed for installation in manufactured housing, or approved.

10.28.2
~~, and~~Appliances shall be installed in accordance with the requirements of this code and the manufacturers' installation instructions.

10.28.3

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.

10.29.1
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.

10.29.2
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~~ Open-Flame Decorative Appliances.

Permanently fixed in place, outdoor ~~open~~ open-flame decorative appliances shall be installed in accordance with 10.30.1 through 10.30.2.

10.30.1 Application.

10.30.1.1
Outdoor ~~open~~ open-flame decorative appliances shall be listed in accordance with ANSI Z21.97/CSA 2.41, *Outdoor Decorative Gas Appliances*.

10.30.1.2
Outdoor open-flame decorative appliances ~~, and~~ shall be installed in accordance with the manufacturer's installation instructions.

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).

10.31 Outdoor Infrared Heaters.

10.31.1
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*.

10.31.2
Outdoor infrared heaters for residential and commercial applications ~~, and~~ shall be installed in accordance with the manufacturer's installation instructions.

Committee Input No. 79-NFPA 54-2024 [Chapter 11]

Chapter 11 Procedures to Be Followed to Place Appliance in Operation [See attached Word document for changes to chapter 11]

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.

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 under the following conditions:

(1) The building or structure envelope is complete and intact.

(2) All combustion air systems and openings are in place.

(3) All air-exhausting appliances, power-vented appliances, and exhaust fans are operating.

(4) All air-moving equipment used for heating, cooling, or ventilation is operating.

(5) The draft hood spillage test is conducted only after all of the conditions in 11.6(1) through 11.6(4) are established.

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.

Supplemental Information

File Name	Description	Approved
54-2024_editorial_review_Chapter_11_V1_Reviewed_For_CI.docx		

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Wed Sep 25 16:10:55 EDT 2024

Committee Statement

Committee Statement: The technical committee is considering the changes to chapter 11 to conform with the NFPA Manual of Style.

Response Message: CI-79-NFPA 54-2024

Chapter 11 Procedures to Be Followed to Place Appliance in Operation

11.1 Adjusting the Burner Input.

11.1.1* Adjusting Input.

11.1.1.1*
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.~~

A.11.1.1.1~~.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).

11.1.1.1.1~~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

11.1.1.2
Firing at a rate in excess of the nameplate rating shall be prohibited.

11.1.1.3

Overfiring shall be prohibited.

11.1.2 High Altitude.

11.1.2.1
Gas input ratings of appliances shall be used for elevations up to 2000 ft (600 m).

11.1.2.2
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.

11.2.1
The primary air for injection ~~(i.e., Bunsen)~~-type (Bunsen) burners shall be adjusted for ~~proper~~ flame characteristics in accordance with the appliance manufacturer's instructions.

11.2.2
After setting the primary air, the adjustment means shall be secured in position.

11.3 Safety Shutoff Devices.

11.3.1
Where a safety shutoff device is provided, the safety shutoff device~~it~~ shall be checked for operation within the parameters provided by the manufacturer ~~for proper operation~~ and adjusted~~tment~~ in accordance with the appliance manufacturer's instructions.

11.3.2
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.

11.4.1

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Appliances supplied with means for automatic ignition shall be checked for operation within the parameters provided by the manufacturer.

11.4.2
Any adjustments to the automatic ignition made shall be in accordance with the manufacturer's installation instructions.

11.5 Protective Devices.

11.5.1
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.

11.5.2
Any adjustments made to protective devices furnished with the appliance 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 under the following conditions:

(1) The building or structure envelope is complete and intact.

(2) All combustion air systems and openings are in place.

(3) All air-exhausting appliances, power-vented appliances, and exhaust fans are operating.

(4) All air-moving equipment used for heating, cooling, or ventilation is operating.

(5) The draft hood spillage test is conducted only after all of the conditions in 11.6(1) through 11.6(4) are established.

11.7 Operating Instructions.

11.7.1
Operating instructions shall be furnished.

11.7.2
Operating instructions ~~and~~ shall be left ~~in a prominent position near~~in a readily accessible location ~~the appliance~~ for use by the consumer.

Committee Input No. 80-NFPA 54-2024 [Chapter 12]

Chapter 12 Venting of Appliances [See attached Word document for proposed changes to chapter 12]

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 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 an appliance is installed as stated in 12.3.2(5), 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.

12.3.2.2

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).

12.3.2.3

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.

12.3.5 Direct Vent Appliances.

12.3.5.1

Listed direct vent appliances shall be installed in accordance with the manufacturer’s installation instructions.

12.3.5.2

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

12.3.6 Appliances with Integral Vents.

Appliances incorporating integral venting means shall be installed in accordance with 12.9.1.

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.

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	12.6.1.4
	-	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	Chimney	12.6	
Combination gas- and solid fuel–burning appliances			
Appliances listed for use with chimneys only			
Unlisted appliances			
Listed combination	Type L vent	12.7	

Appliances	Type of Venting System	Location of Requirements	
gas- and oil-burning appliances	Chimney	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

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*.

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.

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.

12.6.1.1

Factory-built chimneys shall be listed in accordance with UL 103, *Factory-Built Chimneys for 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.

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.

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.

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.

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.

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:

(2) 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 .

(3) 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.

(4) Industrial appliances as provided in 12.3.4 .

(5) Direct vent systems as provided in 12.3.5 .

(6) Appliances with integral vents as provided in 12.3.6 .

(7) Mechanical draft systems as provided in 12.4.3 .

(8) Ventilating hoods and exhaust systems as provided in 12.4.4 .

(9) 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.

(10) 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.

(11) 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.

(12) 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.

(13) All gas vents shall extend through the roof flashing, roof jack, or roof thimble and terminate with a listed cap or listed roof assembly.

(14) A gas vent shall terminate at least 3 ft (0.9 m) above a forced air inlet located within 10 ft (3.0 m).

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.

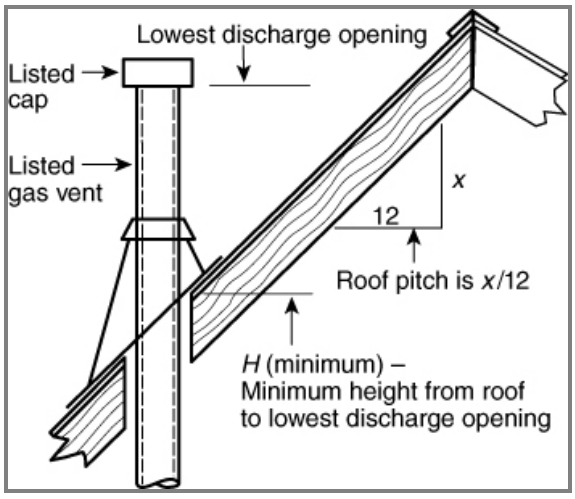


Table 12.7.3 Roof Slope Heights

Roof Slope	*H* (minimum)	
	ft	m
Flat to 6/12	1.0	0.30

Roof Slope	*H* (minimum)	
	ft	m
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

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.

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.

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.

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:

(2) For a draft hood–equipped appliance, in accordance with Chapter 13 .

(3) 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.

(4) Approved engineering methods.

(5) 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).

(6) 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.

12.9.1

The clearance for through-the-wall direct vent and non-direct 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.

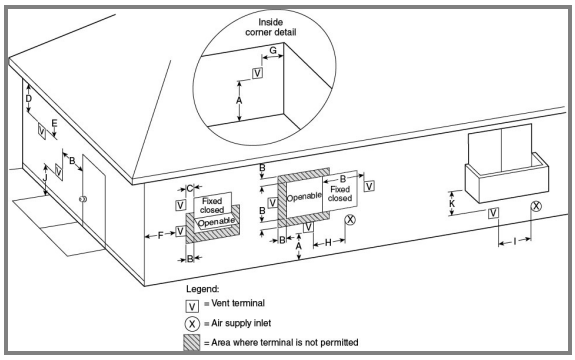
Table 12.9.1 Through the Wall Vent Terminal Clearances

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 - - -	4 ft below or to side of opening or 1 ft above opening 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
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	10 ft horizontally from inlet or 3 ft above inlet	

Figure Clearance	Clearance Location	Minimum Clearances for Direct Vent Terminals	Minimum Clearances for Non-Direct Vent Terminals
	supply 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.

Figure 12.9.1 Through the Wall Vent Terminal Clearances.



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.

12.10 Condensation Drain.

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.

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:

(2) Type B or Type L vent material

(3) Galvanized sheet steel not less than 0.018 in. (0.46 mm) thick

(4) Aluminum (1100 or 3003 alloy or equivalent) sheet not less than 0.027 in. (0.69 mm) thick

(5) Stainless steel sheet not less than 0.012 in. (0.31 mm) thick

(6) 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)

(7) A listed vent connector

(8) 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.

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.

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 12.11.2.5 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.

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.

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.

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.

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

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.

12.11.11 Chimney Connection.

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.

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.

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.

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.

12.14 Manually Operated Dampers.

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.

12.14.2*

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

12.14.3

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

12.15 Automatic Vent Damper.

An automatic vent damper shall be listed.

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

Supplemental Information

File Name	Description	Approved
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Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Wed Sep 25 16:21:07 EDT 2024

Committee Statement

Committee Statement:	The technical committee is thinking of the proposed revisions to chapter 12 to conform with the NFPA Manual of Style.
Response Message:	CI-80-NFPA 54-2024

Chapter 12 Venting of Appliances

12.2 General.

12.2.1 Installation.

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

12.3.2 Appliances Not Required to Be Vented.

The following appliances shall not be required to be vented:

(1) Listed ranges

(2) Built-in 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~~ where 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. *(See also, 12.3.2.1.)* ~~[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

12.3.2.3

Where the calculation ~~stated~~ in 12.3.2.2 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.

12.3.5.2

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

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 the appliance and the mechanical draft system manufacturer's installation instructions.

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: (1) the damper is open to a position to ~~properly~~ vent the appliance and (2) when the power means of exhaust is in operation. *(See also, A.12.3.3.)*

Commented [AI1]: Sections not changing are not shown

Commented [AI2R1]: Create CI

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 non-ducted portion of an air-handling system, it shall conform to one of the following requirements:

(1) The venting system shall be a listed special gas vent, other system serving a Category III or Category IV appliance, or other ~~positive~~ 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.

12.5.2 Plastic Piping.

12.5.2.1
Where plastic piping is used to vent an appliance, both of the following shall apply:

(1) ~~the~~ The appliance shall be listed for use with such venting materials.
(2) ~~and t~~The appliance manufacturer's installation instructions shall identify the specific plastic piping material.

