Tentative Interim Amendment

NFPA® 54

National Fuel Gas Code

2024 Edition

Reference: Various paragraphs throughout
TIA 24-1
(SC 23-8-51 / TIA Log #1726)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

See attached for text changes.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

1.1.1 Applicability.

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

(A)~~1.1.1.1.1*~~
Coverage of piping systems shall extend from the point of delivery to the appliance connections.

~~1.1.1.1.2~~
For other than undiluted liquefied petroleum gas (LP-Gas) systems, the point of delivery shall be the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where no meter is provided.

~~1.1.1.1.3~~
For undiluted LP-Gas systems, the point of delivery shall be considered to be the outlet of the final pressure regulator, exclusive of line gas regulators where no meter is installed.

~~1.1.1.1.4~~
Where a meter is installed, the point of delivery shall be the outlet of the meter.

(B)~~1.1.1.1.5~~
This code shall apply to natural gas systems operating at a pressure of 125 psi (862 kPa) or less.

(C)~~1.1.1.1.6~~
This code shall apply to LP-Gas systems operating at a pressure of 50 psi (345 kPa) or less.

(D)~~1.1.1.1.7~~
This code shall apply to gas–air mixture systems operating within the flammable range at a pressure of 10 psi (69 kPa) or less.

(E)~~1.1.1.1.8~~
Requirements for piping systems shall include design, materials, components, fabrication, assembly, installation, testing, inspection, purging, operation, and maintenance.

(F)~~1.1.1.1.9~~
Requirements for appliances, equipment, and related accessories shall include installation, combustion air, ventilation air, and venting.

4.2.1 Notification of Interrupted Service.

~~4.2.1.1~~
When the gas supply is to be turned off, it shall be the duty of the qualified agency to notify all affected users.

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

~~4.2.1.2~~
Where two or more users are served from the same supply system, precautions shall be exercised to ensure that service only to the proper user is turned off.

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

4.3.1 Potential Ignition Sources.
Where work is being performed on piping that contains or has contained gas, the following shall apply:

1. Provisions for electrical continuity shall be made before alterations are made in a metallic piping system.
2. Smoking, open flames, lanterns, welding, or other sources of ignition shall not be permitted.
3. A metallic electrical bond shall be installed around the location of cuts in metallic gas pipes made by other than cutting torches.
~~4.~~ Where cutting torches, welding, or other sources of ignition are to be used, it shall be determined that all sources of gas or gas–air mixtures have been secured and that all flammable gas or liquids have been cleared from the area.
~~5.~~ Piping shall be purged as required in Section 8.3 before welding or cutting with a torch is attempted.
~~6~~4.Artificial illumination shall be restricted to listed safety-type flashlights and safety lamps.
~~7.~~ Electric switches shall not be turned on or turned off.

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Commented [BM2]: Prod: This goes with list item (4)

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~~ shall comply with ~~both~~ the dimensional standards of ANSI/ASME B36.10M, *Welded and Seamless Wrought Steel Pipe,* and one of the following:

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1. ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless*
2. ASTM A106, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*
3. ASTM A312, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*

5.5.2.5 Aluminum Alloy.

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

~~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~~ shall be marked at each end of each length indicating compliance.

~~5.5.2.5.4~~

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

5.5.3.4* Copper and Copper Alloy.

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

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

5.5.6.4.3
Thread joint sealing materials shall be ~~both~~ nonhardening and shall be resistant to the chemical constituents of the gases to be conducted through the piping.

5.5.7.2 Copper Tubing Joints.

~~5.5.7.2.1~~
Copper tubing joints shall be ~~in accordance with any of the following:~~
~~1.~~ ~~Assembled~~ assembled with approved gas tubing fittings, shall be
~~2. Be~~ brazed with a material having a melting point in excess of 1000°F (538°C), or shall be
~~3. Be~~ assembled with press-connect fittings listed to ANSI LC 4/CSA 6.32, *Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems*.
~~5.5.7.2.2~~
Brazing alloys shall not contain more than 0.05 percent phosphorus.

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5.5.7.3 Stainless Steel Tubing Joints.

~~5.5.7.3.1~~
Stainless steel joints shall be ~~in accordance with any of the following:~~
~~1.~~ ~~Welded~~welded,
~~2.~~ ~~Assembled~~ assembled with approved tubing fittings,
~~3.~~ ~~Brazed~~ brazed with a material having a melting point in excess of 1000°F (538°C), or
~~4.~~ ~~Assembled~~ 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.

5.5.8 Plastic Piping Joints and Fittings.

~~5.5.8.1~~
Plastic pipe, tubing, and fittings shall be joined in accordance with the manufacturers' instructions.

~~5.5.8.2~~
The following shall be observed when making such joints ~~as stated in 5.5.8.1~~:

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.
~~3. Heat fusion~~ Joints shall be made with the joining method recommended by the pipe manufacturer.
~~4.~~ Polyethylene heat fusion fittings shall be marked "ASTM D2513."
~~5.~~ Polyamide heat fusion fittings shall be marked "ASTM F2945."
~~6.~~3. Where ~~The following shall apply when~~ compression-type mechanical joints are used~~.~~:
~~a.~~ ~~The~~ the gasket material in the fitting shall be compatible with the plastic piping and with the gas distributed by the system.
~~b.~~ An internal tubular rigid stiffener shall be used in conjunction with the fitting ~~compression-type mechanical joints~~.
~~c.~~ The stiffener shall be ~~both~~ flush with the end of the pipe or tubing and shall extend~~ed~~ at least to the outside end of the compression fitting when installed.
~~d.~~ The stiffener shall be free of rough or sharp edges~~.~~
~~e.~~ ~~The stiffener~~ and shall not be a force fit in the plastic.
~~f.~~ Split tubular stiffeners shall not be used.
~~7.~~4. Plastic piping joints and fittings for use in LP-Gas piping systems shall be in accordance with NFPA 58.

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Commented [BM4]: Prod: These go with list item (3)

5.5.9.3 Flange Facings.

~~5.5.9.3.1~~
Standard facings shall be permitted for use under this code.

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

5.5.10 Flange Gaskets.

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

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

5.5.10.1.~~2~~
Acceptable materials shall include the following:

1. Metal (plain or corrugated)
2. Composition
3. Aluminum "O" rings
4. Spiral-wound metal gaskets
5. Rubber-faced phenolic
6. Elastomeric

5.8.1 Where Required.

~~5.8.1.1~~
Where the serving gas supplier delivers gas at a pressure greater than 2 psi (14 kPa) for piping systems serving appliances designed to operate at a gas pressure of 14 in. w.c. (3.4 kPa) or less, overpressure protection devices shall be installed.

~~5.8.1.2~~
Piping systems serving equipment designed to operate at inlet pressures greater than 14 in. w.c. (3.4 kPa) shall be equipped with overpressure protection devices as required by the appliance manufacturer's installation instructions.

5.8.3.2
The devices in 5.8.3.1 shall be installed either as an integral part of the service or line pressure regulator or as separate units. ~~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.

5.8.8.1
The discharge stacks, vents, or outlet parts of all pressure ~~pressure~~ relieving and pressure ~~pressure~~ limiting devices shall be located so that gas is safely discharged to the outdoors.

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

5.8.8.2~~3~~
The discharge stack or vent line shall be at least the same size as the outlet of the pressure ~~pressure~~ relieving device.

5.11 Shutoff Valves.

~~5.11.1~~
Shutoff valves shall be selected in accordance with Table 5.11~~.1~~.

~~Table 5.11.1 Manual Gas Valve Standards~~

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

Shutoff Valve Application	Valve Meeting the Following Standards
Valve up to 5 psi	ANSI/ASME B16.44 labeled 5G
	ANSI/ASME B16.33
	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.44 marked 5G
	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G
Valve up to 125 psi	ANSI/ASME B16.33 marked 125 G
	ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G

For SI units, 1 psi gauge = 6.895 kPa.

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

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

Table 5.11. Manual Gas Valve Standards

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

For SI units, 1 psi gauge = 6.895 kPa.

5.12 Excess Flow Valve(s).

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

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

5.14 Pressure Regulator and Pressure Control Venting.

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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.
2. Independent vents for multiple regulators shall 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 ~~vent~~ limiting device shall not be required to be vented to the outdoors.
5. A listed gas pressure limit control that is factory equipped with a vent ~~vent~~ limiting device and in accordance with UL 353, *Limit Controls*, or UL 60730-2-6, *Automatic Electrical Controls for Household and Similar Use, Part 2*, shall not be required to be vented to the outdoors.
6. Materials for vent piping shall be in accordance with Section 5.5.
7. The vent terminus shall be designed to prevent the entry of water, insects, and other foreign matter that could cause blockage.
8. Vent piping shall be installed to minimize static loads and bending moments placed on the regulators and gas pressure control devices.
9. Vents shall terminate not less than 3 ft (0.9 m) from a possible source of ignition.
10. At locations where a vent termination could be submerged during floods or snow accumulations, one of the following shall apply:
    a. An antiflood-type breather vent fitting shall be installed.
    b. The vent terminal shall be located above the height of the expected flood waters or snow.
11. Vent piping from pressure regulators and gas pressure controls shall not be connected to a common manifold that serves a bleed line from a diaphragm-type gas valve.

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

7.1.3.3
Cathodic protection systems shall be monitored by testing~~.~~

~~7.1.4.4~~
~~Testing results for cathodic protection systems~~ and the results shall be documented.

~~7.1.3.5~~
The test results shall demonstrate one of the following:

1. A pipe-to-soil voltage of −0.85 volts or more negative is produced, with reference to a saturated copper-copper sulfate half cell
2. A pipe-to-soil voltage of −0.78 volts or more negative is produced, with reference to a saturated KCl calomel half cell
3. A pipe-to-soil voltage of −0.80 volts or more negative is produced, with reference to a silver-silver chloride half cell
4. Compliance with a method described in Appendix D of Title 49 of the Code of Federal Regulations, Part 192

7.1.3.~~4~~6
Sacrificial anodes shall be tested in accordance with the following:

1. Upon installation of the cathodic protection system, except where prohibited by climatic conditions, in which case the testing shall be performed not later than 180 days after the installation of the system
2. 12 to 18 months after the initial test
3. Upon successful verification testing in accordance with (1) and (2), periodic follow-up testing shall be performed at intervals not to exceed 36 months

7.1.3.~~7~~ 5
Systems failing a test shall be repaired not more than 180 days after the date of the failed testing.

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

~~7.1.3.9~~
~~The~~ the results ~~of the testing in 7.1.3.8~~ shall comply with 7.1.3.3~~5~~.

