Copyright © 2026 by American Gas Association and the National Fire Protection Association, All Rights Reserved

BSR Z223.1–20xx

NFPA® 54–20xx

National Fuel Gas Code

2027 Edition

SECOND PUBLIC REVIEW DRAFT

The following revisions are open for review and comment in accordance with ASC Z223 procedures. The joint committee, ASC Z223/NFPA 54, acted on public comments received during the NFPA Frist Revision Draft Public Review. Persons who submitted comments on the first draft will need to refer to the Public Comment Report for disposition of their public comments. This Z223 Second Public Review Draft is the result of public comments that were either approved as submitted or committee amended code text to address a public comment.

How to Use the Draft: Revisions from the First Revision Draft are identified as additions (underlined) and deletions (strikethrough). Each revision is identified by its Second Revision Number in brackets (for example, "[SR No. 1-NFPA 54/Z223.1-2024]"). The SR identification is placed at the end of each revised section(s) or specific revision. The committee reason for each revision can be found attached.

How to Submit a Comment: Comments must address only the revisions shown in this draft. Complete the ASC Z223 comment form and return it by the deadline date to address shown on the form. Please note that comments received will be addressed in accordance with the ASC Z223 procedures and are not forwarded to NFPA.

Chapter 1
Administrative

{1.1 through 1.1.1.1(F) unchanged}

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 (feedstock) applications except for piping to special atmosphere generators

(4) Oxygen-fuel gas cutting and welding systems

(5) Industrial gas applications under the scope of NFPA 51 or NFPA 55

(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

[SR No. 17-NFPA 54/Z223.1-2024]

(8) LP-Gas installations at utility gas plants

(9)* Liquefied natural gas (LNG) systems

(10) Fuel gas piping in electric utility power plants

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

(12) 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

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

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

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

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

(17) Fuel gas systems under the scope of NFPA 2

(18) Construction of appliances

(19*) Selection, design, application, installation, location, performance, operation, inspection, testing, and maintenance of fuel gas detection and warning equipment in buildings and structures.

[SR No. 17-NFPA 54/Z223.1-2024]

{1.1.2 through 1.3 unchanged}

1.4 Equivalency. Nothing in this code shall prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this code.

~~**1.4.1** The provisions of this code are shall not be intended to prevent the use of any material, appliance, equipment, method of construction, or installation procedure, provided that any such alternatives is in accordance with the following: acceptable to the authority having jurisdiction. The authority having jurisdiction shall require that sufficient evidence be submitted to substantiate any claims made regarding the safety of such alternatives.~~

~~(1) It is equivalent or superior to that prescribed in this code in terms of quality, strength, fireresistance, durability, and safety as applicable~~

~~(2) It meets the intent of this code~~

~~(3) It is approved for the intended purpose by the AHJ~~

~~**1.4.2** Technical documentation satisfactory to the AHJ shall be submitted to demonstrate equivalency.~~

1.4.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.4.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

[SR No. 15-NFPA 54/Z223.1-2024]

{1.5 unchanged}

Chapter 2
Referenced Standards

{2.1 through 2.2 unchanged}

2.3 Other Publications

2.3.1 ASME Publications. American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990, ~~800.843.2763,~~ www.asme.org.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI/ASME B1.20.1, *Pipe Threads, General Purpose, Inch*, 2013 (R2018).

ANSI/ASME B16.1, *Gray Iron Pipe Flanges and Flanged Fittings*: *Classes 25, 125, and 250*, 2020.

ANSI/ASME B16.5, *Pipe Flanges and Flanged Fittings: NPS ½ through NFPS 24 Metric/Inch Standard,* ~~2020~~ 2025.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI/ASME B16.20*, Metallic Gaskets for Pipe Flanges~~: Ring Joint, Spiral Wound and Jacketed,~~* 2023.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI/ASME B16.21*, Nonmetallic Flat Gaskets for Pipe Flanges,* 2021.

ANSI/ASME B16.24*, Cast Copper Alloy Pipe Flanges*, ~~*and*~~ *Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500*, 2021.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI/ASME B16.33, *Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS 1/2 through NPS 2)*, 2024.

ANSI/ASME B16.38, *Large Metallic Valves for Gas Distribution*, 2023.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI/ASME B16.42*, Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300,* 2021.

ANSI/ASME B16.44, *Manually Operated Metallic Gas Valves for Use in ~~Above Ground~~ Aboveground Piping Systems up to 5 psi*, 2023.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI/ASME B16.47*, Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric/Inch Standard,* ~~2020~~ 2025.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI/ASME B36.10M, *Welded and Seamless Wrought Steel Pipe*, 2018.

2.3.2 ASTM Publications. American Society for Testing and Materials International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, ~~610.832.9500~~, www.astm.org.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM A53/A53M, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless*, 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM A106/A106M, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*, 2019a.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM A254/A254M, *Standard Specification for Copper-Brazed Steel Tubing*, 2012, reaffirmed 2019.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM A268/A268M, *Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service,* 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM A269/A269M, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service,* 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM A312/A312M, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes,* ~~2024a~~ 2025.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM B88, *Standard Specification for Seamless Copper Water Tube*, 2022.

ASTM B210/B210M, *Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes*, 2019a.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM B241/B241M, *Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube*, 2022.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM B280, *Standard Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service*, 2023.

ASTM D2513, *Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings*, ~~2020~~ 2025.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM E136, *Standard Test Method for ~~Behavior~~ Assessing Combustibility of Materials ~~in~~ Using a Vertical Tube Furnace at 750°C,* 2024c.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM E2652, *Standard Test Method for ~~Behavior~~ Assessing Combustibility of Materials ~~in~~ Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C,* 2022.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM F1924, *Standard Specification for Plastic Mechanical Fittings for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing*, 2025.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM F1973, *Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems,* ~~2021~~ 2025.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM F2509, *Standard Specification for Field-assembled Anodeless Riser Kits for Use on Outside Diameter Controlled Polyethylene and Polyamide-11 (PA11) Gas Distribution Pipe and Tubing,* 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

ASTM F2945, *Standard Specification for Polyamide 11 Gas Pressure Pipe, Tubing, and Fittings,* 2018 reaffirmed 2023.

2.3.3 CSA Group Publications. CSA Group, Inc., 8501 East Pleasant Valley Road, Cleveland, OH 44131-5575, ~~216.524.4990,~~ www.csa-group.org.

[SR No. 1-NFPA 54/Z223.1-2024]

CSA/ANSI/ FC 1~~:21~~/CSA 22.2 No. ~~0.~~ 622822-3-100~~:21~~, Fuel Cell Technologies - Part 3-100: *Stationary Fuel Cell Power Systems – Safety* (adopted IEC 6228-3-100:2016, second edition, 2019-02, with Canadian and US deviations), 2021.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI/CSA NGV 5.1, *Residential Fueling Appliances (RFA),* 2023.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI/CSA NGV 5.2, *Vehicle Fueling Appliances (VFA)*, ~~2017, reaffirmed 2021~~ 2023.

[SR No. 1-NFPA 54/Z223.1-2024]

CSA/ANSI LC 1/CSA 6.26, *Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing*, ~~2019~~ 2023.

[SR No. 1-NFPA 54/Z223.1-2024]

CSA/ANSI LC 4/CSA 6.32, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems2022*.

CSA/ANSI Z21.1/CSA 1.1, *Household Cooking Gas Appliances*, 2024.

ANSI Z21.5.1/CSA 7.1, *Gas Clothes Dryers, Volume I, Type 1 Clothes Dryers*, ~~2022~~ 2017, reaffirmed 2022.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI Z21.5.2/CSA 7.2, *Gas Clothes Dryers, Volume II, Type 2 Clothes Dryers*, 2016, reaffirmed 2021.

ANSI Z21.8, *Installation of Domestic Gas Conversion Burners*, 1994, reaffirmed 2017.

CSA/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,* 2019, reaffirmed 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

CSA/ANSI Z21.10.3/CSA 4.3, *Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous*, 2019.

[SR No. 1-NFPA 54/Z223.1-2024]

CSA/ANSI Z21.11.2, *Gas-Fired Room Heaters - Volume II, Unvented Room Heaters,* 2019.

CSA/ANSI Z21.13/CSA 4.9, *Gas-fired Low Pressure Steam and Hot Water Boilers,* 2022.

ANSI Z21.15/CSA 9.1, *Manually ~~operated gas valves for appliances, appliance connector valves and hose end valves~~ Operated Gas Valves for Appliances, Appliance Connector Valves, and Hose-End Valves*, 2021.

[SR No. 1-NFPA 54/Z223.1-2024]

CSA/ANSI Z21.18/CSA 6.3, *Gas Appliance Pressure Regulators*, 2019.

CSA/ANSI Z21.19/CSA 1.4, *Refrigerators Using Gas Fuel*, 2019, reaffirmed 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI Z21.22/CSA 4.4, *Relief Valves for Hot Water Supply Systems*, 2015, raffirmed 2020.

CSA/ANSI Z21.24/CSA 6.10, *Connectors for Gas Appliances*, 2022.

ANSI Z21.40.1/CSA 2.91, *Gas-fired Heat Activated Air Conditioning and Heat Pump Appliances*, 1996, reaffirmed 2022.

ANSI Z21.40.2/CSA 2.92, *Gas-Fired, Work-Activated Air Conditioning and Heat Pump Appliances (Internal Combustion)*, 1996, reaffirmed 2022.

ANSI Z21.41/CSA 6.9, *Quick-Disconnect Devices for use with Gas Fuel Appliances,* 2023.

CSA/ANSI Z21.47/CSA 2.3, *Gas-fired Central Furnaces*, 2021.

ANSI Z21.50/CSA 2.22, *Vented Decorative Gas Appliances*, 2019.

CSA/ANSI Z21.54/CSA 8.4, *Gas Hose Connectors for Portable Outdoor Gas-Fired Appliances*, 2019, reaffirmed 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

CSA/ANSI Z21.56/CSA 4.7, *Gas-fired Pool Heaters*, 2019.

ANSI Z21.58/CSA 1.6, *Outdoor Cooking Gas Appliances*, 2022.

ANSI Z21.60/CSA 2.26, *Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces*, 2017, reaffirmed 2021.

ANSI Z21.69/CSA 6.16, *Connectors for ~~Movable~~ Moveable Gas Appliances*, 2015, reaffirmed 2020.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI Z21.75/CSA 6.27, *Connectors for Outdoor Gas Appliances and Manufactured Homes,* 2016, reaffirmed 2021.

ANSI Z21.80/CSA 6.22, *Line Pressure Regulators,* 2019, reaffirmed 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI Z21.86/CSA 2.32, *Vented Gas-fired Space Heating Appliances*, 2016, reaffirmed 2021.

CSA/ANSI Z21.88/CSA 2.33, *Vented Gas Fireplace Heaters*, 2019,

ANSI Z21.89/CSA 1.18, *Outdoor Cooking Specialty Gas Appliances*, 2023.

ANSI Z21.90/CSA 6.24, *Gas Convenience Outlets and Optional Enclosures,* 2019, reaffirmed 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI Z21.93/CSA 6.30, *Excess Flow Valves for Natural Gas and ~~LP~~ Propane Gas with Pressures Up to 5 psig,* 2017, reaffired 2022.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI Z21.97/CSA 2.41, *Outdoor Decorative Gas Appliances*, 2017.

ANSI Z83.4/CSA 3.7, *Non-Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Application,* 2017, reaffirmed 2022.

ANSI Z83.8/CSA 2.6, *Gas Unit Heaters, as Packaged Heaters, Gas Utility Heaters, and Gas-fired Duct Furnaces,* 2016, reaffirmed 2021.

ANSI Z83.11/CSA 1.8, *Gas Food Service Equipment,* 2016, reaffirmed 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI Z83.18, *Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Application,* 2017, reaffirmed 2021.

ANSI Z83.19/CSA 2.35, *Gas-fired High-Intensity Infrared Heaters*, 2017, reaffirmed ~~2021~~ 2022.

[SR No. 1-NFPA 54/Z223.1-2024]

ANSI Z83.20/CSA 2.34, *Gas-fired Tubular and Low-intensity Infrared Heaters*, 2016, reaffirmed 2021.

ANSI Z83.26/CSA 2.~~27~~ 37, Gas-fired Outdoor Infrared Patio Heaters, 2020.

[SR No. 1-NFPA 54/Z223.1-2024]

2.3.4 MSS Publications. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, VA, 22180-4602, ~~703.281.6613,~~ www.mss-hq.com.

ANSI/MSS SP-58, *Pipe Hangers and Supports — Materials, Design, Manufacture, Selection, Application, and Installation,* ~~2018~~ 2025.

[SR No. 1-NFPA 54/Z223.1-2024]

2.3.5 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 103, *Factory-Built Chimneys for Residential Type and Building Heating Appliances,* 2010, revised 2021.

UL 353, *Limit Controls*, 1994, revised 2011.

UL 378, *Draft Equipment,* 2006, revised 2013.

UL 441, *Gas Vents,* 2016 revised 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

UL 467, *Grounding and Bonding Equipment,* 2022.

UL 641, *Type L Low-Temperature Venting Systems,* 2010, revised ~~2018~~ 2022.

[SR No. 1-NFPA 54/Z223.1-2024]

UL 651, *Schedule 40, ~~and~~ 80, Type EB and A Rigid PVC Conduit and Fittings,* 2011, revised 2022.

[SR No. 1-NFPA 54/Z223.1-2024]

UL 959, *Medium Heat Appliance Factory-Built Chimneys,* 2010, revised 2024.

UL 1738, *Venting Systems for Gas Burning Appliances, Categories II, III, and IV*, 2023.

UL 1777, *Chimney Liners*, 2015, revised-2024.

UL 2158A, *Clothes Dryer Transition Ducts,* 2013, revised 2023.

UL 2561, *1400 Degree Fahrenheit Factory-Built Chimneys,* 2016, revised 2022.

UL 2989, *Outline of Investigation of Tracer Wire*, 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

UL 60730-2-6, *Automatic Electrical Controls - ~~for Household and Similar Use;~~ Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements*, 2016, revised ~~2021~~ 2024.

[SR No. 1-NFPA 54/Z223.1-2024]

2.3.6 U.S. Government Publication. U.S. Government Printing Office, Washington, DC 20402, www.gpo.gov.

Title 49, *Code of Federal Regulations*, Part 192, "Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards."

