

SECOND PUBLIC REVIEW DRAFT
2024 Z223.1 NATIONAL FUEL GAS CODE

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BSR Z223.1–20xx

NFPA® 54–20xx

National Fuel Gas Code

2024 Edition

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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 First Revision Draft Public Review. Persons who submitted comments on the first draft will need to refer to the NFPA Second Revision Report for disposition of their public comments and follow the NFPA process for any challenges to those actions. The ASC 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/Z223.1-2021]”). 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.

- (6) Petroleum refineries, pipeline compressor or pumping stations, loading terminals, compounding plants, refinery tank farms, and natural gas processing plants
- (7) Large integrated chemical plants or portions of such plants where flammable or combustible liquids or gases are produced by chemical reactions or used in chemical reactions
- (8) LP-Gas installations at utility gas plants
- (9)* Liquefied natural gas (LNG) ~~installations~~ systems
- (10) Fuel gas piping in electric utility power plants
- (11) Proprietary items of equipment, apparatus, or instruments such as gas generating sets, compressors, and calorimeters
- (12) LP-Gas equipment for vaporization, gas mixing, and gas manufacturing
- (13) LP-Gas piping for buildings under construction or renovations that is not to become part of the permanent building piping system—that is, temporary fixed piping for building heat
- (14) Installation of LP-Gas systems for railroad switch heating
- (15) Installation of LP-Gas and compressed natural gas systems on vehicles
- (16) Gas piping, meters, gas pressure regulators, and other appurtenances used by the serving gas supplier in distribution of gas, other than undiluted LP-Gas
- (17) Building design and construction, except as specified herein
- (18) Fuel gas systems on recreational vehicles manufactured in accordance with NFPA 1192
- (19) Fuel gas systems using hydrogen as a fuel
- (20) Construction of appliances

[SR No. 20-NFPA 54/Z223.1-2021]

{1.1.2 through 1.5 unchanged}

Chapter 1
Administrative

{1.1 through 1.1.1.2 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 using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen, and nitrogen

Chapter 2
Referenced Standards

{2.1 through 2.3 unchanged}

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

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.

ANSI/ASME B16.20, *Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound and Jacketed*, 2017.

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- ANSI/ASME B16.21, *Nonmetallic Flat Gaskets for Pipe Flanges*, ~~2016~~ 2021. [SR No. 1-NFPA 54/Z223.1-2021]
- ANSI/ASME B16.24, *Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500*, ~~2016~~ 2021. [SR No. 1-NFPA 54/Z223.1-2021]
- 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)*, 2012 (R2017).
- ANSI/ASME B16.42, *Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300*, ~~2016~~ 2021. [SR No. 1-NFPA 54/Z223.1-2021]
- ANSI/ASME B16.44, *Manually Operated Metallic Gas Valves for Use in Above Ground Piping Systems up to 5 psi*, 2012 (R2017).
- ANSI/ASME B16.47, *Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric/Inch Standard*, 2020.
- ANSI/ASME B36.10M, *Welded and Seamless Wrought Steel Pipe*, 2018.
- 2.3.2 ASTM International Publications.** American Society for Testing and Materials International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, 610.832.9500, www.astm.org.
- ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless*, ~~2020~~ 2022. [SR No. 1-NFPA 54/Z223.1-2021]
- ASTM A106, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*, 2019a.
- ASTM A254, *Standard Specification for Copper-Brazed Steel Tubing*, 2012 reaffirmed 2019.
- ASTM A268, *Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service*, ~~2020~~ 2022. [SR No. 1-NFPA 54/Z223.1-2021]
- ASTM A269, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*, 2015a, reaffirmed 2019.
- ASTM A312, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*, 2021.
- ASTM B88, *Standard Specification for Seamless Copper Water Tube*, 2020.
- ASTM B210, *Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes*, 2019a.
- ASTM B241, *Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube*, 2016.
- ASTM B280, *Standard Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service*, 2020.
- ASTM D2513, *Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings*, 2020.
- ASTM E136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, 2019a.
- ASTM E2652, *Standard Test Method for Behavior of Materials in a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C*, 2018.
- 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*, ~~2013~~ reaffirmed 2018 2021. [SR No. 1-NFPA 54/Z223.1-2021]
- ASTM F2509, *Standard Specification for Field-assembled Anodeless Riser Kits for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing*, 2015, reaffirmed 2019.
- ASTM F2945, *Standard Specification for Polyamide 11 Gas Pressure Pipe, Tubing, and Fittings*, 2018.
- 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.
- CSA/ANSI/CSA FC 1:21/CSA 22.2 NO. 622822-3-100:21, Fuel Cell Technologies - Part 3-100: *Stationary Fuel Cell Power Systems – Safety* (Adopted IEC 6228-3-100:2016, second edition, 2019-2, with Canadian and U.S. deviations, ~~2014~~, reaffirmed 2018 2021. [SR No. 1-NFPA 54/Z223.1-2021]
- ANSI/CSA NGV 5.1, *Residential Fueling Appliances*, 2016 reaffirmed 2020.
- ANSI/CSA NVG 5.2, *Vehicle Fueling Appliances (VFA)*, 2017, reaffirmed 2021. [SR No. 1-NFPA 54/Z223.1-2021]
- CSA/ANSI LC 1/CSA 6.26, *Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST)*, ~~2018~~ 2019. [SR No. 1-NFPA 54/Z223.1-2021]
- CSA/ANSI LC 4/CSA 6.32, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems*, ~~2012~~, reaffirmed 2016 2022. [SR No. 1-NFPA 54/Z223.1-2021]
- CSA/ANSI Z21.1/CSA 1.1, *Household Cooking Gas Appliances*, ~~2018~~ 2019. [SR No. 1-NFPA 54/Z223.1-2021]
- ANSI Z21.5.1/CSA 7.1, *Gas Clothes Dryers, Volume I, Type 1 Clothes Dryers*, 2017.
- ANSI Z21.5.2/CSA 7.2, *Gas Clothes Dryers, Volume II, Type 2 Clothes Dryers*, 2016, reaffirmed 2021. [SR No. 1-NFPA 54/Z223.1-2021]
- 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. [SR No. 1-NFPA 54/Z223.1-2021]
- CSA/ANSI Z21.10.3/CSA 4.3, *Gas Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour; Circulating or Instantaneous*, 2019. [SR No. 1-NFPA 54/Z223.1-2021]
- CSA/ANSI Z21.11.2, *Gas-Fired Room Heaters, —Volume II, Unvented Room Heaters*, 2019. [SR No. 1-NFPA 54/Z223.1-2021]
- CSA/ANSI Z21.13/CSA 4.9, *Gas-fired Low Pressure Steam and Hot Water Boilers*, ~~2017~~ 2022. [SR No. 1-NFPA 54/Z223.1-2021]
- ANSI Z21.15/CSA 9.1, *Manually operated gas valves for appliances, appliance connector valves and hose end valves*, 2007, reaffirmed 2014 2019. [SR No. 1-NFPA 54/Z223.1-2021]