12.5.2.2
The plastic pipe venting materials shall be either 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*.

12.5.3 Plastic Vent Joints.

12.5.3.1
Plastic pipe and fittings used to vent appliances shall be installed in accordance with the appliance manufacturer's installation instructions.

12.5.3.2
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.

12.5.3.3
Where primer is required, it shall be of a contrasting color.

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.

12.6.1.2
Factory-built chimneys used to vent appliances that operate at positive vent pressure shall be listed for such application.

12.6.1.~~2~~ 3

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

12.6.1.~~3~~4* Masonry Chimneys.

12.6.1.4.1
Masonry chimneys shall be built and installed in accordance with NFPA 211.

12.6.1.4.2

Masonry chimneys ~~and~~ shall be 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:~~12.6.1.4.3
~~-~~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.

12.6.1.4.3.1
The liner shall be installed in accordance with the liner manufacturer's installation instructions.

12.6.1.4.3.2
A permanent identifying label shall be attached at the point where the connection is to be made to the liner.

12.6.1.4.3.3
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."

12.6.3 Size of Chimneys.
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 listed in Chapter 13 or other engineering 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.~~

12.6.3.2

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.

12.6.3.3
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.

12.6.3.4
Chimney venting systems using mechanical draft shall be sized in accordance with 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.

12.6.4.2
The chimney passageway ~~and~~ shall be cleaned if previously used for venting solid- or ~~liquid~~ liquid-fuel~~-~~-burning appliances or fireplaces.

12.6.4.~~2~~ 3

Chimneys shall be lined in accordance with NFPA 211.

12.6.4.~~3~~ 4

Cleanouts shall be examined.

12.6.4.5
~~and w~~Where cleanouts ~~they~~ do not remain ~~tightly~~ closed and gastight when not in use, they shall be repaired or replaced.

12.6.4.~~4~~ 6

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.

12.6.4.7
Vents and chimneys shall be designed ~~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~~ liquid-fuel~~-~~-burning appliances, the appliances shall be either connected through separate openings or connected through a single opening where joined by a ~~suitable~~ fitting located as close as practical to the chimney.

12.6.5.3
Where two or more openings are provided into one chimney flue, they shall be at different levels.

12.6.5.4
Where the gas appliance is automatically controlled, it shall be equipped with a safety shutoff device.

12.6.5.~~3~~5*

A listed combination gas- and ~~solid~~ 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.

12.6.5.6
The chimney flue shall be sized to ~~properly~~ vent the appliance.

12.6.5.~~4~~ 7

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.

12.6.6.1
All portions of chimneys shall be supported for the design and weight of the materials employed.

12.6.6.2
Listed factory-built chimneys shall be supported and spaced in accordance with the manufacturer's installation instructions.

12.6.7 Cleanouts.

12.6.7.1
Where a chimney that formerly carried flue products from liquid- or ~~solid~~ solid-fuel~~-~~-burning appliances is used with an appliance using fuel gas, an accessible cleanout shall be provided.

12.6.7.2

The cleanout shall have a tight-fitting cover.

12.6.7.3
~~and~~The cleanout shall 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, except as provided in 12.6.8.2.

~~Exception:~~12.6.8.2
~~-~~The insertion of another liner or vent within the chimney shall be permitted as provided in this code and the liner or vent manufacturer's instructions.
12.6.8.~~2~~ 3

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

~~Exception:~~12.6.8.4
~~Direct~~ Direct-vent appliances designed for installation in a ~~solid~~ solid-fuel-~~-~~burning fireplace shall be permitted where installed in accordance with the manufacturer's installation instructions.

12.6.9 Insulation Shield.

12.6.9.1
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.

12.6.9.2
The clearance shall not be less than the clearance to combustibles specified by the chimney manufacturer's installation instructions.

12.6.9.3
Where chimneys pass through attic space, both of the following shall apply:

(1) ~~the~~ The shield shall terminate not less than 2 in. (51 mm) above the insulation materials.
~~(1)~~(2) ~~and~~The shield shall be secured in place to prevent displacement.

12.7 Gas Vents.
12.7.1 Materials.

12.7.1.1
Type B and Type BW gas vents shall be listed in accordance with UL 441, *Gas Vents*.

12.7.1.2
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.

(4) Gas vents installed within masonry chimneys shall be identified with a permanent label installed at the point where the vent enters the chimney.

(5) The label required in 12.7.2(4) shall contain the following language: "This gas vent is for appliances that burn gas. Do not connect to solid- or ~~liquid~~ liquid-fuel~~-~~ burning appliances or incinerators."

(~~4~~6) 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) Above the roof in accordance with Figure 12.7.3 and Table 12.7.3~~Gas~~ for 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) Not less than 2 ft (0.6 m) above the highest point where the vents 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~~Gas~~ for 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.

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 sizing shall comply with 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~~ The sizing shall comply with ~~accepted~~ engineering methods.

12.7.4.2 Vent Offsets.

12.7.4.2.1
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. *(See 12.7.4.2.2.)*

12.7.4.2.2
~~, except that a~~A vent system having not more than one ~~60~~ 60-degree offset shall be permitted.

12.7.4.2.3
Any angle greater than 45 degrees from the vertical ~~is~~ shall be considered horizontal.

12.7.4.2.4
The total horizontal distance of a vent plus the horizontal vent connector serving ~~draft~~ 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.

12.7.4.3.1
The sizing of gas vents for Category II, Category III, and Category IV appliances shall be in accordance with the appliance manufacturers' instructions.

12.7.4.3.2
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.

12.7.5.2
Crawl spaces, basements, and attics shall be considered as floor levels.

12.7.5.~~2~~3*

All appliances connected to the common vent shall be located in rooms separated from occupiable space.

12.7.5.4
Each ~~of these~~ room~~s~~ separated from occupiable space shall have provisions for ~~an adequate~~the required supply of combustion, ventilation, and dilution air that is not supplied from the occupiable space.

12.7.5.~~3~~ 5

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~~ is 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.

12.7.7 Marking.

12.7.7.1
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.

12.7.7.2
The label required in 12.7.7.1 shall read: "This gas vent is for appliances that burn gas. Do not connect to solid or liquid fuel–burning appliances or incinerators."

12.7.7.3
The authority having jurisdiction shall determine whether its area constitutes such a locality stated in 12.7.7.1.

12.8.4.3
A pipe passing through a roof shall extend without interruption through the roof flashing, roof jacket, or roof thimble.

12.8.4.~~3~~ 4

Single-wall metal pipe shall ~~not~~ neither originate in any unoccupied attic or concealed space ~~and shall not~~nor pass through any attic, inside wall, concealed space, or floor.

12.8.4.~~4~~ 5

Minimum clearances from single-wall metal pipe to combustible material shall be in accordance with Table 12.8.4.~~4~~5.

~~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~~ 5 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.~~See 12.8.4.6.

12.8.4.6
The clearances specified in Table 12.8.4.5 shall apply unless the installation instructions of a listed appliance or connector specify different clearances.

12.8.4.7

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

12.8.4.5 8

Where a single-wall metal pipe passes through a roof constructed of combustible material, a noncombustible, non-ventilating thimble shall be used at the point of passage.

12.8.4.8.1
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.

12.8.4.8.2
The thimble shall be sized in accordance with 12.8.4.69.

12.8.4.6 9

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) (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.

(1)(2) For listed appliances with draft hoods and appliances listed for use with Type B gas vents, and Wwhere 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.

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

(34) 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.~~

~~Exception:~~ 12.8.4.10

~~In lieu of~~Where a thimble ~~protection~~is not installed, the following shall ~~be required~~apply:

(1) ~~a~~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.
(2) Any material used to close up such an opening as required in 12.8.4.10(1) 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 ~~both~~ in accordance with one of the following methods and the appliance manufacturer's instructions:

(a) For a ~~draft~~ draft-hood~~-~~equipped appliance, in accordance with Chapter 13~~.~~

(b) For a venting system for a single appliance with a draft hood, in accordance with the following:

i. ~~the~~ 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.
~~i.~~ii. The vent area shall not be greater than seven times the draft hood outlet area.

(c) Approved engineering methods~~.~~

(2) Where a single-wall metal pipe is used and has a shape other than round, the following shall apply:

i. ~~it~~ The pipe shall have an equivalent effective area equal to the effective area of the round pipe for which it is substituted.

~~i.~~ii. ~~and t~~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.

12.9 Through-the-Wall Vent Termination.

12.9.1

The clearance for through-the-wall ~~direct~~ direct-vent and non-~~direct~~ direct-vent terminals shall be in accordance with Table 12.9.1 and Figure 12.9.1, except as provided in 12.9.2.

~~Exception:~~12.9.2

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

12.9.~~2~~ 3

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~~ 4

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. *(See 12.9.5.)*

~~Exception:~~12.9.5

~~This~~ The requirement in 12.9.4 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.

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 designed ~~of sufficient thickness~~ to withstand anticipated 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. *(See 12.11.2.3.)*

12.11.2.3

~~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 shall be permitted.

12.11.2.~~3~~ 4

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

(1) Vent connectors for listed appliances having draft hoods, for appliances having draft hoods and equipped with listed conversion burners, and for 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~~4(1)(b), 12.11.2.~~3~~4(1)(c), or 12.11.2.~~3~~4(1)(d)

(f) A listed vent connector

(2) Vent connectors shall not be covered with insulation, except as provided in 12.11.2.4(3).

~~Exception:~~

(3) Listed insulated vent connectors shall be installed in accordance with the manufacturer's installation instructions.

12.11.2.~~4~~ 5

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~~5.

12.11.2.6

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

Table 12.11.2.~~4~~ 5 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.

12.11.2.~~5~~ 7

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~~7.

12.11.2.8

Vent connectors for medium-heat appliances~~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 required in 12.11.2.8(1) 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 required in 12.11.2.8(1) 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.~~5~~ 7 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.

12.11.3.2

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.

12.11.3.3

Where there are no instructions, the manifold shall be designed and constructed in accordance with engineering methods.

12.11.3.4
As an alternative method, the effective area of the manifold shall be in accordance with the following:

(1) The effective area shall be equal to the combined area of the flue collars or draft hood outlets.

~~(1)~~(2) ~~, and t~~The vent connectors shall have a minimum 1 ft (0.3 m) rise.