[SR No. 1-NFPA 54/Z223.1-2024]

{2.3.7 unchanged}

2.4 References for Extracts in Mandatory Sections.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment,* 2024 edition.

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

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

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

•

NFPA 5000®, *Building Construction and Safety Code®*, ~~2021~~ 2024 edition.

[SR No. 4-NFPA 54/Z223.1-2024]

Chapter 3
Definitions

{3.1 through 3.3.82 unchanged}

3.3.82 Qualified Agency. Any individual, firm, corporation, or company that either in person or through a representative is engaged in and ~~that is~~ responsible for: (1) the design, installation, testing, removal, or replacement of gas piping or (2) the connection, installation, testing, repair, or servicing of appliances and equipment; experienced in such work; familiar with all precautions required; and compliant with all the requirements of the authority having jurisdiction.

[SR No. 14-NFPA 54/Z223.1-2024]

{3.3.84 through 3.3.96.4 unchanged}

3.3.96.5 Piping System. All pipe, tubing, valves, and fittings from the point of delivery up to and including the ~~outlets of the~~ appliance shutoff valve(s).

[SR No. 18-NFPA 54/Z223.1-2024]

{3.3.96.6 through 3.3.105 unchanged}

Chapter 4
General

{Chapter 4 unchanged}

Chapter 5
Gas Piping System Design, Materials, and Components

{5.1 through 5.1.1.2 unchanged}

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 pressure 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.

[SR No. 21-NFPA 54/Z223.1-2024]

{5.2 through 5.2.1 unchanged}

5.2.2* Interconnections for Stand-By 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.~~

[SR No. 21-NFPA 54/Z223.1-2024]

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 through 5.5.1 unchanged}

5.5.1.1 Acceptable Materials. Materials used for piping systems shall comply with the requirements of this chapter or be approved ~~shall 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 approved ~~ascertained to be adequate~~ for the service intended.

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.2 through 5.5.2.1 unchanged}

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.*

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.2.3 through 5.5.2.4 unchanged}

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

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.2.6 unchanged}

5.5.3 Metallic Tubing.

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

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.3.2 through 5.5.3.3 unchanged}

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 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.*

[SR No. 21-NFPA 54/Z223.1-2024]

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

5.5.3.5.3 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.

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

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.3.6 through 5.5.4.1.3 unchanged}

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.

[SR No. 21-NFPA 54/Z223.1-2024]

5.5.4.3 Anodeless Risers. Anodeless risers shall comply with all of the following:

(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.

~~(2)~~(3) 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).

(5) The manufacturer shall provide the user qualified installation instructions as prescribed by 49 CFR 192.283(b).

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

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.5 through 5.5.7.4 unchanged}

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*.

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.6.2 through 5.5.6.4.2 unchanged}

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.

[SR No. 21-NFPA 54/Z223.1-2024]

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, and 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 Fitting 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 1,000°F (538°C).~~

~~(C) Brazing alloys shall not contain more than 0.05 percent phosphorus.~~

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

5.5.7.1.2 Where nonferrous pipe is brazed, the brazing materials shall have a melting point in excess of 1,000°F (538°C)~~.~~ and ~~Brazing alloys shall not~~ contain more than 0.05 percent phosphorus.

[SR No. 21-NFPA 54/Z223.1-2024]

5.5.7.2 Copper Tubing Joints.

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

(1) ~~a~~Assembled with approved gas tubing fittings

(2) ~~, shall be b~~Brazed with a material having a melting point in excess of 1,000°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*.

[SR No. 21-NFPA 54/Z223.1-2024]

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) ~~w~~Welded~~,~~

(2) ~~a~~Assembled with approved tubing fittings

(3) ~~, b~~Brazed with a material having a melting point in excess of 1,000°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 brazing alloy or flux manufacturer.

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.7.4 unchanged}

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) *Field Drilled and Tapped Fittings*. When pipe fittings are drilled and tapped in the field, the operation shall be in accordance with Section 7.5.

[SR No. 21-NFPA 54/Z223.1-2024]

5.5.8 Plastic Piping Joints and Fittings. The joint shall be designed and installed so that the longitudinal pullout resistance of the joint will be at least equal to the tensire strength of the plastic piping material.

5.5.8.1 Polyethylene heat fusion fittings shall be marked "ASTM D2513."

5.5.8.2 Polyamide heat fusion fittings shall be marked "ASTM F2945."

~~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.~~

[SR No. 32-NFPA 54/Z223.1-2024]

{5.5.9 through 5.5.9.1.1 unchanged}

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*

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.9.1.3 through 5.5.9.2 unchanged}

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.

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.9.4 unchanged}

5.5.10 Flange Gaskets.

~~**5.5.10.1** Acceptable material 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~~

5.5.10.1* 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.

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.10.2 through 5.5.10.2.1 unchanged}

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

5.5.10.3 Full-face flame gaskets shall be used with all ~~non-steel~~ nonsteel flanges.

[SR No. 21-NFPA 54/Z223.1-2024]

{5.5.10.4 through 5.8.3.1 unchanged}

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.~~

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

[SR No. 21-NFPA 54/Z223.1-2024]

5.8.4 Construction and Installation. ~~All o~~Overpressure protection devices shall be designed, contructed, and installed to meet all of the following requirements:

(1) The operation of the device will not be impaired by the ambient environment, corrosion of external parts, or the corrosion of internal parts by the gas.

(2) The device is capable of being operated as designed.

(3) The device is capable of being tested to determine the pressure at which it operates.

(4) The device is capable of being examined for internal leakage when in the closed position.

[SR No. 21-NFPA 54/Z223.1-2024]

{5.8.2 through 5.8.3.1 unchanged}

{5.8.5 unchanged}

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

[SR No. 21-NFPA 54/Z223.1-2024]

{5.8.7 unchanged}

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.

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**~~ **5.8.8.3** The discharge stack or vent line shall be at least the same size as the outlet of the pressure relieving device.

[SR No. 21-NFPA 54/Z223.1-2024]

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 hammering of the valve and to prevent reduction of relief capacity.

[SR No. 21-NFPA 54/Z223.1-2024]

{5.9 through 5.9.1.2 unchanged}

5.9.2 Protective Devices. Protective devices shall include but are not 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

[SR No. 21-NFPA 54/Z223.1-2024]

{5.10 unchanged}

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.

[SR No. 21-NFPA 54/Z223.1-2024]

Table 5.11.1 Manual Gas Valve Standards

Shutoff Valve Application	Valve Meeting the Following Standards
Appliance shutoff valve up to ½ psi	ANSI LC-4/CSA 6.32 ANSI Z21.15/CSA 9.1 ASME B16.33 marked 125 G ASME B16.44 ANSI/ASME B16.38
Valve up to ½ psi	ANSI LC-4/CSA 6.32 ASME B16.33 marked 125 G ASME B16.44 ANSI/ASME B16.38
Valve up to 2 psi	ANSI LC-4/CSA 6.32 with ASME B16.44 labeled 2G or labeled 5G ANSI LC-4/CSA 6.32 with ASME B16.33 marked 125 G ASME B16.33 marked 125 G ASME B16.44 labeled 2G ANSI/ASME B16.38
Valve up to 5 psi	ANSI LC-4/CSA 6.32 with ASME B16.44 marked 5G ANSI LC-4/CSA 6.32 with ASME B16.33 marked 125 G ASME B16.33 ASME B16.44 labeled 5G ANSI/ASME B16.38
Valve up to 125 psi	ANSI LC-4/CSA 6.32 with ASME B16.33 marked 125 G ASME B16.33 marked 125 G ANSI/ASME B16.38

For SI units: 1 psi gauge = 6.895 kPa.

[SR No. 21-NFPA 54/Z223.1-2024]

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~~ Where excess flow valves are installed, they shall be sized and installed in accordance with the manufacturers' instructions.

[SR No. 21-NFPA 54/Z223.1-2024]

{5.13 through 5.13.1 unchanged}

5.13.2 Special Load 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 shall be considered.

[SR No. 18-NFPA 54/Z223.1-2024]

[SR No. 21-NFPA 54/Z223.1-2024]

{5.14 unchanged}

Chapter 6
Pipe Sizing

{6.1 through 6.1.3 unchanged}

6.1.4 Hybrid Pressure.

6.1.4.1 The pipe size for each section of higher pressure gas piping in a hybrid pressure system shall be determined using the longest length of piping from the point of delivery to the most remote line pressure regulator.

6.1.4.2 The pipe size from the line pressure regulator to each outlet in a hybrid pressure system shall be determined using the length of piping from the regulator to the most remote outlet served by the regulator.

[SR No. 22-NFPA 54/Z223.1-2024]

{6.2 unchanged}

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 6.1.1 through 6.1.3 for piping materials other than ~~non-corrugated~~ noncorrugated stainless steel tubing.

[SR No. 22-NFPA 54/Z223.1-2024]

6.2.2 Section 6.4 shall be used in conjunction with one of the methods describe in 6.1.1 through 6.1.3 for ~~non-corrugated~~ noncorrugated stainless steel tubing.

{6.3 unchanged}

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 6.1.1 through 6.1.3 for piping materials other than ~~non-corrugated~~ noncorrugated stainless steel tubing.

[SR No. 22-NFPA 54/Z223.1-2024]

6.3.2 Section 6.4 shall be used in conjunction with one of the methods described in 6.1.1 through 6.1.3 for ~~non-corrugated~~ noncorrugated stainless steel tubing.

[SR No. 22-NFPA 54/Z223.1-2024]

{6.4 unchanged}

6.4.1* Low-Pressure Gas Formula. For ~~L~~less than 1.5 psi (10.3 kPa), the following equation shall be used:

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

where:

D = inside diameter of pipe, in.

Q = input rate appliance(s), cubic feet per hour at 60°F (16°C) and 30 in. mercury column

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

Cr = see table 6.4.2 for values of Cr

L = equivalent length of pipe, ft

~~See Table 6.4.2 for values of *Cr*.~~

[SR No. 22-NFPA 54/Z223.1-2024]

6.4.2* High-Pressure Gas Formula. For 1.5 psi (10.3 kPa) and above, the following equation shall be used:

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

where:

D = inside diameter of pipe, in.

Q = input rate appliance(s), cubic feet per hour at 60°F (16°C) and 30 in. mercury column

P_1 = upstream pressure, psia (P_1 + 14.7)

P_2 = downstream pressure, psia (P_2 + 14.7)

Y = see table 6.4.2 for values of Y

Cr = see table 6.4.2 for values of Cr

L = equivalent length of pipe, ft

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

~~See Table 6.4.2 for values of *Cr* & *Y*.~~

[SR No. 22-NFPA 54/Z223.1-2024]

{Table 6.4.2 unchanged}

Table 6.2.1(a)	Schedule 40 Metallic Pipe	Gas	Natural
		Inlet pressure	Less than 2 psi
		Pressure Drop	0.3 in w.c.
		Specific Gravity	0.60
INTENDED USE: Inlet gas pressure less than 8 in. w.c.			
Pipe Size (in.)			
{No change to rest of existing table}			
Notes: 1. NA: a flow of less than 10 cfh 2. All table entries have been rounded to ~~3~~ three significant digits			

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(b)	Schedule 40 Metallic Pipe	Gas	Natural
		Inlet pressure	Less than 2 psi
		Pressure Drop	0.5 in w.c.
		Specific Gravity	0.60
INTENDED USE: Inlet gas pressure less than 8 in. w.c.			
Pipe Size (in.)			
{No change to rest of existing table}			
Notes: 1. NA: a flow of less than 10 cfh 2. All table entries have been rounded to ~~3~~ three significant digits			

[SR No. 22-NFPA 54/Z223.1-2024]

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
Note: All table entries have been rounded to ~~3~~ three significant digits			

[SR No. 22-NFPA 54/Z223.1-2024]

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	0.60
Note: All table entries have been rounded to ~~3~~ three significant digits			

[SR No. 22-NFPA 54/Z223.1-2024]

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
Note: All table entries have been rounded to ~~3~~ three significant digits			

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(f)	Schedule 40 Metallic Pipe	Gas	Natural
		Inlet pressure	5.0 psi
		Pressure Drop	3.5 psi
		Specific Gravity	0.60
Note: All table entries have been rounded to ~~3~~ three significant digits			

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(g)		Gas	Natural
	Semirigid Copper Tubing	Inlet pressure	Less than 2 psi
		Pressure Drop	0.3 in w.c.
		Specific Gravity	0.60
INTENDED USE: Inlet gas pressure less than 8 in. w.c.			
Pipe Size (in.)			
{No change to rest of existing table}			
Notes: 1. Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products. 2. NA: a flow of less than 10 cfh. 3. All table entries have been rounded to ~~3~~ three significant digits			

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(h)	Semirigid Copper Tubing	Gas	Natural
		Inlet pressure	Less than 2 psi
		Pressure Drop	0.5 in w.c.
		Specific Gravity	0.60
INTENDED USE: Inlet gas pressure less than 8 in. w.c.			
Pipe Size (in.)			
{No change to rest of existing table}			
Notes: 1. Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products. 2. NA: a flow of less than 10 cfh. 3. All table entries have been rounded to ~~3~~ three significant digits			

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(i)	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 Line Pressure Regulator and theAppliance			
Tube Size (in.)			

{No change to rest of existing table}
Notes: 1. Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products. 2. NA: a flow of less than 10 cfh. 3. All table entries have been rounded to ~~3~~ three significant digits

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(j)	Semirigid Copper Tubing	Gas	Natural
		Inlet pressure	2.0 psi
		Pressure Drop	1.0 psi
		Specific Gravity	0.60
Notes: 1. Table capacities are based on Type K copper tubing inside dia (shown), which has the smallest inside diameter of the copper products. 2. All table entries have been rounded to ~~3~~ three significant digits.			

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(k)	Semirigid Copper Tubing	Gas	Natural
		Inlet pressure	5.0 psi
		Pressure Drop	3.5 psi
		Specific Gravity	0.60
Notes: 1. Table capacities are based on Type K copper tubing inside dia (shown), which has the smallest inside diameter of the copper products. 2. All table entries have been rounded to ~~3~~ three significant digits.			

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(l)	Corrugated Stainless Steel Tubing (CSST)	Gas	Natural
		Inlet pressure	Less than 2 psi
		Pressure Drop	0.5 in. w.c.
		Specific Gravity	0.60
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. EHD— Equivalent Hydraulic Diameter, which is 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. 3. All table entries have been rounded to ~~3~~ three significant digits.			

