

# Code Review

## 2018 Changes to International Codes

W A R N I N G

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W A R N I N G



# International Fire Code (IFC) / International Fuel Gas Code (IFGC) / International Residential Code (IRC) – Fire Prevention

Plumbing Technical Advisory Committee (TAC)

2018 International Fire Code (IFC) / International Fuel Gas Code (IFGC) / International Residential Code (IRC) – Fire Prevention – Plumbing TAC

IFGC- Code Change No.	IFGC- Section	Change Summary b/t 2015 IFGC and 2018 IFGC – Plumbing TAC	Change Summary b/t 2017 FGC and 2018 IFGC.	Staff comments
F274-16	IMC [F]502.16, [F]502.16.1 (New), [F]502.16.2 (New), [F]502.16.1, [F]502.16.2, Chapter 15; IMC [FG] 304.5.1, [FG] 304.5.1.1, IMC [FG] 304.5.1.2, IMC [FG] 304.5.2, IMC [FG] 304.5.3, 703.1, 703.1.1, 703.1.1.1, 703.1.1.2, 703.1.3	<p>Modifies text of section [F] 502.16 “Repair garages for vehicles fueled by lighter-than-air fuels”, [F] 502.16.2.1 “Design”, [F] 502.16.2.2 “Operation”, 703.1 “Hydrogen-generating and refueling operations”. <i>Adds new Section [F] 502.16.1 “Repair garages used for the repair of hydrogen-fueled vehicles”, [F] 502.16.2 “Exhaust ventilation system”.</i> Adds new reference standard NFPA 2-2016 “Hydrogen Technologies Code”. Deletes entirety of Section 703.1.1 “Natural ventilation”, 703.1.2 “Mechanical ventilation”, 703.1.3 “Specially engineered installations”. The exception language in 2311.7.2 (new numbering) was modified to match existing verbiage found in the IMC.</p> <p>This proposal is a comprehensive fix of the exhaust ventilation requirements for repair garages for hydrogen fueled vehicles and for exhaust ventilation requirements for the installation hydrogen-generating and refueling operations. The primary goal was consistency and correlation between the requirements found within the IFC, the IMC and the IFGC along with tighter correlation with the requirements of NFPA 2.</p> <p><b>Cost Impact:</b> Will not increase the cost of construction. This proposal <b>will reduce the cost</b> of installation by eliminating an internal conflict within the IMC, by <b>correlating</b> all of the ICC codes dealing with this topic, and by providing for tighter correlation with NFPA 2 which the I-Codes already refer to for these types of installations.</p>	Same as change between 2015 IFGC and 2018 IFGC	

Rule 61G20-2.002 2. Technical amendments needed to accommodate the specific needs of this state include but are not limited to amendments to the Florida Building Code that provide for the following:

a. Establish minimum life safety construction requirements to protect buildings and their occupants from fire, wind, flood, and storm surge using the latest technical research and engineering standards for buildings and materials products. b. Provide for flood protection provisions that are consistent with the latest flood protection requirements of the National Flood Insurance Program. c. Maintain eligibility for federal funding and discounts from the National Flood Insurance Program, the Federal Emergency Management Agency, and the United States Department of Housing and Urban Development. d. Provide for energy efficiency standards for buildings that meet or exceed the national energy standards as mandated by Title III of the Energy Conservation and Protection Act. e. Maintain coordination with the Florida Fire Prevention Code. f. Provide for the latest industry standards and design