12.11.3.~~3~~ 5
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~~ 6
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.
12.11.3.~~5~~ 7
Where two or more appliances are vented through a common vent connector or vent manifold, the common vent connector or vent manifold shall be ~~both~~ 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~~ 8
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~~ 9
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.
12.11.5 Clearance.
12.11.5.1
Minimum clearances from vent connectors to combustible material shall be in accordance with Table 12.8.4.~~4~~5, except as provided in 12.11.5.2.
~~Exception:~~12.11.5.2
~~-~~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.

12.11.8 Slope.
12.1.8.1
A vent connector shall be installed without any dips or sags.

12.1.8.2
A vent connector ~~and~~ shall slope upward toward the vent or chimney at least 1/4 in./ft (20 mm/m).
12.1.8.3
~~Exception:~~ Vent connectors attached to a mechanical draft system installed in accordance with appliance and the draft system manufacturers' instructions shall be permitted.

12.11.9.3
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.
12.11.11.2
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.
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~~9.
12.13 Draft Hoods and Draft Controls.
12.13.1 Appliances Requiring Draft Hoods.
12.13.1.1
Vented appliances shall be installed with draft hoods, except as provided in 12.13.1.2.
~~Exception:~~12.13.1.2

-Dual oven-type combination ranges; ~~direct~~ 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 shall be permitted to be installed without draft hoods.

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 in accordance ~~all of~~ with the following:

~~Installed~~
(1) ~~, be o~~Of ~~a~~ be listed or approved ~~type~~
(2) ~~, and, i~~In the absence of other instructions, ~~be~~ of the same size as the appliance flue collar~~.~~

12.13.2.2
Where a draft hood is required with a conversion burner, it shall be of a listed or approved type.
12.13.3 Draft Control Devices.
12.13.3.1
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.

12.13.3.2
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.
12.13.6 Positioning.
12.13.6.1
Draft hoods and draft regulators shall be installed in the position for which they were designed with reference to the horizontal and vertical planes.

12.13.6.2
Draft hoods and draft regulators ~~and~~ shall be located so that the relief opening is not obstructed by any part of the appliance or adjacent construction.

12.13.6.3
The appliance and its draft hood shall be located so that the relief opening is accessible for checking vent operation.
12.13.7 Clearance.
12.13.7.1
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.

12.13.7.2
Where a greater or lesser clearance is indicated on the appliance label, the clearance shall not be less than that specified on the label.

12.13.7.3
~~Such~~ The clearances in 12.13.7 shall not be reduced.
12.14 Manually Operated Dampers.
12.14.1
A manually operated damper shall not be placed in any appliance vent connector.

12.14.2
Fixed baffles and balancing baffles shall not be classified as manually operated dampers.
12.14.~~2~~3*
Balancing baffles shall be mechanically locked in the desired position before placing the appliance in service.
12.14.~~3~~ 4
Balancing baffles shall be listed in accordance with UL 378, *Draft Equipment*.
12.16 Obstructions.
12.16.1

Devices that retard the flow of vent gases shall not be installed in a vent connector, chimney, or vent.

12.16.2
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

Committee Input No. 81-NFPA 54-2024 [Chapter 13]

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 Appliance																			
Appliance Typ																			
Appliance Vent Connectio																			
Vent Diameter —*D* (in.)																			
3					4			5			6			7					
Appliance Input Rating in Thousands of Btu pe																			
Height *H* (ft)	Lateral *L* (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		N			
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	M			
6	0	0	78	46	0	152	86	0	251	141	0	375	205	0	524	28			
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	321	21			
	4	21	49	34	30	94	64	39	153	103	50	227	153	66	316	21			
	6	25	46	32	36	91	61	47	149	100	59	223	149	78	310	20			
8	0	0	84	50	0	165	94	0	276	155	0	415	235	0	583	32			
	2	12	57	40	16	109	75	25	178	120	28	263	180	42	365	24			
	5	23	53	38	32	103	71	42	171	115	53	255	173	70	356	23			
	8	28	49	35	39	98	66	51	164	109	64	247	165	84	347	22			
10	0	0	88	53	0	175	100	0	295	166	0	447	255	0	631	34			
	2	12	61	42	17	118	81	23	194	129	26	289	195	40	402	27			
	5	23	57	40	32	113	77	41	187	124	52	280	188	68	392	26			
	10	30	51	36	41	104	70	54	176	115	67	267	175	88	376	24			
15	0	0	94	58	0	191	112	0	327	187	0	502	285	0	716	39			
	2	11	69	48	15	136	93	20	226	150	22	339	225	38	475	31			
	5	22	65	45	30	130	87	39	219	142	49	330	217	64	463	30			
	10	29	59	41	40	121	82	51	206	135	64	315	208	84	445	28			
	15	35	53	37	48	112	76	61	195	128	76	301	198	98	429	27			
20	0	0	97	61	0	202	119	0	349	202	0	540	307	0	776	43			
	2	10	75	51	14	149	100	18	250	166	20	377	249	33	531	34			
	5	21	71	48	29	143	96	38	242	160	47	367	241	62	519	33			
	10	28	64	44	38	133	89	50	229	150	62	351	228	81	499	32			
	15	34	58	40	46	124	84	59	217	142	73	337	217	94	481	30			
	20	48	52	35	55	116	78	69	206	134	84	322	206	107	464	29			
30	0	0	100	64	0	213	128	0	374	220	0	587	336	0	853	47			
	2	9	81	56	13	166	112	14	283	185	18	432	280	27	613	39			
	5	21	77	54	28	160	108	36	275	176	45	421	273	58	600	38			
	10	27	70	50	37	150	102	48	262	171	59	405	261	77	580	37			
	15	33	64	NA	44	141	96	57	249	163	70	389	249	90	560	35			
	20	56	58	NA	53	132	90	66	237	154	80	374	237	102	542	34			
	30	NA	NA	NA	73	113	NA	88	214	NA	104	346	219	131	507	32			
50	0	0	101	67	0	216	134	0	397	232	0	633	363	0	932	51			

											Number of Appliance							
											Appliance Typ							
											Appliance Vent Connectio							
		Vent Diameter —*D* (in.)																
		3			4			5			6			7				
		Appliance Input Rating in Thousands of Btu pe																
Height *H* (ft)	Lateral *L* (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		N		
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	M		
	2	8	86	61	11	183	122	14	320	206	15	497	314	22	715	44		
	5	20	82	NA	27	177	119	35	312	200	43	487	308	55	702	43		
	10	26	76	NA	35	168	114	45	299	190	56	471	298	73	681	42		
	15	59	70	NA	42	158	NA	54	287	180	66	455	288	85	662	41		
	20	NA	NA	NA	50	149	NA	63	275	169	76	440	278	97	642	40		
	30	NA	NA	NA	69	131	NA	84	250	NA	99	410	259	123	605	37		
100	0	NA	NA	NA	0	218	NA	0	407	NA	0	665	400	0	997	56		
	2	NA	NA	NA	10	194	NA	12	354	NA	13	566	375	18	831	51		
	5	NA	NA	NA	26	189	NA	33	347	NA	40	557	369	52	820	50		
	10	NA	NA	NA	33	182	NA	43	335	NA	53	542	361	68	801	49		
	15	NA	NA	NA	40	174	NA	50	321	NA	62	528	353	80	782	48		
	20	NA	NA	NA	47	166	NA	59	311	NA	71	513	344	90	763	47		
	30	NA	NA	NA	NA	NA	NA	78	290	NA	92	483	NA	115	726	44		
	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	147	428	NA	180	651	40		

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

											Number of Ap							
											Appliar							
											Appliance Vent Co							
		Vent Diameter — *D* (i																
		10			12			14			16			18				
		Appliance Input Rating in Thousand																
Height *H* (ft)	Lateral *L* (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN				
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max			
6	0	0	1121	570	0	1645	850	0	2267	1170	0	2983	1530	0	3802	1		
	2	75	675	455	103	982	650	138	1346	890	178	1769	1170	225	2250	1		
	4	110	668	445	147	975	640	191	1338	880	242	1761	1160	300	2242	1		
	6	128	661	435	171	967	630	219	1330	870	276	1753	1150	341	2235	1		
8	0	0	1261	660	0	1858	970	0	2571	1320	0	3399	1740	0	4333	2		
	2	71	770	515	98	1124	745	130	1543	1020	168	2030	1340	212	2584	1		
	5	115	758	503	154	1110	733	199	1528	1010	251	2013	1330	311	2563	1		
	8	137	746	490	180	1097	720	231	1514	1000	289	2000	1320	354	2552	1		
10	0	0	1377	720	0	2036	1060	0	2825	1450	0	3742	1925	0	4782	2		
	2	68	852	560	93	1244	850	124	1713	1130	161	2256	1480	202	2868	1		