[SR No. 22-NFPA 54/Z223.1-2024]

{Table 6.2.1(m) [previously Table 6.2.1 (p)] unchanged}

Table 6.2.1(n)	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. up to 14.0 in. w.c. without a line pressure regulator			
{Table values unchanged}			
Notes: 1. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fittings need to 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. Do not use unless the gas supplier can supply 11 in. w.c. orgreater. 3. EHD— Equivalent Hydraulic Diameter, which is 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. 4. All table entries have been rounded to ~~3~~ three significant digits.			

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(o)	Corrugated Stainless Steel Tubing (CSST)	Gas	Natural
		Inlet pressure	2.0 psi
		Pressure Drop	1.0 psi
		Specific Gravity	0.60

Notes: 1. Table does not include effect of pressure drop across the line regulator. Where regulator loss exceeds ¾ ½ psi, DO NOT USE THIS TABLE. Consult with regulator manufacturer for pressure drops and capacity factors. Pressure drops across a regulator ~~may~~ can vary with flow rate.
2. CAUTION: Capacities shown in table ~~may~~ might 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 numbers of bends and/or fittings shall be increased by an equivalent length of tubing determined by ~~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. EHD— Equivalent Hydraulic Diameter, which is 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.
5. All table entries have been rounded to ~~3~~ three significant digits.

[SR No. 30-NFPA 54/Z223.1-2024]

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(p)	Corrugated Stainless Steel Tubing (CSST)	Gas	Natural
		Inlet pressure	5.0 psi
		Pressure Drop	3.5 psi
		Specific Gravity	0.60

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~~ can vary with flow rate.
2. CAUTION: Capacities shown in table ~~may~~ might 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 numbers of bends and/or fittings shall be increased by an equivalent length of tubing determined by ~~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. EHD— Equivalent Hydraulic Diameter, which is 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.
5. All table entries have been rounded to ~~3~~ three significant digits.

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(q)	Polyethylene Plastic Pipe	Gas	Natural
		Inlet pressure	Less than 2 psi
		Pressure Drop	0.3 in. w.c.
		Specific Gravity	0.60

Note: All table entries have been rounded to ~~3~~ three significant digits.

Table 6.2.1(r)	Polyethylene Plastic Pipe	Gas	Natural
		Inlet pressure	Less than 2 psi
		Pressure Drop	0.5 in. w.c.
		Specific Gravity	0.60

Note: All table entries have been rounded to ~~3~~ three significant digits.

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(s)	Polyethylene Plastic Pipe	Gas	Natural
		Inlet pressure	2.0 psi
		Pressure Drop	1.0 psi
		Specific Gravity	0.60

Note: All table entries have been rounded to ~~3~~ three significant digits.

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(t)	Polyethylene Plastic Tubing	Gas	Natural
		Inlet pressure	Less than 2.0 psi
		Pressure Drop	0.3 in. w.c.
		Specific Gravity	0.60

Notes: 1. NA means a flow of less than 10 cfh.
2. All table entries have been rounded to ~~3~~ three significant digits
3. CTS: Copper tube size.

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.2.1(u)	Polyethylene Plastic Tubing	Gas	Natural
		Inlet pressure	Less than 2.0 psi
		Pressure Drop	0.5 in. w.c.
		Specific Gravity	0.60

Notes: 1. NA means a flow of less than 10 cfh. 2. All table entries have been rounded to ~~3~~ three significant digits 3. CTS: Copper tube size.

[SR No. 22-NFPA 54/Z223.1-2024]

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
Note: All table entries have been rounded to ~~3~~ three 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
Note: All table entries have been rounded to ~~3~~ three significant digits.			

[SR No. 22-NFPA 54/Z223.1-2024]

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
Note: All table entries have been rounded to ~~3~~ three significant digits.			

[SR No. 22-NFPA 54/Z223.1-2024]

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
Note: All table entries have been rounded to ~~3~~ three significant digits.			

[SR No. 22-NFPA 54/Z223.1-2024]

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
Notes: 1. Table capacities are based on Type K copper tubing inside di (shown), which has the smallest inside diameter of the copper products. 2. All table entries have been rounded to ~~3~~ three significant digits.			

[SR No. 22-NFPA 54/Z223.1-2024]

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
Notes: 1. Table capacities are based on Type K copper tubing inside di (shown), which has the smallest inside diameter of the copper products. 2. NA means a flow of less than 10,000 But/hr. 3. All table entries have been rounded to ~~3~~ three significant digits.			

[SR No. 22-NFPA 54/Z223.1-2024]

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

Notes: 1. Table capacities are based on Type K copper tubing inside di (shown), which has the smallest inside diameter of the copper products.
2. All table entries have been rounded to ~~3~~ three significant digits.

[SR No. 22-NFPA 54/Z223.1-2024]

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

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 determined by ~~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. EHD— Equivalent Hydraulic Diameter, which is 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.
3. All table entries have been rounded to ~~3~~ three significant digits.

[SR No. 22-NFPA 54/Z223.1-2024]

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

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~~ can vary with flow rate.
2. CAUTION: Capacities shown in table ~~may~~ might 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 numbers of bends ~~and~~/or fittings shall be increased by an equivalent length of tubing determined by ~~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. EHD— Equivalent Hydraulic Diameter, which is 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.
5. All table entries have been rounded to ~~3~~ three significant digits.

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.3.1(j)	Corrugated Stainless Steel Tubing (CSST)	Gas	Undiluted Propane
		Inlet pressure	5.0 psi
		Pressure Drop	3.5 psi
		Specific Gravity	1.50

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~~ can vary with the flow rate.
2. CAUTION: Capacities shown in table ~~may~~ might 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 determined by ~~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. EHD— Equivalent Hydraulic Diameter, which is 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.
5. All table entries have been rounded to ~~3~~ three significant digits.

[SR No. 22-NFPA 54/Z223.1-2024]

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

Note: All table entries have been rounded to ~~3~~ three significant digits.

[SR No. 22-NFPA 54/Z223.1-2024]

Table 6.3.1(l)	Polyethylene Plastic Pipe	Gas	Undiluted Propane
		Inlet pressure	2.0 psi
		Pressure Drop	1.0 psi
		Specific Gravity	1.50
Note: All table entries have been rounded to ~~3~~ three significant digits.			

[SR No. 22-NFPA 54/Z223.1-2024]

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
Note: 1. All table entries have been rounded to ~~3~~ three significant digits. 2. CTS: Copper tube size.			

[SR No. 22-NFPA 54/Z223.1-2024]

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.

[SR No. 23-NFPA 54/Z223.1-2024]

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.

7.1.2.~~1~~2 Cover Requirements. Underground piping systems shall be installed with a minimum of 12 in. (300 mm) of cover.

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~~.

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.

[SR No. 23-NFPA 54/Z223.1-2024]

7.1.3* Corrosion Protection of Piping. Steel pipe and steel tubing installed underground shall be installed in accordance with 7.1.3.1 through 7.1.3.~~9~~13.

7.1.3.1 Zinc coating ~~(galvanizing)~~ shall not be considered as 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.

(~~3~~4) The piping shall have a cathodic protection system installed and ~~the system shall be~~ maintained in accordance with 7.1.3.3 ~~or~~ through 7.1.3.6.

[SR No. 23-NFPA 54/Z223.1-2024]

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 as provided in 7.1.3.6.1, ~~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~~

[SR No. 23-NFPA 54/Z223.1-2024]

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.

[SR No. 23-NFPA 54/Z223.1-2024]

7.1.3.5 7 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 7.1.3.6(2),

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

[SR No. 23-NFPA 54/Z223.1-2024]

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.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.1.4 through 7.1.6 unchanged}

7.1.6.1 Conduit with One End Terminating Outdoors.

7.1.6.1.1 Where the conduit has one end that terminates indoors, t~~T~~he 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 will retain 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

(3) ~~and be~~ Be installed so as to prevent the entrance of water and insects~~.~~

[SR No. 23-NFPA 54/Z223.1-2024]

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.

[SR No. 23-NFPA 54/Z223.1-2024]

7.1.7 Plastic Pipe.

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.

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

7.1.7.1.2 ~~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.

[SR No. 23-NFPA 54/Z223.1-2024]

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 (PA12) 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.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.1.7.3 through 7.1.7.3.1 unchanged}

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

(1) ~~access~~ Access shall be provided from aboveground.

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

[SR No. 23-NFPA 54/Z223.1-2024]

{7.1.8 unchanged}

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 against 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 3 ½ inches (89 mm) above the ground.

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

[SR No. 23-NFPA 54/Z223.1-2024]

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.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.2.3 through 7.2.5 unchanged}

7.2.6 Hangers, Supports, and Anchors.

7.2.6.1 Support Type. Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, or 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.*

7.2.6.25 The spacing of supports in gas piping installations shall not be greater than shown in Table 7.2.6.2. Spacing of supports for CSST shall be in accordance with the CSST manufacturer's instruction.

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 (Inch 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

7.2.6.~~3~~6 Spacing of supports ~~for~~ of corrugated stainless steel tubing CSST shall be in accordance with the CSST manufacturer's instruction.

7.2.6.7 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 a ~~the~~ supporting system shall be designed and installed so they will not be disengaged by movement of the supported piping.

[SR No. 23-NFPA 54/Z223.1-2024]

7.2.6.4 Piping on Roofs.

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

[SR No. 23-NFPA 54/Z223.1-2024]

{7.2.6.4.2 through 7.3.3 unchanged}

7.3.4 Tubing in Partitions.

7.3.4.1 ~~This provision~~ Section 7.3.4 shall not apply locations where 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 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

other members ~~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.

[SR No. 23-NFPA 54/Z223.1-2024]

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.

[SR No. 23-NFPA 54/Z223.1-2024]

7.3.~~5.2~~6 Other Occupancies. Gas piping in nonindustrial occupancies shall not be embedded in concrete floor slabs unless in accordance with ~~7.3.5.2.1~~ 7.3.6.1 through ~~7.3.5.2.5~~ 7.3.6.5.

~~7.3.5.2.1~~ 7.3.6.1 The installation of embedded gas piping shall be approved.

~~7.3.5.2.2~~ 7.3.6.2 Embeded gas piping shall be surrounded with a minimum of 1 ½ in (38 mm) of concrete.

~~7.3.5.2.3~~ 7.3.6.3 Embeded 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~~ 7.3.6.4 All piping, fittings, and risers shall be protected against corrosion in accordance with 7.2.2.

~~7.3.5.2.5~~ 7.3.6.5 Piping shall not be embedded in concrete slabs containing quickset additives or cinder aggregate.

[SR No. 23-NFPA 54/Z223.1-2024]

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 to prevent movement when operated.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.4 unchanged}

7.4.1 Pressure Reduction.

7.4.1.1 Where pressure reduction is required in branch connections for compliance with 5.4.4, 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 5.8.

7.4.1.3 Pressure Reduction. 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.

(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.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.4.2 unchanged}

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 psi (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.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.5 unchanged}

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.

[SR No. 23-NFPA 54/Z223.1-2024]

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

(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.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.5.3 unchanged}

7.7 Drips and Sediment Traps.

7.7.1 Provide Drips Where Necessary.

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

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

7.7.1.3 ~~This~~ A drip shall be so installed as to constitute a trap wherein an accumulation of condensate will shut off the flow of gas before it will run back into the meter.

[SR No. 23-NFPA 54/Z223.1-2024]

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.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.6.3 unchanged}

7.6.4 Installation of Plastic Piping and Tubing Joints and Fittings.

7.6.4.1 Plastic pipe, tubing, and fittings shall be joined in accordance with the manufacturers' instructions.

7.6.4.2 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.

7.6.4.3 Heat fusion joints shall be made with the joining method recommended by the pipe manufacturer.

7.6.4.4 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.

7.6.4.5 Where compression-type stiffeners are used, an internal tubular rigid stiffener shall be used in conjunction with the fitting as follows.

(1) The stiffener shall be flush with the end of the pipe or tubing and extend at least to the outside end ofthe compression fitting when installed.

(2) The stiffener shall be free of rough or sharp edges and not be a force fit in the plastic.

(3) Split tubular stiffeners shall not be used.

7.6.4.6 Plastic piping joints and fittings for use in LP-Gas piping systems shall be in accordancewith NFPA 58.

[SR No. 32-NFPA 54/Z223.1-2024]

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.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.7.1.2 unchanged}

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

[SR No. 8-NFPA 54/Z223.1-2024]

{7.7.1.4 through 7.7.1.5 unchanged}

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.~~

[SR No. 23-NFPA 54/Z223.1-2024]

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 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 and 7.7.2.4.

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

7.7.2.4 ~~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~~5 Appliance shutoff valves installed in fireplaces shall be removed and the piping capped gastight where the fireplace is used for ~~solid fuel~~ solid-fuel burning.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.8 through 7.8.1.2 unchanged}

7.8.2 Valves at Regulators.

7.8.2.1 An accessible gas shutoff valve shall be provided upstream of each gas pressure regulator except as provided in 7.8.2.2.

7.8.2.2 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.

[SR No. 23-NFPA 54/Z223.1-2024]

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~~n~~ readily accessible 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.

[SR No. 23-NFPA 54/Z223.1-2024]

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 identified ~~plainly marked as~~ "Emergency Shutoff Valve" ~~such~~ and their locations posted as required by the authority having jurisdiction.

[SR No. 23-NFPA 54/Z223.1-2024]

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 a 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 and shall be located within the laboratory or located adjacent to the laboratory's egress door and shall be identified.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.8.4 through 7.11 unchanged}

~~7.11~~ 7.12 Systems Containing Flammable Gas-Air Mixtures.

7.12.1 Systems containing flammable gas–air mixtures shall be designed in accordance withengineering methods.

7.12.2 Equipment used in flammable gas–air mixtures shall be selected in accordance withengineering methods.

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.

7.13.2 ~~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.

[SR No. 23-NFPA 54/Z223.1-2024]

{7.14 through 7.14.2 unchanged}

Chapter 8
Inspection, Testing, and Purging

{8.1 through 8.1.1.8 unchanged}

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 test pressure.

[SR No. 24-NFPA 54/Z223.1-2024]

{8.1.1.10 through 8.1.1.11 unchanged}

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.