TAC Action		Commission Action		TAC	Cmsn.
Accommodate Florida Specific Need: YES (Select Criteria) <input type="checkbox"/> a. <input type="checkbox"/> b. <input type="checkbox"/> c. <input type="checkbox"/> d. <input type="checkbox"/> e. <input type="checkbox"/> f. <input type="checkbox"/> NO: <input type="checkbox"/>		Accommodate Florida Specific Need: YES (Select Criteria) <input type="checkbox"/> a. <input type="checkbox"/> b. <input type="checkbox"/> c. <input type="checkbox"/> d. <input type="checkbox"/> e. <input type="checkbox"/> f. <input type="checkbox"/> NO: <input type="checkbox"/>		<input type="checkbox"/> No Action Needed	<input type="checkbox"/>
Others (Explain):  		Others (Explain):  		<input type="checkbox"/> Overlapping provisions	<input type="checkbox"/>
FG11-15	303.3	Modifies text of Section 303.3 Prohibited locations. Adds new item to Section 303.3. In older homes the electrical service is not large enough for an electric dryer, so installing a gas dryer is the only option. In many homes it is desirable to have the gas dryer in an over-sized bathroom or toilet room on an upper floor. This provision provides a safe installation by requiring a minimum 100 square inch opening to a common space that ensures adequate natural ventilation is provided. Approved as modified by public committee, changing wording of original mod.  <b>Cost Impact:</b> Will not increase the cost of construction. This provision will not increase the cost of construction since it <b>provides flexibility</b> in the dryer installation	Same as change between 2015 IFGC/IRC and 2018 IFGC/IRC		
RCCIWG – Comment		TAC Action	Commission Action	TAC	Commission
Impactful (Explain) <input type="checkbox"/>		Accommodate Florida Specific Need: YES (Select Criteria) <input type="checkbox"/> a. <input type="checkbox"/> b. <input type="checkbox"/> c. <input type="checkbox"/> d. <input type="checkbox"/> e. <input type="checkbox"/> f. <input type="checkbox"/> NO: <input type="checkbox"/>	Accommodate Florida Specific Need: YES (Select Criteria) <input type="checkbox"/> a. <input type="checkbox"/> b. <input type="checkbox"/> c. <input type="checkbox"/> d. <input type="checkbox"/> e. <input type="checkbox"/> f. <input type="checkbox"/> NO: <input type="checkbox"/>	<input type="checkbox"/> No Action Needed	<input type="checkbox"/>
		Others (Explain):  	Others (Explain):  	<input type="checkbox"/> Overlapping provisions	<input type="checkbox"/>
Correlation with NFPA 54	IFGC 304.5.3, 310.2, 310.3, 402.3, 402.4, 402.7, 402.7.1, Table 402.4 (16),	Correlation with NFPA 54, National Fuel Gas Code.	Same as change between 2015 IFGC/IRC and 2018 IFGC/IRC		

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	Table 402.4 (17), 403.4, 403.5, 403.6, 403.10, 406.2, 413.2.3, 413.3, 413.4.1, 416.3, 503.2, 503.3, 503.3.4, 503.4, 503.5, Table 503.4, 503.6.2, 503.5.7.4, 503.5.11, 503.6.1, 503.6.10, 503.8, Table 503.8, 614.4, 614.8.1															
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## Code Change No: **F274-16**

### Original Proposal

**Section: 2311, 2311.7, 2311.7.1 (New), 2311.7.1, 2311.7.1.1, 2311.7.1.2, 2311.7.2, 2311.7.2.1, 2311.7.2.1.1, 2311.7.2.2, 2311.7.2.3; IMC: [F]502.16, [F]502.16.1 (New), [F]502.16.2 (New), [F]502.16.1, [F]502.16.2, Chapter 15; IFGC: 703.1, 703.1.1 (IMC: [FG] 304.5.1) 703.1.1.1 (IMC: [FG] 304.5.1.1), 703.1.1.2 (IMC [FG] 304.5.1.2), 703.1.2 (IMC:[FG] 304.5.2), 703.1.3 (IMC:[FG] 304.5.3), Chapter 8**

**Proponent:** Robert Davidson, Davidson Code Concepts, LLC, representing Quong & Associates, Inc./Toyota (rjd@davidsoncodeconcepts.com) ; Martin Gresho (marty@fp2fire.com)

**Revise as follows:**

#### CHAPTER 23 MOTOR FUEL-DISPENSING FACILITIES AND REPAIR GARAGES

#### SECTION 2311 REPAIR GARAGES

**2311.7 Repair garages for vehicles fueled by lighter-than-air fuels.** Repair garages for the conversion and repair of vehicles that use CNG, liquefied natural gas (LNG), hydrogen or other lighter-than-air motor fuels shall be in accordance with Sections 2311.7 through ~~2311.7.2.3~~ 2311.7.3.3 in addition to the other requirements of Section 2311.

**Exceptions:**

1. Repair garages where work is not performed on the fuel system and is limited to exchange of parts and maintenance not requiring open flame or welding on the CNG-, LNG-, hydrogen- or other lighter-than-air-fueled motor vehicle.
2. Repair garages for hydrogen-fueled vehicles where work is not performed on the hydrogen storage tank and is limited to the exchange of parts and maintenance not requiring open flame or welding on the hydrogen-fueled vehicle. During the work, the entire hydrogen fuel system shall contain ~~a quantity that is less than~~ 200 cubic feet (5.6 m<sup>3</sup>) of hydrogen.

**Add new text as follows:**

**2311.7.1 Repair garages used for the repair of hydrogen-fueled vehicles.** Repair garages used for the repair of hydrogen-fueled vehicles shall be provided with an approved exhaust ventilation system in accordance with the International Mechanical Code and Chapter 6 of NFPA 2.

**Revise as follows:**

**2311.7.1-2311.7.2 Exhaust Ventilation System.** Repair garages used for the repair of CNG, liquefied natural gas- (LNG), or hydrogen-fueled vehicles ~~other lighter-than-air motor fuels other than hydrogen~~ shall be provided with an *approved* mechanical exhaust ventilation system. The mechanical ventilation system shall be in accordance with the *International Mechanical Code* and Sections ~~2311.7.1.4-2311.7.2.1~~ and ~~2311.7.1.2-2311.7.2.2~~.