												Number of Ap						
												Appliar						
												Appliance Vent Co						
												Vent Diameter — *D* (i						
		10			12			14			16			18				
		Appliance Input Rating in Thousand																
Height *H* (ft)	Lateral *L* (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN				
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max			
	5	112	839	547	149	1229	829	192	1696	1105	243	2238	1461	300	2849	1		
	10	142	817	525	187	1204	795	238	1669	1080	298	2209	1430	364	2818	1		
15	0	0	1596	840	0	2380	1240	0	3323	1720	0	4423	2270	0	5678	2		
	2	63	1019	675	86	1495	985	114	2062	1350	147	2719	1770	186	3467	2		
	5	105	1003	660	140	1476	967	182	2041	1327	229	2696	1748	283	3442	2		
	10	135	977	635	177	1446	936	227	2009	1289	283	2659	1712	346	3402	2		
	15	155	953	610	202	1418	905	257	1976	1250	318	2623	1675	385	3363	2		
20	0	0	1756	930	0	2637	1350	0	3701	1900	0	4948	2520	0	6376	3		
	2	59	1150	755	81	1694	1100	107	2343	1520	139	3097	2000	175	3955	2		
	5	101	1133	738	135	1674	1079	174	2320	1498	219	3071	1978	270	3926	2		
	10	130	1105	710	172	1641	1045	220	2282	1460	273	3029	1940	334	3880	2		
	15	150	1078	688	195	1609	1018	248	2245	1425	306	2988	1910	372	3835	2		
	20	167	1052	665	217	1578	990	273	2210	1390	335	2948	1880	404	3791	2		
30	0	0	1977	1060	0	3004	1550	0	4252	2170	0	5725	2920	0	7420	3		
	2	54	1351	865	74	2004	1310	98	2786	1800	127	3696	2380	159	4734	3		
	5	96	1332	851	127	1981	1289	164	2759	1775	206	3666	2350	252	4701	3		
	10	125	1301	829	164	1944	1254	209	2716	1733	259	3617	2300	316	4647	2		
	15	143	1272	807	187	1908	1220	237	2674	1692	292	3570	2250	354	4594	2		
	20	160	1243	784	207	1873	1185	260	2633	1650	319	3523	2200	384	4542	2		
	30	195	1189	745	246	1807	1130	305	2555	1585	369	3433	2130	440	4442	2		
50	0	0	2231	1195	0	3441	1825	0	4934	2550	0	6711	3440	0	8774	4		
	2	41	1620	1010	66	2431	1513	86	3409	2125	113	4554	2840	141	5864	3		
	5	90	1600	996	118	2406	1495	151	3380	2102	191	4520	2813	234	5826	3		
	10	118	1567	972	154	2366	1466	196	3332	2064	243	4464	2767	295	5763	3		
	15	136	1536	948	177	2327	1437	222	3285	2026	274	4409	2721	330	5701	3		
	20	151	1505	924	195	2288	1408	244	3239	1987	300	4356	2675	361	5641	3		
	30	183	1446	876	232	2214	1349	287	3150	1910	347	4253	2631	412	5523	3		
100	0	0	2491	1310	0	3925	2050	0	5729	2950	0	7914	4050	0	10,485	5		
	2	30	1975	1170	44	3027	1820	72	4313	2550	95	5834	3500	120	7591	4		
	5	82	1955	1159	107	3002	1803	136	4282	2531	172	5797	3475	208	7548	4		
	10	108	1923	1142	142	2961	1775	180	4231	2500	223	5737	3434	268	7478	4		
	15	126	1892	1124	163	2920	1747	206	4182	2469	252	5678	3392	304	7409	4		
	20	141	1861	1107	181	2880	1719	226	4133	2438	277	5619	3351	330	7341	4		
	30	170	1802	1071	215	2803	1663	265	4037	2375	319	5505	3267	378	7209	4		
	50	241	1688	1000	292	2657	1550	350	3856	2250	415	5289	3100	486	6956	4		

For SI units, 1 in. = 25.4 mm, l 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

											Num								
											Appliance								
		Vent Diameter —																	
		3			4			5			6			7					
		Appliance Input Rating in Thou																	
Height H (ft)	Lateral L (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		N			
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	M			
6	0	38	77	45	59	151	85	85	249	140	126	373	204	165	522	28			
	2	39	51	36	60	96	66	85	156	104	123	231	156	159	320	21			
	4	NA	NA	33	74	92	63	102	152	102	146	225	152	187	313	20			
	6	NA	NA	31	83	89	60	114	147	99	163	220	148	207	307	20			
8	0	37	83	50	58	164	93	83	273	154	123	412	234	161	580	31			
	2	39	56	39	59	108	75	83	176	119	121	261	179	155	363	24			
	5	NA	NA	37	77	102	69	107	168	114	151	252	171	193	352	23			
	8	NA	NA	33	90	95	64	122	161	107	175	243	163	223	342	22			
10	0	37	87	53	57	174	99	82	293	165	120	444	254	158	628	34			
	2	39	61	41	59	117	80	82	193	128	119	287	194	153	400	27			
	5	52	56	39	76	111	76	105	185	122	148	277	186	190	388	26			
	10	NA	NA	34	97	100	68	132	171	112	188	261	171	237	369	24			
15	0	36	93	57	56	190	111	80	325	186	116	499	283	153	713	38			
	2	38	69	47	57	136	93	80	225	149	115	337	224	148	473	31			
	5	51	63	44	75	128	86	102	216	140	144	326	217	182	459	29			
	10	NA	NA	39	95	116	79	128	201	131	182	308	203	228	438	28			
	15	NA	NA	NA	NA	NA	72	158	186	124	220	290	192	272	418	26			
20	0	35	96	60	54	200	118	78	346	201	114	537	306	149	772	42			
	2	37	74	50	56	148	99	78	248	165	113	375	248	144	528	34			
	5	50	68	47	73	140	94	100	239	158	141	363	239	178	514	33			
	10	NA	NA	41	93	129	86	125	223	146	177	344	224	222	491	31			
	15	NA	NA	NA	NA	NA	80	155	208	136	216	325	210	264	469	30			
	20	NA	NA	NA	NA	NA	NA	186	192	126	254	306	196	309	448	28			
30	0	34	99	63	53	211	127	76	372	219	110	584	334	144	849	47			
	2	37	80	56	55	164	111	76	281	183	109	429	279	139	610	39			
	5	49	74	52	72	157	106	98	271	173	136	417	271	171	595	38			
	10	NA	NA	NA	91	144	98	122	255	168	171	397	257	213	570	36			
	15	NA	NA	NA	115	131	NA	151	239	157	208	377	242	255	547	34			
	20	NA	NA	NA	NA	NA	NA	181	223	NA	246	357	228	298	524	33			
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	389	477	30			
50	0	33	99	66	51	213	133	73	394	230	105	629	361	138	928	51			
	2	36	84	61	53	181	121	73	318	205	104	495	312	133	712	44			

												Num							
												Appliance							
		Vent Diameter —																	
		3			4			5			6			7					
		Appliance Input Rating in Thou																	
Height H (ft)	Lateral L (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		N			
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	M			
	5	48	80	NA	70	174	117	94	308	198	131	482	305	164	696	43			
	10	NA	NA	NA	89	160	NA	118	292	186	162	461	292	203	671	42			
	15	NA	NA	NA	112	148	NA	145	275	174	199	441	280	244	646	40			
	20	NA	NA	NA	NA	NA	NA	176	257	NA	236	420	267	285	622	38			
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	315	376	NA	373	573	N			
100	0	NA	NA	NA	49	214	NA	69	403	NA	100	659	395	131	991	55			
	2	NA	NA	NA	51	192	NA	70	351	NA	98	563	373	125	828	50			
	5	NA	NA	NA	67	186	NA	90	342	NA	125	551	366	156	813	50			
	10	NA	NA	NA	85	175	NA	113	324	NA	153	532	354	191	789	48			
	15	NA	NA	NA	132	162	NA	138	310	NA	188	511	343	230	764	47			
	20	NA	NA	NA	NA	NA	NA	168	295	NA	224	487	NA	270	739	45			
	30	NA	NA	NA	NA	NA	NA	231	264	NA	301	448	NA	355	685	N			
	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	540	584	N			

For SI units, 1 in. = 25.4 mm, l 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

												Num							
												Appliance							
		Type B Double-Wall Connecto																	
		To be used with chimney areas with																	
		3			4			5			6			7					
		Appliance Input Rating in Thou																	
Height H (ft)	Lateral L (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		N			
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	M			
6	2	NA	NA	28	NA	NA	52	NA	NA	86	NA	NA	130	NA	NA	18			
	5	NA	NA	25	NA	NA	49	NA	NA	82	NA	NA	117	NA	NA	16			
8	2	NA	NA	29	NA	NA	55	NA	NA	93	NA	NA	145	NA	NA	19			
	5	NA	NA	26	NA	NA	52	NA	NA	88	NA	NA	134	NA	NA	18			
	8	NA	NA	24	NA	NA	48	NA	NA	83	NA	NA	127	NA	NA	17			
10	2	NA	NA	31	NA	NA	61	NA	NA	103	NA	NA	162	NA	NA	22			
	5	NA	NA	28	NA	NA	57	NA	NA	96	NA	NA	148	NA	NA	20			

												Num							
												Appliance							
		Type B Double-Wall Connecto																	
		To be used with chimney areas with																	
		3			4			5			6			7					
		Appliance Input Rating in Thou																	
Height H (ft)	Lateral L (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		N			
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	M			
	10	NA	NA	25	NA	NA	50	NA	NA	87	NA	NA	139	NA	NA	19			
15	2	NA	NA	35	NA	NA	67	NA	NA	114	NA	NA	179	53	475	25			
	5	NA	NA	35	NA	NA	62	NA	NA	107	NA	NA	164	NA	NA	23			
	10	NA	NA	28	NA	NA	55	NA	NA	97	NA	NA	153	NA	NA	21			
	15	NA	NA	NA	NA	NA	48	NA	NA	89	NA	NA	141	NA	NA	20			
20	2	NA	NA	38	NA	NA	74	NA	NA	124	NA	NA	201	51	522	27			
	5	NA	NA	36	NA	NA	68	NA	NA	116	NA	NA	184	80	503	25			
	10	NA	NA	NA	NA	NA	60	NA	NA	107	NA	NA	172	NA	NA	23			
	15	NA	NA	NA	NA	NA	NA	NA	NA	97	NA	NA	159	NA	NA	22			
	20	NA	NA	NA	NA	NA	NA	NA	NA	83	NA	NA	148	NA	NA	20			
30	2	NA	NA	41	NA	NA	82	NA	NA	137	NA	NA	216	47	581	30			
	5	NA	NA	NA	NA	NA	76	NA	NA	128	NA	NA	198	75	561	28			
	10	NA	NA	NA	NA	NA	67	NA	NA	115	NA	NA	184	NA	NA	26			
	15	NA	NA	NA	NA	NA	NA	NA	NA	107	NA	NA	171	NA	NA	24			
	20	NA	NA	NA	NA	NA	NA	NA	NA	91	NA	NA	159	NA	NA	22			
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18			
50	2	NA	NA	NA	NA	NA	92	NA	NA	161	NA	NA	251	NA	NA	35			
	5	NA	NA	NA	NA	NA	NA	NA	NA	151	NA	NA	230	NA	NA	32			
	10	NA	NA	NA	NA	NA	NA	NA	NA	138	NA	NA	215	NA	NA	30			
	15	NA	NA	NA	NA	NA	NA	NA	NA	127	NA	NA	199	NA	NA	28			
	20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	185	NA	NA	26			
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			
Minimum internal area of chimney (in.^{2})		12			19			28			38			50					
Maximum internal area of chimney (in.^{2})		Seven times the listed appliance categorized vent area																	

For SI units, 1 in. = 25.4 mm, l 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