[SR No. 24-NFPA 54/Z223.1-2024]

{8.1.3 through 8.1.3.2 unchanged}

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 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~~.~~5 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~~6 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~~7 All testing of piping systems shall be performed in a manner that protects the safety of employees and the public during the test.

[SR No. 24-NFPA 54/Z223.1-2024]

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 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). ~~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.~~

8.1.4.5 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. Test duration shall be not less than ½ hr 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.~~

8.1.4.7 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.

[SR No. 24-NFPA 54/Z223.1-2024]

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 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.

[SR No. 24-NFPA 54/Z223.1-2024]

{8.2 through 8.2.2 unchanged}

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.)*~~

[SR No. 10-NFPA 54/Z223.1-2024]

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

[SR No. 24-NFPA 54/Z223.1-2024]

{8.2.4 through 8.3.1 unchanged}

Table 8.3.1 Size and Length of Piping*

Nominal Piping Size (in.)	Length of Piping (ft)
≥ 2 ½ < 3	> 50
≥ 3 < 4	> 30
≥ 4 < 6	> 15
≥ 6 < 8	> 10
≥ 8	Any length

For SI units, 1 inch = 25.4 mm, 1 ft =304.8 mm.
* Note: CSST EHD size of 62 is equivalent to a 2 in. nominal size pipe or tubing.

[SR No. 24-NFPA 54/Z223.1-2024]

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.

[SR No. 24-NFPA 54/Z223.1-2024]

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.

[SR No. 24-NFPA 54/Z223.1-2024]

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.

[SR No. 24-NFPA 54/Z223.1-2024]

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.

[SR No. 24-NFPA 54/Z223.1-2024]

{8.3.2 unchanged}

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 that is ~~and shall~~ discharged ~~to the~~ outdoors.

(2) The piping shall be purged with fuel gas that is ~~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 that is ~~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~~5~~) 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~~6) ~~Purging~~ The purging in 8.3.2.1(4) shall be stopped when fuel gas is detected.

(7) The piping shall be purged by the gas supplier in accordance with written procedures.

[SR No. 24-NFPA 54/Z223.1-2024]

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.

[SR No. 24-NFPA 54/Z223.1-2024]

{8.3.3 through 8.3.4 unchanged}

Chapter 9
Appliance, Equipment and Accessory Installation

{9.1 through 9.1.1.2 unchanged}

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

[SR No. 25-NFPA 54/Z223.1-2024]

9.1.2 Added or Converted Appliances. When additional or replacement appliance or equipment ~~is~~ are installed or an appliance is converted to gas from another fuel, the location in which the appliance or equipment ~~is~~ are to be operated shall be in accordance with ~~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.~~

[SR No. 25-NFPA 54/Z223.1-2024]

9.1.3 Type of Gas(es).

9.1.3.1 ~~The~~ An 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~~ an appliance from the gas specified on the rating plate for use with a different gas without consulting the installation instructions, the 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.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.1.4 unchanged}

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.

9.1.5.2 Where oxygen is used, installation shall be in accordance with NFPA 51.

[SR No. 25-NFPA 54/Z223.1-2024]

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

[SR No. 25-NFPA 54/Z223.1-2024]

{9.1.6.2 nchanged}

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.

[SR No. 25-NFPA 54/Z223.1-2024]

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 appliance and equipment.

{9.1.8.2 unchanged}

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.

[SR No. 25-NFPA 54/Z223.1-2024]

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 be in compliance ~~comply~~ with the intent of 9.1.9.1 ~~this provision~~.

[SR No. 25-NFPA 54/Z223.1-2024]

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~~ flammable-vapor ignition resistant.

9.1.10.2 ~~Such a~~Appliances installed in locations covered in 9.1.10.1 shall be located or protected so they are not subject to physical damage by a moving vehicle.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.1.10.3 through 9.1.17 unchanged}

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 will 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.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.1.19 unchanged}

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.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.1.21 unchanged}

9.1.22* Existing Appliances.

9.1.22.1 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 the following: ~~9.1.22 (1) through 9.1.22 (6).~~

(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 re installed over existing windows.

(5) One or more exterior door and frame assemblies are replaced.

9.1.22.2 Where the inspection in 9.1.22.1 identifies noncompliance with ~~appliance installation does not comply with~~ 9.3 and Chapter 12, the installation shall be altered as necessary to be in compliance with 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 re installed over existing windows.~~

~~(5) One or more exterior door and frame assemblies are replaced~~.

[SR No. 25-NFPA 54/Z223.1-2024]

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.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.2.1.2 through 9.2.1.3 unchanged}

9.2.2* Clearance to Combustible Materials. Appliances and their vent connectors shall be installed with clearances from combustible material so their operation will 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 Chapter 10 and Chapter 12. (*Reference can also be made to NFPA 211.*)~~ (See Chapters 10 and 12,and *NFPA 211*.)

[SR No. 25-NFPA 54/Z223.1-2024]

{9.2.3 through 9.3.1 unchanged}

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.

9.3.1.3 ~~*Exception No. 1:* This~~ The provision in 9.3.1.2 shall not apply to ~~direct vent~~ direct-vent appliances~~. *Exception No. 2:*~~ or 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, makeup air shall be provided.

[SR No. 25-NFPA 54/Z223.1-2024]

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 method 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 9.3.2.~~2~~3 shall be used.

9.3.2.1.2 ~~The required volume of indoor air shall be determined in accordance with method 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 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.

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^3/1,000 Btu/hr (4.8 m^3/kW).

[SR No. 25-NFPA 54/Z223.1-2024]

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 all appliances ~~other than fan-assisted~~, ~~calculate using~~ the following equation shall be used:

~~Required volume$_{other} \geq \frac{21 ft^3}{ACH}\left(\frac{I_{other}}{1{,}000\ Btu/hr}\right)$~~ **[9.3.2.2a]**

Required volume **[9.3.2.2]** $\geq \frac{21 ft^3}{ACH}\left(\frac{I}{1{,}000\ Btu/hr}\right)$

where:

I = all appliances input (Btu/hr)
ACH = air change per hour (percent of volume of space exchanged per hr, expressed as a decimal)

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

~~Required volume$_{fan} \geq \frac{15 ft^3}{ACH}\left(\frac{I_{fan}}{1{,}000\ Btu/hr}\right)$~~ **[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 hr, expressed as a decimal)~~

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

[SR No. 25-NFPA 54/Z223.1-2024]

9.3.2.2.1 For purposes of this calculation, an infiltration rate greater than 0.60 ACH shall not be used in Equation 9.3.2.2.

9.3.2.~~3~~4 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 shall be in accordance with the following:*

(a) Each opening shall have a minimum free area of 1 in.^{2}/1,000 Btu/hr (2,200 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.
(d) The minimum dimension of air openings shall be not 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}/1,000 Btu/hr (4,400 mm^2/kW) of total input rating of appliances.

[SR No. 25-NFPA 54/Z223.1-2024]

9.3.3 Outdoor Combustion Air. Outdoor combustion air shall be provided through opening(s) to the outdoors, with a minimum dimension not less than 3 in. (80 mm), 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).~~

[SR No. 25-NFPA 54/Z223.1-2024]

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}/4,000 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}/2,000 Btu/hr (1,100 mm^2/kW) of total input rating of all appliances in the enclosure.

[SR No. 25-NFPA 54/Z223.1-2024]

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 ~~or spaces that freely communicate with the outdoors and shall have a~~ The minimum free area of the opening in 9.3.3.2.3 shall be accordance with ~~of~~ the following:

(1) 1 in.^{2}/3,000 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

[SR No. 25-NFPA 54/Z223.1-2024]

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 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).

[SR No. 25-NFPA 54/Z223.1-2024]

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.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.3.6 through 9.3.7.3.2 unchanged}

9.3.8 Combustion Air Ducts. Combustion air ducts shall comply with 9.3.8.1 through 9.3.8.~~8~~10.

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.

9.3.8.2 ~~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~~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 service 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-built~~ 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~~10 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.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.4 through 9.4.2.1 unchanged}

9.4.2.2 Appliances shall be installed on a well-drained surface of the roof.

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 to be provided on the exposed side.

9.4.2.~~3~~4 Appliances requiring an external source of electrical power shall be installed in accordance with NFPA 70®, *National Electrical Code*.

9.4.2.~~4~~5 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 ~~Such~~ The platform(s) or walkway(s) required in 9.4.2.5 shall be located adjacent to the appliance and control panels so that the appliance can be ~~safely~~ serviced where water stands on the roof.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.4.3 through 9.4.3.2 unchanged}

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 ~~Such~~ sScuttles and ~~or~~ trapdoors shall be at least 22 in. × 24 in. (560 mm × 610 mm) in size.

9.4.3.5 Scuttles and trapdoors~~, and~~ shall open ~~easily and safely~~ under all conditions, ~~especially~~ including snow.

9.4.3.6 Scuttles and 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 to be provided on the exposed side.

9.4.3.8 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.

[SR No. 25-NFPA 54/Z223.1-2024]

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.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.5 through 9.5.1.1 unchanged}

9.5.1.2 The passageway shall be unobstructed.

9.5.1.~~2~~3 The passageway ~~and~~ shall have solid flooring not less than 24 in. (610 mm) wide from the entrance opening to the appliance.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.5.2 unchanged}

9.5.3 Lighting and Convenience Outlet.

9.5.3.1 A permanent 120 V ac 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.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.6 through 9.6.1 unchanged}

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 so as 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 rain water.

[SR No. 25-NFPA 54/Z223.1-2024]

9.6.1.2 ~~Passage through~~ 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.

[SR No. 25-NFPA 54/Z223.1-2024]

9.6.1.3 Food Service Appliance Connections.

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*.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.6.1.4 unchanged}

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.~~

9.6.1.5.1 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.

9.6.1.5.3 Only one connector shall be used per appliance.

[SR No. 25-NFPA 54/Z223.1-2024]

9.6.2 Use of Nonmetallic Gas Hose Connectors. Listed gas hose connectors shall be ~~both~~ used 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).

(~~e~~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.

[SR No. 25-NFPA 54/Z223.1-2024]

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

[SR No. 25-NFPA 54/Z223.1-2024]

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~~.

{9.6.4.2 unchanged}

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

[SR No. 25-NFPA 54/Z223.1-2024]

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 ~~and~~ Flexible connections shall be provided with gas shutoff valves in readily accessible locations in rigid piping upstream from the flexible connections.

[SR No. 25-NFPA 54/Z223.1-2024]

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.

[SR No. 25-NFPA 54/Z223.1-2024]

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.

9.6.5.4.1 ~~(A)~~ 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.

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

[SR No. 25-NFPA 54/Z223.1-2024]

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. 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.

[SR No. 25-NFPA 54/Z223.1-2024]

9.6.5.~~3~~6 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 Where installed at a manifold, the appliance shutoff valve ~~and~~ shall be readily accessible and permanently identified.

9.6.5.8 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.

[SR No. 25-NFPA 54/Z223.1-2024]

{9.6.6 through 9.6.8.1 unchanged}

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 other device recognized as a~~n effective~~ sediment trap.

[SR No. 25-NFPA 54/Z223.1-2024]

{Figure 9.6.8.2 and section 9.6.8.3 unchanged}

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.

[SR No. 25-NFPA 54/Z223.1-2024]

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 appliance.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.1.2 unchanged}

10.1.3 Locations with Air-handlers. 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~~5.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.2.1 through 10.2.2 unchanged}

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

[SR No. 26-NFPA 54/Z223.1-2024]

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

(4) Air-conditioning appliances shall have the clearance from supply ducts within 3 ft (0.9m) of the furnace plenum be not less than that specified from the furnace plenum. ~~N~~no clearance is necessary beyond this distance.

[SR No. 26-NFPA 54/Z223.1-2024]

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.				

For SI units, 1 in. = 25.4 mm.

Notes: See 10.2.4.1 through 10.2.4.135. All clearances and thicknesses are minimums; larger clearances and thicknesses are acceptable.

~~(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 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 1in. (25 mm) air gap. To provide 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 manufacturer's installation instructions.~~

[SR No. 26-NFPA 54/Z223.1-2024]

~~(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. No spacer or tie shall be used directly opposite appliance or connector.

~~(4)~~ **10.2.4.4** Where all clearance reduction systems use a ventilated air space, adequate provision for air circulation shall be provided as described.

~~(5)~~ **10.2.4.5** 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)~~ **10.2.4.6** Where a wall protector is installed on a single flat wall away from corners, it shall have a minimum 1in. (25 mm) air gap. To provide air circulation, the bottom and top edges, or only the side and top edges, or all edges shall be left open.

~~(7)~~ **10.2.4.7** Mineral wool batts (blanket or board) shall have a minimum density of 8 lb/ft3 (128 kg/m3) and a minimum melting point of 1500°F (816°C).

~~(8)~~ **10.2.4.8** Insulation material used as part of a clearance reduction system shall have a thermal conductivity of 1.0 Btu in./ft2/hr-°F (0.144 W/m-°K) or less.

~~(9)~~ **10.2.4.9** 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)~~ **10.2.4.10** All clearances and thicknesses are minimum; larger clearances and thicknesses are acceptable.

~~(11)~~ **10.2.4.11** Listed single-wall connectors shall be installed in accordance with the manufacturer's installation instructions.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.2.5 unchanged}

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~~5~~.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.2.7 through 10.3.1.2 unchanged}

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 in accordance with the following:

(a) The closet is equipped with a weather-stripped door with no openings, and with a self-closing device.

(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 vent ~~direct vent~~ type.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.3.3 through 10.3.3.3 unchanged}

{Table 10.3.3.2 unchanged}

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

10.3.3.4~~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.

10.3.3.5~~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.~~6~~7 Supply Air Duct- Listed Furnace. 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 ~~Clearance~~ The clearance in 10.3.3.7 is not required beyond the 3 ft (0.9 m) distance.

10.3.3.~~7~~8 Supply Air Duct- Unlisted Furnace. 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.

10.3.3.8.1 ~~Clearance~~ The clearance in 10.3.3.8 is not required beyond the 6 ft (1.8 m) distance.

[SR No. 26-NFPA 54/Z223.1-2024]

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.

10.3.4.2 ~~Exception No. 1:~~ 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.

[SR No. 26-NFPA 54/Z223.1-2024]

10.3.5 Temperature or 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.

[SR No. 26-NFPA 54/Z223.1-2024]

10.3.6 Low Water Cutoff.

10.3.6.1 All hot 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 sensing~~ flow-sensing device arranged to shut down the boiler when the flow rate is less than required ~~inadequate~~ to protect the boiler against overheating.