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- CSA/ANSI Z21.18/CSA 6.3, Gas Appliance Pressure Regulators, 2019. **[SR No. 1-NFPA 54/Z223.1-2021]**
- CSA/ANSI Z21.19/CSA 1.4, Refrigerators Using Gas Fuel, ~~2014~~ 2019. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z21.22/CSA 4.4, *Relief Valves for Hot Water Supply Systems*, 2015, reaffirmed 2020.
- CSA/ANSI Z21.24/CSA 6.10, Connectors for Gas Appliances, ~~2015, reaffirmed 2020~~ 2022. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z21.40.1/CSA 2.91, *Gas-fired Heat Activated Air Conditioning and Heat Pump Appliances*, 1996, reaffirmed ~~2017~~ 2022. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z21.40.2/CSA 2.92, *Gas-Fired, Work Activated Air-Conditioning and Heat Pump Appliances (Internal Combustion)*, 1996, reaffirmed ~~2017~~ 2022. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z21.41/CSA 6.9, *Quick-Disconnect Devices for use with Gas Fuel Appliances*, 2014, reaffirmed 2019.
- CSA/ANSI Z21.47/CSA 2.3, Gas-fired Central Furnaces, 2021. **[SR No. 1-NFPA 54/Z223.1-2021]**
- 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. **[SR No. 1-NFPA 54/Z223.1-2021]**
- CSA/ANSI Z21.56/CSA 4.7, Gas-fired Pool Heaters, ~~2017~~ 2019. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z21.58/CSA 1.6, *Outdoor Cooking Gas Appliances*, ~~2018~~ 2022. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z21.60/CSA 2.26, *Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces*, 2017, reaffirmed 2021. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z21.69/CSA 6.16, *Connectors for Movable Gas Appliances*, 2015, reaffirmed 2020.
- 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.
- ANSI Z21.86/CSA 2.32, *Vented Gas-fired Space Heating Appliances*, 2016, reaffirmed 2021. **[SR No. 1-NFPA 54/Z223.1-2021]**
- CSA/ANSI Z21.88/CSA 2.33, Vented Gas Fireplace Heaters, ~~2017~~ 2019. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z21.89/CSA 1.18, *Outdoor Cooking Specialty Gas Appliances*, 2017.
- ANSI Z21.90/CSA 6.24, *Gas Convenience Outlets and Optional Enclosures*, 2019.
- ANSI Z21.93/CSA 6.30, *Excess flow valves for natural and LP gas with pressures up to 5 psig*, 2017, reaffirmed 2022. **[SR No. 1-NFPA 54/Z223.1-2021]**
- 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. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z83.8/CSA 2.6, *Gas Unit Heaters, as Packaged Heaters, Gas Utility Heaters, and Gas-fired Duct Furnaces*, 2016, reaffirmed 2021. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z83.11/CSA 1.8, *Gas Food Service Equipment*, 2016, reaffirmed 2021. **[SR No. 1-NFPA 54/Z223.1-2021]**
- 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. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z83.20/CSA 2.34, *Gas-fired Tubular and Low-intensity Infrared Heaters*, 2016, reaffirmed 2021. **[SR No. 1-NFPA 54/Z223.1-2021]**
- ANSI Z83.26/CSA 2.27, *Gas-fired Outdoor Infrared Patio Heaters*, 2020.
- {2.3.4 unchanged}
- 2.3.5 UL Publications.** Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, 877.854.3577, www.ul.com.
- UL 103, *Factory-Built Chimneys for Residential Type and Building Heating Appliances*, 2010, revised ~~2017~~ 2021. **[SR No. 1-NFPA 54/Z223.1-2021]**
- UL 353, *Limit Controls*, 1994.
- UL 378, *Draft Equipment*, 2006, revised 2013.
- UL 441, *Gas Vents*, 2019.
- UL 467, *Grounding and Bonding Equipment*, 2013. **[SR No. 1-NFPA 54/Z223.1-2021]**
- UL 641, *Type L Low-Temperature Venting Systems*, 2010, revised 2018.
- UL 651, *Schedule 40 and 80 Rigid PVC Conduit and Fittings*, 2011, revised 2022 ~~2019~~. **[SR No. 1-NFPA 54/Z223.1-2021]**
- UL 959, *Medium Heat Appliance Factory-Built Chimneys*, 2010, revised 2019.
- UL 1738, *Venting Systems for Gas Burning Appliances, Categories II, III, and IV*, 2010, revised 2021.
- UL 1777, *Chimney Liners*, 2015, revised 2019.
- UL 2158A, *Clothes Dryer Transition Ducts*, 2013, revised ~~2017~~ 2021. **[SR No. 1-NFPA 54/Z223.1-2021]**
- UL 2561, *1400 Degree Fahrenheit Factory-Built Chimneys*, 2016, revised 2018.
- UL 2989, *Outline of Investigation of Tracer Wire*, 2017.
- UL 60730-2-6, *Automatics Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements*, 2016, revised 2021. **[SR No. 1-NFPA 54/Z223.1-2021]**

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{2.3.6 unchanged}

2.3.7 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2020. [SR No. 1-NFPA 54/Z223.1-2021]

2.3.3 References for Extracts in Mandatory Sections.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 2016 2020 edition.

NFPA 70, *National Electrical Code*, 2020 2023 edition.

NFPA 88A, *Standard for Parking Structures*, 2019 2023 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 2018 2024 edition.

NFPA 101, *Life Safety Code*, 2018 2021 edition. [EDITORIAL- Z223.1-2021]

NFPA 501, *Standard on Manufactured Housing*, 2017 edition.

NFPA 5000, *Building Construction and Safety Code*, 2018 2021 edition. [SR No. 1-NFPA 54/Z223.1-2021]

Chapter 3
Definitions

{3.1 through 3.3.4.4 unchanged}

3.3.4.4.1 Baking and Roasting Oven. An oven primarily intended for volume food preparation ~~that is composed of one or more sections or units of the following types: (1) cabinet oven, an oven having one or more cavities heated by a single burner or group of burners; (2) reel-type oven, an oven employing trays that are moved by mechanical means; or (3) sectional oven, an oven composed of one or more independently heated cavities.~~ [SR No. 21-NFPA 54/Z223.1-2021]

{3.3.4.4.3 through 3.3.4.4.6 unchanged}

3.3.4.5 Household Cooking Appliance. An appliance for domestic food preparation, providing at least one function of (1) top or surface cooking, (2) oven cooking, or (3) broiling. [SR No. 22-NFPA 54/Z223.1-2021]

{3.3.4.7 through 3.3.10.4 unchanged}

3.3.11 Bonding Jumper. A reliable conductor to ensure that ensures the required electrical conductivity between metal parts required to be electrically connected [70:100 2023]. [SR No. 2-NFPA 54/Z223.1-2021]

{3.3.12 through 3.3.32 unchanged}

3.3.33 Effective Ground-Fault Current Path. An intentionally constructed, low impedance electrically conductive path designed and intended to carry current ~~under~~ during ground-fault conditions events from the point of a ground fault on a wiring system to the electrical supply source and that facilitates the operation of the overcurrent protective device or ground-fault detectors [70:100 2023]. [SR No. 3-NFPA 54/Z223.1-2021]

{3.3.34 through 3.3.56.6 unchanged}

3.3.56.7 Water Heater. An appliance for supplying hot water for domestic or commercial purposes. [SR No. 23-NFPA 54/Z223.1-2021]