												Num							
												Appliance							
		Single-Wall Metal Connector																	
		To be used with chimney areas with																	
		3			4			5			6			7					
		Appliance Input Rating in Thou																	
Height *H* (ft)	Lateral *L* (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		N			
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	M			
6	2	NA	NA	28	NA	NA	52	NA	NA	86	NA	NA	130	NA	NA	18			
	5	NA	NA	25	NA	NA	48	NA	NA	81	NA	NA	116	NA	NA	16			
8	2	NA	NA	29	NA	NA	55	NA	NA	93	NA	NA	145	NA	NA	19			
	5	NA	NA	26	NA	NA	51	NA	NA	87	NA	NA	133	NA	NA	18			
	8	NA	NA	23	NA	NA	47	NA	NA	82	NA	NA	126	NA	NA	17			
10	2	NA	NA	31	NA	NA	61	NA	NA	102	NA	NA	161	NA	NA	22			
	5	NA	NA	28	NA	NA	56	NA	NA	95	NA	NA	147	NA	NA	20			
	10	NA	NA	24	NA	NA	49	NA	NA	86	NA	NA	137	NA	NA	18			
15	2	NA	NA	35	NA	NA	67	NA	NA	113	NA	NA	178	166	473	24			
	5	NA	NA	32	NA	NA	61	NA	NA	106	NA	NA	163	NA	NA	23			
	10	NA	NA	27	NA	NA	54	NA	NA	96	NA	NA	151	NA	NA	21			
	15	NA	NA	NA	NA	NA	46	NA	NA	87	NA	NA	138	NA	NA	19			
20	2	NA	NA	38	NA	NA	73	NA	NA	123	NA	NA	200	163	520	27			
	5	NA	NA	35	NA	NA	67	NA	NA	115	NA	NA	183	NA	NA	25			
	10	NA	NA	NA	NA	NA	59	NA	NA	105	NA	NA	170	NA	NA	23			
	15	NA	NA	NA	NA	NA	NA	NA	NA	95	NA	NA	156	NA	NA	21			
	20	NA	NA	NA	NA	NA	NA	NA	NA	80	NA	NA	144	NA	NA	20			
30	2	NA	NA	41	NA	NA	81	NA	NA	136	NA	NA	215	158	578	30			
	5	NA	NA	NA	NA	NA	75	NA	NA	127	NA	NA	196	NA	NA	27			
	10	NA	NA	NA	NA	NA	66	NA	NA	113	NA	NA	182	NA	NA	26			
	15	NA	NA	NA	NA	NA	NA	NA	NA	105	NA	NA	168	NA	NA	24			
	20	NA	NA	NA	NA	NA	NA	NA	NA	88	NA	NA	155	NA	NA	22			
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18			
50	2	NA	NA	NA	NA	NA	91	NA	NA	160	NA	NA	250	NA	NA	35			
	5	NA	NA	NA	NA	NA	NA	NA	NA	149	NA	NA	228	NA	NA	32			
	10	NA	NA	NA	NA	NA	NA	NA	NA	136	NA	NA	212	NA	NA	30			
	15	NA	NA	NA	NA	NA	NA	NA	NA	124	NA	NA	195	NA	NA	27			
	20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	180	NA	NA	25			
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			
Minimum internal area of chimney ($in.^2$)		12			19			28			38			50					

-	-	-	-	-	-	-	-	-	-	-	Num					
-						-										
-	-	-	-	-	-	-	-	-	-	-	Appliance					
-	-	Single-Wall Metal Connector To be used with chimney areas with														
-	-	3			4			5			6			7		
-	-	Appliance Input Rating in Thou														
Height *H* (ft)	Lateral *L* (ft)	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		N
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	M
Maximum internal area of chimney (in.^{2})	Seven times the listed appliance categorized vent area															

For SI units, 1 in. = 25.4 mm, I 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				
-	-	Diameter — *D* (in.) To be used with chimney areas within the size limits at bottom							
Height *H* (ft)	Lateral *L* (ft)	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

				Number of Appliances:		Single			
				Appliance Type:		Draft Hood–Equipped			
				Appliance Vent Connection:		Connected Directly to Pipe or Vent			
		Diameter — *D* (in.) To be used with chimney areas within the size limits at bottom							
Height *H* (ft)	Lateral *L* (ft)	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							
	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

_ _ _ _ _	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
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.

13.1.5.1

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.

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).

Table 13.2(a) Type B Double-Wall Vent

	Numbe
	Appliance V

Vent Connector Capacity

Vent Height *H* (ft)	Connector Rise *R* (ft)	Type B Double-Wall Vent and Connecto													
		3			4			5			6			7	
		Appliance Input Rating Limits in Thous													
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN	
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298
	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	391
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423
50	1	19	71	36	30	133	64	43	216	101	57	349	145	78	477
	2	21	73	43	32	137	76	45	223	119	59	358	172	81	490
	3	22	75	48	33	141	86	46	229	134	61	366	194	83	502
100	1	18	82	37	28	158	66	40	262	104	53	442	150	73	611
	2	19	83	44	30	161	79	42	267	123	55	447	178	75	619
	3	20	84	50	31	163	89	44	272	138	57	452	200	78	627

Common Vent Capacity

Vent Height *H* (ft)	Type B Double-Wall Common Vent Diam												
	4			5			6			7			
	Combined Appliance Input Rating in Thousan												
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FA +FA
6	92	81	65	140	116	103	204	161	147	309	248	200	404
8	101	90	73	155	129	114	224	178	163	339	275	223	444
10	110	97	79	169	141	124	243	194	178	367	299	242	477
15	125	112	91	195	164	144	283	228	206	427	352	280	556
20	136	123	102	215	183	160	314	255	229	475	394	310	621
30	152	138	118	244	210	185	361	297	266	547	459	360	720
50	167	153	134	279	244	214	421	353	310	641	547	423	854
100	175	163	NA	311	277	NA	489	421	NA	751	658	479	102

Table 13.2(a) ***Continued***

													Number of Appliances
													Appliance Type
													Appliance Ven Connection

Vent Connector Capacity

Vent Height *H* (ft)	Connector Rise *R* (ft)	Type B Double-Wall Vent and Connector Diame														
		12			14			16			18			20		
		Appliance Input Rating Limits in Thousands of														
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	
6	2	174	764	496	223	1046	653	281	1371	853	346	1772	1080	NA	NA	
	4	180	897	616	230	1231	827	287	1617	1081	352	2069	1370	NA	NA	
	6	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	
	4	192	952	644	244	1307	884	305	1719	1150	372	2211	1460	471	2737	
	6	198	1050	772	252	1445	1072	313	1902	1390	380	2434	1770	478	3018	
10	2	196	870	536	249	1195	730	311	1570	955	379	2049	1205	NA	NA	
	4	201	997	664	256	1371	924	318	1804	1205	387	2332	1535	486	2887	
	6	207	1095	792	263	1509	1118	325	1989	1455	395	2556	1865	494	3169	
15	2	214	967	568	272	1334	790	336	1760	1030	408	2317	1305	NA	NA	
	4	221	1085	712	279	1499	1006	344	1978	1320	416	2579	1665	523	3197	
	6	228	1181	856	286	1632	1222	351	2157	1610	424	2796	2025	533	3470	
20	2	223	1051	596	291	1443	840	357	1911	1095	430	2533	1385	NA	NA	
	4	230	1162	748	298	1597	1064	365	2116	1395	438	2778	1765	554	3447	
	6	237	1253	900	307	1726	1288	373	2287	1695	450	2984	2145	567	3708	
30	2	216	1217	632	286	1664	910	367	2183	1190	461	2891	1540	NA	NA	
	4	223	1316	792	294	1802	1160	376	2366	1510	474	3110	1920	619	3840	

											Number of Appliances
-	-	-	-	-	-	-	-	-	-	-	Number of Appliances
	-				-			-	-	-	Appliance Type
	-	-	-	-	-	-	-	-	-	-	Appliance Vent Connection

Vent Connector Capacity

-	-	Type B Double-Wall Vent and Connector Diame														
-	-	12			14			16			18			20	
Vent Height *H* (ft)	Connector Rise *R* (ft)	Appliance Input Rating Limits in Thousands of													
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN	
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max
	6	231	1400	952	303	1920	1410	384	2524	1830	485	3299	2340	632	4080
50	2	206	1479	689	273	2023	1007	350	2659	1315	435	3548	1665	NA	NA
	4	213	1561	860	281	2139	1291	359	2814	1685	447	3730	2135	580	4601
	6	221	1631	1031	290	2242	1575	369	2951	2055	461	3893	2605	594	4808
100	2	192	1923	712	254	2644	1050	326	3490	1370	402	4707	1740	NA	NA
	4	200	1984	888	263	2731	1346	336	3606	1760	414	4842	2220	523	5982
	6	208	2035	1064	272	2811	1642	346	3714	2150	426	4968	2700	539	6143

Common Vent Capacity

-	Type B Double-Wall Common Vent Diam												
-	12			14			16			18			
Vent Height *H* (ft)	Combined Appliance Input Rating in Thousan												
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FA +FA
6	900	696	588	1284	990	815	1735	1336	1065	2253	1732	1345	283
8	994	773	652	1423	1103	912	1927	1491	1190	2507	1936	1510	316
10	1076	841	712	1542	1200	995	2093	1625	1300	2727	2113	1645	344
15	1247	986	825	1794	1410	1158	2440	1910	1510	3184	2484	1910	402
20	1405	1116	916	2006	1588	1290	2722	2147	1690	3561	2798	2140	454
30	1658	1327	1025	2373	1892	1525	3220	2558	1990	4197	3326	2520	530
50	2024	1640	1280	2911	2347	1863	3964	3183	2430	5184	4149	3075	656
100	2569	2131	1670	3732	3076	2450	5125	4202	3200	6749	5509	4050	859

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

Vent Connector Capacity

Vent Height H (ft)	Connector Rise R (ft)	Single-Wall Metal Vent Connector D													
		3			4			5			6			7	
		Appliance Input Rating Limits in Thous													
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN	
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max
6	1	NA	NA	26	NA	NA	46	NA	NA	71	NA	NA	102	207	223
	2	NA	NA	31	NA	NA	55	NA	NA	85	168	182	123	215	251
	3	NA	NA	34	NA	NA	62	121	131	95	175	198	138	222	273
8	1	NA	NA	27	NA	NA	48	NA	NA	75	NA	NA	106	226	240
	2	NA	NA	32	NA	NA	57	125	126	89	184	193	127	234	266
	3	NA	NA	35	NA	NA	64	130	138	100	191	208	144	241	287
10	1	NA	NA	28	NA	NA	50	119	121	77	182	186	110	240	253
	2	NA	NA	33	84	85	59	124	134	91	189	203	132	248	278
	3	NA	NA	36	89	91	67	129	144	102	197	217	148	257	299
15	1	NA	NA	29	79	87	52	116	138	81	177	214	116	238	291
	2	NA	NA	34	83	94	62	121	150	97	185	230	138	246	314
	3	NA	NA	39	87	100	70	127	160	109	193	243	157	255	333
20	1	49	56	30	78	97	54	115	152	84	175	238	120	233	325
	2	52	59	36	82	103	64	120	163	101	182	252	144	243	346
	3	55	62	40	87	107	72	125	172	113	190	264	164	252	363
30	1	47	60	31	77	110	57	112	175	89	169	278	129	226	380
	2	51	62	37	81	115	67	117	185	106	177	290	152	236	397
	3	54	64	42	85	119	76	122	193	120	185	300	172	244	412
50	1	46	69	34	75	128	60	109	207	96	162	336	137	217	460
	2	49	71	40	79	132	72	114	215	113	170	345	164	226	473
	3	52	72	45	83	136	82	119	221	123	178	353	186	235	486
100	1	45	79	34	71	150	61	104	249	98	153	424	140	205	585
	2	48	80	41	75	153	73	110	255	115	160	428	167	212	593
	3	51	81	46	79	157	85	114	260	129	168	433	190	222	603