[SR No. 26-NFPA 54/Z223.1-2024]

10.3.7* Steam Safety and Pressure-Relief Valves.

10.3.7.1 Steam and hot water boilers shall be equipped, respectively, with listed or approved steam safety or ~~pressure relief~~ 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 discharged 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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.3.8 through 10.3.8.2 unchanged}

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 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. ~~Return air shall not be taken from the mechanical room containing the furnace.~~

10.3.8.6 Return air shall not be taken from the mechanical room containing the furnace.

[SR No. 26-NFPA 54/Z223.1-2024]

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~~ 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 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.

(45) Means shall be provided ~~both~~ for the disposal of condensate and to prevent dripping of condensate on the heating element.

[SR No. 26-NFPA 54/Z223.1-2024]

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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.3.10.2 through 10.4.1 unchanged}

10.4.2 Clearance.

10.4.2.1 The installation of Type I clothes dryers shall comply with the following requirements:

(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.

(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 manufacturers' 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:

(~~2~~1) ~~Type 2 c~~Clothes dryers shall be installed with clearances of not less than those shown on the marking plate and in the manufacturers' instructions.

(2) ~~Type 2 c~~Clothes dryers designed and marked "For use only in noncombustible locations" shall not be installed elsewhere.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.4.3 through 10.4.5.2 unchanged}

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.~~

10.4.5.4 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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.6.1 through 10.7 unchanged}

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 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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.4.7 through 10.6.2 unchanged}

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~~ 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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.6.4 through 10.7.1 unchanged}

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 vent~~ Direct-vent gas fireplaces shall not be required to comply with 10.7.2.1.

[SR No. 26-NFPA 54/Z223.1-2024]

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.

(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 vent~~ Direct-vent gas fireplaces shall be installed with the vent air intake terminal in the outdoors and in accordance with the manufacturers' instructions.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.7.4 through 10.8 unchanged}

10.8.1 Listing. 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 Applications*~~.~~

(2) ANSI Z83.18, *Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Application*~~.~~

[SR No. 26-NFPA 54/Z223.1-2024]

{10.8.2 through 10.8.2.1 unchanged}

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

[SR No. 26-NFPA 54/Z223.1-2024]

{10.8.2.3 through 10.8.4 unchanged}

10.8.5 Air Supply. The air supply to direct gas-fired heating and forced ventilation appliances shall be in accordance with sections 10.8.5.1 through 10.8.5.~~3~~4.

{10.8.5.1 unchanged}

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 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.

[SR No. 26-NFPA 54/Z223.1-2024]

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~~. 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.

10.8.6.2 An atmospheric vent line shall not be required to be provided on a valve train component equipped with a listed vent limiter.

[SR No. 26-NFPA 54/Z223.1-2024]

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 over pressurizing the space served by the heater by taking into account the structure's designed infiltration rate, ~~properly~~ designed relief openings, an interlocked powered exhaust system, or a combination of these methods.

{10.8.7.1 unchanged}

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

10.8.7.3 Where motorized dampers or closeable louvers are used, they shall be proved to be in their open position prior to main burner operation.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.8.8 through 10.9.1 unchanged}

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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.9.3 through 10.9.4 unchanged}

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.

[SR No. 26-NFPA 54/Z223.1-2024]

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.

[SR No. 26-NFPA 54/Z223.1-2024]

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, 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, 10.9.7.3 and 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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.9.8 through 10.10.4 unchanged}

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.*~~ 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.

(~~2~~3) 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.~~

(4) Wall register models shall not be placed closer than 6 in. (150 mm) to a corner.

(~~3~~5) ~~*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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.10.6 through 10.10.7 unchanged}

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~~ the clearances in 10.10.8.1 and 10.10.8.2 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.

10.10.8.3.1 A 12 in. (300 mm) clearance shall be provided on all sides except the control side.

10.10.8.3.2 ~~, which~~ The control side shall have an 18 in. (460 mm) clearance.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.10.9 unchanged}

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 pan shall be anchored in place so as to prevent floating.

10.10.10.2.2 ~~, and t~~The walls of the pan shall extend at least 4 in. (100 mm) above the ground level.

10.10.10.2.3 ~~with at least~~ The walls of the pan shall have at least have 18 inches (460 mm) of horizontal clearance on the control side and at least 6 in. (150 mm) of horizontal clearance on all other sides~~, except on the control side, which shall have at least an 18 in. (460 mm) clearance~~.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.10.11 unchanged}

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 ~~(entirely separated from the nonhabitable space)~~ with means for air intake to meet the provisions of 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.

[SR No. 26-NFPA 54/Z223.1-2024]

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 except as required by 10.10.13.2.

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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.11 through 10.11.3.1 unchanged}

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 mounted in accordance~~ with one of the following:

(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.

(~~2~~3) 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) ~~, it~~ The appliance 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.

(b) The ~~preceding specified~~ floor protection shall extend not less than 6 in. (150 mm) beyond the appliance on all sides.

(~~3~~4) 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) ~~it~~ 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.

(45) 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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.11.4 through 10.11.4.1 unchanged}

10.11.4.2 ~~Such~~ The construction described in 10.11.4.1 shall in all cases extend not less than 12 in. (300 mm) beyond the appliance on all sides.

[SR No. 26-NFPA 54/Z223.1-2024]

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, 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.

[SR No. 26-NFPA 54/Z223.1-2024]

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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.11.7 unchanged}

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

[SR No. 26-NFPA 54/Z223.1-2024]

{10.12 through 10.13.2 unchanged}

10.13.3 Clearances.

10.13.3.1 Clearances. ~~(1)~~ Floor-mounted household cooking appliances, where installed on combustible floors, shall be set on their own bases or legs.

10.13.3.2 Clearances. ~~The clearances specified as follows~~ Floor-mounted household cooking appliances shall not interfere with combustion air, accessibility for operation, and servicing:

~~(1) Floor-mounted household cooking appliances, where installed on combustible floors, shall be set on their own bases or legs.~~

[SR No. 26-NFPA 54/Z223.1-2024]

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) is 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 will conform to the terms of the upper manufacturer's installation instructions.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.14 through 10.14.1 unchanged}

10.14.2 Clearances for Unlisted Appliances.

10.14.2.1 Enclosed-Type. Clearance for enclosed-type illuminating appliances shall comply with the following:

[SR No. 26-NFPA 54/Z223.1-2024]

10.14.2.2 Open Flame Type. Clearance for open-flame-type illuminating appliances shall comply with the following:

(1) Unlisted open flame illuminating appliances installed outdoors shall have clearances in accordance with the following:

(a) ~~from~~ Clearance 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.

(c) Lesser clearances shall be permitted to be used where acceptable to the authority having jurisdiction.

(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.

[SR No. 26-NFPA 54/Z223.1-2024]

{Table 10.14.2.2 through 10.14.3 unchanged}

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 post in accordance with the manufacturer's instructions.

10.14.4.2 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. (25 mm) ~~Schedule~~ NPS (25 DN) Schedule 40 steel pipe.

10.14.4.3 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 Drain openings shall be provided near the base of posts where water collecting inside the posts is possible.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.14.5 through 10.16.1 unchanged}

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.

[SR No. 26-NFPA 54/Z223.1-2024]

10.16.3 Clearance. The installation of infrared heaters shall comply with 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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.16.4 through 10.16.4.2 unchanged}

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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.17 through 10.17.2.3 unchanged}

10.17.2.4 Domestic open-top broiler units incorporating an integral exhaust system and listed for use without a ventilating hood need not be provided with a ventilating hood if installed in accordance with 10.13.3.~~1~~3.2 (1).

[SR No. 26-NFPA 54/Z223.1-2024]

{10.17.3 through 10.19.3 unchanged}

10.19.4 Temperature or ~~Pressure~~ Pressure-Limiting Devices. Where a pool heater is provided with over temperature 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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.19.5 through 10.20.1 unchanged}

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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.20.3 through 10.21.1 unchanged}

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.

10.21.2.1 ~~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 6,000 Btu/hr (1,760 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 (2,930 W/hr) and combustion and ventilation air is provided as specified in 10.1.2.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.21.3 unchanged}

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.

[SR No. 26-NFPA 54/Z223.1-2024]

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

10.22.1 The installation of gas engines shall conform with NFPA 37.

10.22.~~1~~2 Connection. Stationary gas engines shall not be rigidly connected to the gas supply piping.

[SR No. 26-NFPA 54/Z223.1-2024]

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

(3) ~~provided that the clearance in any case is sufficient to afford ready accessibility for use,~~ clearance for cleanout~~,~~

(4) ~~and necessary~~ clearance for servicing.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.23.2 unchanged}

10.23.3 Installation of Vents or Vent Connectors. 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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.24 through 10.24.3 unchanged}

10.24.3.1 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) 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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.24.4 through 10.25.2.1 unchanged}

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

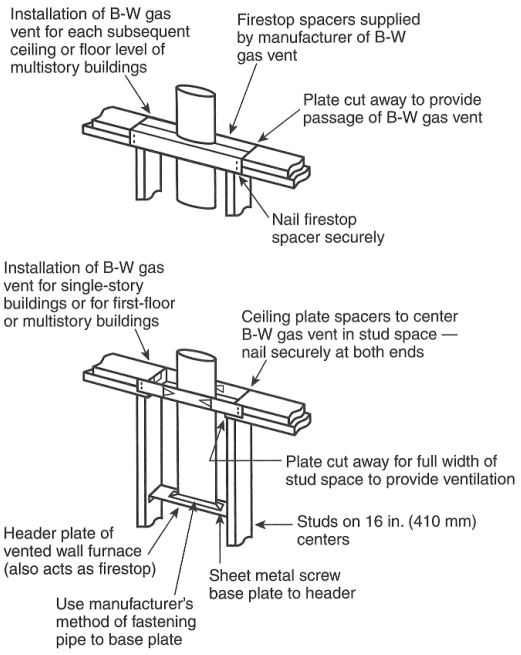
10.25.2.3 Vented wall furnaces connected to a Type B-W gas vent system listed for installation in multistory buildings shall be permitted to be installed in single-story or multistory buildings.

10.25.2.4 Type B-W gas vents shall be attached directly to a solid header plate that serves as a firestop at that point and the solid header is ~~that shall~~ be permitted to be an integral part of the vented wall furnace, as illustrated in Figure 10.25.2.~~2~~5.

10.25.2.5 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.

[SR No. 26-NFPA 54/Z223.1-2024]

Figure 10.25.2.~~2~~5
Installation of Type B-W gas vents for w vented wall furnaces.



10.25.2.6 Firestop spacers shall be installed at each subsequent ceiling or floor level penetrated by the vent.

10.25.2.~~3~~7 Direct vent wall furnaces shall be installed with the combustion air intake terminal outdoors.

10.25.2.4~~8~~ 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.)

[SR No. 26-NFPA 54/Z223.1-2024]

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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.25.4 through 10.26.1 unchanged}

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

(1) The ~~W~~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.

(b) All combustion air shall be obtained from the outdoors in accordance with 9.3.3.

(2) The ~~W~~water heater shall be of the ~~direct~~ direct-vent type.

[SR No. 26-NFPA 54/Z223.1-2024]

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. ~~Listed water heaters shall be installed in accordance with the manufacturer's installation instructions.~~

10.26.3.2 Listed water heaters shall be installed in accordance with the manufacturer's installation instructions.

[SR No. 26-NFPA 54/Z223.1-2024]

10.26.4 Pressure Relief Devices.

10.26.4.1 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.

10.26.4.2 The pressure setting of the device shall exceed the water service pressure and ~~shall~~ not exceed the maximum pressure rating of the water heater.

[SR No. 26-NFPA 54/Z223.1-2024]

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

[SR No. 26-NFPA 54/Z223.1-2024]

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.

[SR No. 26-NFPA 54/Z223.1-2024]

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.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.26.8 unchanged}

10.27 Compressed Natural Gas (CNG) Vehicular Fuel Systems.

10.27.1 The installation of compressed natural gas (CNG) fueling (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 to the appliance manufacturer's installation instructions.

[SR No. 26-NFPA 54/Z223.1-2024]

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 9.3.

[SR No. 26-NFPA 54/Z223.1-2024]

10.29 Fuel Cell Power Plants.

10.29.1 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.

10.29.2 Fuel cell power plants with a power output of greater than 50 kW shall be installed in accordance with NFPA 853.

[SR No. 26-NFPA 54/Z223.1-2024]

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 Open Flame Decorative Gas Appliances*.

10.30.1.2 Outdoor open-flame decorative appliances~~, and~~ shall be installed in accordance with the manufacturer's installation instructions.

[SR No. 26-NFPA 54/Z223.1-2024]

{10.30.2 through 10.31 unchanged}

10.31.1 Application. 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.~~

10.31.2 Outdoor infrared heaters for residential and commercial applications ~~and~~ shall be installed in accordance with the manufacturer's installation instructions.

[SR No. 26-NFPA 54/Z223.1-2024]

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.~~

~~**11.1.1.2** 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~~1.1 The input rate shall be determined by one of the following:

11.1.1.2 Firing at a rate in excess of the nameplate rating shall be prohibited.

[SR No. 27-NFPA 54/Z223.1-2024]

{11.1.1.3 unchanged}

11.1.2 High Altitude.

11.1.2.1 Gas input ratings of appliances shall be used for elevations up to 2,000 ft (600 m).

11.1.2.2 The input ratings of appliances operating at elevations above 2,000 ft (600 m) shall be reduced in accordance with one of the following methods:

(1) At the rate of 4 percent for each 1,000 ft (300 m) above sea level ~~before selecting appropriately sized appliance~~

(2) As permitted by the authority having jurisdiction

(3) In accordance with the listed manufacturer's installation instructions

[SR No. 27-NFPA 54/Z223.1-2024]

11.2* Primary Air Adjustment.

11.2.1 The primary air for injection ~~(Bunsen)~~ -type (Bunsen) burners shall be adjusted for ~~proper~~ flame characteristics in accordance with the appliance manufacturers' instructions.

11.2.2 After setting the primary air, the adjustment means shall be secured in position.

[SR No. 27-NFPA 54/Z223.1-2024]

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~~ment~~ 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.

[SR No. 27-NFPA 54/Z223.1-2024]

11.4 Automatic Ignition.

11.4.1 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.