{3.3.57 through 3.3.62.2 unchanged}

3.3.63 Manufactured Home. A structure, transportable in one or more sections, that, in the traveling mode, is 8 body-ft (2.4 m) or more in width or 40 body-ft (12.2 m) or more in length or, that on site is 320 ft² (29.7 m²) or more, is built on a permanent chassis, is designed to be used as a dwelling with or without a permanent foundation, ~~whether or not connected to the utilities~~ and includes plumbing, heating, air-conditioning, and electrical systems contained therein. ~~Such terms shall include any structure which meets all the requirements of this paragraph except the size requirements and with respect to which the manufacturer voluntarily files a certification required by the regulatory agency. Calculations used to determine the number of square feet in a structure are based on a structure's exterior dimensions, include all expandable rooms, cabinets, and other projections containing interior space, but do not include bay windows.~~ [501, 2017] [SR No. 5-NFPA 54/Z223.1-2021]

{3.3.64 through 3.3.64 unchanged}

3.3.64.1* Combustible Material. A material that, in the form in which it is used and under the conditions anticipated, will ignite and burn; a material that does not meet the definition of noncombustible. [101, 2015] [EDITORIAL- Z223.1-2021]

{3.3.64.2 through 3.3.84.2 unchanged}

3.3.84.3 Line Pressure Regulator. A pressure regulator placed in a gas line between the service regulator and the appliance regulator shutoff valve. [SR No. 24-NFPA 54/Z223.1-2021]

{3.3.84.4 through 3.3.104 unchanged}

Chapter 4
General

{4.1 through 4.5 unchanged}

Chapter 5
Gas Piping System Design, Materials, and Components

{5.1 through 5.5.9.1.2 unchanged}

5.5.9.1.3 Non-Ferrous Nonferrous Flanges shall be in accordance with ANSI/ASME B16.24, *Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500* except listed components using aluminum flange connections constructed in accordance with the dimensional specifications of ANSI/ASME B16.5, *Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard*, or ANSI/ASME B16.1, *Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250*. [SR No. 10-NFPA 54/Z223.1-2021]

{5.5.9.1.4 through 5.5.10.4 unchanged}

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

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- (1) Flange faces shall be cleaned. [SR No. 11-NFPA 54/Z223.1-2021]
- (2) Flange surfaces shall be inspected for pitting, corrosion, and other surface defects.
- (3) Flanges that contain pitting, corrosion, and other surface defects on faces shall be repaired or replaced.

{5.6 through 5.6.2.3 unchanged}

5.6.3 Supports.

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

5.6.3.2 Where flexible connectors are used to connect a gas meter to downstream piping at manufactured homes in manufactured home parks and mobile homes in mobile-home parks, the meter shall be supported by a post or bracket placed in a firm footing or by other means providing equivalent support. [SR No. 12-NFPA 54/Z223.1-2021]

{5.6.4 through 5.7.7 unchanged}

5.8 Overpressure Protection Devices. [SR No. 33-NFPA 54/Z223.1-2021]

{5.8.1 through 5.8.3 unchanged}

5.8.3.1 Overpressure protection devices shall be one of the following:

- (1) Pressure relief valve-
- (2) Monitor regulator-
- (3) Series regulator installed upstream from the line regulator and set to continuously limit the pressure on the inlet of the line regulator ~~to the maximum values specified by 5.8.2.1 or less.~~
- (4) Automatic shutoff device installed in series with the line pressure regulator ~~and set to shut off when the pressure on the downstream piping system reaches the maximum values specified by 5.8.2.1 or less. This device shall be and~~ designed so that it will remain close until manually reset. [SR No. 13-NFPA 54/Z223.1-2021]

{5.8.3.2 through 5.8.8.2 unchanged}

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 impairment reduction of relief capacity. [SR No. 15-NFPA 54/Z223.1-2021]

{5.9 through 5.13.2 unchanged}

5.14 Pressure Regulator and Pressure Control Venting. The venting of the atmospheric side of diaphragms in line-pressure regulators, ~~gas appliance regulators,~~ and gas-pressure-limit controls shall be in accordance with all of the following:

- (1) An independent vent pipe to the outdoors, sized in accordance with the device manufacturer's instructions, shall be provided where the location of a device is such that a discharge of fuel gas will cause a hazard. ~~backpressure in the event of diaphragm failure and such design is approved.~~
- (2) ~~For devices other than appliance~~ Independent vents for multiple regulators, vents shall are not be required ~~to be~~

~~independent~~ where the vents are connected to a common manifold designed in accordance with engineering methods to minimize backpressure in the event of diaphragm failure and such design is approved.

- (3) A regulator and vent limiting means combination listed in accordance with ANSI Z21.80/CSA 6.22, Line Pressure Regulators, shall not be required to be vented to the outdoors.
- (4) A listed gas appliance regulator factory equipped with a vent-limiting device ~~is~~ shall not be required to be vented to the outdoors.
- (5) A listed gas pressure limit control that is factory equipped with a vent-limiting device and in accordance with UL 353, *Limit Controls*, or UL 60730-2-6, *Automatic Electrical Controls for Household and Similar Use, Part 2*, shall not be required to be vented to the outdoors.
- (6) Materials for vent piping shall be in accordance with Section 5.5.
- (7) The vent terminus shall be designed to prevent the entry of water, insects, and other foreign matter that could cause blockage.
- (8) Vent piping shall be installed to minimize static loads and bending moments placed on the regulators and gas pressure control devices.
- (9) Vents shall terminate not less than 3 ft (0.9 m) from a possible source of ignition.
- (10) At locations where a vent termination could be submerged during floods or snow accumulations, ~~an antiflood-type breather vent fitting shall be installed, or the vent terminal shall be located above the height of the expected flood waters or snow.~~ one of the following shall apply:
 - (a) An antiflood-type breather vent fitting shall be installed.
 - (b) The vent terminal shall be located above the height of the expected flood waters or snow.
- (11) Vent piping from pressure regulators and gas pressure controls shall not be a connected to a common manifold that serves a bleed line from a diaphragm-type gas valve. [SR No. 29-NFPA 54/Z223.1-2021]

Chapter 6 Pipe Sizing

{6.1 through 6.4.2 unchanged}

{Table 6.4.2 unchanged}

{Table 6.2.1(a) through 6.3.1(m) unchanged}

Chapter 7 Gas Piping Installation

{7.1 through 7.14.2 unchanged}

{Table 7.26.2 unchanged}

Chapter 8
Inspection, Testing, and Purging

{8.1 through 8.3.4 unchanged}

{Table 8.3.1 unchanged}

Chapter 9
Appliance, Equipment and Accessory Installation

{9.1 through 9.1.8.1 unchanged}

9.1.8.2* At the locations selected for installation of appliances and equipment, the dynamic and static load carrying capacities of the building structure shall be checked to determine whether they are adequate able to carry the additional loads. ~~The appliances and equipment shall be supported and shall be connected to the piping so as not to exert undue stress on the connections.~~ **[SR No. 30-NFPA 54/Z223.1-2021]**

{9.1.9 through 9.1.20 unchanged}

9.1.21 Protection Installation of Outdoor Appliances. Appliances ~~not listed for outdoor installation but~~ installed outdoors shall be ~~provided with protection to the degree that the environment requires.~~ Appliances listed for outdoor installation shall be permitted to be installed without protection in accordance with the manufacturer's installation instructions. **[SR No. 16-NFPA 54/Z223.1-2021]**

{9.1.22 through 9.8.2 unchanged}

{Figure 9.6.8 unchanged}

Chapter 10
Installation of Specific Appliances

{10.1 through 10.11.1 unchanged}

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

10.11.2.1* Floor-mounted food service appliances shall be installed at least 6 in. (150 mm) from combustible material with at least a 2 in. (50 mm) clearance provided between a draft hood and combustible material.