Common Vent Capacity

Vent Height H (ft)	Type B Double-Wall Vent Diameter -														
	4			5			6			7					
	Combined Appliance Input Rating in Thousan														
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FA +FA		
6	NA	78	64	NA	113	99	200	158	144	304	244	196	398		
8	NA	87	71	NA	126	111	218	173	159	331	269	218	436		
10	NA	94	76	163	137	120	237	189	174	357	292	236	467		

Common Vent Capacity

Vent Height *H* (ft)	Type B Double-Wall Vent Diameter -												
	4			5			6			7			
	Combined Appliance Input Rating in Thousan												
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FA +F
15	121	108	88	189	159	140	275	221	200	416	343	274	544
20	131	118	98	208	177	156	305	247	223	463	383	302	606
30	145	132	113	236	202	180	350	286	257	533	446	349	703
50	159	145	128	268	233	208	406	337	296	622	529	410	833
100	166	153	NA	297	263	NA	469	398	NA	726	633	464	999

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

														N
														Applia

Vent Connector Capacity

Vent Height *H* (ft)	Connector Rise *R* (ft)	Type B Double-Wall Vent Connector														
		3			4			5			6			7		
		Appliance Input Rating Limits in Thous														
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	
6	1	24	33	21	39	62	40	52	106	67	65	194	101	87	274	
	2	26	43	28	41	79	52	53	133	85	67	230	124	89	324	
	3	27	49	34	42	92	61	55	155	97	69	262	143	91	369	
8	1	24	39	22	39	72	41	55	117	69	71	213	105	94	304	
	2	26	47	29	40	87	53	57	140	86	73	246	127	97	350	
	3	27	52	34	42	97	62	59	159	98	75	269	145	99	383	
10	1	24	42	22	38	80	42	55	130	71	74	232	108	101	324	
	2	26	50	29	40	93	54	57	153	87	76	261	129	103	366	
	3	27	55	35	41	105	63	58	170	100	78	284	148	106	397	
15	1	24	48	23	38	93	44	54	154	74	72	277	114	100	384	
	2	25	55	31	39	105	55	56	174	89	74	299	134	103	419	
	3	26	59	35	41	115	64	57	189	102	76	319	153	105	448	
20	1	24	52	24	37	102	46	53	172	77	71	313	119	98	437	
	2	25	58	31	39	114	56	55	190	91	73	335	138	101	467	
	3	26	63	35	40	123	65	57	204	104	75	353	157	104	493	
30	1	24	54	25	37	111	48	52	192	82	69	357	127	96	504	
	2	25	60	32	38	122	58	54	208	95	72	376	145	99	531	
	3	26	64	36	40	131	66	56	221	107	74	392	163	101	554	

-	-	-	-	-	-	-	-	-	-	-	-	-	-	N
	-					-						-		
-	-	-	-	-	-	-	-	-	-	-	-	-	-	Applia

Vent Connector Capacity

		Type B Double-Wall Vent Connector														
-	-	3			4			5			6			7	
Vent Height *H* (ft)	Connector Rise *R* (ft)	Appliance Input Rating Limits in Thous													
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN	
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max
50	1	23	51	25	36	116	51	51	209	89	67	405	143	92	582
	2	24	59	32	37	127	61	53	225	102	70	421	161	95	604
	3	26	64	36	39	135	69	55	237	115	72	435	180	98	624
100	1	23	46	24	35	108	50	49	208	92	65	428	155	88	640
	2	24	53	31	37	120	60	51	224	105	67	444	174	92	660
	3	25	59	35	38	130	68	53	237	118	69	458	193	94	679

Common Vent Capacity

-	Minimum Internal Area of Maso												
-	12			19			28			38			
Vent Height *H* (ft)	Combined Appliance Input Rating in												
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FA +F
6	NA	74	25	NA	119	46	NA	178	71	NA	257	103	NA
8	NA	80	28	NA	130	53	NA	193	82	NA	279	119	NA
10	NA	84	31	NA	138	56	NA	207	90	NA	299	131	NA
15	NA	NA	36	NA	152	67	NA	233	106	NA	334	152	523
20	NA	NA	41	NA	NA	75	NA	250	122	NA	368	172	565
30	NA	NA	NA	NA	NA	NA	NA	270	137	NA	404	198	615
50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
100	NA	NA	NA	NA	NA	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.

Table 13.2(d) Masonry Chimney

Vent Connector Capacity

Vent Height H (ft)	Connector Rise R (ft)	Single-Wall Metal Vent Connecto													
		3			4			5			6				
		Appliance Input Rating Limits in Tho													
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN	
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	I
6	1	NA	NA	21	NA	NA	39	NA	NA	66	179	191	100	231	2
	2	NA	NA	28	NA	NA	52	NA	NA	84	186	227	123	239	3
	3	NA	NA	34	NA	NA	61	134	153	97	193	258	142	247	3
8	1	NA	NA	21	NA	NA	40	NA	NA	68	195	208	103	250	2
	2	NA	NA	28	NA	NA	52	137	139	85	202	240	125	258	3
	3	NA	NA	34	NA	NA	62	143	156	98	210	264	145	266	3
10	1	NA	NA	22	NA	NA	41	130	151	70	202	225	106	267	3
	2	NA	NA	29	NA	NA	53	136	150	86	210	255	128	276	3
	3	NA	NA	34	97	102	62	143	166	99	217	277	147	284	3
15	1	NA	NA	23	NA	NA	43	129	151	73	199	271	112	268	3
	2	NA	NA	30	92	103	54	135	170	88	207	295	132	277	4
	3	NA	NA	34	96	112	63	141	185	101	215	315	151	286	4
20	1	NA	NA	23	87	99	45	128	167	76	197	303	117	265	4
	2	NA	NA	30	91	111	55	134	185	90	205	325	136	274	4
	3	NA	NA	35	96	119	64	140	199	103	213	343	154	282	4
30	1	NA	NA	24	86	108	47	126	187	80	193	347	124	259	4
	2	NA	NA	31	91	119	57	132	203	93	201	366	142	269	5
	3	NA	NA	35	95	127	65	138	216	105	209	381	160	277	5
50	1	NA	NA	24	85	113	50	124	204	87	188	392	139	252	5
	2	NA	NA	31	89	123	60	130	218	100	196	408	158	262	5
	3	NA	NA	35	94	131	68	136	231	112	205	422	176	271	6
100	1	NA	NA	23	84	104	49	122	200	89	182	410	151	243	6
	2	NA	NA	30	88	115	59	127	215	102	190	425	169	253	6
	3	NA	NA	34	93	124	67	133	228	115	199	438	188	262	6

Common Vent Capacity

Vent Height H (ft)	Minimum Internal Area of Masc														
	12			19			28			38					
	Combined Appliance Input Rating i														
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FA +F		
6	NA	NA	25	NA	118	45	NA	176	71	NA	255	102	NA		
8	NA	NA	28	NA	128	52	NA	190	81	NA	276	118	NA		

Common Vent Capacity

	Minimum Internal Area of Masc												
	12			19			28			38			
Vent Height *H* (ft)	Combined Appliance Input Rating ir												
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FA +FA
10	NA	NA	31	NA	136	56	NA	205	89	NA	295	129	NA
15	NA	NA	36	NA	NA	66	NA	230	105	NA	335	150	NA
20	NA	NA	NA	NA	NA	74	NA	247	120	NA	362	170	NA
30	NA	NA	NA	NA	NA	NA	NA	NA	135	NA	398	195	NA
50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
100	NA	NA	NA	NA	NA	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.

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

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						
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.

Table 13.2(g) Exterior Masonry Chimney

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

Minimum Allowable Input Rating of Space-Heating Appliance in Thousands of Btu per Hour								
Vent Height *H* (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	NA
8	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
15	NA	0	0	0	0	0	0	0

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

Minimum Allowable Input Rating of Space-Heating Appliance in Thousands of Btu per Hour

Vent Height *H* (ft)	Internal Area of Chimney (in.^{2})							
	12	19	28	38	50	63	78	113
20	NA	NA	NA	NA	NA	184	0	0
30	NA	NA	NA	NA	NA	393	334	0
50	NA	NA	NA	NA	NA	NA	NA	579
100	NA	NA	NA	NA	NA	NA	NA	NA
	Local 99% winter design temperature: 27°F to 36°F							
6	0	0	68	NA	NA	180	212	NA
8	0	0	82	NA	NA	187	214	263
10	0	51	NA	NA	NA	201	225	265
15	NA	NA	NA	NA	NA	253	274	305
20	NA	NA	NA	NA	NA	307	330	362
30	NA	NA	NA	NA	NA	NA	445	485
50	NA	NA	NA	NA	NA	NA	NA	763
100	NA	NA	NA	NA	NA	NA	NA	NA
	Local 99% winter design temperature: 17°F to 26°F							
6	NA	NA	NA	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA	NA	264	352
10	NA	NA	NA	NA	NA	NA	278	358
15	NA	NA	NA	NA	NA	NA	331	398
20	NA	NA	NA	NA	NA	NA	387	457
30	NA	NA	NA	NA	NA	NA	NA	581
50	NA	NA	NA	NA	NA	NA	NA	862
100	NA	NA	NA	NA	NA	NA	NA	NA
	Local 99% winter design temperature: 5°F to 16°F							
6	NA	NA	NA	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA	NA	NA	NA
10	NA	NA	NA	NA	NA	NA	NA	430
15	NA	NA	NA	NA	NA	NA	NA	485
20	NA	NA	NA	NA	NA	NA	NA	547
30	NA	NA	NA	NA	NA	NA	NA	682
50	NA	NA	NA	NA	NA	NA	NA	NA
100	NA	NA	NA	NA	NA	NA	NA	NA
	Local 99% winter design temperature: 4°F or lower Not recommended for any vent configurations							

For SI units, 1 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.