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7.1.6.1 Conduit with One End Terminating Outdoors.

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

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

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

~~7.1.6.1.4~~
The conduit shall ~~comply with all of the following~~:

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

7.1.6.2 Conduit with Both Ends Terminating Indoors.

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

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

7.1.7.3.2
Where tracer wire is used, access shall~~, either of the following shall apply:~~
~~1) Access shall~~ be provided from aboveground~~.~~
~~2) One~~ or one end of the tracer wire or tape shall be ~~shall be~~ brought aboveground at a building wall or riser.

7.2.2* Protective Coating.

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

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

7.2.6.1
Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers, or building structural components suitable for the size of piping, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration.

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

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

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

7.2.6.2~~5~~
Spacings of supports in gas piping installations shall not be greater than shown in Table 7.2.6.2.

~~7.2.6.6~~
Spacing of supports of CSST shall be in accordance with the CSST manufacturer's instructions.

7.2.6.3~~7~~
Supports, hangers, and anchors shall be installed so as not to interfere with the free expansion and contraction of the piping between anchors.

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

7.3.4 Tubing in Partitions.

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

~~7.3.4.2~~
Tubing installed vertically and horizontally inside hollow walls or partitions without protection along its entire concealed length shall meet the following requirements:

1) A steel striker barrier not less than 0.0508 in. (1.3 mm) thick, or equivalent, is ~~shall be~~ installed between the tubing and the finished wall and extend at least 4 in. (100 mm) beyond concealed penetrations of plates, firestops, wall studs, and so on.
2) The tubing is ~~shall be~~ installed in single runs.
~~3) The tubing shall~~ and is not ~~be~~ rigidly secured.

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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 ~~both~~ laid in channels in the floor and covered to permit access to the piping with a minimum of damage to the building.

~~7.3.5.2~~
Where piping in floor channels could be exposed to excessive moisture or corrosive substances, the piping shall be protected in an approved manner.

7.3.5.2~~6 Piping in Floors in~~ Other ~~Than Industrial~~ Occupancies.
Gas piping in nonindustrial occupancies shall not be embedded in concrete floor slabs unless in accordance with 7.3.6.1 through 7.3.6.5.

7.4.1 Pressure Reduction.
~~7.4.1.1~~
Where pressure reduction is required in branch connections for compliance with 5.4.1, such reduction shall take place either inside the chase or immediately adjacent to the outside wall of the chase.

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

~~7.4.1.3~~
The regulator shall be accessible for service and repair and vented in accordance with one of the following:

1) Where the fuel gas is lighter than air, ~~either of the following shall apply:~~
   ~~a.~~ ~~Regulators~~ regulators equipped with a vent limiting means shall be permitted to be vented into the chase.
   ~~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.

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2) Where the fuel gas is heavier than air, the regulator vent shall be vented only directly to the outdoors.

7.4.3* Ventilation.

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

~~7.4.3.2~~
The ~~ventilation~~ opening(s) shall have a minimum free area [in square inches (square meters)] equal to the product of one-half of the maximum pressure in the piping [in pounds per square inch (kilopascals)] times the largest nominal diameter of that piping [in inches (millimeters)], or the cross-sectional area of the chase, whichever is smaller.

~~7.4.3.3~~
Where more than one fuel gas piping system is present, the free area for each system shall be calculated and the largest area used.

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

1) The pipe shall not be damaged~~.~~ and the
~~2) The~~ internal diameter of the pipe shall not be effectively reduced.
~~3)~~ 2) Joints shall not be located in pipe bends.
~~4)~~ 3) The radius of the inner curve of such bends shall not be less than 25 times the inside diameter of the pipe.
~~5)~~ 4) Where the piping manufacturer specifies the use of special bending tools or procedures, such tools or procedures shall be used.

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7.6.1 Provide Drips Where Necessary.

~~7.6.1.1~~
For other than dry gas conditions, a drip shall be provided at any point in the line of pipe where condensate could collect.
~~7.6.1.2~~
Where required by the authority having jurisdiction or the serving gas supplier, a drip shall also be provided at the outlet of the meter.

~~7.6.1.3~~
~~A~~ This drip shall be installed so as to constitute a trap wherein an accumulation of condensate shuts off the flow of gas before it runs back into the meter.

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

~~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 freeze.

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.

~~7.7.1.7~~
~~Quick-disconnect devices of the flush-mounted type or listed gas convenience outlets.~~ Such devices shall be installed in accordance with the manufacturers' installation instructions.

7.8.2 Valves at Regulators.

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

~~7.8.2.2~~
Where two gas pressure regulators are installed in series in a single gas line, a manual valve shall not be required at the second regulator.

7.8.3 Valves Controlling Multiple Systems.

7.8.3.1 Shutoff Valves for Multiple House Lines.

~~7.8.3.1.1~~
In multiple-tenant buildings supplied through a master meter, through one service regulator where a meter is not provided, or where meters or service regulators are not readily accessible from the appliance or equipment location, an individual shutoff valve for each apartment or tenant line shall be provided at a convenient point of general accessibility.

~~7.8.3.1.2~~
In a common system serving a number of individual buildings, shutoff valves shall be installed at each building.

7.8.3.2 Emergency Shutoff Valves.

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

~~7.8.3.2.2~~
The emergency shutoff valves shall be plainly marked as such and their locations posted as required by the authority having jurisdiction.

7.8.3.3 Shutoff Valve for Laboratories.

~~7.8.3.3.1~~
Each laboratory space containing two or more gas outlets installed on tables, benches, or in hoods in educational, research, commercial, and industrial occupancies shall have a single shutoff valve through which all such gas outlets are supplied.

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

7.11.3 Additional Requirements.

~~7.11.3.1~~
Gas-mixing machines shall have nonsparking blowers~~.~~

~~7.11.3.2~~
~~Gas-mixing machines~~ and shall be constructed so that a flashback does not rupture machine casings.

7.11.4* Special Requirements for Mixing Blowers.

~~7.11.4.1~~
A mixing blower system shall be limited to applications with minimum practical lengths of mixture piping, limited to a maximum mixture pressure of 10 in. w.c. (2.5 kPa), and limited to gases containing no more than 10 percent hydrogen.

~~7.11.4.2~~
The blower shall be equipped with a gas control valve at its air entrance arranged so that gas is admitted to the airstream, entering the blower in proper proportions for correct combustion by the type of burners employed, ~~with~~ the said gas control valve being of either the zero governor or mechanical ratio valve type that controls the gas and air adjustment simultaneously.

~~7.11.4.3~~
No valves or other obstructions shall be installed between the blower discharge and the burner or burners.

7.11.5.1* Location.

~~7.11.5.1.1~~
The gas-mixing machine shall be located in a well-ventilated area or in a detached building or cutoff room provided with room construction and explosion vents in accordance with engineering methods.

~~7.11.5.1.2~~
~~Cut-off~~ Such rooms or below grade installations shall have adequate positive ventilation.

7.11.5.4* Controls.

~~7.11.5.4.1~~
Controls for gas-mixing machines shall include interlocks and a safety shutoff valve of the manual reset type in the gas supply connection to each machine arranged to automatically shut off the gas supply in the event of high or low gas pressure.

~~7.11.5.4.2~~
Except for open burner installations only, the controls shall be interlocked so that the blower or compressor stops operating following a gas supply failure.

~~7.11.5.4.3~~
Where a system employs pressurized air, means shall be provided to shut off the gas supply in the event of air failure.

7.11.6 Use of Automatic Firechecks, Safety Blowouts, or Backfire Preventers.

~~7.11.6.1~~
Automatic firechecks and safety blowouts or backfire preventers shall be provided in piping systems distributing flammable air–gas mixtures from gas-mixing machines to protect the piping and the machines in the event of flashback~~.~~

~~7.11.6.2~~
~~The automatic firechecks and safety blowouts or backfire preventors provided in 7.11.6.1 shall be~~ in accordance with the following:

1)*Approved automatic firechecks shall be installed upstream as close as practical to the burner inlets following the firecheck manufacturers' instructions.
2) A separate manually operated gas valve shall be provided at each automatic firecheck for shutting off the flow of the gas–air mixture through the firecheck after a flashback has occurred.
~~3)~~ The valve ~~required in 7.11.6.2(2)~~ shall be located upstream as close as practical to the inlet of the automatic firecheck. Caution: ~~These~~ these valves shall not be reopened after a flashback has occurred until the firecheck has cooled sufficiently to prevent re-ignition of the flammable mixture and has been reset properly.
~~4)~~3) A safety blowout or backfiring preventer shall be provided in the mixture line near the outlet of each gas-mixing machine where the size of the piping is larger than 2½ in. (64 mm) NPS, or equivalent, to protect the mixing equipment in the event of an explosion passing through an automatic firecheck.
~~5)~~ The manufacturers' instructions shall be followed when installing these ~~safety blowout or backfiring preventers~~ devices, particularly after a disc has burst.
~~6)~~ The discharge from the safety blowout or backfire preventer shall be located or shielded so that particles from the ruptured disc cannot be directed toward personnel.
~~7)~~ Wherever there are interconnected installations of gas-mixing machines with safety blowouts or backfire preventers, provision shall be made to keep the mixture from other machines from reaching any ruptured disc opening.
~~8)~~ Check valves shall not be used for this purpose ~~as a safety blowout or backfire preventer~~.
~~9)~~ 4) Large-capacity premix systems provided with explosion heads (rupture discs) to relieve excessive pressure in pipelines shall be located at~~,~~ and vented to~~,~~ a safe outdoor location.
~~10)~~ Provisions shall be provided for automatically shutting off the supply of the gas–air mixture in the event of rupture.

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7.12.2.3*
The length of the jumper between the connection to the gas piping system and the grounding electrode system shall not exceed 75 ft (22 m).

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

8.1.2 Test Medium.

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

~~8.1.2.2~~
Oxygen shall not be used as a test medium.

8.1.3.3
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.

~~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.

8.1.4 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.

~~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.

8.1.4.24
The test pressure to be used shall be no less than 1½ times the proposed maximum working pressure, but not less than 3 psi (20 kPa).

~~8.1.4.5~~
Where the test pressure exceeds 125 psi (862 kPa), the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength of the pipe.

8.1.4.3~~6~~*
Test duration shall be not less than ½ hour for each 500 ft^3 (14 m^3) of pipe volume or fraction thereof.

~~8.1.4.7~~
When testing a system having a volume less than 10 ft^3 (0.28 m^3) or a system in a single-family dwelling, the test duration shall be a minimum of 10 minutes.

~~8.1.4.8~~
The duration of the test shall not be required to exceed 24 hours.