[SR No. 27-NFPA 54/Z223.1-2024]

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.

[SR No. 27-NFPA 54/Z223.1-2024]

11.6* Checking the Draft. ~~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:

[SR No. 27-NFPA 54/Z223.1-2024]

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 the appliance~~ in a readily accessible location for the use of the consumer.

[SR No. 27-NFPA 54/Z223.1-2024]

Chapter 12
Venting of Appliances

{12.1 through 12.3.1 unchanged}

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

(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 ~~shall be~~ 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.)* ~~the following criteria are met (see 12.3.2.1).~~

(a) ~~That the appliance shall be installed with the draft hood in place and unaltered, if a draft hood is required, in a commercial kitchen having a mechanical exhaust system.~~

~~(b) 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.~~

[SR No. 28-NFPA 54/Z223.1-2024]

{12.3.2.1 through 12.3.2.2 unchanged}

12.3.2.3 Where the calculation 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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.3.3 through 12.3.5.1 unchanged}

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

[SR No. 28-NFPA 54/Z223.1-2024]

{12.3.6 through 12.4.3.4 unchanged}

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~~.

[SR No. 28-NFPA 54/Z223.1-2024]

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.)*

[SR No. 28-NFPA 54/Z223.1-2024]

{12.4.5 through 12.4.5.1 unchanged}

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 manufacturers' instructions.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.5 through 12.5.1 unchanged}

{Table 12.5.1 unchanged}

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*.

[SR No. 28-NFPA 54/Z223.1-2024]

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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.5.4 through 12.6.1 unchanged}

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

12.6.1.2 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 ~~and~~ Masonry chimneys shall be lined with one of the following:

12.6.1.4.3 ~~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.

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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.6.2 through 12.6.3 unchanged}

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, other engineering methods, or in accordance with 12.6.3.2 through 12.6.3.4. :

~~(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 or 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 smallest draft hood outlet area.~~

~~(4) Chimney venting systems using mechanical draft shall be sized in accordance with approved engineering methods.~~

~~(5) Other engineering methods.~~

[SR No. 28-NFPA 54/Z223.1-2024]

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.

[SR No. 28-NFPA 54/Z223.1-2024]

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 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 compatible ~~suitable for the~~ with the appliances to be connected ~~attached~~.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.6.5 through 12.6.5.1 unchanged}

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. ~~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 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.

[SR No. 28-NFPA 54/Z223.1-2024]

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.

[SR No. 28-NFPA 54/Z223.1-2024]

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.

[SR No. 28-NFPA 54/Z223.1-2024]

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 flue shall not be used to vent another appliance, except as provided in 12.6.8.2.

~~*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 ~~Exception:~~ 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, 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.*~~

12.6.8.4 ~~Exception:~~ ~~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.

[SR No. 28-NFPA 54/Z223.1-2024]

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 inch (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) ~~t~~The shield shall terminate not less than 2 in. (51 mm) above the installation materials.

(2) ~~and~~ The shield shall be secured in place to prevent displacement.

[SR No. 28-NFPA 54/Z223.1-2024]

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.*

[SR No. 28-NFPA 54/Z223.1-2024]

12.7.2 Installation. The installation of gas vents shall comply with the following requirements:

(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) 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."

(46) 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.

[SR No. 28-NFPA 54/Z223.1-2024]

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~~.~~

[SR No. 28-NFPA 54/Z223.1-2024]

{Figure 12.7.3 unchanged}

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 Type B gas vent, installed in a single story of a building, shall be in accordance with one of the following methods:

(1) The sizing shall comply with the provisions of Chapter 13.

(5) The sizing shall comply with ~~E~~engineering methods.

[SR No. 28-NFPA 54/Z223.1-2024]

12.7.4.2 Vent Offsets.

12.7.4.2.1 Type B and Type L vents sized in accordance with item 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~~ 60-degree offset is ~~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.

[SR No. 28-NFPA 54/Z223.1-2024]

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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.7.4.4 unchanged}

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 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 Type B double-wall gas vent shall be in accordance with Table 13.2(a), provided all of the following apply:

(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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.7.6 unchanged}

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.

[SR No. 28-NFPA 54/Z223.1-2024]

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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.8 through 12.8.4.1 unchanged}

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 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.

12.8.4.45 Minimum clearances from single-wall metal pipe to combustible material shall be in accordance with Table 12.8.4.45. ~~Reduced clearances from single-wall metal pipe to combustible material shall be as specified for vent connectors in Table 10.2.4.~~

[SR No. 28-NFPA 54/Z223.1-2024]

{12.8.4.5 unchanged}

Table 12.8.4.45 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

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.

[SR No. 28-NFPA 54/Z223.1-2024]

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.~~6~~9.

[SR No. 28-NFPA 54/Z223.1-2024]

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) 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 listed appliances with draft hoods and appliances listed for use with Type B gas vents, and ~~W~~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~~3) 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~~4) For residential and low-heat appliances, the thimble shall be a minimum of 12 in. (300 mm) larger in diameter than the metal pipe.

12.8.4.10 ~~Exception: In lieu of~~ Where a thimble ~~protection~~ is not installed, the following shall apply:

(1) ~~a~~All combustible material in the wall shall be removed ~~a sufficient distance~~ from ~~a~~ 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.

[SR No. 28-NFPA 54/Z223.1-2024]

12.8.5 Size of Single-Wall Metal Pipe. Single-wall metal piping shall comply with the following requirements:

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

(a) For a ~~draft~~ 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. ~~t~~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.

ii. The vent area shall not be greater than seven times the draft hood outlet area.

(c) Approved ~~E~~engineering methods

{12.8.6 through 12.9 unchanged}

(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.

ii. ~~and t~~The minimum internal dimension of the pipe shall be 2 in. (50 mm).

[SR No. 28-NFPA 54/Z223.1-2024]

12.9.1 The clearance~~s~~ for through-the-wall ~~direct~~ direct-vent and non-direct-vent ~~vent~~ terminals shall be in accordance with Table 12.9.1 and Figure 12.9.1, except as provided in 12.9.2.

{Table 12.9.1 unchanged}

12.9.2 ~~Exception:~~ 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.)*

12.9.5 ~~Exception: 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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.10 through 12.22.2 unchanged}

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:

(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)

(2) Vent connectors shall not be covered with insulation, except as provided in 12.11.2.4(3).

(3) ~~Exception:~~ 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.

[SR No. 28-NFPA 54/Z223.1-2024]

Table 12.11.2.45 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.

12.11.2.57 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 12.11.2.57.

12.11.2.8 Vent connectors for medium-heat appliances ~~and~~ shall comply with the following:

(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).

Table 12.11.2.57 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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.11.3 through 12.11.3.1 unchanged}

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 alternate 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 there are no instructions, the manifold shall be designed and constructed in accordance with engineering methods.

12.11.3.4 As an alternate 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

(2) ~~, and t~~The vent connectors shall have a minimum 1 ft (0.3 m) rise.

12.11.3.35 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.

12.11.3.46 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.

12.11.3.57 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 shall be sized in accordance with Chapter 13 or engineering methods.

12.11.3.68 As an alternate 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 smaller flue collar outlet.

12.11.3.79 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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.11.4 through 12.11.4.3 unchanged}

12.11.5 Clearance.

12.11.5.1 Minimum clearances from vent connectors to combustible material shall be in accordance with Table 12.8.4.44.5, except as provided in 12.11.5.2.

12.11.5.2 ~~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.

[SR No. 28-NFPA 54/Z223.1-2024]

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) By sheet metal screws or rivets

(2) Vent connectors of listed vent material shall be assembled and connected to flue collars or draft hood outlets in accordance with the manufacturers' instructions

(3) Other approved means

[SR No. 13-NFPA 54/Z223.1-2024]

{12.11.7 through 12.11.7 unchanged}

12.11.8 Slope.

12.11.8.1 A vent connector shall be installed without any dips or sags.

12.11.8.2 A vent connector ~~and~~ shall slope upward toward the vent or chimney at least ¼ in./ft (20 mm/m), except for ~~Exception:~~ ~~V~~vent connectors attached to a mechanical draft system installed in accordance with the appliance and draft system manufacturers' instructions.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.11.9 through 12.11.9.1 unchanged}

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.~~

12.11.9.2 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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.11.10 through 12.11.11.1 unchanged}

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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.11.11.3 through 12.11.14 unchanged}

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.

{12.11.14.2 through 12.13 unchanged}

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.

12.13.1.2 ~~Exception:~~ 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.

12.13.2.1 If a draft hood is not supplied by the appliance manufacturer where one is required, a draft hood shall be installed in accordance with the following:

(1) ~~,~~be ~~of a~~ 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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.13.2 through 12.13.2.1 unchanged}

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.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.13.4 through 12.13.5 unchanged}

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.

[SR No. 28-NFPA 54/Z223.1-2024]

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.

[SR No. 28-NFPA 54/Z223.1-2024]

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 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*.

[SR No. 28-NFPA 54/Z223.1-2024]

{12.15 unchanged}

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:

[SR No. 28-NFPA 54/Z223.1-2024]

Chapter 13
Sizing of Category I Venting Systems

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

13.1.1.2 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:

(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) ~~t~~The vent configuration shall not be permitted.
(b) ~~and a~~An alternative venting configuration shall be utilized.

[SR No. 29-NFPA 54/Z223.1-2024]

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~~:

(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~~ The provision in 13.1.2.1(5) shall not apply to fan-assisted appliances.

[SR No. 29-NFPA 54/Z223.1-2024]

13.1.3 Elbows.

13.1.3.1* Single-appliance venting configurations with zero (0) lateral lengths in Tables 13.1(a), 13.1(b), and 13.1(e) shall not have elbows in the venting system.

13.1.3.2* 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 Tables 13.1(a) through (e).

[SR No. 29-NFPA 54/Z223.1-2024]

{13.1.4 unchanged}

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.

[SR No. 29-NFPA 54/Z223.1-2024]

13.1.6 Two Stage/Modulating Appliances. For appliances with more than one input rate, both of the following shall apply:

(1) 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.

(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.

[SR No. 29-NFPA 54/Z223.1-2024]

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 13.1(b) for Type B vents, with the maximum capacity reduced by 20 percent (0.80 x maximum capacity) and the minimum capacity as shown in Table 13.1(a) or 13.1(b).

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. ~~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.~~

[SR No. 29-NFPA 54/Z223.1-2024]

{13.1.8 unchanged}

13.1.9 Vertical Vent Upsizing/7x 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 approved engineering methods.

[SR No. 29-NFPA 54/Z223.1-2024]

{13.1.10 unchanged}

13.1.11 Chimneys and Vent Locations.

13.1.11.1 Table 13.1(a) through Table 13.1(e) shall only be used 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 venting system shall be engineered.

13.1.11.4 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-tile-lined exterior masonry chimneys, provided all of the following ~~requirements~~ provisions are met:

(1) Vent connector is Type B double wall.

(2) 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).

[SR No. 29-NFPA 54/Z223.1-2024]

{13.1.12 through 13.1.16 unchanged}

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.

[SR No. 29-NFPA 54/Z223.1-2024]

{13.1.18 unchanged}

{Tables 13.1(a) through Table 13.1(f) unchanged}

{Tables 13.2(a) through Table 13.1(i) unchanged}

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

13.2.1 Obstructions and Vent Dampers.

13.2.1 Obstructions and Vent Dampers.

13.2.1.1 Venting Table 13.2(a) through 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. ~~t~~The vent configuration shall not be permitted.

ii. ~~and a~~An alternative venting configuration shall be utilized.

[SR No. 29-NFPA 54/Z223.1-2024]

{13.2.2 unchanged}

{Table 13.2.2 unchanged}

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 above 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.

[SR No. 29-NFPA 54/Z223.1-2024]

13.2.4 Vent Connector Manifold.

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 (.90 x 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 (L_M) shall not exceed 18 in./in. (18 mm/mm) of common vent diameter (*D*).

[SR No. 29-NFPA 54/Z223.1-2024]

13.2.5 Vent Offset.

13.2.5.1 Vent Offset. 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~~ The horizontal length of the common vent offset (L_O) 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 (*D*).

[SR No. 29-NFPA 54/Z223.1-2024]

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.

[SR No. 29-NFPA 54/Z223.1-2024]

13.2.7 Elbows in Connectors.

13.2.7.1 ~~The vent connector capacities listed in the common vent sizing tables include allowance for two 90-degree elbows.~~ The vent connector capacities listed in the common vent sizing tables include allowance for two 90-degree elbows and ~~F~~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.

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.

[SR No. 29-NFPA 54/Z223.1-2024]

{13.2.8 through 13.2.9 unchanged}

13.2.10 Tee and Wye Sizing.

13.2.10.1 At the point where tee or wye fittings connect to a common 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 vent connectors.

[SR No. 29-NFPA 54/Z223.1-2024]

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.

[SR No. 29-NFPA 54/Z223.1-2024]

{13.2.12 through 13.2.16 unchanged}

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 x maximum common vent capacity).

(4) A multistory common vent shall not be reduced in size above the offset.

[SR No. 29-NFPA 54/Z223.1-2024]

{13.2.18 through 13.2.19 unchanged}

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) ~~d~~Determined from Table 13.2(a) through Table 13.2(i) ~~the tables~~

(2) ~~and shall be g~~Greater than the highest appliance input rating~~.~~

[SR No. 29-NFPA 54/Z223.1-2024]

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).

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.~~

[SR No. 29-NFPA 54/Z223.1-2024]

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.

[SR No. 29-NFPA 54/Z223.1-2024]

13.2.22 Chimneys and Vents 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-tile-lined exterior masonry chimneys, provided all of the following conditions are met:

(1) 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 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).

[SR No. 29-NFPA 54/Z223.1-2024]

{13.2.23 unchanged}

13.2.24 Vent Connector Sizing.

13.2.24.1 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.

13.2.24.2 Vent connectors for draft hood-equipped appliances shall not be smaller than the draft hood outlet diameter.

13.2.24.3 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.

[SR No. 29-NFPA 54/Z223.1-2024]

13.2.25 Multiple Vent and Connector Sizes.

13.2.25.1 All combinations of pipe sizes, single-wall, 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 must be sized using Table 13.2(b) or Table 13.2(d) as ~~appropriate~~ applicable.

[SR No. 29-NFPA 54/Z223.1-2024]

{13.2.26 unchanged}

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 of 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.