10.11.2.2 Floor-mounted food service appliances listed for installation at lesser clearances shall be installed in accordance with the manufacturer's installation instructions.

10.11.2.3 Appliances designed and marked "For use only in noncombustible locations" shall not be installed elsewhere. **[SR No. 17-NFPA 54/Z223.1-2021]**

{10.11.3 through 10.17.1 unchanged}

10.17.2 Protection above Domestic Units.

10.17.2.1 Domestic open-top broiler units shall be provided with a metal ventilating hood not less than 0.0122 in. (0.3 mm) thick with a clearance of not less than ¼ in. (6 mm) between the hood and the underside of combustible material or metal cabinets.

10.17.2.2 A clearance of at least 24 in. (610 mm) shall be maintained between the cooking top and the combustible material or metal cabinet, ~~and~~

10.17.2.3 The hood shall be at least as wide as the open-top broiler unit and centered over the unit.

10.17.2.4 Domestic open-top broiler units incorporating an integral exhaust system and listed for use without a ventilating hood need not be provided with a ventilating hood if installed in accordance with 10.13.3.1 (1). **[SR No. 18-NFPA 54/Z223.1-2021]**

{10.17.3 through 10.31 unchanged}

Chapter 11
Procedures to Be Followed to Place Appliance in Operation

{11.1 through 11.5 unchanged}

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

(1) The building or structure envelope is complete and intact, ~~and all openings to the outdoors are closed.~~

(2) All combustion air systems and openings are in place.

(3) All air-exhausting appliances, power-vented appliances, and exhaust fans are operating.

(4) All air-moving equipment used for heating, cooling, or ventilation is operating.

(5) The draft hood spillage test is conducted only after all of the conditions in 11.6(1) through 11.6(4) are established. **[SR No.25-NFPA54/Z223.1-2021]**

{11.7 unchanged}

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:

(1) Listed ranges

(2) Built-in domestic ~~cooking~~ units listed and marked for optional venting

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- (3) Listed hot plates
- (4) Listed Type 1 clothes dryers exhausted in accordance with 10.4.
- (5) A single listed booster-type (automatic instantaneous) water heater, when designed and used solely for the sanitizing rinse requirements of a dishwashing machine, provided ~~that the appliance is installed, with the draft hood in place and unaltered, if a draft hood is required, in a commercial kitchen having a mechanical exhaust system [Where installed in this manner, the draft hood outlet shall not be less than 36 in. (910 mm) vertically and 6 in. (150 mm) horizontally from any surface other than the appliance.]~~ 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.
- (6) Listed refrigerators
- (7) Counter appliances
- (8) Room heaters listed for unvented use
- (9) Direct-gas-fired make-up air heaters
- (10) Other appliances listed for unvented use and not provided with flue collars
- (11) Specialized appliances of limited input such as laboratory burners or gas lights **[SR No.27-NFPA54/Z223.1-2021]**

12.3.2.1 Where an appliance is installed as stated in 12.3.2(5), the draft hood outlet shall not be less than 36 in. (910 mm) vertically and 6 in. (150 mm) horizontally from any surface other than the appliance.

~~**12.3.2.2**~~ Where any or all of these appliances in 12.3.2 (5) through 12.3.2 (11) are installed so the aggregate input rating exceeds 20 Btu/hr/ft³ (207 W/m³) of room or space in which it is installed, one or more shall be provided with venting systems or other approved means for conveying the vent gases to the outdoors so the aggregate input rating of the remaining unvented appliances does not exceed the 20 Btu/hr/ft³ (207 W/m³).

~~**12.3.2.3**~~ Where the calculation includes the volume of an adjacent room or space, the room or space in which the appliances are installed shall be directly connected to the adjacent room or space by a doorway, archway, or other opening of comparable size that cannot be closed. **[SR No.34-NFPA54/Z223.1-2021]**

{12.3.3 through 12.16 unchanged}

Chapter 13
Sizing of Category I Venting Systems

{13.1 through 13.2.30 unchanged}

{Table 13.1(a) through Table 13.2.2 unchanged}

Annex A

Explanatory Material

{A.1.1.1.1(A) unchanged}

A.1.1.1.2(9) Fuel gas systems not related to the LNG processes such as those used for building heating or cooking installed within LNG facilities are under the scope of NFPA 54. Industrial fuel gas systems that are also normally designed under NFPA 54 are also under the scope of NFPA 54. **[SR No.20-NFPA54/Z223.1-2021]**

{A.3.2.1 through A.3.2.5 unchanged}

A.3.3.4.1 Baking and Roasting Oven. The types of baking and roasting ovens are as follows:

- (1) Cabinet oven – an oven having one or more cavities heated by a single burner or group of burners
- (2) Real-type oven – an oven employing trays that are moved by mechanical means
- (3) Sectional oven – an oven composed of one or more independently heated cavities **[SR No.21-NFPA54/Z223.1-2021]**

{A.3.3.4.10.1 through A.3.3.49 unchanged}

A.3.3.63 Manufactured Home. Manufactured homes include any structure that meets all the conditions stated in 3.3.63 except those for size and with respect to which the manufacturer voluntarily files a certification required by the regulatory agency. Calculations used to determine the number of square feet in a structure are based on a structure's exterior dimensions, including all expandable rooms, cabinets, and other projections containing interior space, but not including bay windows. **[SR No.5-NFPA54/Z223.1-2021]**

{A.3.3.64.1 through A.5.3.2 unchanged}

A.5.3.2.1 Some older appliances do not have a nameplate. In this case Table A.5.3.2.1 or an estimate of the appliance input should be used. The input can be based on the following:

- (1) A rating provided by the manufacturer
- (2) The rating of similar appliances
- (3) Recommendations of the gas supplier
- (4) Recommendations of a qualified agency
- (5) A gas flow test
- (6) Measurement of the orifice size of the appliance

The requirement of 5.3.1 that the piping system provide sufficient gas to each appliance inlet must be complied with.