**Exception:** ~~Repair garages with natural ventilation when approved.~~ Where approved by the fire code official, natural ventilation shall be permitted in lieu of mechanical exhaust ventilation.

**~~2311.7.1.1~~ ~~2311.7.2.1~~ Design.** Indoor locations shall be ~~ventilated~~ exhausted utilizing air supply inlets and exhaust outlets arranged to provide uniform air movement to the extent practical. Inlets shall be uniformly arranged on ~~exterior~~ walls near floor level. Outlets shall be located at the high point of the room in ~~exterior~~ walls or the roof.

~~Ventilation~~ Exhaust ventilation shall be by a continuous mechanical exhaust ventilation system or by a mechanical exhaust ventilation system activated by a continuously monitoring natural gas detection system ~~or, for hydrogen, a continuously monitoring flammable gas detection system, each~~ activating at a gas concentration of not more than 25 percent of the lower flammable limit (LFL). In all cases, the system shall shut down the fueling system in the event of failure of the ventilation system.

The exhaust ventilation rate shall be not less than 1 cubic foot per minute per 12 cubic feet [0.00139 m<sup>3</sup> × (s · m<sup>3</sup>)] of room volume.

**~~2311.7.2.2~~ Operation.** ~~Activation of the gas detection~~ The mechanical exhaust ventilation system shall ~~result in all the following:~~ operate continuously.

- ~~1. Initiation of distinct audible and visual alarm signals in the repair garage.~~
- ~~2. Deactivation of all heating systems located in the repair garage.~~
- ~~3. Activation of the mechanical ventilation system, where the system is interlocked with gas detection.~~

**Exceptions:**

1. Mechanical exhaust ventilation systems that are interlocked with a gas detection system designed in accordance with Sections 2311.7.3 through 2311.7.3.3.
2. Mechanical exhaust ventilation systems in repair garages that are used only for repair of vehicles fueled by liquid fuels or odorized gases, such as CNG, where the exhaust ventilation system is electrically interlocked with the lighting circuit.

**~~2311.7.2~~ ~~2311.7.3~~ Gas detection system.** *No change to text.*

**~~2311.7.2.1~~ ~~2311.7.3.1~~ System design.** *No change to text.*

**~~2311.7.2.1.1~~ ~~2311.7.3.1.1~~ Gas detection system components.** *No change to text.*

**~~2311.7.2.2~~ ~~2311.7.3.2~~ Operation.** Activation of the gas detection system shall result in all the following:

1. Initiation of distinct audible and visual alarm signals in the repair garage.
2. Deactivation of all heating systems located in the repair garage.
3. Activation of the mechanical exhaust ventilation system, where the system is interlocked with gas detection.

**~~2311.7.2.3~~ ~~2311.7.3.3~~ Failure of the gas detection system.** Failure of the gas detection system shall result in the deactivation of the heating system, activation of the mechanical exhaust ventilation system where the system is interlocked with the gas detection system and cause a trouble signal to sound in an *approved* location.

## 2015 International Mechanical Code

Revise as follows:

**[F] 502.16 Repair garages for ~~natural gas and hydrogen fueled vehicles~~ fueled by lighter-than-air fuels.** Repair garages used for the conversion and repair of vehicles which use CNG, liquefied natural

gas (LNG), hydrogen or hydrogen-fueled vehicles ~~other lighter-than-air motor fuels~~ shall be provided with an *approved* mechanical exhaust ventilation system. The mechanical exhaust ventilation system shall be in accordance with Sections 502.16.1 ~~and or~~ 502.16.2 as applicable.

**Exception** ~~Exceptions:~~ ~~Where approved by the code official, natural ventilation shall be permitted in lieu of mechanical ventilation.~~

1. Repair garages where work is not performed on the fuel system and is limited to exchange of parts and maintenance not requiring open flame or welding on the CNG-, LNG-, hydrogen- or other lighter-than-air-fueled motor vehicle.
2. Repair garages for hydrogen-fueled vehicles where work is not performed on the hydrogen storage tank and is limited to the exchange of parts and maintenance not requiring open flame or welding on the hydrogen-fueled vehicle. During the work, the entire hydrogen fuel system shall contain a quantity that is less than 200 cubic feet (5.6 m<sup>3</sup>) of hydrogen.

**Add new text as follows:**

**[F] 502.16.1 Repair garages used for the repair of hydrogen-fueled vehicles** Repair garages used for the repair of hydrogen-fueled vehicles shall be provided with an approved exhaust ventilation system in accordance with this code and Chapter 6 of NFPA 2.