8.1.5.1
The piping system shall withstand the test pressure specified without showing any evidence of leakage or other defects.

~~8.1.5.2~~
Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate the presence of a leak unless such reduction can be readily attributed to some other cause.

8.2.3* 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.

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

8.3.1.2* Placing in Operation.

~~8.3.1.2.1~~
Where gas piping containing air and meeting the criteria of Table 8.3.1 is placed in operation, the air in the piping shall first be displaced with an inert gas.

~~8.3.1.2.2~~
The inert gas shall then be displaced with fuel gas in accordance with 8.3.1.3.

8.3.1.3 Outdoor Discharge of Purged Gases.

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

~~8.3.1.3.2~~
Purging operations shall comply with all of the following requirements:

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

8.3.1.4* Combustible Gas Indicator.

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

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

8.3.2.2 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.

9.1.1.3
The unlisted appliance, equipment, or accessory shall be safe~~.~~

~~9.1.1.4~~
~~The unlisted appliance, equipment, or accessory~~ and shall be recommended for the service by the manufacturer.

9.1.3 Type of Gas(es).

~~9.1.3.1~~
The appliance shall be connected to the fuel gas for which it was designed.

~~9.1.3.2~~
No attempt shall be made to convert the appliance from the gas specified on the rating plate for use with a different gas without consulting the installation instructions, the serving gas supplier, or the appliance manufacturer for complete instructions.

~~9.1.3.3~~
Listed appliances shall not be converted unless permitted by, and in accordance with, the manufacturer's installation instructions.

9.1.5 Use of Air or Oxygen Under Pressure.

~~9.1.5.1~~
Where air or oxygen under pressure is used in connection with the gas supply, effective means such as a back pressure regulator and relief valve shall be provided to prevent air or oxygen from passing back into the gas piping.

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

9.1.8.2
At the locations selected for installation of appliances and equipment, the dynamic and static load carrying capacities of the building structure shall be checked to determine whether they are adequate to carry the additional loads.

~~9.1.8.3~~
The appliances and equipment shall be ~~both~~ supported and shall be connected to the piping so as not to exert undue stress on the connections.

9.1.9 Flammable Vapors.

~~9.1.9.1~~

Appliances shall not be installed in areas where the open use, handling, or dispensing of flammable liquids occurs, unless the design, operation, or installation reduces the potential of ignition of the flammable vapors.

~~9.1.9.2~~
Appliances installed in compliance with 9.1.10 through 9.1.12 shall be considered to comply with the intent of this provision.

9.1.18 Bleed Lines for Diaphragm-Type Valves.
Bleed lines shall comply with the following requirements:

1. Diaphragm-type valves shall be equipped to convey bleed gas to the outdoors or into the combustion chamber adjacent to a continuous pilot.
2. In the case of bleed lines leading outdoors, means shall be employed to prevent water from entering this piping and also to prevent blockage of vents by insects and foreign matter.
3. Bleed lines shall not terminate in the appliance flue or exhaust system.
4. In the case of bleed lines entering the combustion chamber, the bleed line shall be located so the bleed gas is readily ignited by the pilot and the heat liberated thereby does not adversely affect the normal operation of the safety shutoff system.
~~5.~~ The terminus of the bleed line ~~entering the combustion chamber~~ shall be 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.
~~7~~5. A bleed line(s) from a diaphragm-type valve and a vent line(s) from an appliance pressure regulator shall not be connected to a common manifold terminating in a combustion chamber. Bleed lines shall not terminate in positive-pressure-type combustion chambers.

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9.1.20* Installation Instructions.

~~9.1.20.1~~
The installer shall conform to the appliance and equipment manufacturers' recommendations in completing an installation.

~~9.1.20.2~~
The installer shall leave the manufacturers' installation, operating, and maintenance instructions on the premises.

9.1.22* Existing Appliances.

~~9.1.22.1~~
Existing appliance installations shall be inspected to verify compliance with the provisions of Section 9.3 and Chapter 12 where a component of the building envelope is modified as described by one or more of 9.1.22(1) through 9.1.22(6). ~~Where the appliance installation does not comply with Section 9.3 and Chapter 12, the installation shall be altered as necessary to be in compliance with Section 9.3 and Chapter 12.~~
~~the following~~:

~~1. The building is modified under a weatherization program.~~
~~2.~~1. ~~A building permit is issued for a building addition or exterior building modification.~~
~~3.~~1. ~~Three or more window assemblies are replaced.~~
~~4.~~1. ~~Three or more storm windows are installed over existing windows.~~

~~5.1. One or more exterior door and frame assemblies are replaced.~~
~~6.1. A building air barrier is installed or replaced.~~

~~9.1.22.2~~
Where the appliance installation does not comply with Section 9.3 and Chapter 12, the installation shall be altered as necessary to be in compliance with Section 9.3 and Chapter 12.

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

9.3.2 Indoor Combustion Air.

~~9.3.2.1 Required Indoor Air Volume.~~
The required volume of indoor air shall be determined in accordance with the method in 9.3.2.1 or 9.3.2.2 ~~*(see 9.3.2.1.1)*~~.

~~9.3.2.1.1~~
~~W~~ except that where the air infiltration rate is known to be less than 0.40 ACH (air change per hour), the method in 9.3.2.2 shall be used.

~~9.3.2.1.1~~2
The total required volume shall be the sum of the required volume calculated for all appliances located within the space.

~~9.3.2.1.2~~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, are ~~shall be~~ considered a part of the required volume.

9.3.2.~~4~~3 Indoor Opening Size and Location.
Openings used to connect indoor spaces shall be sized and located in accordance with the following:

1. *~~*~~*Combining spaces on the same story*. ~~shall be in accordance with the following:~~
   ~~a.~~ Each opening shall have a minimum free area of 1 in.^{2}/1000 Btu/hr (2200 mm^2/kW) of the total input rating of all appliances in the space but not less than 100 in.^{2} (0.06 m^2).
   ~~b.~~ One permanent opening shall commence within 12 in. (300 mm) of the top of the enclosure~~.~~
   ~~c. O~~and one permanent opening shall commence within 12 in. (300 mm) of the bottom of the enclosure.
   ~~d.~~ The minimum dimension of air openings shall not be less than 3 in. (80 mm).
2. ~~Where c~~*Combining spaces in different stories*. ~~t~~The volumes of spaces in different stories shall be considered as communicating spaces where such spaces are connected by one or more permanent openings in doors or floors having a total minimum free area of 2 in.^{2}/1000 Btu/hr (4400 mm^2/kW) of total input rating of all appliances.

9.3.3.1 Two Permanent Openings Method.

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~~9.3.3.1.1~~
Two permanent openings, one commencing within 12 in. (300 mm) of the top of the enclosure and one commencing within 12 in. (300 mm) of the bottom of the enclosure, shall be provided.

~~9.3.3.1.2~~
The openings shall communicate directly, or by ducts, with the outdoors or spaces that freely communicate with the outdoors, as follows:

1. *Where directly communicating with the outdoors or where communicating to the outdoors through vertical ducts, each opening shall have a minimum free area of 1 $in.^2$/4000 Btu/hr (550 mm^2/kW) of total input rating of all appliances in the enclosure.
2. *Where communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 $in.^2$/2000 Btu/hr (1100 mm^2/kW) of total input rating of all appliances in the enclosure.

9.3.3.2* One Permanent Opening Method.

~~9.3.3.2.1~~
One permanent opening, commencing within 12 in. (300 mm) of the top of the enclosure, shall be provided.

~~9.3.3.2.2~~
The appliance shall have clearances of at least 1 in. (25 mm) from the sides and back and 6 in. (150 mm) from the front of the appliance.

~~9.3.3.2.3~~
The opening shall ~~either~~ directly communicate with the outdoors or communicate through a vertical or horizontal duct to the outdoors or spaces that freely communicate with the outdoors~~.~~

~~9.3.3.2.4~~
~~The openings in 9.3.3.2.3~~ and shall have a minimum free area of the following:

1. 1 $in.^2$/3000 Btu/hr (700 mm^2/kW) of the total input rating of all appliances located in the enclosure
2. Not less than the sum of the areas of all vent connectors in the space

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

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

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9.3.7.1 Louvers and Grilles.

~~9.3.7.1.1~~
The required size of openings for combustion, ventilation, and dilution air shall be based on the net free area of each opening.

~~9.3.7.1.2~~
Where the free area through a design of louver, grille, or screen is known, it shall be used in calculating the size opening required to provide the free area specified.

~~9.3.7.1.3~~
Where the louver and grille design and free area are not known, it shall be assumed that wood louvers have 25 percent free area, and metal louvers and grilles have 75 percent free area.

~~9.3.7.1.4~~
Nonmotorized louvers and grilles shall be fixed in the open position.

9.3.7.3 Motorized Louvers.

~~9.3.7.3.1~~
Motorized louvers shall be interlocked with the appliance so they are proven in the full open position prior to main burner ignition and during main burner operation.

~~9.3.7.3.2~~
Means shall be provided to prevent the main burner from igniting should the louver fail to open during burner startup and to shut down the main burner if the louvers close during burner operation.

9.3.8.4
Ducts shall not serve both upper and lower combustion air openings where both such openings are used.

~~9.3.8.5~~
The separation between ducts serving upper and lower combustion air openings shall be maintained to the source of combustion air.

9.4.1 General.

9.4.1.1
Appliances on roofs shall be designed or enclosed so as to withstand climatic conditions in the area in which they are installed.

~~9.4.1.2~~
Where enclosures are provided, each enclosure shall ~~be in accordance with the following:~~

~~1.~~ ~~P~~permit easy entry and movement.

~~2. Be~~ shall be of reasonable height.

~~3. Have~~ and shall have at least a 30 in. (760 mm) clearance between the entire service access panel(s) of the appliance and the wall of the enclosure.

9.4.1.2~~3~~
Roofs on which appliances are to be installed shall be ~~either~~ capable of supporting the additional load or shall be reinforced to support the additional load.

9.4.1.34
All access locks, screws, and bolts shall be of corrosion-resistant material.

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. ~~*(see 9.4.2.4)*~~.

~~9.4.2.4~~
~~If least 6 ft (1.8 m) of clearance is not possible between any part of the appliance and the edge of a roof or similar hazard,~~ or rigidly fixed rails, guards, parapets, or other building structures at least 42 in. (1.1 m) in height shall be provided on the exposed side.

9.4.2.3~~5~~
Appliances requiring an external source of electrical power shall be installed in accordance with *NFPA 70*.