Table 13.2(h) Exterior Masonry Chimney

	Number of Appliances:	**Two or More**
	Appliance Type:	**FAN + NAT**
	Appliance Vent Connection:	**Type B Double-Wall Connector**

Combined Appliance Maximum Input Rating in Thousands of Btu per Hour

Vent Height *H* (ft)	**Internal Area of Chimney (in.^{2})**							
	12	**19**	**28**	**38**	**50**	**63**	**78**	**113**
6	74	119	178	257	351	458	582	853
8	80	130	193	279	384	501	636	937
10	84	138	207	299	409	538	686	1010
15	NA	152	233	334	467	611	781	1156
20	NA	NA	250	368	508	668	858	1286
30	NA	NA	NA	404	564	747	969	1473
50	NA	NA	NA	NA	NA	831	1089	1692
100	NA	NA	NA	NA	NA	NA	NA	1921

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(i) Exterior Masonry Chimney

	Number of Appliances:	**Two or More**
	Appliance Type:	**FAN + NAT**
	Appliance Vent Connection:	**Type B Double-Wall Connector**

Minimum Allowable Input Rating of Space-Heating Appliance in Thousands of Btu per Hour

Vent Height *H* (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	334	398	393	334	0
50	NA	NA	NA	NA	NA	714	707	579
100	NA	NA	NA	NA	NA	NA	NA	1600
	Local 99% winter design temperature: 27°F to 36°F							
6	0	0	68	116	156	180	212	266
8	0	0	82	127	167	187	214	263
10	0	51	97	141	183	201	225	265

_ _ _ _ _	Number of Appliances:	Two or More
_ _ _ _ _	Appliance Type:	FAN + NAT
_ _ _ _ _	Appliance Vent Connection:	Type B Double-Wall Connector

Minimum Allowable Input Rating of Space-Heating Appliance in Thousands of Btu per Hour

Vent Height *H* (ft)	Internal Area of Chimney (in.^{2})							
	12	19	28	38	50	63	78	113
15	NA	111	142	183	233	253	274	305
20	NA	NA	187	230	284	307	330	362
30	NA	NA	NA	330	319	419	445	485
50	NA	NA	NA	NA	NA	672	705	763
100	NA	NA	NA	NA	NA	NA	NA	1554
	Local 99% winter design temperature: 17°F to 26°F							
6	0	55	99	141	182	215	259	349
8	52	74	111	154	197	226	264	352
10	NA	90	125	169	214	245	278	358
15	NA	NA	167	212	263	296	331	398
20	NA	NA	212	258	316	352	387	457
30	NA	NA	NA	362	429	470	507	581
50	NA	NA	NA	NA	NA	723	766	862
100	NA	NA	NA	NA	NA	NA	NA	1669
	Local 99% winter design temperature: 5°F to 16°F							
6	NA	78	121	166	214	252	301	416
8	NA	94	135	182	230	269	312	423
10	NA	111	149	198	250	289	331	430
15	NA	NA	193	247	305	346	393	485
20	NA	NA	NA	293	360	408	450	547
30	NA	NA	NA	377	450	531	580	682
50	NA	NA	NA	NA	NA	797	853	972
100	NA	NA	NA	NA	NA	NA	NA	1833
	Local 99% winter design temperature: −10°F to 4°F							
6	NA	NA	145	196	249	296	349	484
8	NA	NA	159	213	269	320	371	494
10	NA	NA	175	231	292	339	397	513
15	NA	NA	NA	283	351	404	457	586
20	NA	NA	NA	333	408	468	528	650
30	NA	NA	NA	NA	NA	603	667	805
50	NA	NA	NA	NA	NA	NA	955	1003
100	NA	NA	NA	NA	NA	NA	NA	NA
	Local 99% winter design temperature: −11°F or lower Not recommended for any vent configurations							

For SI units, 1 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.2.4 for a map showing local 99 percent winter design temperatures in the United States.

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.

Table 13.2.2 Vent Connector Maximum Length

Connector Diameter (in.)	Maximum Connector Horizontal Length (ft)
3	4½
4	6
5	7½
6	9
7	10½
8	12
9	13½
10	15
12	18
14	21
16	24
18	27
20	30
22	33
24	36

For SI units, 1 in. = 25.4 mm, 1 ft = 0.305 m.

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.

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 in accordance with the following:

(1) Type B double wall

(2) 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.

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.

13.2.19 Two-Stage/Modulating Appliances.

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.

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.

13.2.21 Connections to Chimney Liners.

Where double-wall connectors are required, tee and wye fittings used to connect to the common vent chimney liner shall be listed double-wall fittings. Connections between chimney liners and listed double-wall fittings shall be made with listed adapter fittings designed for such purpose.

13.2.22 Chimneys and Vent Locations.

Table 13.2(a) through Table 13.2(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. A Type B vent passing through an unventilated enclosure or chase insulated to a value of not less than R8 shall not be considered to be exposed to the outdoors. Where vents extend outdoors above the roof more than 5 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. Table 13.2(f), Table 13.2(g), Table 13.2(h), and Table 13.2(i) shall be used for clay tile lined exterior masonry chimneys, provided all the following conditions are met:

(1) The vent connector is Type B double wall.

(2) At least one appliance is draft hood equipped.

(3) The combined appliance input rating is less than the maximum capacity given by Table 13.2(f) (for NAT+NAT) or Table 13.2(h) (for FAN+NAT).

(4) The input rating of each space-heating appliance is greater than the minimum input rating given by Table 13.2(g) (for NAT+NAT) or Table 13.2(i) (for FAN+NAT).

(5) The vent connector sizing is in accordance with Table 13.2(c).

13.2.23 Draft Hood Conversion Accessories.

Draft hood conversion accessories for use with masonry chimney venting listed Category I fan-assisted appliances shall be listed and installed in accordance with the listed accessory manufacturer's installation instructions.

13.2.24 Vent Connector Sizing.

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

(1) Vent connectors for fan-assisted appliance flue collars 12 in. (300 mm) in diameter or smaller are not reduced by more than one table size [e.g., 12 in. to 10 in. (300 mm to 250 mm) is a one-size reduction], and those larger than 12 in. (300 mm) in diameter are not reduced more than two table sizes [e.g., 24 in. to 20 in. (610 mm to 510 mm) is a two-size reduction].

(2) The fan-assisted appliance(s) is common vented with a draft hood–equipped appliance(s).

(3) The vent connector has a smooth interior wall.

13.2.25 Multiple Vent and Connector Sizes.

All combinations of pipe sizes, single-wall metal pipe, and double-wall metal pipe shall be allowed within any connector run(s) or within the common vent, provided ALL of the appropriate tables permit ALL of the desired sizes and types of pipe, as if they were used for the entire length of the subject connector or vent. Where single-wall and Type B double-wall metal pipes are used for vent connectors within the same venting system, the common vent shall be sized using Table 13.2(b) or Table 13.2(d) as appropriate.

13.2.26 Multiple Vent and Connector Sizes Permitted.

Where a Chapter 13 table permits more than one diameter of pipe to be used for a connector or vent, all the permitted sizes shall be permitted to be used.

13.2.27 Interpolation.

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

13.2.28 Extrapolation.

Extrapolation beyond the table entries shall not be permitted.

13.2.29 Sizing Vents Not Covered by Tables.

For vent heights lower than 6 ft (1.8 m) and higher than shown in the tables, engineering methods shall be used to calculate vent capacities.

13.2.30 Height Entries.

Where the actual height of a vent falls between entries in the height column of the applicable table in Table 13.2(a) through Table 13.2(i), 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

Supplemental Information

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Response Message: CI-81-NFPA 54-2024

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).~~

13.1.1 Obstructions and Vent Dampers.

13.1.1.1
Venting Table 13.1(a) through Table 13.1(f) shall not be used where obstructions are installed in the venting system.

12.1.1.2
The installation of vents serving listed appliances with vent dampers shall be either 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.

(3) Where the corresponding "Fan Min" is "NA," both of the following shall apply:

a) ~~the~~ The vent configuration shall not be permitted.
~~a)~~b) ~~and a~~An alternative venting configuration shall be utilized.

13.1.2 Vent Downsizing.

13.1.2.1
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. *(See 13.1.2.3.)* ~~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~~.

13.1.2.2
A 3 in. (80 mm) diameter vent shall not be connected to a 4 in. (100 mm) diameter draft hood outlet.

13.1.2.3
~~This~~e provision in 13.1.2.1(5) shall not apply to fan-assisted appliances.

13.1.3 Elbows.

13.1.3.1*
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.

A.13.1.3.1
Single-appliance venting with lateral lengths include two ~~90~~ 90-degree elbows.

13.1.3.2*

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For each additional elbow up to and including 45 degrees, the maximum capacity listed in the venting tables shall be reduced by 5 percent.

13.1.3.3
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.

13.1.3.4
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).

13.1.5 High-Altitude Installations.
13.1.5.1

Sea level input ratings shall be used when determining maximum capacity for high-altitude installation.

13.1.5.2
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, both of the following shall apply:

(1) ~~t~~The minimum vent capacity (FAN Min) determined from Table 13.1(a) through Table 13.1(f)~~the Chapter 13 tables~~ shall be less than the lowest appliance input rating.
~~(1)~~(2) ~~, and t~~The maximum vent capacity (FAN Max/NAT Max) determined from Table 13.1(a) through Table 13.1(f)~~the tables~~ shall be greater than the highest appliance rating input.

13.1.7* Corrugated Chimney Liners.

13.1.7.1*
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).

A.13.1.7.1
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.

13.1.7.2
Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with 13.1.3.

~~13.1.7.3~~
~~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.~~

13.1.9 Vertical Vent Upsizing/7 × Rule.

13.1.9.1
Where the vertical vent has a larger diameter than the vent connector, both of the following shall apply:

(1) ~~t~~The vertical vent diameter shall be used to determine the minimum vent capacity.
(2) ~~, and t~~The connector diameter shall be used to determine the maximum vent capacity.

13.1.9.2
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.

13.1.11.1
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.

13.1.11.2
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.