**[F] 502.16.2 Exhaust ventilation system** Repair garages used for the repair of CNG, liquefied natural gas (LNG), or other lighter-than-air motor fuels other than hydrogen shall be provided with an approved mechanical exhaust ventilation system. The mechanical exhaust ventilation system shall be in accordance with this code and Sections 502.16.2.1 and 502.16.2.2.

**Exception:** Where approved by the code official, natural ventilation shall be permitted in lieu of mechanical exhaust ventilation.

**Revise as follows:**

**[F] ~~502.16.1~~502.16.2.1 Design.** Indoor locations shall be ~~ventilated~~ exhausted utilizing air supply inlets and exhaust outlets arranged to provide uniform air movement to the extent practical. Inlets shall be uniformly arranged on ~~exterior~~ walls near floor level. Outlets shall be located at the high point of the room in ~~exterior~~ walls or the roof.

~~Ventilation~~ Exhaust ventilation shall be by a continuous mechanical exhaust ventilation system or by a mechanical exhaust ventilation system activated by a continuously monitoring natural gas detection system, ~~or for hydrogen, a continuously monitoring flammable gas detection system, each~~ activating at a gas concentration of 25 percent of the lower flammable limit (LFL). In all cases, the system shall shut down the fueling system in the event of failure of the exhaust ventilation system.

The exhaust ventilation rate shall be not less than 1 cubic foot per minute per 12 cubic feet [0.00138 m<sup>3</sup>/(s • m<sup>3</sup>)] of room volume.

**[F] ~~502.16.2~~502.16.2.2 Operation.** The mechanical exhaust ventilation system shall operate continuously.

**Exceptions:**

1. Mechanical exhaust ventilation systems that are interlocked with a gas detection system designed in accordance with the *International Fire Code*.
2. Mechanical exhaust ventilation systems in garages that are used only for the repair of vehicles fueled by liquid fuels or odorized gases, such as CNG, where the exhaust ventilation system is electrically interlocked with the lighting circuit.



## 2015 International Fuel Gas Code

**703.1 Hydrogen-generating and refueling operations.** Hydrogen-generating and refueling appliances shall be installed and located in accordance with their listing and the manufacturer's instructions. ~~Ventilation-Exhaust ventilation shall be required in accordance with Section 703.1.1, 703.1.2 or 703.1.3 in public garages, private garages, repair garages, automotive motor fuel-dispensing facilities and parking garages that contain hydrogen-generating appliances or refueling systems in accordance with NFPA 2.~~ For the purpose of this section, rooms or spaces that are not part of the living space of a dwelling unit and that communicate directly with a private garage through openings shall be considered to be part of the private garage.

### Delete without substitution:

**703.1.1 Natural ventilation.** Indoor locations intended for hydrogen-generating or refueling operations shall be limited to a maximum floor area of 850 square feet (79 m<sup>2</sup>) and shall communicate with the outdoors in accordance with Sections 703.1.1.1 and 703.1.1.2. The maximum rated output capacity of hydrogen-generating appliances shall not exceed 4 standard cubic feet per minute (0.00189 m<sup>3</sup>/s) of hydrogen for each 250 square feet (23.2 m<sup>2</sup>) of floor area in such spaces. The minimum cross-sectional dimension of air openings shall be 3 inches (76 mm). Where ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect. In such locations, equipment and appliances having an ignition source shall be located such that the source of ignition is not within 12 inches (305 mm) of the ceiling.

**703.1.1.1 Two openings.** Two permanent openings shall be provided within the garage. The upper opening shall be located entirely within 12 inches (305 mm) of the ceiling of the garage. The lower opening shall be located entirely within 12 inches (305 mm) of the floor of the garage. Both openings shall be provided in the same exterior wall. The openings shall communicate directly with the outdoors and shall have a minimum free area of  $\frac{1}{2}$  square foot per 1,000 cubic feet (1 m<sup>2</sup>/610 m<sup>3</sup>) of garage volume.

**703.1.1.2 Louvers and grilles.** In calculating the free area required by Section 703.1.1.1, the required size of openings shall be based on the net free area of each opening. If the free area through a design of louver or grille is known, it shall be used in calculating the size opening required to provide the free area specified. If the design and free area are not known, it shall be assumed that wood louvers will have 25-percent free area and metal louvers and grilles will have 75-percent free area. Louvers and grilles shall be fixed in the open position.

**703.1.2 Mechanical ventilation.** Indoor locations intended for hydrogen-generating or refueling operations shall be ventilated in accordance with Section 502.16 of the *International Mechanical Code*. In such locations, equipment and appliances having an ignition source shall be located such that the source of ignition is below the mechanical ventilation outlet(s).

**703.1.3 Specially engineered installations.** As an alternative to the provisions of Sections 703.1.1 and 703.1.2, the necessary supply of air for ventilation and dilution of flammable gases shall be provided by an approved engineered system.