9.4.2.4~~6~~
Where water stands on the roof at the appliance or in the passageways to the appliance, or where the roof is of a design having a water seal, a suitable platform, walkway, or both shall be provided above the water line.

~~9.4.2.7~~
Such platform(s) or walkway(s) ~~as stated in 9.4.2.6~~ shall be located adjacent to the appliance and control panels so that the appliance can be safely serviced where water stands on the roof.

9.4.3.3
The inside means of access shall be a permanent or foldaway inside stairway or ladder, terminating in an enclosure, scuttle, or trapdoor.

~~9.4.3.4~~
Scuttles or trapdoors shall be at least 22 in. × 24 in. (560 mm × 610 mm) in size~~.~~.

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

~~9.4.3.6~~
~~Scuttles or trapdoors~~ and shall be constructed so as to permit access from the roof side unless deliberately locked on the inside.

~~9.4.3.7~~
At least 6 ft (1.8 m) of clearance shall be available between the access opening and the edge of the roof or similar hazard ~~*(see 9.4.3.8)*~~.

~~9.4.3.8~~
~~If at least 6 ft (1.8 m) of clearance is not possible between the access opening and the edge of the roof or similar hazard,~~ or rigidly fixed rails or guards a minimum of 42 in. (1.1 m) in height shall be provided on the exposed side.

~~9.4.3.9~~
Where parapets or other building structures are utilized in lieu of guards or rails, they shall be a minimum of 42 in. (1.1 m) in height.

9.5.1.2
The passageway shall be unobstructed~~.~~

~~9.5.1.3~~
~~The passageway~~ and shall have solid flooring not less than 24 in. (610 mm) wide from the entrance opening to the appliance~~.~~

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9.5.3 Lighting and Convenience Outlet.

~~9.5.3.1~~
A permanent 120 V receptacle outlet and a luminaire shall be installed near the appliance.

~~9.5.3.2~~
The switch controlling the luminaire shall be located at the entrance to the passageway.

9.6.1.1 Protection of Connectors.

~~9.6.1.1.1~~
Connectors and tubing addressed in 9.6.1(2), 9.6.1(3), 9.6.1(4), 9.6.1(5), and 9.6.1(6) shall be installed to be protected against physical and thermal damage.

~~9.6.1.1.2~~
Aluminum alloy tubing and connectors shall be coated to protect against external corrosion where they are in contact with masonry, plaster, or insulation or are subject to repeated wettings by such liquids as detergents, sewage, or water other than rainwater.

9.6.4.4
Where flexible connections are used, they shall be of the minimum practical length~~.~~

~~9.6.4.5~~
~~Flexible connections~~ and 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~~
~~Flexible connections~~ They shall be protected against physical or thermal damage~~.~~

~~9.6.4.8~~
~~Flexible connections~~ and shall be provided with gas shutoff valves in readily accessible locations in rigid piping upstream from the flexible connections.

9.6.5 Appliance Shutoff Valves and Connections.

~~9.6.5.1~~

Each appliance connected to a piping system shall have an accessible, approved manual shutoff valve with a nondisplaceable valve member, or a listed gas convenience outlet.

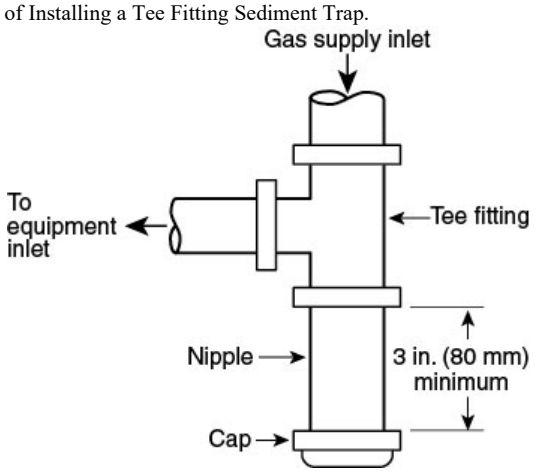
~~9.6.5.2~~
Appliance shutoff valves and convenience outlets shall serve a single appliance only~~.~~

~~9.6.5.3~~
~~Appliance shutoff valves and convenience outlets~~ and shall be installed in accordance with 9.6.5.1.

9.6.8 Sediment Trap.
~~9.6.8.1~~
Where a sediment trap is not incorporated as a part of the appliance, a sediment trap shall be installed downstream of the appliance shutoff valve as close to the inlet of the appliance as practical at the time of appliance installation.

~~9.6.8.2~~
The sediment trap shall be either a tee fitting with a capped nipple in the bottom outlet, as illustrated in Figure 9.6.8~~.2~~, or another device recognized as an effective sediment trap.

Figure 9.6.8~~.2~~ Method of Installing a Tee Fitting Sediment Trap.



~~9.6.8.3~~
Illuminating appliances, gas ranges, clothes dryers, decorative appliances for installation in vented fireplaces, gas fireplaces, and outdoor cooking appliances shall not be required to be so equipped ~~with a sediment trap~~.

10.1.1* Application.

~~10.1.1.1~~
Appliances shall be installed in accordance with the manufacturers' installation instructions and, as elsewhere specified in this chapter, as applicable to the appliance.

~~10.1.1.2~~

Unlisted appliances shall be installed as specified in this chapter as applicable to the appliances.

10.3.2 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 ~~direct~~ vent type.

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10.3.3.7

~~10.3.3.7.1~~
Supply air ducts connecting to listed central heating furnaces shall have the same minimum clearance to combustibles as required for the furnace supply plenum for a distance of not less than 3 ft (0.9 m) from the supply plenum.

~~10.3.3.7.2~~
Clearance shall not be required beyond the 3 ft (0.9 m) distance.

10.3.3.8

~~10.3.3.8.1~~
Supply air ducts connecting to unlisted central heating furnaces equipped with temperature limit controls with a maximum setting of 250°F (121°C) shall have a minimum clearance to combustibles of 6 in. (150 mm) for a distance of not less than 6 ft (1.8 m) from the furnace supply plenum.

~~10.3.3.8.2~~
Clearance shall not be required beyond the 6 ft (1.8 m) distance.

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.

10.3.6 Low-Water Cutoff.

~~10.3.6.1~~
All water boilers and steam boilers shall be provided with an automatic means to shut off the fuel supply to the burner(s) if the boiler water level drops below the lowest safe water line.

~~10.3.6.2~~

In lieu of the low-water cutoff, water tube or coil-type boilers that require forced circulation to prevent overheating and failure shall have an approved flow ~~flow-~~sensing device arranged to shut down the boiler when the flow rate is inadequate to protect the boiler against overheating.

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 valves of appropriate discharge capacity 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.

10.3.8.3*
Where a furnace plenum is not supplied with the furnace, any fabrication and installation instructions provided by the manufacturer shall be followed.

~~10.3.8.4~~
The method of connecting supply and return ducts shall facilitate proper circulation of air.

10.3.8.4~~5~~
Where a furnace is installed so supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.

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

10.4.2 Clearance.

~~10.4.2.1~~
The installation of ~~Type 1~~ clothes dryers shall comply with the following requirements:

1. ~~C~~Type 1 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.~~ ~~C~~Type 1 clothes dryers installed in closets shall be specifically listed for such installation.

Commented [BM16]: Prod: Goes with list item (1)

~~10.4.2.2~~
~~The installation of Type 2 clothes dryers shall comply with the following requirements:~~
~~1.~~2. ~~C~~ Type 2 Clothes dryers shall be installed with clearances of not less than those shown on the marking plate and in the manufacturer's instructions.
~~2.~~ ~~C~~ Type 2 Clothes dryers designed and marked “For use only in noncombustible locations” shall not be installed elsewhere.

Commented [BM17]: Prod: Goes with list item (2)

10.4.5.3
Exhaust ducts shall be constructed of rigid metallic material.

~~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.

10.4.6.2
Exhaust ducts for Type 2 clothes dryers shall be constructed of sheet metal or other noncombustible material.

~~10.4.6.3~~
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.

10.6.3 Installation.

~~10.6.3.1~~
A decorative appliance for installation in a vented fireplace shall be installed only in a vented fireplace having a working chimney flue and constructed of noncombustible materials.
~~10.6.3.2~~
These appliances ~~in 10.6.3.1~~ shall not be thermostatically controlled.

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

1. Vented gas fireplaces shall be installed in accordance with the manufacturer's installation instructions~~.~~ and where
~~2. Where~~ installed in or attached to combustible material~~, the vented gas fireplace~~ shall be specifically listed for such installation.
~~3.~~2. Panels, grilles, and access doors that are required to be removed for normal servicing operations shall not be attached to the building.
~~4. Direct~~ 3. Direct vent gas fireplaces shall be installed with the vent air intake terminal in the outdoors and in accordance with the manufacturer's instructions.

Commented [BM18]: Prod: Goes with list item (1)

10.8.5.2
Ventilation air to the recirculating direct gas-fired heating and forced ventilation appliance shall be ducted directly from outdoors.

~~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.

10.8.6 Atmospheric Vents or Gas Reliefs or Bleeds.

~~10.8.6.1~~
Direct gas-fired heating and forced ventilation appliances with valve train components equipped with atmospheric vents, gas reliefs, or bleeds shall have their vent lines, gas reliefs, or bleeds lead to a safe point outdoors.

~~10.8.6.2~~

Means shall be employed on these lines to prevent water from entering and to prevent blockage from insects and foreign matter.

~~10.8.6.3~~
An atmospheric vent line shall not be required to be provided on a valve train component equipped with a listed vent limiter.

10.8.7.2
Louver or counterbalanced gravity damper relief openings shall be permitted.

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

10.9.5 Location of Draft Hood and Controls.

~~10.9.5.1~~
The controls, combustion air inlet, and draft hoods for duct furnaces shall be located outside the ducts.

~~10.9.5.2~~
The draft hood shall be located in the same enclosure from which combustion air is taken.

10.9.6 Circulating Air.

~~10.9.6.1~~
Where a duct furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.

~~10.9.6.2~~
The duct furnace shall be installed on the positive-pressure side of the circulating air blower.

10.9.7.3*
Where a duct furnace is installed downstream of an evaporative cooler or air washer, the heat exchanger shall be constructed of corrosion-resistant materials.

~~10.9.7.4~~
Air washers operating with chilled water that deliver air below the dew point of the ambient air at the duct furnace shall be considered as refrigeration systems.

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

1. *Floors.* Floor furnaces shall not be installed in the floor of any doorway, stairway landing, aisle, or passageway of any enclosure, public or private, or in an exitway from any such room or space.
2. *Walls and Corners.* ~~Floor furnaces installed near walls and corners shall be in accordance with the following:~~
    ~~a.~~ 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.