[SR No. 29-NFPA 54/Z223.1-2024]

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

For SI units, 1 in. = 25.4 mm, 1 in.^{2} = 645 mm^2; 1 ft = 0.305 m, 1,000 Btu/hr = 0.293 kW

[SR No. 29-NFPA 54/Z223.1-2024]

{Table 13.2(a) through 13.2(i) unchanged}

Annex A
Explanatory Material

{A.1.1.1.1(A) through A.1.1.1.2(9) unchanged}

A.1.1.1.2(19) NFPA 715 is the standard for fuel gas detection and warning equipment in buildings andstructures. Requiring the installation of fuel gas detection is outside the scope of this code and is under the scope of the relevant building, fire, and life safety codes. The enforcement of fuel gas detection requirements is more applicable to the enforcers of those codes than the enforcers of the fuel gas code. Fuel gas detection installation is similar to smoke or carbon monoxide detection installation.

[SR No. 17-NFPA 54/Z223.1-2024]

{A.3.2.1 through A.3.3.64.1 unchanged}

A.3.3.80 Qualified Agency. Removal relates only to piping that is in service. Removal of gas piping that has been properly purged from service does not require a qualified agency.

[SR No. 14-NFPA 54/Z223.1-2024]

{A.3.3.84.4 through A.4.5(3) unchanged}

A.4.6 The distribution of hydrogen admixtures in natural gas in building systems does not changethe safety or operability of fuel gas systems where reasonable limits on hydrogen percentages (by volume), such as 20 percent, are used. Pipe system components and sizing methods currently in the code can be used to size hydrogen admixtures up to 20 percent hydrogen by volume with the different natural gas sources already used indeveloping the sizing methods and based upon current technical justification of admixture compatibility.

Adding hydrogen to a fuel gas affects appliance function, specifically combustion behavior. The primary safety concern of increasing hydrogen percentages is burner "flashback,"where burner flame front retreats into the burner itself (regression), ~~leading to~~ and causes burner failure, ~~failure of the~~ burner system failure, and potential release of unburned gas in the building. Regression of flame fronts into burners occurs when hydrogen concentrations are increased and gas mixture flame speeds increase proportionally, exceeding the flow rate of the mixed fuel gas/air mixture to the flame within the combustion chamber. Hydrogen'sburning velocity is approximately six times faster than that of methane. A 20 percent maximum threshold for hydrogen admixtures with natural gas represents a reasonable limitto minimize the potential of flashback behavior and associated safety risks of burner failure. This admixture maximum threshold is consistent with compatibility of piping system limit of20 percent hydrogen.

Separate fuel gas systems independently supplied by pure hydrogen or higher admixture levels should be designed, installed, and operated in accordance with NFPA 2 until further guidance is provided within this code.

Appliances that are certified for use with natural gas enriched with more than 5 percent hydrogen should include an indication of the permissible fuel type.

[SR No. 6-NFPA 54/Z223.1-2024]

[SR No. 5-NFPA 54/Z223.1-2024]

{A.5.3.1 through A.5.2.1 unchanged}

{Table A.5.3.2.1 unchanged}

A.5.2.2.2 ~~2~~ A three-way valve that has no intermediate position flow path and that is installed to admit the standby supply and at the same time shut off the regular supply can ~~shall be permitted to~~ be used to prevent backflow ~~for this purpose~~.

[FR No. 4-NFPA 54/Z223.1-2024]

[SR No. 21-NFPA 54/Z223.1-2024]

{A.5.3 through A.5.5.9.2 unchanged}

A.5.5.9.3 Standard facings are permitted for use under this code.

[SR No. 21-NFPA 54/Z223.1-2024]

{A.5.5.9.4 through A.5.5.10 unchanged}

A.5.5.10.1 Acceptable material can 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

[SR No. 21-NFPA 54/Z223.1-2024]

{A.5.5.10.2 through A.7.1.2 unchanged}

{Table A.6.1 unchanged}

A.7.1.2.1.1 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.

[SR No. 23-NFPA 54/Z223.1-2024]

{A.7.1.3 through A.8.1.4.3 unchanged}

A.8.2.3 See Annex C for a suggested method. The performance of a leak check is only required on the sectionof the piping system that is being placed in service. If portions of the piping system have been removedfrom service and segregated by an isolation valve, it is not expected for out of service piping sections tobe leak checked. Leak checking is only required for in service piping when service is restored followingan interruption.

[SR No. 10-NFPA 54/Z223.1-2024]

{A.8.3 through A.9.1.1 unchanged}

A.9.1.5.1 Means to prevent air or oxygen from entering the gas piping could be back pressure regulators or relief valves.

[SR No. 25-NFPA 54/Z223.1-2024]

{A.9.1.6 through A.9.2.1.3 unchanged}

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.)

[SR No. 25-NFPA 54/Z223.1-2024]

{A.9.2.3 through A.9.3.2.2 unchanged}

{Table A.9.3.2.1 through Table A.9.3.2.3(b) unchanged}

{Figure A.9.3.2.3(1) through Figure A.12.13.4 unchanged}

{A.9.3.2.3(1) through A.9.3.8.8 unchanged}

A.9.3.8.9 ~~Exception: Direct vent~~ Direct-vent appliances designed for installation in a ~~solid fuel burning~~ solid-fuel-burning fireplace where installed in accordance with the manufacturer's installation instructions are permitted.

[SR No. 25-NFPA 54/Z223.1-2024]

{A.9.4 through A.11.1.1 unchanged}

A.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).

[SR No. 27-NFPA 54/Z223.1-2024]

{Table A.11.1.1.2 through A.11.1.1.3 unchanged}

{A.11.2 through Figure A.12.14.2 unchanged}

A.13.1.3.1 Single-appliance venting with lateral lengths include two ~~90~~ 90-degree elbows.

[SR No. 29-NFPA 54/Z223.1-2024]

{A.13.1.7 unchanged}

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.

[SR No. 29-NFPA 54/Z223.1-2024]

{A.13.1.8 through Figure A.13.2.3.1 unchanged}

A.13.2.3.2(1) For example, the maximum length listed above 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).

[SR No. 29-NFPA 54/Z223.1-2024]

{A.13.2.4 through Figure A.13.2.19.2 unchanged}

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.

[SR No. 29-NFPA 54/Z223.1-2024]

{A.13.2.21 through Figure A.13.2.30 unchanged}

Annex B
Sizing and Capacities of Gas Piping

{B.1 through B.7.6 Example 6, (6) unchanged}

{Table B.3.2 through Table B.6(b) unchanged}

{Figure B.7.1 through Figure B.7.4 unchanged}

Annex C
Suggested Method for Checking for Leakage

{C.1 through C.4 unchanged}

{Table C.2 unchanged}

{C.3 through C.4 unchanged}

Annex D
Suggested Emergency Procedure for Gas Leaks

{D.1 unchanged}

D.2 Where accumulation of gas inside a building is detected by odor or by activation of a combustible gas detector or system ~~designed and installed in accordance with NFPA 715~~, the procedures in Section D.1 should be followed.

Annex E
Flow of Gas through Fixed Orifices

{E.1 through E.1.2 unchanged}

{Table E.1.1(a) through Table E.1.1(d) unchanged}

Annex F
Sizing of Venting Systems Serving Appliances Equipped with Draft Hoods, Category I Appliances, and Appliances Listed for Use with Type B Vents

{F.1 through F.2.4 Example 5(c) unchanged}

{Figure F.1(a) through Figure F.2.4 unchanged}

Annex G
Recommended Procedure for Safety Inspection of an Existing Appliance Installation

{G.1 through G.6.8 unchanged}

{Table G.6 unchanged}

Annex H
Indoor Combustion Air Calculation Examples

{H.1 unchanged}

H.2 New Installation, Known Air Infiltration Rate Method. Determine if the indoor volume is sufficient to supply combustion air for the following new installation example.

Example Installation 2: A 100,000 Btu/hr ~~fan-assisted~~ furnace and a 40,000 Btu/hr draft hood-equipped water heater are being installed in a new single family house. It was determined (either

by use of the ASHRAE calculation method or blower door test) that the house will have 0.65 air changes per hour (ACH). The furnace and water heater are being installed in a 20 ft × 35 ft basement with an 8 ft ceiling height.

Solution

(1) *Determine the required volume:* Because two types of appliances are located in the space, a ~~fan-assisted~~ furnace and a draft hood equipped water heater, the required volume must be determined for each appliance and then combined to determine the total required volume:

(a) ~~*Fan-assisted f*~~ *Furnace:* For structures for which the air infiltration rate is known, the method shown in 9.3.2.2 permits the use of Equation 9.3.2.3 ~~9.3.2.2b~~ to determine the required volume for a fan-assisted appliance. Section 9.3.2.3.1 ~~9.3.2.2(3)~~ limits the use of the equation to air change rates equal to or less than 0.60 ACH. While the house was determined to have a 0.65 ACH, 0.60 ACH is used to calculate the required volume. Using Equation in 9.3.2.3 ~~9.3.2.2b~~ , the required volume for a 100,000 Btu/hr fan-assisted furnace is calculated as follows:

$$\frac{15\,ft^3}{0.60}\left(\frac{100{,}000\,Btu/hr}{1{,}000\,Btu/hr}\right) \qquad \textbf{[H.2a]}$$

~~= 2,500 ft³~~

$$\frac{21\,ft^3}{0.60}\left(\frac{100{,}000\,Btu/hr}{1000\,Btu/hr}\right) \qquad \textbf{[H.2a]}$$

= 3,500 ft³

(b) *Draft-hood equipped water heater:* For structures for which the air infiltration rate is known, the method shown in 9.3.2.2 permits the use of Equation in 9.3.2.3 ~~9.3.2.2a~~ to determine the required volume for a draft hood-equipped appliance. Paragraph 9.3.2.3.1 ~~9.3.2.2(3)~~ limits the use of the equation to air change rates equal to or less than 0.60 ACH. While the house was determined to have a 0.65 ACH, 0.60 ACH is used to calculate the required volume. Using Equation in 9.3.2.3 ~~9.3.2.2a~~, the required volume for the 40,000 Btu/hr water heater is calculated as follows:

$$\frac{21\,ft^3}{0.60}\left(\frac{40{,}000\,Btu/hr}{1{,}000\,Btu/hr}\right) \qquad \textbf{[H.2b]}$$

= 1,400 ft³

(c) *Total required volume:* Subsection 9.3.2 states that the total required volume of indoor air is the sum of the required volumes for all appliances located in the space.

3,500 ~~2,500~~ ft³+ 1,400 ft³

= 4,900 ~~3,900~~ ft³

(2) *Determine available volume:* The available volume is determine as follows:

(20 ft × 35 ft) × 8 ft = 5,600 ft³ **[H.2c]**

Conclusion: The installation can use indoor air because the available volume of 5,600 ft³ exceeds the total required volume of 4,900 ~~3,900~~ ft³. No outdoor air openings are required.

H.3 New Installation, Known Air Infiltration Rate Method. Determine if the indoor volume is sufficient to supply combustion air for the following new installation example.

Example Installation 3: A 100,000 Btu/hr ~~fan-assisted~~ furnace and a 40,000 Btu/hr draft hood-equipped water heater will be installed in a new single family house. It was determined (either by use of the ASHRAE calculation method or blower door test) that the house will have 0.30 air changes per hour. The furnace and water heater will be installed in a 20 ft × 35 ft basement with an 8 ft ceiling height.

Solution

(1) *Determine the required volume:* Because two types of appliances are located in the space, a ~~fan-assisted~~ furnace and a draft hood equipped water heater, the required volume must be determined for each appliance and then combined to determine the total required volume:

(a) ~~*Fan-assisted f*~~ *Furnace:* For structures that the air infiltration rate is known, the method shown in 9.3.2.2 permits the use of Equation in 9.3.2.3 ~~9.3.2.2b~~ to determine the required volume for a fan-assisted appliance. Section Paragraph 9.3.2.3.1 ~~9.3.2.2(3)~~ limits the use of the equation to air change rates equal to or less than 0.60 ACH. Because 0.30 ACH is less than 0.60 ACH, 0.30 ACH can be used to calculate the required volume. Using Equation 9.3.2.3 ~~9.3.2.2b~~ , the required volume for a 100,000 Btu/hr fan-assisted furnace is calculated as follows:

$$\frac{15\,ft^3}{0.30}\left(\frac{100{,}000\,Btu/hr}{1{,}000\,Btu/hr}\right) \qquad \textbf{[H.3a]}$$

~~= 5,000 ft³~~

$$\frac{21\,ft^3}{0.30}\left(\frac{100{,}000\,Btu/hr}{1000\,Btu/hr}\right) \qquad \textbf{[H.3a]}$$

= 7,000 ft³

(b) *Draft hood-equipped water heater:* For structures that the air infiltration rate is known, the method in 9.3.2.2 permits the use of Equation 9.3.2.3 ~~9.3.2.2a~~ to determine the required volume for a draft hood-equipped appliance. Paragraph 9.3.2.3.1 ~~9.3.2.2(3)~~ limits the use of the equation to air change rates equal to or less than 0.60 ACH. Because 0.30 ACH is less than 0.60 ACH, 0.30 ACH can be used to calculate the required volume. Using Equation 9.3.2.3 ~~9.3.2.2a~~, the required volume for the 40,000 Btu/hr water heater is calculated as follows:

$$\frac{21\,ft^3}{0.30}\left(\frac{40{,}000\,Btu/hr}{1{,}000\,Btu/hr}\right) \qquad \textbf{[H.3b]}$$

= 2,800 ft³

(c) *Total required volume:* Section 9.3.2 states that the total required volume of indoor air is the sum of the required volumes for all appliances located in the space.

7,000 ~~5,000~~ ft^3+ 2,800 ft^3

= 9,800 ~~7,800~~ ft^3

(2) *Determine available volume:* The available volume is determine as follows:

(20 ft ×35 ft) × 8 ft = 5,600 ft^3 **[H.3c]**

Conclusion: The installation cannot use indoor air alone, because the available volume of 5,600 ft^3 is less than the total required volume of 9,800 ~~7,800~~ ft^3. Outdoor air openings can be sized in accordance with all air from the outdoors or by use of the combination of indoor/outdoor air method.

[SR No. 33-NFPA 54/Z223.1-2024]

Annex I
Example of Combination of Indoor and Outdoor Combustion and Ventilation Opening Design.