**Reference standards type:** This is an update to reference standard(s) already in the ICC Code Books  
**Add new standard(s) as follows:**

IMC and IFGC  
NFPA 2-2016 Hydrogen Technologies Code

**Reason:** This proposal is a comprehensive fix of the exhaust ventilation requirements for repair garages for hydrogen fueled vehicles and for exhaust ventilation requirements for the installation hydrogen-generating and refueling operations. The primary goal was consistency and correlation between the requirements found within the IFC, the IMC and the IFGC along with tighter correlation with the requirements of NFPA 2. (A special note: Currently the hydrogen exhaust requirements are blended with the requirements for other lighter than air fuels; this proposal separates those technical requirements with no technical change other than for hydrogen.)

Section 2311.7 of the fire code has been modified to separate the requirements for hydrogen fueled vehicles from other lighter than air fueled vehicles. A new Section 2311.7.1 has been added to direct the code user to NFPA 2 for hydrogen fueled vehicle repair garages.

All of the requirements for exhaust of repair garages for hydrogen fuel vehicles is covered in NFPA 2 where the IFC already directs the user for the overwhelming majority of the hydrogen as a fuel construction and operation requirements regulated by the fire code. In addition, the air exhaust rate is different in NFPA 2 for hydrogen and this proposal would point the user to the correct exhaust rate.

The exception language in 2311.7.2 (new numbering) was modified to match existing verbiage found in the IMC.

The word exhaust was added to or replaced references to ventilation throughout 2311.7 to correlate with the type of system being required in accordance with Chapter 5 Exhaust in the IMC.

The IMC correlating language found in Section 502.16 has been modified to match the scoping language found within the IFC as to types of fuels covered. The technical language has been aligned to pick up earlier changes to the IFC over several cycles as well as the new modifications proposed to separate out hydrogen fueled vehicles and point to NFPA 2 for those facilities.

Section 304.5 of the IMC, the correlating Section 703.1 of the IFGC address exhaust ventilation for occupancies with Hydrogen-generating and refueling appliances. The language has been modified to delete the three subsections and point the user to NFPA 2 where the requirements are covered. Eliminating the language provides clarification and eliminates a conflict within the mechanical code. Option 1 was natural ventilation with very specific requirements; Option 2 was mechanical exhaust which points to Section 502.16 of the mechanical code which again provided for a natural ventilation exception with no specific requirements. Option 3 was for a specialty engineered system with no parameters, as a result a designer would default to NFPA 2 for guidance. By deleting the three options and pointing the user to NFPA 2 the correct requirements are provided including a natural ventilation option along with the other comprehensive portions of NFPA 2 that apply to this specialized type of installation.

The provisions NFPA 2 - related to the issues addressed in this proposal are found in Section 6.17 of NFPA 2-2016. A link to the NFPA website where free access is provided to the standard is as follows: [NFPA 2](#)

**Cost Impact:** Will not increase the cost of construction

This proposal will reduce the cost of installation by eliminating an internal conflict within the IMC, by correlating all of the ICC codes dealing with this topic, and by providing for tighter correlation with NFPA 2 which the I-Codes already refer to for these types of installations.

<b>Report of Committee Action Hearings</b>
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**Committee Action:**

**Approved as Submitted**

**Committee Reason:** This proposal was approved based upon the proponent's reason statement.

**Assembly Action:**

**None**

<b>Final Action Results</b>
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**F274-16**

**AS**

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# Code Change No: FG11-15

## Original Proposal

### FG11-15

#### 303.3

BACK

**Proponent:** Timothy Manz, representing Association of Minnesota Building Officials  
(tmanz@ci.blaine.mn.us)

**Revise as follows:**

**303.3 Prohibited locations.** Appliances shall not be located in sleeping rooms, bathrooms, toilet rooms, storage closets or surgical rooms, or in a space that opens only into such rooms or spaces, except where the installation complies with one of the following:

1. The *appliance* is a direct-vent *appliance* installed in accordance with the conditions of the listing and the manufacturer's instructions.
2. Vented room heaters, wall furnaces, vented decorative appliances, vented gas fireplaces, vented gas fireplace heaters and decorative appliances for installation in vented solid fuel-burning fireplaces are installed in rooms that meet the required volume criteria of Section 304.5.
3. A single wall-mounted unvented room heater is installed in a bathroom and such unvented room heater is equipped as specified in Section 621.6 and has an input rating not greater than 6,000 Btu/h (1.76 kW). The bathroom shall meet the required volume criteria of Section 304.5.
4. A single wall-mounted unvented room heater is installed in a bedroom and such unvented room heater is equipped as specified in Section 621.6 and has an input rating not greater than 10,000 Btu/h (2.93 kW). The bedroom shall meet the required volume criteria of Section 304.5.
5. The *appliance* is installed in a room or space that opens only into a bedroom or bathroom, and such room or space is used for no other purpose and is provided with a solid weather-stripped door equipped with an *approved* self-closing device. All *combustion air* shall be taken directly from the outdoors in accordance with Section 304.6.
6. A gas clothes dryer is installed in a bathroom or toilet room and a permanent opening having an area of not less than 100 square inches is provided that allows the toilet room or bathroom to communicate with a common hallway or common space.