~~b.~~ A distance of at least 18 in. (460 mm) from two adjoining sides of the floor furnace register to walls shall be provided to eliminate the necessity of occupants walking over the warm air discharge.
~~c.~~ The remaining sides shall be a minimum of 6 in. (150 mm) from a wall.
~~d.~~ Wall register models shall not be placed closer than 6 in. (150 mm) to a corner.

Commented [BM19]: Prod: Goes with list item (2)

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

10.10.8 Clearance.

~~10.10.8.1~~
The lowest portion of the floor furnace shall have at least a 6 in. (150 mm) clearance from the general ground level.

~~10.10.8.2~~
A reduced clearance to a minimum of 2 in. (50 mm) shall be permitted, provided the lower 6 in. (150 mm) portion of the floor furnace is sealed by the manufacturer to prevent entrance of water.

~~10.10.8.3~~
Where these clearances ~~in 10.10.8.1~~ are not present, the ground below and to the sides shall be excavated to form a "basin-like" pit under the furnace so that the required clearance is provided beneath the lowest portion of the furnace.

~~10.10.8.4~~
A 12 in. (300 mm) clearance shall be provided on all sides except the control side~~.~~.

~~10.10.8.5~~
~~The control side~~ which shall have an 18 in. (460 mm) clearance.

10.10.10 Seepage Pan.

~~10.10.10.1~~
Where the excavation exceeds 12 in. (300 mm) in depth or water seepage is likely to collect, a watertight copper pan, concrete pit, or other suitable material shall be used, unless adaquate 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.

~~10.10.10.3~~
The pan shall be anchored in place ~~so as~~ to prevent floating~~.~~.

~~10.10.10.4~~
~~The~~ and the walls ~~of the pan~~ shall extend at least 4 in. (100 mm) above the ground level with at least a 6 in. (150 mm) clearance on all sides, ~~and 18 in. (460 mm) on the control side.~~ except on the control side, which shall have at least an 18 in. (460 mm) clearance.

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 ~~the~~ such installations ~~in 10.10.12.1~~, the floor furnace shall be enclosed completely (~~i.e.,~~ entirely separated from the nonhabitable space) with means for air intake to meet the provisions of Section 9.3, with access for servicing, minimum furnace clearances of 6 in. (150 mm) to all sides and bottom, and with the enclosure constructed of Portland cement plaster or metal lath or other noncombustible material.

10.10.13 First Floor Installation.

~~10.10.13.1~~
Floor furnaces installed in the first or ground floors of buildings shall not be required to be enclosed~~.~~

~~10.10.13.2~~
~~Where the~~ unless the basements of these buildings have been converted to apartments or sleeping quarters, in which case the floor furnace shall be enclosed as specified ~~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.

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

~~1. It shall be installed in accordance with 10.11.4.~~
~~2.~~ 1. Where the appliance is set on legs that provide not less than 18 in. (460 mm) open space under the base of the appliance or where it has no burners and no portion of any oven or broiler within 18 in. (460 mm) of the floor, it shall be permitted to be installed on a combustible floor without special floor protection, provided at least one sheet metal baffle is between the burner and the floor.
~~3.~~ 2. Where the appliance is set on legs that provide not less than 8 in. (200 mm) open space under the base of the appliance, ~~the following shall apply:~~
   ~~a. It~~ it shall be permitted to be installed on combustible floors, provided the floor under the appliance is protected with not less than ⅜ in. (9.5 mm) insulating millboard covered with sheet metal not less than 0.0195 in. (0.5 mm) thick.
   ~~b.~~ The preceding specified floor protection shall extend not less than 6 in. (150 mm) beyond the appliance on all sides.
~~4.~~ 3.Where the appliance is set on legs that provide not less than 4 in. (100 mm) under the base of the appliance, ~~the following shall apply:~~
   ~~a.~~ ~~I~~it shall be permitted to be installed on combustible floors, provided the floor under the appliance is protected with hollow masonry not less than 4 in. (100 mm) in thickness covered with sheet metal not less than 0.0195 in. (0.5 mm) thick.
   ~~b.~~ Such masonry courses shall be laid with ends unsealed and joints matched in such a way as to provide for free circulation of air through the masonry.
~~5.~~4. Where the appliance does not have legs at least 4 in. (100 mm) high, it shall be permitted to be installed on combustible floors, provided the floor under the appliance is protected by two courses of 4 in. (100 mm) hollow clay tile, or equivalent, with courses laid at right angles and with ends unsealed and joints matched in such a way as to provide for free circulation of air through such masonry courses, and covered with steel plate not less than 3⁄16 in. (4.8 mm) in thickness.

Commented [BM20]: Prod: Goes with list item (2)

Commented [BM21]: Prod: Goes with list item (3)

10.13.3 Clearances.

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

~~10.13.3.2~~
~~Floor-mounted household cooking appliances.~~ and shall not interfere with combustion air, accessibility for operation, and servicing.

10.13.3.1~~2~~* Vertical Clearance Above Cooking Top.
Household cooking appliances shall have a vertical clearance above the cooking top of not less than 30 in. (760 mm) to combustible material or metal cabinets.

~~10.13.3.4~~
A minimum clearance of 24 in. (610 mm) shall be permitted when one of the following is installed:

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

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

1. Unlisted open-flame illuminating appliances installed outdoors shall have clearances ~~in accordance with the following:~~
   ~~a.~~ ~~F~~from combustible material not 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.
2. Unlisted open-flame illuminating appliances installed outdoors shall be equipped with a limiting orifice or other limiting devices that maintain a flame height consistent with the clearance from combustible material, as given in Table 10.14.2.2.
3. Appliances designed for flame heights in excess of 30 in. (760 mm) shall be approved.
~~4. Appliances with a flame heights in excess of 30 in. (760 mm)~~ Such appliances shall be equipped with a safety shutoff device or automatic ignition.
~~5.~~ 4. Clearances to combustible material from unlisted open-flame illuminating appliances shall be approved.

Commented [BM22]: Prod: Goes with list item (1)

Commented [BM23]: Prod: Goes with list item (3)

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.

~~10.14.4.2~~
Posts shall be rigidly installed.

~~10.14.4.3~~
The strength and rigidity of posts greater than 3 ft (0.9 m) in height shall be at least equivalent to that of a 2½ in. (64 mm) diameter post constructed of 0.064 in. (1.6 mm) thick steel or a 1 in. Schedule 40 steel pipe.

~~10.14.4.4~~
Posts 3 ft (0.9 m) or less in height shall not be smaller than a ¾ in. Schedule 40 steel pipe.

~~10.14.4.5~~
Drain openings shall be provided near the base of posts where water collecting inside the posts is possible.

10.16.2 Support.

~~10.16.2.1~~

Suspended-type infrared heaters shall be fixed in position independent of gas and electric supply lines.

~~10.16.2.2~~
Hangers and brackets shall be of noncombustible material.

~~10.16.2.3~~
Heaters subject to vibration shall be provided with vibration-isolating hangers.

10.16.5 Installation in Commercial Garages and Aircraft Hangars.

~~10.16.5.1~~
Overhead heaters installed in garages for more than three motor vehicles or in aircraft hangars shall be listed~~.~~

~~10.16.5.2~~
~~Overhead heaters installed in garages for more than three motor vehicles or in aircraft hangars~~ and shall be installed in accordance with 9.1.11 and 9.1.12.

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 such ~~manufacturers'~~ instructions are not available, ~~clearance shall be provided of~~ at least 2 in. (50 mm) shall be provided between the back of the refrigerator and the wall and at least 12 in. (300 mm) above the top.

10.24.2 Support.

~~10.24.2.1~~

Suspended-type unit heaters shall be safely and adequately supported, with due consideration given to their weight and vibration characteristics.

~~10.24.2.2~~
Hangers and brackets shall be of noncombustible material.

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

1. Unit heaters shall be installed with clearances from combustible material of not less than 18 in. (460 mm) at the sides, 12 in. (300 mm) at the bottom, and 6 in. (150 mm) above the top where the unit heater has an internal draft hood, or 1 in. (25 mm) above the top of the sloping side of a vertical draft hood.
~~2.~~ A unit heater listed for reduced clearances shall be installed in accordance with the manufacturer's installation instructions.
~~3.~~ 2. Clearances for servicing shall be in accordance with the manufacturers' installation instructions.

Commented [BM24]: Prod: Goes with list item (1)

10.25.2 Installation.

10.25.2.1
Wall furnaces shall be installed in accordance with the manufacturer's installation instructions.

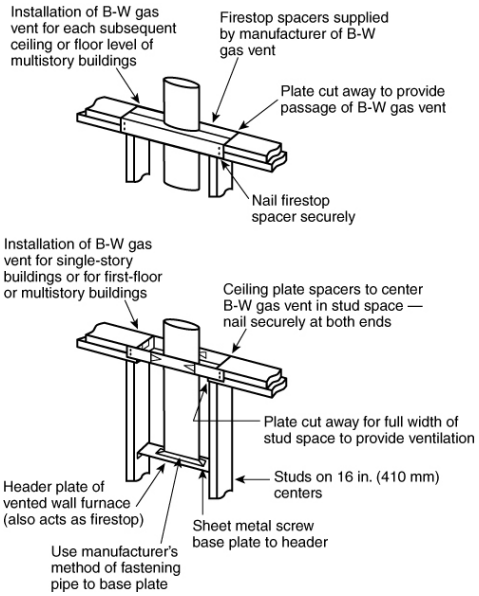
~~10.25.2.2~~
Wall furnaces installed in~~,~~ or attached to~~,~~ combustible material shall be listed for such installation.

10.25.2.2~~3~~
Vented wall furnaces connected to a Type B-W gas vent system listed only for a single story shall be installed only in single-story buildings or the top story of multistory buildings.

~~10.25.2.4~~
Vented wall furnaces connected to a Type B-W gas vent system listed for installation in multistory buildings shall be permitted to be installed in single-story or multistory buildings.

~~10.25.2.5~~
Type B-W gas vents shall be ~~both~~ attached directly to a solid header plate that serves as a firestop at that point and that shall be permitted to be an integral part of the vented wall furnace, as illustrated in Figure 10.25.2.2~~5~~.

Figure 10.25.2.2~~5~~ Installation of Type B-W Gas Vents for Vented Wall Furnaces.



~~10.25.2.6~~
The stud space in which the vented wall furnace is installed shall be ventilated at the first ceiling level by installation of the ceiling plate spacers furnished with the gas vent.

~~10.25.2.7~~
Firestop spacers shall be installed at each subsequent ceiling or floor level penetrated by the vent.