Table A.5.3.2.1 Approximate Gas Input for Typical Selected Appliances Used in Residential Occupancies

Appliance	Input Btu/hr (Approx.)
Space Heating Units	
Warm air furnace	
Single family	100,000
Multifamily, per unit	60,000
Hydronic boiler	

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Single family Multifamily, per unit	100,000 60,000
Space and Water Heating Units	
Hydronic boiler	
Single family Multifamily, per unit	120,000 75,000
Water Heating Appliances	
Water heater, automatic storage 30 to 40 gal tank	35,000
Water heater, automatic storage 50 gal tank	50,000
Water heater, automatic instantaneous	
Capacity at 2 gal/min	142,800
Capacity at 4 gal/min	285,000
Capacity at 6 gal/min	428,400
Water heater, domestic, circulator or side-arm	35,000
Cooking Appliances	
Range, free standing, domestic	65,000
Built-in oven or broiler unit, domestic	25,000
Built-in top unit, domestic	40,000
Other Appliances	
Refrigerator	3,000
Clothes dryer, type 1 (domestic)	35,000
Gas fireplace direct vent	40,000
Gas log	80,000
Barbecue	40,000
Gas light	2,500

[SR No. 19-NFPA54/Z223.1-2021]

{A.5.5.3 through A.5.5.7.1 unchanged}

A.5.5.10.5 ASME PCC-1, Guidelines for Pressure Boundary Bolted Flanges Joint Connections, contains information and guidelines for evaluating flange face defects. **[SR No. 11-NFPA 54/Z223.1-2021]**

{A.5.6 through A.9.1.6 unchanged}

A.9.1.8.2 The installation of new, replacement, or retrofit appliances can result in unanticipated static or dynamic loads that were not considered by the original building design. This problem often occurs when older equipment or appliances are replaced by new equipment or appliances that are physically larger or heavier. Examples of this include new, more energy efficient rooftop units that are heavier and taller (affecting roof snow loads in northern climates), larger and heavier water heaters, boilers, cooking equipment or other appliances.

This information is intended to be a reminder to the AHJ and the installer that the structural capabilities should be considered whenever changes to equipment and appliance sizes or locations within a building are changed. The services of a licensed or registered design professional might be needed to provide the analysis required by 9.1.8.2. **[SR No. 30-NFPA 54/Z223.1-2021]**

{A.9.1.20 through A.9.3.2.1 unchanged}

A.9.3.2.2 See Figure A.9.3.2.2 (a), and Table A.9.3.2.2 (b), and A.9.3.2.2 (c).

Meeting the requirements of the “known air infiltration rate method” is not a guarantee that the equipment will pass the Section

11.6 draft test with current tighter construction, remodeling, and weatherization methods. There are also factors related to building airflows and combustion air that cannot be quantified or predicted, including leakage of supply and return ducts in unconditioned spaces, multiple appliances operating at the same time, operation of exhaust fans, wind and weather conditions, and isolation of appliance areas from sources of combustion air by the closing of doors. This code is not a design manual and should not be considered as such. The formula used to determine the required indoor air volume is meant to provide you with the best guidance available at the time of publication of this edition of NFPA 54. Even tracer gas methods, for determining air infiltration rates, which require specialized equipment, can only determine rates of flow for the time and conditions when the test is conducted.

Air changes per hour (ACH) in this formula is the number of air changes that occur within the building by natural means (ACH_{NAT}). There are several methods to measure ACH, although any factors can affect this value, such as wind velocities, wind direction, barometric pressure, and the number and type of appliances installed and operated within the building.

Tracer gas methods have been developed to determine ACH. Such methods produce the most reliable values for ACH. However, these methods can be expensive and cumbersome, making them out of reach of most contractors or installers. Other published methods for estimating ACHs include ASHRAE estimating methods and those developed by the Air Conditioning Contractors of America Manual J, Residential Load Calculations, which includes tightness categories and estimated ACH for each category. The most prevalent technology in use today for evaluating air leakage characteristics associated with structures is through the use of blower door testing. This tool, called ACH₅₀, provides a somewhat consistent and quantifiable means for arriving at the air leakage for a uniform depressurization of a building compared to atmosphere—normally 50 pascals. This method has been successfully correlated to tracer-gas-measured natural air infiltration rates. ASHRAE 62.2 provides a method, called ACH_{NAT}, for converting ACH₅₀ to an ACH value that reflects the actual number of air changes under normal conditions.

Many buildings constructed to current building and energy codes can achieve very low ACH_{NAT} values, which need a relatively large indoor volume for naturally drafted appliances. Designers, builders, installers, and inspectors should know that these kinds of values might need indoor air volumes that are greater than structures have available. In such cases, draft testing per Section 11.6 might fail. This could necessitate an alternate means of appliance venting, replacing the appliance, or other remedies for achieving the necessary combustion air other than using indoor air.

The following is intended to provide guidance on developing the ACH factor for use in the “known air infiltration rate” (see 9.3.2.2) method of providing combustion air. It supports converting commonly used ACH₅₀ blower door air change measurements to estimated natural air infiltration rates.

ASHRAE 62.2, Ventilation and Acceptable Indoor Air Quality in Residential Buildings, provides an infiltration credit formula used with single-point blower door testing for estimating natural infiltration rates. Table A.9.3.2.2(C) represents one set of simplified ASHRAE method calculations for a single-story

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building for an ACH_{50} of 3. The formula should be used to calculate ACH_{NAT} for buildings with larger ACH_{50} leakage rates. A design professional should be consulted to validate calculations before they are used as the basis for providing combustion air.

$$Q_{50} = CFM_{50} \text{ blower door reading or } ACH_{50} \times \text{volume} / 60$$

[A.9.3.2.3a]

$$ACH_{NAT} = .052 \times Q_{50} \times wsf \times (H / Hr)^z \times 60 / \text{volume}$$

[A.9.3.2.3b]

where:

wsf = Weather and shielding factor (from ASHRAE 62.2)

H = Conditioned height above grade

Hr = Reference height, 8.2 ft

$z = 0.4$

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Appliance Input Btu/hr	Space Volume (ft ³)		
	0.25 ACH	0.30 ACH	0.35 ACH
5,000	420	350	300
10,000	840	700	600
15,000	1,260	1,050	900
20,000	1,680	1,400	1,200
25,000	2,100	1,750	1,500
30,000	2,520	2,100	1,800
35,000	2,940	2,450	2,100
40,000	3,360	2,800	2,400
45,000	3,780	3,150	2,700
50,000	4,200	3,500	3,000
55,000	4,620	3,850	3,300
60,000	5,040	4,200	3,600
65,000	5,460	4,550	3,900
70,000	5,880	4,900	4,200
75,000	6,300	5,250	4,500
80,000	6,720	5,600	4,800
85,000	7,140	5,950	5,100
90,000	7,560	6,300	5,400
95,000	7,980	6,650	5,700
100,000	8,400	7,000	6,000
105,000	8,820	7,350	6,300
110,000	9,240	7,700	6,600
115,000	9,660	8,050	6,900
120,000	10,080	8,400	7,200
125,000	10,500	8,750	7,500
130,000	10,920	9,100	7,800
135,000	11,340	9,450	8,100
140,000	11,760	9,800	8,400
145,000	12,180	10,150	8,700
150,000	12,600	10,500	9,000
160,000	13,440	11,200	9,600
170,000	14,280	11,900	10,200
180,000	15,120	12,600	10,800
190,000	15,960	13,300	11,400
200,000	16,800	14,000	12,000
210,000	17,640	14,700	12,600
220,000	18,480	15,400	13,200
230,000	19,320	16,100	13,800
240,000	20,160	16,800	14,400
250,000	21,000	17,500	15,000
260,000	21,840	18,200	15,600
270,000	22,680	18,900	16,200
280,000	23,520	19,600	16,800
290,000	24,360	20,300	17,400
300,000	25,200	21,000	18,000