**Reason:** In older homes the electrical service is not large enough for an electric dryer, so installing a gas dryer is the only option. In many homes it is desirable to have the gas dryer in an over-sized bathroom or toilet room on an upper floor. This provision provides a safe installation by requiring a minimum 100 square inch opening to a common space that ensures adequate natural ventilation is provided.

**Cost Impact:** Will not increase the cost of construction.

This provision will not increase the cost of construction since it provides flexibility in the dryer installation.

## Report of Committee Action Hearings

### FG11-15

**Committee Action:**

**Approved as Modified**

**303.3 Prohibited locations.** Appliances shall not be located in sleeping rooms, bathrooms, toilet rooms, storage closets or surgical rooms, or in a space that opens only into such rooms or spaces, except where the installation complies with one of the following:

1. The *appliance* is a direct-vent *appliance* installed in accordance with the conditions of the listing and the manufacturer's instructions.
2. Vented room heaters, wall furnaces, vented decorative appliances, vented gas fireplaces, vented gas fireplace heaters and decorative appliances for installation in vented solid fuel-burning fireplaces are installed in rooms that meet the required volume criteria of Section 304.5.
3. A single wall-mounted unvented room heater is installed in a bathroom and such unvented room heater is equipped as specified in Section 621.6 and has an input rating not greater than 6,000 Btu/h (1.76 kW). The bathroom shall meet the required volume criteria of Section 304.5.
4. A single wall-mounted unvented room heater is installed in a bedroom and such unvented room heater is equipped as specified in Section 621.6 and has an input rating not greater than 10,000 Btu/h (2.93 kW). The bedroom shall meet the required volume criteria of Section 304.5.

5. The *appliance* is installed in a room or space that opens only into a bedroom or bathroom, and such room or space is **used for no other purpose** and is provided with a solid weather-stripped door equipped with an *approved* self-closing device. All *combustion air* shall be taken directly from the outdoors in accordance with Section 304.6.
6. A gas clothes dryer is installed in a residential bathroom or toilet room and having a permanent opening having with an area of not less than 100 square inches is provided that allows the toilet room or bathroom to communicate/communicates with a common hallway space outside of a sleeping room, bathroom, toilet room, or common space-storage closet.

**Committee Reason:** Approval was based on the proponent's published reason statement. The modification replaced the undefined terms common hallway and common space with references to the spaces outside of the room containing the dryer.

**Assembly Motion:**

**Disapproved**

<b>Public Comments</b>
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*Public Comment 1:*

**Proponent: Bruce Swiecicki, representing Self (bswecicki@npga.org) requests Approve as Modified by Committee.**

**Commenter's Reason:** The fact is that gas clothes dryers are being installed and used in residential bathrooms. This is necessary because of the shift to scaled down living spaces being utilized today. It is necessary for the code to address these installations so they can be made in a safe manner.

*Public Comment 2:*

**Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute (srosenstock@eei.org) requests Approve as Modified by this Public Comment.**

**Modify as Follows:**

**303.3 Prohibited locations.** Appliances shall not be located in sleeping rooms, bathrooms, toilet rooms, storage closets or surgical rooms, or in a space that opens only into such rooms or spaces, except where the installation complies with one of the following:

1. The *appliance* is a direct-vent *appliance* installed in accordance with the conditions of the listing and the manufacturer's instructions.
2. Vented room heaters, wall furnaces, vented decorative appliances, vented gas fireplaces, vented gas fireplace heaters and decorative appliances for installation in vented solid fuel- burning fireplaces are installed in rooms that meet the required volume criteria of Section 304.5.
3. A single wall-mounted unvented room heater is installed in a bathroom and such unvented room heater is equipped as specified in Section 621.6 and has an input rating not greater than 6,000 Btu/h (1.76 kW). The bathroom shall meet the required volume criteria of Section 304.5.
4. A single wall-mounted unvented room heater is installed in a bedroom and such unvented room heater is equipped as specified in Section 621.6 and has an input rating not greater than 10,000 Btu/h (2.93 kW). The bedroom shall meet the required volume criteria of Section 304.5.
5. The *appliance* is installed in a room or space that opens only into a bedroom or bathroom, and such room or space is used for no other purpose and is provided with a solid weather-stripped door equipped with an *approved* self-closing device. All *combustion air* shall be taken directly from the outdoors in accordance with Section 304.6.
6. A gas clothes dryer is installed in a residential bathroom or toilet room having a permanent opening with an area of not less than 100 square inches that communicates with a space outside of a sleeping room, bathroom, toilet room, or storage closet.