10.25.2.3~~8~~
~~Direct~~ Direct vent wall furnaces shall be installed with the combustion air intake terminal outdoors.

10.25.2.4~~9~~
Panels, grilles, and access doors that are required to be removed for normal servicing operations shall not be attached to the building. *(For additional information on the venting of wall furnaces, see Chapter 12.)*

10.25.3 Location.

~~10.25.3.1~~
Wall furnaces shall be located so as not to cause a hazard to walls, floors, curtains, furniture, or doors.

~~10.25.3.2~~
Wall furnaces installed between bathrooms and adjoining rooms shall not circulate air from bathrooms to other parts of the building.

10.26.1 Application.

~~10.26.1.1~~

Water heaters shall be listed in accordance with ANSI Z21.10.1/CSA 4.1, *Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less*, or ANSI Z21.10.3/CSA 4.3, *Gas Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating or Instantaneous*.

~~10.26.1.2~~
~~Water heaters~~ and shall be installed in accordance with the manufacturer's installation instructions.

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

1. Water heater shall be installed in a closet ~~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. Water heater shall be of the direct vent type.

Commented [BM25]: Prod: Goes with list item (1)

10.26.3 Clearance.

~~10.26.3.1~~
The clearances shall not be such as to interfere with combustion air, draft hood clearance and relief, and accessibility for servicing.

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

10.26.4 Pressure 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 ~~*(see 10.26.4.3).*~~

~~10.26.4.3~~
~~The pressure setting of the device~~ and shall not exceed the maximum pressure rating of the water heater.

10.26.6 Temperature, Pressure, and Vacuum Relief Devices.

~~10.26.6.1~~
Temperature, pressure, and vacuum relief devices, or combinations thereof, and automatic gas shutoff devices shall be installed in accordance with the manufacturer's installation instructions.

~~10.26.6.2~~
A shutoff valve shall not be placed between the relief valve and the water heater or on discharge pipes between such valves and the atmosphere.

~~10.26.6.3~~

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

10.27 Compressed Natural Gas (CNG) Vehicular Fuel Systems.

~~10.27.1~~
The installation of compressed natural gas (CNG) fueling (i.e., dispensing) systems shall be in accordance with NFPA 52.

~~10.27.2~~
Residential CNG fueling appliances shall be both listed in accordance with ANSI/CSA NGV 5.1, *Residential Fueling Appliances*, and installed in accordance to the appliance manufacturer's installation instructions.

~~10.27.3~~
Nonresidential CNG fueling appliances shall be both listed in accordance with ANSI/CSA NGV 5.2, *Vehicle Fueling Appliances (VFA)*, and installed in accordance with the appliance manufacturer's installation instructions.

10.28 Appliances for Installation in Manufactured Housing.

~~10.28.1~~
Appliances installed in manufactured housing after the initial sale shall be ~~either~~ listed for installation in manufactured housing, or approved~~.~~.

~~10.28.2~~
~~Appliances~~ and shall be installed in accordance with the requirements of this code and the manufacturers' installation instructions.

~~10.28.3~~
Appliances installed in the living space of manufactured housing shall be in accordance with the requirements of Section 9.3.

10.29 Fuel Cell Power Plants.

~~10.29.1~~
Fuel cell power plants with a power output of less than 50 kW shall be ~~both~~ listed in accordance with ANSI/CSA FC 1, *Fuel Cell Technologies — Part 3-100: Stationary Fuel Cell Power Systems — Safety*, and installed in accordance with the manufacturer's instructions.

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

10.30.1 Application.

~~10.30.1.1~~
Outdoor open flame decorative appliances shall be listed in accordance with ANSI Z21.97/CSA 2.41, *Outdoor Decorative Gas Appliances*, ~~.~~ and

~~10.30.1.2~~

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

10.31 Outdoor Infrared Heaters.

~~10.31.1~~
Outdoor infrared heaters for residential and commercial applications shall be listed in accordance with ANSI Z83.26/CSA 2.27, *Gas-Fired Outdoor Infrared Patio Heaters*.~~.~~

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

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.

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

11.1.2 High Altitude.

~~11.1.2.1~~
Gas input ratings of appliances shall be used for elevations up to 2000 ft (600 m).

~~11.1.2.2~~
The input ratings of appliances operating at elevations above 2000 ft (600 m) shall be reduced in accordance with one of the following methods:

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

11.2* Primary Air Adjustment.

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

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

11.3 Safety Shutoff Devices.

~~11.3.1~~
Where a safety shutoff device is provided, it shall be checked for proper operation and adjustment in accordance with the appliance manufacturer's instructions.

~~11.3.2~~
Where the device does not turn off the gas supply in the event of pilot outage or other ignition malfunction, the device shall be serviced or replaced with a new device.

11.4 Automatic Ignition.

~~11.4.1~~
Appliances supplied with means for automatic ignition shall be checked for operation within the parameters provided by the manufacturer.

~~11.4.2~~
Any adjustments made shall be in accordance with the manufacturer’s installation instructions.

11.5 Protective Devices.

~~11.5.1~~
Where required by the manufacturer's installation instructions, all protective devices furnished with the appliance, such as a limit control, fan control to blower, temperature and pressure relief valve, low-water cutoff device, or manual operating features, shall be checked for operation within the parameters provided by the manufacturer.

~~11.5.2~~
Any adjustments made shall be in accordance with the manufacturer’s installation instructions.

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 for use by the consumer.

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.~~ ~~T~~the appliance shall be listed for use with such venting materials~~.~~
~~2.~~ ~~T~~ and the appliance manufacturer's installation instructions shall identify the specific plastic piping material.

~~12.5.2.2~~
The plastic pipe venting materials shall be ~~either~~ labeled in accordance with the product standards specified by the appliance manufacturer or shall be listed and labeled in accordance with UL 1738, *Venting Systems for Gas-Burning Appliances, Categories II, III, and IV*.

12.5.3 Plastic Vent Joints.

~~12.5.3.1~~

Plastic pipe and fittings used to vent appliances shall be installed in accordance with the appliance manufacturer's installation instructions.

~~12.5.3.2~~
Plastic pipe venting materials listed and labeled in accordance with UL 1738, *Venting Systems for Gas-Burning Appliances, Categories II, III, and IV*, shall be installed in accordance with the vent manufacturer's installation instructions.

~~12.5.3.3~~
Where primer is required, it shall be of a contrasting color.

12.6.1.1
Factory-built chimneys shall be listed in accordance with UL 103, *Factory-Built Chimneys for Residential Type and Building Heating Appliances*; UL 959, *Medium Heat Appliance Factory-Built Chimneys;* or *UL 2561, 1400 Degree Fahrenheit Factory-Built Chimneys*.

~~12.6.1.2~~
Factory-built chimneys used to vent appliances that operate at positive vent pressure shall be listed for such application.

12.6.4 Inspection of Chimneys.

12.6.4.1
Before replacing an existing appliance or connecting a vent connector to a chimney, the chimney passageway shall be examined to ascertain that it is clear and free of obstructions~~.~~

~~12.6.4.2~~
~~The chimney passageway~~ and shall be cleaned if previously used for venting solid~~-~~ or liquid~~-~~ 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 where they ~~Where cleanouts~~ do not remain tightly closed when not in use, they shall be repaired or replaced.

12.6.4.~~6~~ ~~4~~
When inspection reveals that an existing chimney is not safe for the intended application, it shall be repaired, rebuilt, lined, relined, or replaced with a vent or chimney to conform to NFPA 211~~.~~

~~12.6.4.7~~
~~Vents and chimneys~~ and shall be suitable for the appliances to be attached.

12.6.5.2
Where one chimney serves gas appliances and ~~liquid~~ liquid fuel~~--~~burning appliances, the appliances shall be ~~either~~ connected through separate openings or connected through a single opening where joined by a suitable fitting located as close as practical to the chimney.

~~12.6.5.3~~
Where two or more openings are provided into one chimney flue, they shall be at different levels.

~~12.6.5.4~~
Where the gas appliance is automatically controlled, it shall be equipped with a safety shutoff device.

12.6.5.3~~5~~*
A listed combination gas- and ~~solid~~ ~~soldi~~ 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.

12.6.6 Support of Chimneys.

~~12.6.6.1~~
All portions of chimneys shall be supported for the design and weight of the materials employed.

~~12.6.6.2~~
Listed factory-built chimneys shall be supported and spaced in accordance with the manufacturer's installation instructions.

12.6.7 Cleanouts.

~~12.6.7.1~~
Where a chimney that formerly carried flue products from liquid~~-~~ or solid~~-~~ 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 and be installed so its upper edge is at least 6 in. (150 mm) below the lower edge of the lowest chimney inlet opening.

12.6.9 Insulation Shield.

~~12.6.9.1~~
Where a factory-built chimney passes through insulated assemblies, an insulation shield constructed of steel having a minimum thickness of 0.0187 in. (0.4712 mm) (nominal 26 gage) shall be installed to provide clearance between the chimney and the insulation material.

~~12.6.9.2~~
The clearance shall not be less than the clearance to combustibles specified by the chimney manufacturer's installation instructions.

~~12.6.9.3~~
Where chimneys pass through attic space, ~~both of the following shall apply:~~

~~1.~~ ~~T~~the shield shall terminate not less than 2 in. (51 mm) above the insulation materials~~.~~
~~2. The shield~~ and shall be secured in place to prevent displacement.

12.7 Gas Vents.

12.7.1 Materials.

~~12.7.1.1~~
Type B and Type BW gas vents shall be listed in accordance with UL 441, *Gas Vents*.

~~12.7.1.2~~
Vents for listed combination gas- and oil-burning appliances shall be listed in accordance with UL 641, *Type L Low-Temperature Venting Systems*.

12.7.4.2 Vent Offsets.

~~12.7.4.2.1~~
Type B and Type L vents sized in accordance with 12.7.4.1(3) or 12.7.4.1(4) shall extend in a generally vertical direction with offsets not exceeding 45 degrees, except that a vent system having not more than one ~~60~~ 60 degree offset shall be permitted.

~~12.7.4.2.2~~
Any angle greater than 45 degrees from the vertical is considered horizontal.

~~12.7.4.2.3~~
The total horizontal distance of a vent plus the horizontal vent connector serving draft~~-~~ hood~~-~~equipped appliances shall not be greater than 75 percent of the vertical height of the vent.

12.7.4.3 Category II, Category III, and Category IV Appliances.

~~12.7.4.3.1~~
The sizing of gas vents for Category II, Category III, and Category IV appliances shall be in accordance with the appliance manufacturers' instructions.