Appliance Input Btu/hr	Space Volume (ft ³)		
	0.25 ACH	0.30 ACH	0.35 ACH
5,000	300	250	214
10,000	600	500	429
15,000	900	750	643
20,000	1,200	1,000	857
25,000	1,500	1,250	1,071
30,000	1,800	1,500	1,286
35,000	2,100	1,750	1,500
40,000	2,400	2,000	1,714
45,000	2,700	2,250	1,929
50,000	3,000	2,500	2,143
55,000	3,300	2,750	2,357
60,000	3,600	3,000	2,571
65,000	3,900	3,250	2,786
70,000	4,200	3,500	3,000
75,000	4,500	3,750	3,214
80,000	4,800	4,000	3,429
85,000	5,100	4,250	3,643
90,000	5,400	4,500	3,857
95,000	5,700	4,750	4,071
100,000	6,000	5,000	4,286
105,000	6,300	5,250	4,500
110,000	6,600	5,500	4,714
115,000	6,900	5,750	4,929
120,000	7,200	6,000	5,143
125,000	7,500	6,250	5,357
130,000	7,800	6,500	5,571
135,000	8,100	6,750	5,786
140,000	8,400	7,000	6,000
145,000	8,700	7,250	6,214
150,000	9,000	7,500	6,429
160,000	9,600	8,000	6,857
170,000	10,200	8,500	7,286
180,000	10,800	9,000	7,714
190,000	11,400	9,500	8,143
200,000	12,000	10,000	8,571
210,000	12,600	10,500	9,000
220,000	13,200	11,000	9,429
230,000	13,800	11,500	9,857
240,000	14,400	12,000	10,286
250,000	15,000	12,500	10,714
260,000	15,600	13,000	11,143
270,000	16,200	13,500	11,571
280,000	16,800	14,000	12,000
290,000	17,400	14,500	12,429
300,000	18,000	15,000	12,857

For SI units, 1 ft³ = 0.028 m³; 1,000 Btu/hr = 0.293 kW

ACH = Air change per hour.

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Table A.9.3.2.3(c)		
ACH₅₀ to ACH_{NAT} Sample Calculations		
$ACH_{NAT} = .052 \times Q_{50} \times wsf \times (H / Hr)^2 \times 60 / \text{volume} *$		
Single Story		
ACH₅₀	wsf †	ACH_{NAT}
3	<u>0.30</u>	<u>0.05</u>
	<u>0.35</u>	<u>0.06</u>
	<u>0.40</u>	<u>0.07</u>
	<u>0.45</u>	<u>0.08</u>
	<u>0.50</u>	<u>0.08</u>
	<u>0.55</u>	<u>0.09</u>
	<u>0.60</u>	<u>0.10</u>
	<u>0.65</u>	<u>0.10</u>
	<u>0.70</u>	<u>0.10</u>
	<u>0.75</u>	<u>0.10</u>
	<u>0.80</u>	<u>0.10</u>
	<u>0.85</u>	<u>0.15</u>
	<u>0.90</u>	<u>0.15</u>
	<u>0.95</u>	<u>0.15</u>
	<u>1.00</u>	<u>0.15</u>
<u>1.05</u>	<u>0.175</u>	
<u>1.10</u>	<u>0.20</u>	
<u>1.15</u>	<u>0.20</u>	

*H/Hr was derived from an average of 10 ft. This made for a representative factor for facilities with 8 ft to 12 ft conditioned heights.

† Created with selected weather shielding factors.

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{A.9.3.2.3 (1) through A.10.9.7.3 unchanged}

A.10.11.2.1 Examples of floor-mounted food service appliances include ranges for hotels and restaurants, deep fat fryers, unit boilers, kettles, steam cookers, steam generators, and baking and roasting ovens. **SR No.17-NFPA54/Z223.1-2021**

{A.10.11.8 through A.13.2.20 unchanged}

Annex B
Sizing and Capacities of Gas Piping

{B.1 through B.7.6 Example 6, (6) unchanged}

Annex C
Suggested Method for Checking for Leakage

{C.1 through C.4 unchanged}

Annex D
Suggested Emergency Procedure for Gas Leaks

{D.1 through D.2 unchanged}

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.5.1 unchanged}

G.5.2 Test for Combustion Air and Vent Drafting for Natural Draft and Category I Appliances. ~~Combustion~~ The following air and vent draft procedures are for natural draft and category I appliances equipped with a draft hood and connected to a natural draft venting system.

- ~~(1) Preparing for Inspection. Close all exterior building doors and windows and all interior doors between the space in which the appliance is located and other spaces of the building that can be closed. Turn on any clothes dryer. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers and any fireplace doors.~~
- ~~(2) Placing the Appliance in Operation. Place the appliance being inspected in operation. Adjust the thermostat or control so the appliance will operate continuously.~~
- ~~(3) Spillage Test. Verify that all appliances located within the same room are in their standby mode and ready for operation. Follow lighting instructions for each appliance as necessary. Test for spillage at the draft hood relief opening as follows:

 - ~~(a) After 5 minutes of main burner operation, check for spillage using smoke.~~
 - ~~(b) Immediately after the first check, turn on all other fuel gas burning appliances within the same room so they will operate at their full inputs and repeat the spillage test.~~
 - ~~(c) Shut down all appliances to their standby mode and wait for 15 minutes.~~
 - ~~(d) Repeat the spillage test steps (a) through (c) on each appliance being inspected.~~~~