**Commenter's Reason:** This addition will clarify the code, and avoid confusion if a different type of dryer (such as an electric dryer) is installed.

*Public Comment 3:*

**Proponent: Assembly Action requests Disapprove.**

**Committer's Reason:** This code change proposal is on the agenda for individual consideration because the proposal received a successful assembly action. The assembly action for Disapprove was successful by a vote of 70.09% (75) to 29.91% (32) by eligible members online during the period of May 14 - May 28, 2015.

<b>Final Action Results</b>
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<b>FG11-15</b>	<b>AM</b>
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GENERAL REGULATIONS

For purposes of this calculation, an infiltration rate greater than 0.60 ACH shall not be used in Equations 3-1 and 3-2.

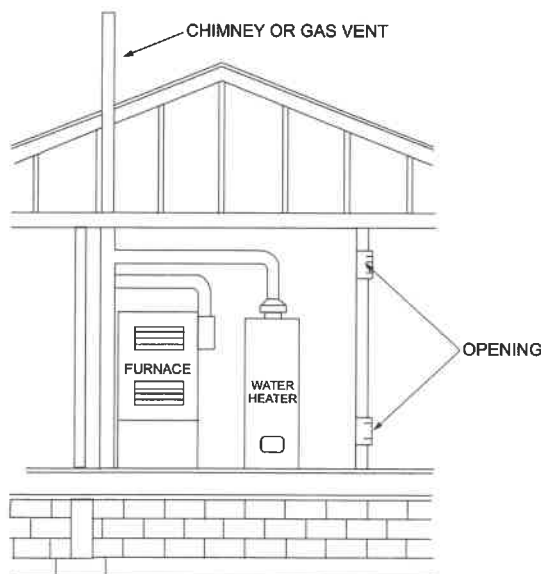
**304.5.3 Indoor opening size and location.** Openings used to connect indoor spaces shall be sized and located in accordance with Sections 304.5.3.1 and 304.5.3.2 (see Figure 304.5.3).

**304.5.3.1 Combining spaces on the same story.** Where combining spaces on the same story, each opening shall have a minimum free area of 1 square inch per 1,000 Btu/h (2200 mm<sup>2</sup>/kW) of the total input rating of all appliances in the space, but not less than 100 square inches (0.06 m<sup>2</sup>). One permanent opening shall commence within 12 inches (305 mm) of the top and one permanent opening shall commence within 12 inches (305 mm) of the bottom of the enclosure. The minimum dimension of air openings shall be not less than 3 inches (76 mm).

**304.5.3.2 Combining spaces in different stories.** The volumes of spaces in different stories shall be considered to be 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 square inches per 1,000 Btu/h (4402 mm<sup>2</sup>/kW) of total input rating of all appliances.

**304.6 Outdoor combustion air.** Outdoor combustion air shall be provided through opening(s) to the outdoors in accordance with Section 304.6.1 or 304.6.2. The minimum dimension of air openings shall be not less than 3 inches (76 mm).

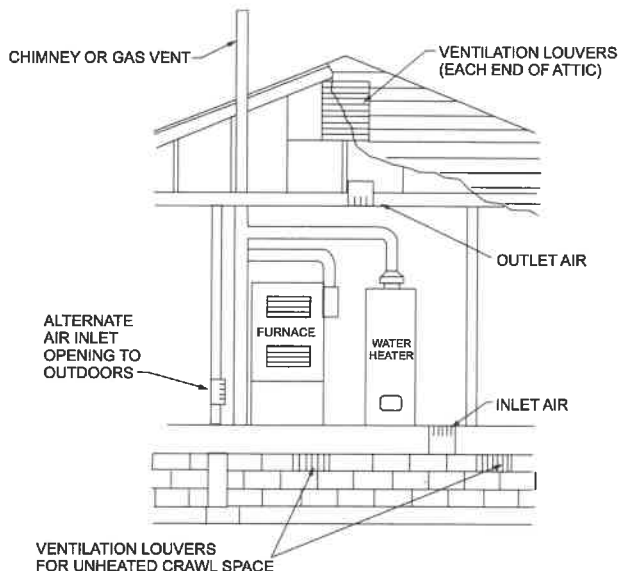
**304.6.1 Two-permanent-openings method.** Two permanent openings, one commencing within 12 inches (305 mm) of the top and one commencing within 12 inches (305 mm) of the bottom of the enclosure, shall be provided. The openings shall communicate directly or by