~~12.7.4.3.2~~
The sizing of plastic pipe specified by the appliance manufacturer as a venting material for Category II, III, and IV appliances shall be in accordance with the appliance manufacturers' instructions.

12.7.5.1
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.

~~12.7.5.2~~
Crawl spaces, basements, and attics shall be considered as floor levels.

12.7.7 Marking.

~~12.7.7.1~~
In those localities where solid and liquid fuels are used extensively, gas vents shall be permanently identified by a label attached to the wall or ceiling at a point where the vent connector enters the gas vent.

~~12.7.7.2~~

The label ~~stated in 12.7.7.1~~ shall read: "This gas vent is for appliances that burn gas. Do not connect to solid~~-~~ or ~~liquid-~~liquid fuel~~-~~burning appliances or incinerators."

~~12.7.7.3~~
The authority having jurisdiction shall determine whether its area constitutes such a locality.

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.

~~12.8.4.3~~
A pipe passing through a roof shall extend without interruption through the roof flashing, roof jacket, or roof thimble.

12.8.4.34
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.

~~12.8.4.6~~
Reduced clearances from single-wall metal pipe to combustible material shall be as specified for vent connectors in Table 10.2.4.

12.8.4.57
Where a single-wall metal pipe passes through a roof constructed of combustible material, a noncombustible, nonventilating thimble shall be used at the point of passage.

~~12.8.4.6~~
The thimble ~~stated in 12.8.4.5~~ 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.

~~12.8.4.7~~
The thimble ~~stated in 12.8.4.5~~ shall be sized in accordance with 12.8.4.69.

12.8.4.69
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.
~~2. For listed appliances with draft hoods and appliances listed for use with Type B gas vents and where~~ 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.
~~3.~~2. For unlisted appliances having draft hoods, the thimble shall be a minimum of 6 in. (150 mm) larger in diameter than the metal pipe.
~~4.~~3. For residential and low-heat appliances, the thimble shall be a minimum of 12 in. (300 mm) larger in diameter than the metal pipe.

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

~~12.8.4.710~~
~~Where a thimble is not installed, the following shall be required:~~
1. ~~All combustible material in the wall shall be removed from the metal pipe to provide the specified clearance from such metal pipe to combustible material.~~
2. ~~Any material used to seal an opening shall be noncombustible.~~

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

1. *A venting system of a single-wall metal pipe shall be sized in accordance with one of the following methods and the appliance manufacturer's instructions:
   a. For a draft~~-~~ hood ~~-~~equipped appliance, in accordance with Chapter 13.
   b. For a venting system for a single appliance with a draft hood, ~~the following:~~
      i. ~~The~~ the areas of the connector and the pipe each shall not be less than the area of the appliance flue collar or draft hood outlet, whichever is smaller.
      ii. ~~The~~ The vent area shall not be greater than seven times the draft hood outlet area.
   c. Engineering methods.
2. Where a single-wall metal pipe is used and has a shape other than round, it shall have an equivalent effective area equal to the effective area of the round pipe for which it is substituted and the minimum internal dimension of the pipe shall be 2 in. (50 mm).
3. The vent cap or a roof assembly shall have a venting capacity not less than that of the pipe to which it is attached.

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12.11.2.4
A vent connector for a nonresidential low-heat appliance shall be a factory-built chimney section or steel pipe having resistance to heat and corrosion equivalent to that for the appropriate galvanized pipe as specified in Table 12.11.2.4.

~~12.11.2.5~~
Factory-built chimney sections shall be joined together in accordance with the chimney manufacturer's instructions~~.~~

12.11.2.5~~6~~
Vent connectors for medium-heat appliances shall be constructed of factory-built, medium-heat chimney sections or steel of a thickness not less than that specified in Table 12.11.2.5~~6~~

~~12.11.2.7~~
~~Vent connectors for medium-heat appliances~~ and shall comply with the following:

1. A steel vent connector for an appliance with a vent gas temperature in excess of 1000°F (538°C) measured at the entrance to the connector shall be lined with medium-duty fire brick or the equivalent.
2. The lining shall be at least 2½ in. (64 mm) thick for a vent connector having a diameter or greatest cross-sectional dimension of 18 in. (460 mm) or less.

3. The lining shall be at least 4½ in. (110 mm) thick laid on the 4½ in. (110 mm) bed for a vent connector having a diameter or greatest cross-sectional dimension greater than 18 in. (460 mm).
4. Where factory-built chimney sections are installed, they shall be joined together in accordance with the chimney manufacturer's instructions.

12.11.3.2
Where a single appliance having more than one draft hood outlet or flue collar is installed, the manifold shall be constructed according to the instructions of the appliance manufacturer.

~~12.11.3.3~~
Where there are no instructions, the manifold shall be designed and constructed in accordance with engineering methods.

~~12.11.3.4~~
As an alternative method, the effective area of the manifold shall ~~be in accordance with the following:~~
~~1. The effective area shall be~~ equal the combined area of the flue collars or draft hood outlets.~~.~~
~~2.~~ ~~T~~ and the vent connectors shall have a minimum 1 ft (0.3 m) rise.

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.

~~12.11.9.3~~
The maximum length of an individual connector for a chimney or vent system serving multiple appliances, from the appliance outlet to the junction with the common vent or another connector, shall be 100 percent of the height of the chimney or vent.

12.13.3 Draft Control Devices.

~~12.13.3.1~~
Where a draft control device is part of the appliance or is supplied by the appliance manufacturer, it shall be installed in accordance with the manufacturer's instructions.

~~12.13.3.2~~
In the absence of manufacturer's instructions, the device shall be attached to the flue collar of the appliance or as near to the appliance as practical.

12.13.4* Additional Devices.
Appliances requiring controlled chimney draft shall be permitted to be equipped with listed double-acting barometric draft regulators installed and adjusted in accordance with the manufacturer's instructions.

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

12.13.6 Positioning.

~~12.13.6.1~~
Draft hoods and draft regulators shall be installed in the position for which they were designed with reference to the horizontal and vertical planes.~~.~~

~~12.13.6.2~~
~~Draft hoods and draft regulators~~ and shall be located so that the relief opening is not obstructed by any part of the appliance or adjacent construction.

~~12.13.6.3~~
The appliance and its draft hood shall be located so that the relief opening is accessible for checking vent operation.

12.13.7 Clearance.

~~12.13.7.1~~
A draft hood shall be located so that its relief opening is not less than 6 in. (150 mm) from any surface except that of the appliance it serves and the venting system to which the draft hood is connected.

~~12.13.7.2~~
Where a greater or lesser clearance is indicated on the appliance label, the clearance shall not be less than that specified on the label.

~~12.13.7.3~~
~~The clearances in 12.13.7~~ Such clearances shall not be reduced.

12.14.1
A manually operated damper shall not be placed in any appliance vent connector.

~~12.14.2~~
Fixed baffles and balancing baffles shall not be classified as manually operated dampers.

12.16 Obstructions.

~~12.16.1~~
Devices that retard the flow of vent gases shall not be installed in a vent connector, chimney, or vent.

~~12.16.2~~
The following shall not be considered as obstructions:

1. Draft regulators and safety controls specifically listed for installation in venting systems and installed in accordance with the manufacturer’s installation instructions
2. Approved draft regulators and safety controls designed and installed in accordance with engineering methods
3. Listed heat reclaimers and automatically operated vent dampers installed in accordance with the manufacturers' installation instructions
4. Vent dampers serving listed appliances installed in accordance with 13.1.1 or 13.2.1 or engineering methods
5. Approved economizers, heat reclaimers, and recuperators installed in venting systems of appliances not required to be equipped with draft hoods, provided the appliance manufacturer’s instructions cover the installation of such a device in the venting system and performance in accordance with Section 12.1 and 12.4.1 is obtained

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:

1. The maximum capacity of the vent system shall be determined using the "NAT Max" column.
2. The minimum capacity shall be determined as though the appliance were a fan-assisted appliance, using the "FAN Min" column to determine the minimum capacity of the vent system.
~~3.~~ Where the corresponding "Fan Min" is "NA," ~~both of the following shall apply:~~
   ~~a.~~ ~~T~~ the vent configuration shall not be permitted~~.~~
   ~~b.~~ ~~A~~ and an alternative venting configuration shall be utilized.

13.1.2 Vent Downsizing.

13.1.2.1
Where the vent size determined from the tables is smaller than the appliance draft hood outlet or flue collar, the use of the smaller size shall be permitted, provided that the installation complies with all of the following requirements:

1. The total vent height (H) is at least 10 ft (3 m).
2. Vents for appliance draft hood outlets or flue collars 12 in. (300 mm) in diameter or smaller are not reduced more than one table size.
3. Vents for appliance draft hood outlets or flue collars larger than 12 in. (300 mm) in diameter are not reduced more than two table sizes.
4. The maximum capacity listed in the tables for a fan-assisted appliance is reduced by 10 percent (0.90 × maximum table capacity).
5. The draft hood outlet is greater than 4 in. (100 mm) in diameter.

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

Commented [BM28]: Prod: These will be part of list item (5)

13.1.3 Elbows.

~~13.1.3.1*~~
Single-appliance venting configurations with zero (0) lateral lengths in Table 13.1(a), Table 13.1(c), and Table 13.1(f) shall not have elbows in the venting system.

~~A.13.1.3.1~~
Single-appliance venting with lateral lengths include two ~~90~~ 90 degree elbows.

~~13.1.3.2~~
For each additional elbow up to and including 45 degrees, the maximum capacity listed in the venting tables shall be reduced by 5 percent.

~~13.1.3.3~~
For each additional elbow greater than 45 degrees up to and including 90 degrees, the maximum capacity listed in the venting tables shall be reduced by 10 percent.

~~13.1.3.4~~
Where multiple offsets occur in a vent, the total lateral length of all offsets combined shall not exceed that specified in Table 13.1(a) through Table 13.1(e).

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

13.1.5 High-Altitude Installations.

~~13.1.5.1~~
Sea level input ratings shall be used when determining maximum capacity for high-altitude installation.

~~13.1.5.2~~
Actual input (derated for altitude) shall be used for determining minimum capacity for high-altitude installation.

13.1.7* Corrugated Chimney Liners.

~~13.1.7.1~~
Listed corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Table 13.1(a) or Table 13.1(c) for Type B vents, with the maximum capacity reduced by 20 percent (0.80 × maximum capacity) and the minimum capacity as shown in Table 13.1(a) or Table 13.1(c).

~~13.1.7.2~~
Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with 13.1.3.

~~13.1.7.3~~
The 20 percent reduction for corrugated metallic chimney liner systems includes an allowance for one long radius 90-degree turn at the bottom of the liner.