13.1.11.3
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), one of the following shall apply:

(1) ~~t~~The outdoor portion of the vent shall be enclosed as required by ~~this paragraph~~13.1.11 for vents not considered to be exposed to the outdoors.
(2) ~~, or such~~The venting system shall be engineered.

13.1.1.4
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.

13.1.11.5
Table 13.1(c), in combination with Table 13.1(f), shall be used for ~~clay~~ clay-tile~~-~~-lined exterior masonry chimneys, provided all of the following ~~requirements~~ provisions 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).

13.1.17 Sizing Vents Not Covered by Tables.

Where a vent height is lower than 6 ft (1.8 m) or higher than shown in Table 13.1(a) through Table 13.1(f)~~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.

13.2.1.1

Venting Table 13.2(a) through Table 13.2(i) shall not be used where obstructions are installed in the venting system.

13.2.1.2
The installation of vents serving listed appliances with vent dampers shall be either 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 of Table 13.2(a) through Table 13.2(i).

(2) The maximum capacity of the vertical vent or chimney shall be determined using the FAN+NAT column of Table 13.2(a) through Table 13.2(i) when the second appliance is a fan-assisted appliance, or the NAT+NAT column of Table 13.2(a) through Table 13.2(i) 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 of Table 13.2(a) through Table 13.2(i).

(b) The FAN+FAN column of Table 13.2(a) through Table 13.2(i) shall be used when the second appliance is a fan-assisted appliance.

(c) ~~, and t~~The FAN+NAT column of Table 13.2(a) through Table 13.2(i) 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~~ applicable (NA).

(d) Where the vent configuration is NA, both of the following shall apply:

i. ~~the~~ The vent configuration shall not be permitted.
~~i.~~ii. ~~and a~~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.

Table 13.2.2 Vent Connector Maximum Length

Connector Diameter (in.)	Maximum Connector Horizontal Length (ft)
3	4½
4	6
5	7½
6	9
7	10½
8	12
9	13½
10	15
12	18
14	21
16	24

Connector Diameter (in.)	Maximum Connector Horizontal Length (ft)
18	27
20	30
22	33
24	36

For SI units, 1 in. = 25.4 mm, 1 ft = 0.305 m.

13.2.3 Vent Connector Exceeding Maximum Length.

13.2.3.1
The vent connector shall be routed to the vent utilizing the shortest possible route.

13.2.3.2
Connectors with longer horizontal lengths than those listed in Table 13.2.2 ~~are~~ shall be 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 Table 13.1(a) through Table 13.1(f)~~single appliance table~~.

(3) For Type B double-wall connectors, Table 13.1(a) shall be used.

(4) For single-wall connectors, Table 13.1(b) shall be used.

(5) 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.

A.13.2.3.2(1)
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).

13.2.4 Vent Connector Manifolds.

13.2.4.1
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.

13.2.4.2
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.

13.2.5.1
Where the common vertical vent is offset, both of the following shall apply:

(1) ~~t~~The maximum capacity of the common vent shall be reduced in accordance with 13.2.6.

(2) ~~and t~~The horizontal length of the common vent offset shall not exceed 18 in./in. (18 mm/mm) of common vent diameter (*D*).

13.2.5.2
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.

13.2.6.1
For each elbow up to and including 45 degrees in the common vent, the maximum common vent capacity listed in Table 13.2(a) through Table 13.2(i) ~~the venting tables~~ shall be reduced by 5 percent.

13.2.6.2
For each elbow greater than 45 degrees up to and including 90 degrees, the maximum common vent capacity listed in Table 13.2(a) through Table 13.2(i)~~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 90-degree elbows.~~

13.2.7.1*
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.

A.13.2.7.1
The vent connector capacities listed in Table 13.2(a) through Table 13.2(i) include allowance for two 90-degree elbows.

13.2.7.2
For each elbow greater than 45 degrees up to and including 90 degrees, the maximum vent connector capacity listed in Table 13.2(a) through Table 13.2(i)~~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.

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.

13.2.10.1
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.

13.2.10.2
Such fittings as stated in 13.2.10.1 shall not be prohibited from having ~~reduced~~ reduced-size openings at the point of connection of appliance gas vent connectors.

13.2.11 High-Altitude Installations.

13.2.11.1
Sea level input ratings shall be used when determining maximum capacity for high-altitude installation.

13.2.11.2
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 in accordance with the following:

(1) Type B double wall

(2) Installed with a listed vent cap

13.2.17 Multistory Vent Offsets and Capacity.

13.2.17.1
Offsets in multistory common vent systems shall be limited to a single offset in each system.

13.2.17.2
~~, and s~~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.

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.

13.2.19 Two-Stage/Modulating Appliances.
13.2.19.1

The minimum vent connector capacity (FAN Min) of appliances with more than one input rate shall be determined from Table 13.2(a) through Table 13.2(i)~~the tables~~.

13.2.19.2
The minimum vent connector capacity (FAN Min) of appliances ~~and~~ shall be less than the lowest appliance input rating.

13.2.19.~~2~~ 3

The maximum vent connector capacity (FAN Max or NAT Max) shall be both of the following:

(1) ~~determined~~ Determined from Table 13.2(a) through Table 13.2(i)~~the tables~~
~~(1)~~(2) ~~and shall be g~~Greater than the highest appliance input rating~~.~~

13.2.20* Corrugated Chimney Liners.

13.2.20.1*

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).

A.13.2.20.1
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.

13.2.20.2
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.~~

13.2.21 Connections to Chimney Liners.

13.2.21.1
Where double-wall connectors are required, tee and wye fittings used to connect to the common vent chimney liner shall be listed double-wall fittings.

13.2.21.2
Connections between chimney liners and listed double-wall fittings shall be made with listed adapter fittings designed for such purpose.

13.2.22 Chimneys and Vent Locations.

13.2.22.1
Table 13.2(a) through Table 13.2(e) shall be used only for chimneys and vents not exposed to the outdoors below the roof line.

13.2.22.2
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.

13.2.22.3
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.

13.2.22.4
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), one of the following shall apply:

(1) ~~t~~The outdoor portion of the vent shall be enclosed as required by ~~this paragraph~~13.2.22 for vents not considered to be exposed to the outdoors.
(2) ~~, or such~~The venting system shall be engineered.

13.2.22.5
Table 13.2(f), Table 13.2(g), Table 13.2(h), and Table 13.2(i) shall be used for ~~clay~~ clay ~~tile~~ tile-lined exterior masonry chimneys, provided all the following conditions are met:

(1) The vent connector is Type B double wall.

(2) At least one appliance is draft hood equipped.

(3) The combined appliance input rating is less than the maximum capacity given by Table 13.2(f) (for NAT+NAT) or Table 13.2(h) (for FAN+NAT).

(4) The input rating of each space-heating appliance is greater than the minimum input rating given by Table 13.2(g) (for NAT+NAT) or Table 13.2(i) (for FAN+NAT).

(5) The vent connector sizing is in accordance with Table 13.2(c).

13.2.23 Draft Hood Conversion Accessories.

Draft hood conversion accessories for use with masonry chimney venting, listed Category I fan-assisted appliances shall be listed and installed in accordance with the listed accessory manufacturer's installation instructions.

13.2.24 Vent Connector Sizing.

13.2.24.1
Vent connectors shall not be increased more than two sizes greater than the listed appliance categorized vent diameter, flue collar diameter, or draft hood outlet diameter.

13.2.24.2
Vent connectors for draft hood–equipped appliances shall not be smaller than the draft hood outlet diameter.

12.2.24.3
Where a vent connector size(s) determined from Table 13.2(a) through Table 13.2(i)~~the tables~~ for a fan-assisted appliance(s) is smaller than the flue collar diameter, the use of the smaller size(s) shall be permitted, provided that the installation complies with all of the following conditions:

(1) Vent connectors for fan-assisted appliance flue collars 12 in. (300 mm) in diameter or smaller are not reduced by more than one table size [e.g., 12 in. to 10 in. (300 mm to 250 mm) is a one-size reduction], and those larger than 12 in. (300 mm) in diameter are not reduced more than two table sizes [e.g., 24 in. to 20 in. (610 mm to 510 mm) is a two-size reduction].

(2) The fan-assisted appliance(s) is common vented with a draft hood–equipped appliance(s).

(3) The vent connector has a smooth interior wall.

13.2.25 Multiple Vent and Connector Sizes.

13.2.25.1
All combinations of pipe sizes, single-wall metal pipe, and double-wall metal pipe shall be allowed within any connector run(s) or within the common vent, provided ~~ALL~~ all of the ~~appropriate~~ applicable tables permit ~~ALL~~ all of the desired sizes and types of pipe, as if they were used for the entire length of the subject connector or vent.

13.2.25.2
Where single-wall and Type B double-wall metal pipes are used for vent connectors within the same venting system, the common vent shall be sized using Table 13.2(b) or Table 13.2(d) as ~~appropriate~~applicable.

13.2.26 Multiple Vent and Connector Sizes Permitted.

Where a Chapter 13 table permits more than one diameter of pipe to be used for a connector or vent, all the permitted sizes shall be permitted to be used.

13.2.27 Interpolation.

Interpolation shall be permitted in calculating capacities for vent dimensions that fall between Table 13.2(a) through Table 13.2(i) ~~table~~ entries.

13.2.28 Extrapolation.

Extrapolation beyond the Table 13.2(a) through Table 13.2(i)~~table~~ entries shall not be permitted.

13.2.29 Sizing Vents Not Covered by Tables.

For vent heights lower than 6 ft (1.8 m) and higher than shown in Table 13.2(a) through Table 13.2(i)~~the tables~~, engineering methods shall be used to calculate vent capacities.

13.2.30 Height Entries.

Where the actual height of a vent falls between entries in the height column of the applicable table in Table 13.2(a) through Table 13.2(i), either of the following shall be used:

(1) Interpolation

(2) The lower appliance input rating shown in Table 13.2(a) through Table 13.2(i)~~the table~~ entries, for FAN Max and NAT Max column values; and the higher appliance input rating for the FAN Min column values

Committee Input No. 24-NFPA 54-2024 [New Section after C.2]

C.2 Access.

None of the suggested leak check methods listed within this section suggest that entry into the home is required if the leak check passes.

The current sections would be moved down

Submitter Information Verification

Committee: NFG-AAA

Submittal Date: Thu Sep 19 08:07:40 EDT 2024

Committee Statement

Committee Statement: The technical committee is seeking input in regards into entry into the home when conducting leak checks. This reflects the original intent of the addition of leak checks into the 1999 revision cycle.

Response Message: CI-24-NFPA 54-2024