{I.1 unchanged}

Annex J
Enforcement

{J.1 unchanged}

Annex K
Informational Publications

{K.1 through K.1.2.1 unchanged}

K.1.2 Other Publications

K.1.2.1 ~~**K.1.2.7**~~ ~~**NACE**~~ **AMPP Publications.** Association for Materials Protection and Performance ~~NACE International~~, 15835 Park Ten Place, Houston, TX 77084-4906, ~~281.228.6200,~~ www.nace.org.

NACE SP0169, *Control of External Corrosion on Underground or Submerged Metallic Piping Systems*, 2024.

[SR No. 2-NFPA 54/Z223.1-2024]

K.1.2.2 ~~**K.1.2.1**~~ **API Publication.** American Petroleum Institute, 200 Massachusetts Avenue NW, Suite 1100, Washington, DC 20001-5571, 202.682.8000, www.api.org.

API 1104, *Welding of Pipelines and Related Facilities*, 2021.

[SR No. 2-NFPA 54/Z223.1-2024]

K.1.2.3 ~~**K.1.2.2**~~ **ASHRAE Publications.** American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 180 Technology Parkway, Peachtree Corners, GA 30092, 404.636.8400, www.ashrae.org.

ASHRAE 62.2, *Ventilation and Acceptable Indoor Air Quality in Residential Buildings*, 2022.

ASHRAE Handbook — Fundamentals, ~~2021~~ 2025.

ASHRAE Handbook — HVAC Systems and Equipment, 2024.

[SR No. 2-NFPA 54/Z223.1-2024]

K.1.2.4 ~~**K.1.2.3**~~ **ASME Publications.** American Society of Mechanical Engineers , Two Park Avenue, New York, NY 10016-5990, ~~800.843.2763,~~ www.asme.org.

Boiler and Pressure Vessel Code, Section IX and Section IV, ~~2023~~ 2025.

[SR No. 2-NFPA 54/Z223.1-2024]

K.1.2.5 ~~**K.1.2.4**~~ **ASTM International Publications.** American Society for Testing and Materials International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, ~~610.832.9500,~~ www.astm.org.

ASTM D2385, *Test Method for Hydrogen Sulfide and Mercaptan Sulfur in Natural Gas (Cadmium Sulfate – Iodometric Titration Method)*, 1981, reaffirmed 1990, (withdrawn 1995).

ASTM D2420, *Standard Test Method for Hydrogen Sulfide in Liquefied Petroleum (LP) Gases (Lead Acetate Method)*, ~~2013, reaffirmed 2018~~ 2023.

[SR No. 2-NFPA 54/Z223.1-2024]

K.1.2.6 ~~**K.1.2.5**~~ **AWS Publications.** American Welding Society, 8669 NW 36 Street, #130, Miami, FL 33166-6672, ~~800.443.9353,~~ www.aws.org.

AWS B2.1/B2.1M, Specification *for Welding Procedure and Performance Qualification*, ~~2014~~ 2021.

AWS B2.2/B2.2M, *Specification for Brazing Procedure and Performance Qualification*, 2016.

[SR No. 2-NFPA 54/Z223.1-2024]

K.1.2.7 ~~**K.1.2.6**~~ **CSA Group Publications.** CSA Group, 8501 East Pleasant Valley Road, Cleveland, OH 44131-5575, ~~216.524.4990,~~ www.csagroup.org.

ANSI Z21.13/CSA 4.9, Gas-Fired Low Pressure Steam and Hot Water Boilers, ~~2017 (~~R2022~~)~~.

ANSI Z21.50/CSA 2.22, *Vented Decorative Gas Appliances*, 2019, reaffirmed 2024.

ANSI Z21.60/CSA 2.26, *Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces*, 2017, reaffirmed 2021.

[SR No. 2-NFPA 54/Z223.1-2024]

K.1.2.8 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, ~~847.272.8800,~~ .

UL 651, *Schedule 40, ~~and~~ 80, Type EB and A Rigid PVC Conduit and Fittings,* 2011, revised 2022.

UL 795, *Standard for Commercial-Industrial ~~Gas Heating Equipment~~ Gas-Fired Package Boilers*, 2024.

[SR No. 2-NFPA 54/Z223.1-2024]

{K.1.2.9 through K.2 unchanged}

K.2.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 30, *Flammable and Combustible Liquids Code,* ~~2021~~ 2024 edition.

NFPA 59, *Utility LP-Gas Plant Code,* ~~2021~~ 2024 edition.

~~NFPA 61, *Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities,* 2020 edition.~~

NFPA 86, *Standard for Ovens and Furnaces,* 2024 2023 edition.

NFPA 501A, *Standard for Fire and Life Safety Criteria for Manufactured Home Installations, Sites, and Communities,* ~~2021~~ 2025 edition.

NFPA 660, *Standard for Combustible Dusts and Particulate Solids*, 2025 edition.

[SR No. 3-NFPA 54/Z223.1-2024]

K.2.2 CSA Group Publications. CSA Group, 178 Rexdale Boulevard, Toronto, ON M9W 1R3, Canada, ~~(216) 524-4990,~~ www.csagroup.org.

CSA/ANSI NGV 3.1 ~~ANSI/AGA NGV3.1/CSA 12.3~~, *Fuel System Components for Compressed Natural Gas Powered Vehicles*, ~~2014 reaffirmed~~ 2020.

CSA/ANSI ~~NGV1/CSA~~ NGV 1, *Compressed Natural Gas Vehicle (NGV) Fueling Connection Devices*, ~~2017 (R2021)~~ 2022.

CSA/ANSI NGV 2, *Compressed Natural Gas Vehicle Fuel Containers*, ~~2019~~ 2023.

ANSI/LC 2A, *Direct Gas-Fired Circulating Heatrs for Agrigultural Animal Confinement Buildings*, 1998, reaffirmed 2020.

ANSI/LC 2, *Direct Gas-Fired Circulating Heaters for Agricultural Animal Confinement Buildings*, 1996, reaffirmed 2020.

ANSI Z21.12, *Draft Hoods*, 1990, reaffirmed 2020.

ANSI Z21.17/CSA 2.7, *Domestic Gas Conversion Burners*, 1998, reaffirmed 2019.

CSA/ANSI Z21.20/CSA 22.2 – No. 60730-2-5, *Automatic Electrical Controls– Part 2-5: Particular Requirements for Automatic Electrical Burner Control*, ~~2014, reaffirmed~~ 2022.

CSA/ANSI Z21.21/CSA 6.5, *Automatic Gas Valves for Gas Appliances*, ~~2019~~ 2023.

CSA/ANSI Z21.23/CSA 6.6, *Gas Appliance Thermostats*, 2022.

ANSI Z21.35/CSA 6.8, *Pilot Gas Filters*, 2005, reaffirmed ~~2020~~ 2024.

ANSI Z21.40.4/CSA 2.94, *Performance Testing and Rating of Gas-Fired, Air-Conditioning and Heat Pump Appliances*, ~~1996, reaffirmed 2022~~ 2023.

ANSI Z21.42/CSA 2.15, *Gas-Fired Domestic Illuminating Appliances*, ~~2013, reaffirmed 2018~~ 2024.

ANSI Z21.57, *Recreational Vehicle Cooking Gas Appliances*, 2010, reaffirmed 2021.

ANSI Z21.58/CSA 1.6, *Outdoor Cooking Gas Appliances*, ~~2015 2018~~ 2022.

ANSI Z21.61, *Gas-Fired Toilets*, 1993, reaffirmed 2013.

ANSI Z21.66/CSA 6.14, *Automatic ~~Vent~~ Damper Devices for Use with Gas-Fired Appliances*, ~~2015, reaffirmed 2020~~ 2023.

ANSI Z21.71, *Automatic Intermittent Pilot Ignition Systems for Field Installation*, 1993, reaffirmed 2021.

ANSI Z21.77/CSA 6.23, *Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components*, 2005, reaffirmed ~~2020~~ 2024.

ANSI Z21.78/CSA 6.20, *Combination Gas Controls for Gas Appliances*, 2010, reaffirmed 2020.

ANSI Z21.84, *Manually Lighted, Natural Gas Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces*, 2017 reaffirmed 2021.

ANSI Z21.87/CSA 4.6, *Automatic Gas Shutoff Devices for Hot Water Supply Systems*, 2007, reaffirmed 2021.

ANSI Z21.88/CSA 2.33, *Vented Gas Fireplace Heaters*, 2019.

CSA/ANSI Z21.91, *Ventless Firebox Enclosures for Gas-Fired Unvented Gas Log-Type Room Heaters*, 2020.

CSA/ANSI Z83.21/CSA C 22.2 No.168, *Commercial Dishwashers*, 2020, reaffirmed 2025.

[SR No. 3-NFPA 54/Z223.1-2024]

{K.2.3 through K.3 unchanged}

[SR No. 1-NFPA 54/Z223.1-2024]: Referenced standards are being updated to their latest edition year.

[SR No. 2-NFPA 54/Z223.1-2024]: Referenced standards are being updated to the latest edition year.

[SR No. 3-NFPA 54/Z223.1-2024]: Referenced standards are being updated to the latest edition year.

[SR No. 4-NFPA 54/Z223.1-2024]: Extracted standards are being updated to the latest reference year.

[SR No. 5-NFPA 54/Z223.1-2024]: Systems using pure hydrogen or at hydrogen admixtures higher than those defined in this codeshould be designed, installed, and operated in accordance with NFPA 2 as they are outside thescope of this code and NFPA 2 is the recommended code for those systems.

[SR No. 6-NFPA 54/Z223.1-2024]: Nationally recognized testing labs such as UL offer certification of new appliances for use withconcentrations of hydrogen over 5% and have some form of labeling to indicate this.

[SR No. 7-NFPA 54/Z223.1-2024]: Special does not add any additional value to the sentence as consideration covers theconcept.

[SR No. 8-NFPA 54/Z223.1-2024]: The list is not all inclusive of the surfaces that could impede wrench usage and the intent is forthere to be enough room to use wrenches on the piping without bending, straining, or damagingthe piping.

[SR No. 10-NFPA 54/Z223.1-2024]: The annex text provides further information on how leak checks are typically conducted inthe field post repairs.

[SR No. 13-NFPA 54/Z223.1-2024]: Rivets are an acceptable means of fastening connectors, piping, and connections to flue collars ordraft hood, and are an equivalent means to screws. They provide a means of interference fasteningrather than friction fitting. The annex material was not added as the section with the changes is clearas to the intent to fasten all of the connectors, piping, and connections to flue collars or draft hoodmechanically. Additionally banding and strapping are already considered in items (2) and (3).

[SR No. 14-NFPA 54/Z223.1-2024]: The annex material is clarifying that removal of piping that is properly purged in accordance with thiscode does not require a qualified agency as defined by this code. There was some interpretation thatthe purged piping had to be removed immediately post purging under the supervision of the qualifiedagency, and once it has been purged there can be other things done to that pipe.

[SR No. 15-NFPA 54/Z223.1-2024]: The text of the boilerplate is moving back towards the language recommended in the Manual ofStyle in order to maintain consistency between the language found in other NFPA Codes andStandards.

[SR No. 16-NFPA 54/Z223.1-2024]: The reference to an NFPA 715 for fuel gas detector is inappropriate in this annex on emergencyprocedures for gas leaks as NFPA 715 is on the installation of fuel gas detection not on fuel gasdetection used by emergency responders.

[SR No. 17-NFPA 54/Z223.1-2024]: NFPA 715 is the standard for fuel gas detection and warning equipment in buildings and structures.Requiring the installation of fuel gas detection is outside the scope of this Code and is under thescope of the relevant building, fire, and life safety codes. The enforcement of fuel gas detectionrequirements is more applicable to the enforcers of those codes rather than the enforcers of the fuelgas code. Fuel gas detection installation is similar to smoke or carbon monoxide detectioninstallation.

The technical committee is aware of the efforts of the Building and Life Safety Code Committees(NFPA 101 and NFPA 5000) and is supportive of their efforts to develop requirements related to fuelgas detection per occupancy type.

The intent of exempting the scope of NFPA 715 from NFPA 54 is to acknowledge the request for fuelgas detection requirements and provide further explanation on the topic.

[SR No. 18-NFPA 54/Z223.1-2024]: Removal of the term outlet removes the specificity as it relates to leak and pressure tests and itremoves the positioning of the valve as it relates to those tests. Some AHJs were requiring thevalves be opened to leak or pressure test the systems and this was not the intent.

[SR No. 21-NFPA 54/Z223.1-2024]: The changes are bringing chapter 5 in-line with the Manual of Style.

[SR No. 22-NFPA 54/Z223.1-2024]: The changes are to align chapter 6 to the NFPA Manual of Style.

[SR No. 23-NFPA 54/Z223.1-2024]: The changes are to align chapter 7 to the NFPA Manual of Style.

[SR No. 24-NFPA 54/Z223.1-2024]: The changes are to align chapter 8 to the NFPA Manual of Style.

[SR No. 25-NFPA 54/Z223.1-2024]: The changes are to align chapter 9 to the NFPA Manual of Style.

[SR No. 26-NFPA 54/Z223.1-2024]: The changes are to align chapter 10 to the NFPA Manual of Style.

[SR No. 27-NFPA 54/Z223.1-2024]: The changes are to align chapter 11 to the NFPA Manual of Style.

[SR No. 28-NFPA 54/Z223.1-2024]: The changes are to align chapter 12 to the NFPA Manual of Style.

[SR No. 29-NFPA 54/Z223.1-2024]: The changes are to align chapter 13 to the NFPA Manual of Style.

[SR No. 30-NFPA 54/Z223.1-2024]: The change is to correlate the regulator pressure drop with its corresponding propane table(6.3.1(i)) regulator pressure drop as the operating conditions are the same in terms of sizing.

[SR No. 32-NFPA 54/Z223.1-2024]: Not all the requirements in current 5.5.8 are design requirements and the pieces that areinstallation related are moving to chapter 7 on installation.

[SR No. 33-NFPA 54/Z223.1-2024]: This revision was developed by NFPA staff for editorial purposes, in accrodance with 4.4.9.6.2and 4.4.9.6.3 of the Regulations Governing the Development of NFPA Standards(www.nfpa.org/regs).

The examples for calculation of the KAIR method are changing as the requirements have changedand there is no longer a difference between fan assisted appliances and non-fan assistedappliances.