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

13.1.9 Vertical Vent Upsizing/7 × Rule.

~~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~~.~~, and
~~2.~~ ~~T~~the connector diameter shall be used to determine the maximum vent capacity.

~~13.1.9.2~~

The flow area of the vertical vent shall not exceed seven times the flow area of the listed appliance categorized vent area, flue collar area, or draft hood outlet area unless designed in accordance with engineering methods.

13.1.11 Chimneys and Vent Locations.

~~13.1.11.1~~
Table 13.1(a) through Table 13.1(f) shall be used only for chimneys and vents not exposed to the outdoors below the roof line.

~~13.1.11.2~~
A Type B vent or listed chimney lining system passing through an unused masonry chimney flue shall not be considered to be exposed to the outdoors.

~~13.1.11.3~~
Where vents extend outdoors above the roof more than 5 ft (1.5 m) higher than required by Table 12.7.3, and where vents terminate in accordance with 12.7.3(1)(b), ~~one of the following shall apply:~~

~~1.~~ ~~The~~ 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. The~~ 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(d) in combination with Table 13.1(g) shall be used for clay ~~clay~~ tile ~~–~~lined exterior masonry chimneys, provided all of the following requirements are met:

1. The vent connector is Type B double wall.
2. The vent connector length is limited to 18 in./in. (18 mm/mm) of vent connector diameter.
3. The appliance is draft hood equipped.
4. The input rating is less than the maximum capacity given in Table 13.1(d).
5. For a water heater, the outdoor design temperature shall ~~is~~ 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(g).

13.2.1 Obstructions and Vent Dampers.

~~13.2.1.1~~
Venting Table 13.2(a) through Table 13.2(j) 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.

2. The maximum capacity of the vertical vent or chimney shall be determined using the FAN+NAT column when the second appliance is a fan-assisted appliance, or the NAT+NAT column when the second appliance is equipped with a draft hood.
3. The minimum capacity shall be determined as if the appliance were a fan-assisted appliance, as follows:

a. The minimum capacity of the vent connector shall be determined using the FAN Min column.

b. The FAN+FAN column shall be used when the second appliance is a fan-assisted appliance~~.~~, and

~~c.~~ ~~T~~the FAN+NAT column shall be used when the second appliance is equipped with a draft hood, to determine whether the vertical vent or chimney configuration is not permitted ~~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.~~ ~~A~~and an alternative venting configuration shall be utilized.

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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 permitted under the following conditions:

1. ~~*~~The maximum capacity (FAN Max or NAT Max) of the vent connector shall be reduced 10 percent for each additional multiple of the length listed in Table 13.2.2. For example, the maximum length listed for a 4 in. (100 mm) connector is 6 ft (1.8 m). With a connector length greater than 6 ft (1.8 m) but not exceeding 12 ft (3.7 m), the maximum capacity must be reduced by 10 percent (0.90 × maximum vent connector capacity). With a connector length greater than 12 ft (3.7 m) but not exceeding 18 ft (5.5 m), the maximum capacity must be reduced by 20 percent (0.80 × maximum vent capacity).

2. For a connector serving a fan-assisted appliance, the minimum capacity (FAN Min) of the connector shall be determined by referring to the corresponding single appliance table.

~~3.~~ For Type B double-wall connectors, Table 13.1(a) shall be used.

~~4.~~ For single-wall connectors, Table 13.1(c) 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.

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~~A.13.2.3.2(1)~~ **[Move to between 13.2.3 (1) and 13.2.3.(2)]**

~~For example, the maximum length listed for a 4 in. (100 mm) connector is 6 ft (1.8 m). With a connector length greater than 6 ft (1.8 m) but not exceeding 12 ft (3.7 m), the maximum capacity must be reduced by 10 percent (0.90 × maximum vent connector capacity). With a connector length greater than 12 ft (3.7 m) but not exceeding 18 ft (5.5 m), the maximum capacity must be reduced by 20 percent (0.80 × maximum vent capacity).~~

13.2.4 Vent Connector Manifolds.

~~13.2.4.1~~

Where the vent connectors are combined prior to entering the vertical portion of the common vent to form a common vent manifold, the size of the common vent manifold and the common vent shall be determined by applying a 10 percent reduction (0.90 × maximum common vent capacity) to the common vent capacity part of the common vent tables.

~~13.2.4.2~~
The length of the common vent manifold (*LM*) shall not exceed 18 in./in. (18 mm/mm) of common vent diameter (*D*).

13.2.5 Vent Offsets.

~~13.2.5.1~~
Where the common vertical vent is offset, ~~both of the following shall apply:~~

~~1)~~ ~~T~~the maximum capacity of the common vent shall be reduced in accordance with 13.2.6~~.~~
~~2)~~ ~~T~~ and the horizontal length of the common vent offset shall not exceed 18 in./in. (18 mm/mm) of common vent diameter (*D*).

~~13.2.5.2~~
Where multiple offsets occur in a common vent, the total horizontal length of all offsets combined shall not exceed 18 in./in. (18 mm/mm) of the common vent diameter.

13.2.6 Elbows in Vents.

~~13.2.6.1~~
For each elbow up to and including 45 degrees in the common vent, the maximum common vent capacity listed in 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 the venting tables shall be reduced by 10 percent.

13.2.7~~*~~ Elbows in Connectors.

~~A.13.2.7~~
The vent connector capacities listed in the common vent sizing tables include allowance for two 90~~-~~ degree elbows.

~~13.2.7.1~~
For each additional elbow up to and including 45 degrees, the maximum vent connector capacity listed in the venting tables shall be reduced by 5 percent.

~~13.2.7.2~~
For each elbow greater than 45 degrees up to and including 90 degrees, the maximum vent connector capacity listed in the venting tables shall be reduced by 10 percent.

13.2.10 Tee and Wye Sizing.

~~13.2.10.1~~
At the point where tee or wye fittings connect to a common gas vent, the opening size of the fitting shall be equal to the size of the common vent.

~~13.2.10.2~~
Such fittings ~~as stated in 13.2.10.1~~ shall not be prohibited from having reduced ~~reduced~~ size openings at the point of connection of appliance gas vent connectors.

13.2.11 High-Altitude Installations.

~~13.2.11.1~~
Sea level input ratings shall be used when determining maximum capacity for high-altitude installation.

~~13.2.11.2~~
Actual input (derated for altitude) shall be used for determining minimum capacity for high-altitude installation.

13.2.16 Multistory B Vents Required.
Where used in multistory systems, vertical common vents shall be ~~in accordance with the following:~~
~~1.~~ Type B double wall
~~2.~~ ~~I~~ and shall be installed with a listed vent cap.

13.2.17 Multistory Vent Offsets and Capacity.

~~13.2.17.1~~
Offsets in multistory common vent systems shall be limited to a single offset in each system.~~.~~

~~13.2.17.2~~
~~S~~and systems with an offset shall comply with all of the following:

1. The offset angle shall not exceed 45 degrees from vertical.
2. The horizontal length of the offset shall not exceed 18 in./in. (18 mm/mm) of common vent diameter of the segment in which the offset is located.
3. For the segment of the common vertical vent containing the offset, the common vent capacity listed in the common venting tables shall be reduced by 20 percent (0.80 × maximum common vent capacity).
4. A multistory common vent shall not be reduced in size above the offset.

13.2.19.1
The minimum vent connector capacity (FAN Min) of appliances with more than one input rate shall be determined from 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.

13.2.20* 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(c) 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(c).

~~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.

> ~~A.13.2.20.1~~
> The 20 percent reduction for corrugated metallic chimney liner systems includes an allowance for one ~~long~~ long radius 90-degree turn at the bottom of the liner.

13.2.21 Connections to Chimney Liners.

~~13.2.21.1~~
Where double-wall connectors are required, tee and wye fittings used to connect to the common vent chimney liner shall be listed double-wall fittings.

~~13.2.21.2~~
Connections between chimney liners and listed double-wall fittings shall be made with listed adapter fittings designed for such purpose.

13.2.22 Chimneys and Vent Locations.

~~13.2.22.1~~
Table 13.2(a) through Table 13.2(f) 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. The~~ or such venting system shall be engineered.

~~13.2.22.5~~
Table 13.2(g), Table 13.2(h), Table 13.2(i), and Table 13.2(j) shall be used for clay-tile-lined exterior masonry chimneys, provided all the following conditions are met:

1. The vent connector is Type B double wall.
2. At least one appliance is draft hood equipped.
3. The combined appliance input rating is less than the maximum capacity given by Table 13.2(g) (for NAT+NAT) or Table 13.2(i) (for FAN+NAT).
4. The input rating of each space-heating appliance is greater than the minimum input rating given by Table 13.2(h) (for NAT+NAT) or Table 13.2(j) (for FAN+NAT).
5. The vent connector sizing is in accordance with Table 13.2(d).

13.2.24 Vent Connector Sizing.

~~13.2.24.1~~
Vent connectors shall not be increased more than two sizes greater than the listed appliance categorized vent diameter, flue collar diameter, or draft hood outlet diameter.

~~13.2.24.2~~
Vent connectors for draft~~-~~ hood~~--~~equipped appliances shall not be smaller than the draft hood outlet diameter.

~~13.2.24.3~~
Where a vent connector size(s) determined from the tables for a fan-assisted appliance(s) is smaller than the flue collar diameter, the use of the smaller size(s) shall be permitted, provided that the installation complies with all of the following conditions:

1. Vent connectors for fan-assisted appliance flue collars 12 in. (300 mm) in diameter or smaller are not reduced by more than one table size [e.g., 12 in. to 10 in. (300 mm to 250 mm) is a one-size reduction], and those larger than 12 in. (300 mm) in diameter are not reduced more than two table sizes [e.g., 24 in. to 20 in. (610 mm to 510 mm) is a two-size reduction].
2. The fan-assisted appliance(s) is common vented with a draft~~-~~hood~~--~~equipped appliance(s).
3. The vent connector has a smooth interior wall.

13.2.25 Multiple Vent and Connector Sizes.

~~13.2.25.1~~
All combinations of pipe sizes, single-wall metal pipe, and double-wall metal pipe shall be allowed within any connector run(s) or within the common vent, provided ALL ~~all~~ of the appropriate ~~applicable~~ tables permit ALL~~all~~ of the desired sizes and types of pipe, as if they were used for the entire length of the subject connector or vent.

~~13.2.25.2~~
Where single-wall and Type B double-wall metal pipes are used for vent connectors within the same venting system, the common vent shall be sized using Table 13.2(c) or Table 13.2(e) as appropriate ~~applicable~~.