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- ~~(4) Additional Spillage Tests. Determine if the appliance venting is impacted by other door and air handler settings by performing the following tests:~~
- ~~(a) Set initial test condition in accordance with G.5.2 (1).~~
 - ~~(b) Place the appliance(s) being inspected in operation. Adjust the thermostat or control so the appliance(s) will operate continuously.~~
 - ~~(c) Open the door between the space in which the appliance(s) is located and the rest of the building. After 5 minutes of main burner operation, check for spillage at each appliance using smoke.~~
 - ~~(d) Turn on any other central heating or cooling air handler fan that is located outside of the area where the appliances are being inspected. After 5 minutes of main burner operation, check for spillage at each appliance using smoke. The test should be conducted with the door between the space in which the appliance(s) is located and the rest of the building in the open and in the closed position.~~
- ~~(5) Return doors, windows, exhaust fans, fireplace dampers, and any other fuel gas burning appliance to their previous conditions of use.~~
- ~~(6) If spillage occurs during testing, the owner should be notified, be instructed as to which configuration of the home would lessen its impact, and to arrange for corrective action by an HVAC or venting professional. Where it is believed that the venting system performance is inadequate the owner should be notified that alternative vent sizing, design or configuration is needed in accordance with Chapter 12 and 13. Where it is believed that sufficient combustion air is not available, the owner should be notified that additional combustion air is needed in accordance with Section 9.3.~~
- (1) Preparation for Testing. The following should be completed prior to testing:
- (a) Close all exterior building doors and windows and other openings to the outdoors.
 - (b) Close solid-fuel burning appliances and fireplace dampers and combustion air controls.
 - (c) Remove or replace the forced-air heating/cooling system air filter.
 - (d) Open heating/cooling supply air registers outside of the combustion appliance zone and close supply air registers within the combustion appliance. The combustion appliance zone is the room or space in which the appliance(s) to be tested is located.
 - (e) Close all interior doors except those to rooms that contain an exhaust fan or air exhausting appliance.
 - (f) Operate all exhaust fans, air exhausting appliances, and appliance mechanical draft exhausters at maximum capacity.
 - (g) Clean filters and exhaust terminals of air exhausting appliances.
- (h) Do not operate summer exhaust fans.
- (2) Measuring Combustion Appliance Zone Pressure. The following should be completed to measure the combustion appliance zone pressure:
- (a) Set up a manometer to measure the combustion appliance zone pressure with reference to the outdoors.
 - (b) Obtain two combustion appliance zone pressure measurements (a total of two data points) with the heating/cooling system air handler(s) not operating as follows:
 - i. One with the entrance/exit doors to the combustion appliance zone room open
 - ii. One with the entrance/exit doors to the combustion appliance zone room closed
 - (c) Operate any heating/cooling system air handler at the maximum speed at which it is expected to operate.
 - (d) Obtain two combustion appliance zone pressure measurements (a total of 2 data points) as follows:
 - i. One with the entrance/exit doors to the combustion appliance zone room open
 - ii. One with the entrance/exit doors to the combustion appliance zone room closed
 - (e) The most negative pressure in the combustion appliance zone, referenced to the outdoors, should be considered to be the most negative depressurization case.
- (3) Placing the Appliance in Operation. The following should be completed to place the appliance in operation:
- (a) Configure the building in the identified most negative pressure referenced to the outdoors of the four data points recorded in G.5.2 (2)(b) and G.5.2 (2)(d).
 - (b) Verify that all appliances located within the same room are in their standby mode and ready for operation.
 - (c) Start with the lowest Btu input appliance in the space.
 - (d) Place the appliance being tested in operation. Adjust the thermostat or control so that the appliance will operate continuously.
 - (e) Test for spillage at the draft hood relief opening according to the appliance manufacturers' instructions. It is recommended, for personnel safety, to monitor ambient carbon monoxide (CO) levels in the space in which the testing is conducted. Do not test in an environment with more than 50 ppm (i.e., the OSHA 8-hour timeweighted average limit) for CO exposure. CO has cumulative effects, and multiple exposures can be dangerous. CO can cause headaches, dizziness, mental dullness, weakness, sleepiness, nausea, vomiting, unconsciousness, and death (see Fire Protection Guide to Hazardous Materials). Persons who exhibit such signs after exposure should seek medical attention immediately.

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(4) Draft Testing. If the manufacturer's instructions for draft spillage testing are not available, test as follows:

- (a) After 5 minutes of main burner operation, check for spillage using smoke or a mirror for fogging.
- (b) Immediately after the first check, turn on all other fuel-gas-burning appliances that obtain combustion air from indoors so that they operate at their full inputs and repeat the spillage test for each appliance to make sure that there is no spillage as all appliances operate together.

(5) After Appliance Testing is Complete. Return doors, windows, exhaust fans, heating/cooling system air handlers, fireplace dampers, and other fuel-gas-burning appliances to their previous conditions prior to preparation for testing.

(6) Owner Warning, Draft Testing Failures. If spillage occurs during draft testing, the owner must be notified in writing, and the owner must be instructed to arrange for corrective action by an HVAC or venting professional before the systems are again operated. [SR No.28-NFPA54/Z223.1-2021]

{G.6 through G.6.8 unchanged}

{Table G.6 unchanged}

Annex H
Indoor Combustion Air Calculation
Examples

{H.1 through H.3 unchanged}

Annex I
Example of Combination of Indoor and Outdoor Combustion
and Ventilation Opening Design.

{I.1 unchanged}

Annex J
Enforcement

{Annex J.1 unchanged}

Annex K
Informational Publications

{K.1 through K.1.2.7 unchanged}

K.1.2.8 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, 847.272.8800, www.ul.com.

UL 651, *Schedule 40 and 80 Type EB and A Rigid PVC Conduit and Fittings*, 2011, revised ~~2019~~ 2022. [SR No.7-NFPA54/Z223.1-2021]

UL 795, *Standard for Commercial-Industrial Gas Heating Equipment*, 2016, revised ~~2020~~ 2022. [SR No.7-NFPA54/Z223.1-2021]

{K.1.2.9 through K.2.1 unchanged}

K.2.2 CSA Group Publications. CSA Group, 178 Rexdale Boulevard, Toronto, ON M9W 1R3, Canada, (216) 524-4990, www.csagroup.org.

ANSI/AGA NGV3.1/CSA 12.3, *Fuel System Components for Compressed Natural Gas-Powered Vehicles*, 2020.

ANSI NGV1/CSA NGV1, *Compressed Natural Gas Vehicle (NGV) Fueling Connection Devices*, 2017.

~~ANSI/CSA/ANSI NGV 2, *Compressed Natural Gas Vehicle Fuel Containers*, 2019.~~ [SR No.8-NFPA54/Z223.1-2021]

ANSI LC 2A, *Direct Gas-Fired Circulating Heaters for Agricultural 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 ~~2014~~ 2019. [SR No.8-NFPA54/Z223.1-2021]

~~CSA/ANSI Z21.20/CSA 22.2 – No. 60730-2-5, *Automatic Electrical Controls for Household and Similar Use – Part 2-5: Particular Requirements for Automatic Electrical Burner Control Ignition Systems and Components*, 2014, reaffirmed 2019~~ 2022. [SR No.8-NFPA54/Z223.1-2021]

~~CSA/ANSI Z21.21/CSA 6.5, *Automatic Gas Valves for Gas Appliances*, 2019.~~ [SR No.8-NFPA54/Z223.1-2021]

~~CSA/ANSI Z21.23/CSA 6.6, *Gas Appliance Thermostats*, 2010,~~ reaffirmed ~~2020~~ 2022. [SR No.8-NFPA54/Z223.1-2021]

ANSI Z21.35/CSA 6.8, *Pilot Gas Filters*, 2005, reaffirmed 2020.

ANSI Z21.40.4/CSA 2.94, *Performance Testing and Rating of Gas-Fired, Air-Conditioning and Heat Pump Appliances*, 1996, reaffirmed ~~2017~~ 2022. [SR No.8-NFPA54/Z223.1-2021]

ANSI Z21.42, *Gas-Fired Illuminating Appliances*, 2013, reaffirmed 2018.

ANSI Z21.57, *Recreational Vehicle Cooking Gas Appliances*, 2010, reaffirmed 2021.

ANSI Z21.58/CSA 1.6, *Outdoor Cooking Gas Appliances*, 2015 2018.

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.

ANSI Z21.71, *Automatic Intermittent Pilot Ignition Systems for Field Installation*, 1993, reaffirmed ~~2016~~ 2021. [SR No.8-NFPA54/Z223.1-2021]

ANSI Z21.77/CSA 6.23, *Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components* 2005, reaffirmed 2020.

ANSI Z21.78/CSA 6.20, *Combination Gas Controls for Gas Appliances*, 2010, reaffirmed 2020.

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ANSI Z21.84, Manually Lighted, Natural Gas Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces, 2017 reaffirmed 2021. [SR No.8-NFPA54/Z223.1-2021]

ANSI Z21.87/CSA 4.6, Automatic Gas Shutoff Devices for Hot Water Supply Systems, 2007, ~~reaffirmed 2016~~ 2021. [SR No.8-NFPA54/Z223.1-2021]

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

CSA/ANSI Z21.91, Ventless Firebox Enclosures for Gas-Fired Unvented Decorative Gas Log-Type Room Heaters, 2020. [SR No.8-NFPA54/Z223.1-2021]

CSA/ANSI Z83.21/CSA C 22.2 No.168, Commercial Dishwashers, 2020. [SR No.8-NFPA54/Z223.1-2021]

K.2.3 MSS Publications. Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, VA, 22180-4602, 703.281.6613, www.msshq.org.

MSS SP-6, *Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings*, 2017 2021. [SR No.9-NFPA54/Z223.1-2021]

{K.2.4 through K.3 unchanged}

SECOND REVISIONS COMMENTS

[SR No. 1-NFPA 54/Z223.1-2021]: Reference standards are being updated.

[SR No. 2-NFPA 54/Z223.1-2021]: Extracts are being updated to match the extract document.

[SR No. 3-NFPA 54/Z223.1-2021]: Extracts are being updated to match the extract document.

[SR No. 5-NFPA 54/Z223.1-2021]: There is no definition of manufactured home in NFPA 501 and as such the extract is being removed.

[SR No. 6-NFPA 54/Z223.1-2021]: Extracts are being updated to the latest edition year and revised to reflect those extracts no longer being extracted.

[SR No. 7-NFPA 54/Z223.1-2021]: UL Standards are being updated to their latest revision years.

[SR No. 8-NFPA 54/Z223.1-2021]: CSA standards are being updated to the latest revision year.

[SR No. 9-NFPA 54/Z223.1-2021]: Reference standards are being updated to the latest edition year.

[SR No. 10-NFPA 54/Z223.1-2021]: This paragraph requires that listed components using aluminum flanges to be constructed to have flat face flange connections according a standard that applies to copper. Many listed components today use aluminum flanges, and they are made with either B16.1 (flat face) or ASME B16.5 (raised face) flanges. Additionally, the paragraph is in conflict with UL 429 for safety shutoff valves. UL 429 allows for aluminum flange connections to be ASME B16.1 (flat face) or ASME B16.5 (raised face), and this reflects also what the industry is doing today for listed components.

[SR No. 11-NFPA 54/Z223.1-2021]: Flanges need to be cleaned prior to inspection in order to have an accurate inspection and there was no requirement to clean the flange prior to inspection or replacement. Annex material is being added to add a guidance document on how to inspect flanges.

[SR No. 12-NFPA 54/Z223.1-2021]: A mobile home is a prefabricated structure, built in a factory on a permanently attached chassis. Mobile homes are permanently or semi-permanently in one place, but can be moved, and may be required to move from time to time for legal reasons. Manufactured homes are built entirely in the factory under a federal building code administered by (HUD). Manufactured homes may be single or multi-section and are transported to the site and installed on a permeant foundation and are not moveable.

[SR No. 13-NFPA 54/Z223.1-2021]: 5.8.3.1 (3) is revised to delete reference 5.8.2.1 which is applicable and does not need to be restated. 5.8.3.1 (4) is revised to delete reference to 5.8.2.1 as 5.8.2.1 does not need to be restated.

[SR No. 15-NFPA 54/Z223.1-2021]: Reduction of relief capacity is the concern when sizing fittings, pipe, and openings between the system and pressure relieving devices. ~~The term hammering is being removed as it is unclear what the term is referring to and if sized correctly hammering is not a concern.~~ **[NOTE: Z223 reversed the removal of the term “hammering” through a supplemental ballot to the Second Draft Ballot.]**

[SR No. 16-NFPA 54/Z223.1-2021]: Appliances need to be listed for outdoor installation as there are a number of considerations (wind, rain, etc.) that are necessary for safe outdoor installation and the listing standards take these into consideration.

[SR No. 17-NFPA 54/Z223.1-2021]: (1) The requirements is separated into 3 paragraphs, as they are separate Requirements. (2) The list of floor-mounted food service appliances is relocated to Annex A as lists are never complete, and belong in Annex A. (3) The requirement for clearance between a draft hood and combustible material is revised that the clearance be provided, rather than maintained. It is not the responsibility of the installer to maintain this distance into the future, rather to ensure that is exists at the time of installation.

[SR No. 18-NFPA 54/Z223.1-2021]: The requirement is separated into 4 separate paragraphs as there are 4

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different requirements

[SR No. 19-NFPA 54/Z223.1-2021]: The title of the Table A.5.3.2.1 is revised to reflect the contents of the Table. The term "domestic" is not needed in the table as it provides no further information.

[SR No. 20-NFPA 54/Z223.1-2021]: LNG Installation refers to everything inside the fence line of an LNG facility while systems covers the LNG process systems (liquefaction, regasification, etc.) and permits the use of NFPA 54 for design of systems typically designed under NFPA 54.

[SR No. 21-NFPA 54/Z223.1-2021]: Examples are being moved to the annex to clean up the definition.

[SR No. 22-NFPA 54/Z223.1-2021]: As the term being defined is inherently a residential appliance the revised definition remains clear.

[SR No. 23-NFPA 54/Z223.1-2021]: The purpose of the heated water is irrelevant to definition.

[SR No. 24-NFPA 54/Z223.1-2021]: The scope of piping in NFPA 54 covers the piping from the point of deliver to the appliance shutoff valve.

[SR No. 25-NFPA 54/Z223.1-2021]: The revisions provide a more complete set of circumstances that could impact the accuracy and usefulness of a draft test. The new considerations include the impacts of exhaust fan and air handler operations and the state of the building completion and configuration.

[SR No. 26-NFPA 54/Z223.1-2021]: The added text provides a method for converting ACH50, (which is commonly used in building tightness evaluations), to ACHNAT which is the parameter used in this code. This additional text provides a better understanding of combustion air deficiencies and the determination of combustion air volume requirements based on the tightness of the building.

[SR No. 27-NFPA 54/Z223.1-2021]: Domestic is deleted because: (1) Domestic is not defined. (2) Domestic was used in the ANSI Z21 standards, but this is being replaced by "household". (3) The requirement is the same with or without "domestic"

[SR No. 28-NFPA 54/Z223.1-2021]: The rewrite provides more accurate and comprehensive method for draft testing. The proposed method provides a means to consider more variables such as the impact of door closure, duct leakage, and testing sequence.

[SR No. 29-NFPA 54/Z223.1-2021]: Appliance regulators are part of appliances, which are outside the scope of NFPA 54. Reference to appliance regulator venting is deleted from the Code.

[SR No. 30-NFPA 54/Z223.1-2021]: Guidance is being added on when to seek outside help when evaluating structural integrity of the building when installing or replacing appliances.

[SR No. 33-NFPA 54/Z223.1-2021]: The title of 5.8 is being revised so that 5.8.3. is titled differently.

[SR No. 34-NFPA 54/Z223.1-2021]: This revision was developed by NFPA staff for editorial purposes, in accordance with 4.4.9.6.2 and 4.4.9.6.3 of the Regulations Governing the Development of NFPA Standards (www.nfpa.org/regs). Parenthetical text is considered supplemental information and the section is being revised so that it complies with the manual of style.