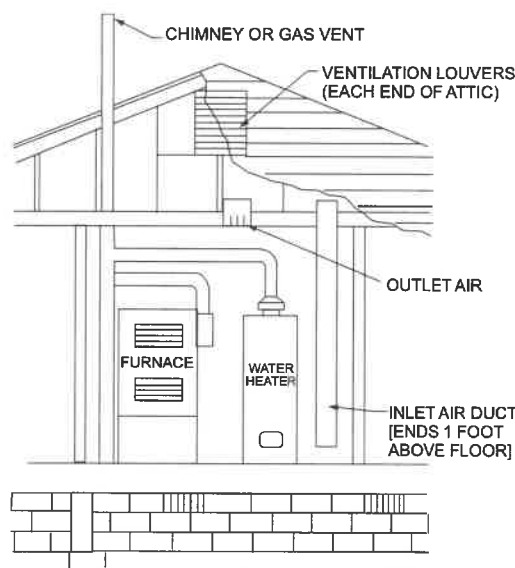
**FIGURE 304.5.3**  
ALL AIR FROM INSIDE THE BUILDING  
(see Section 304.5.3)

ducts with the outdoors or spaces that freely communicate with the outdoors.

Where directly communicating with the outdoors, or where communicating with the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4,000 Btu/h (550 mm<sup>2</sup>/kW) of total input rating of all appliances in the enclosure [see Figures 304.6.1(1) and 304.6.1(2)].



**FIGURE 304.6.1(1)**  
ALL AIR FROM OUTDOORS—INLET AIR FROM VENTILATED  
CRAWL SPACE AND OUTLET AIR TO VENTILATED ATTIC  
(see Section 304.6.1)



For SI: 1 foot = 304.8 mm.

**FIGURE 304.6.1(2)**  
ALL AIR FROM OUTDOORS THROUGH VENTILATED ATTIC  
(see Section 304.6.1)

## GENERAL REGULATIONS

**310.2 CSST.** This section applies to corrugated stainless steel tubing (CSST) that is not listed with an arc-resistant jacket or coating system in accordance with ANSI LC 1/CSA 6.26. CSST gas *piping* systems and piping systems containing one or more segments of CSST shall be electrically continuous and bonded to the electrical service grounding electrode system or, where provided, the lightning protection grounding electrode system.

**310.2.1 Point of connection.** The bonding jumper shall connect to a metallic pipe, pipe fitting or CSST fitting.

**310.2.2 Size and material of jumper.** The bonding jumper shall be not smaller than 6 AWG copper wire or equivalent.

**310.2.3 Bonding jumper length.** The length of the bonding jumper between the connection to a gas piping system and the connection to a grounding electrode system shall not exceed 75 feet (22 860 mm). Any additional grounding electrodes installed to meet this requirement shall be bonded to the electrical service grounding electrode system or, where provided, the lightning protection grounding electrode system.

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

**310.2.5 Connection devices.** Devices used for making the bonding connections shall be listed for the application in accordance with UL 467.

**310.3 Arc-resistant CSST.** This section applies to corrugated stainless steel tubing (CSST) that is listed with an arc-resistant jacket or coating system in accordance with ANSI LC 1/CSA 6.26. The CSST shall be electrically continuous and bonded to an effective ground fault current path. Where any CSST component of a piping system does not have an arc-resistant jacket or coating system, the bonding requirements of Section 310.2 shall apply. Arc-resistant-jacketed CSST shall be considered to be bonded where it is connected to an appliance that is connected to the appliance grounding conductor of the circuit that supplies that appliance.

## CHAPTER 4

# GAS PIPING INSTALLATIONS

### User note:

*About this chapter:* Chapter 4 addresses all aspects of fuel gas piping including the allowed materials, design and sizing, piping support, pressure requirements, controls, connections to appliances, installation requirements, purging and testing. Also addressed are motor vehicle fuel dispensing systems. The overarching intent is to prevent gas leakage, overpressures and underpressures and prevent accidents.

### SECTION 401 (IFGC) GENERAL

**401.1 Scope.** This chapter shall govern the design, installation, modification and maintenance of *piping* systems. The applicability of this code to *piping* systems extends from the *point of delivery* to the connections with the *appliances* and includes the design, materials, components, fabrication, assembly, installation, testing, inspection, operation and maintenance of such *piping* systems.

**401.1.1 Utility piping systems located within buildings.** Utility service *piping* located within buildings shall be installed in accordance with the structural safety and fire protection provisions of the *International Building Code*.

**401.2 Liquefied petroleum gas storage.** The storage system for liquefied petroleum gas shall be designed and installed in accordance with the *International Fire Code* and NFPA 58.

**401.3 Modifications to existing systems.** In modifying or adding to existing *piping* systems, sizes shall be maintained in accordance with this chapter.

**401.4 Additional appliances.** Where an additional *appliance* is to be served, the existing *piping* shall be checked to determine if it has adequate capacity for all *appliances* served. If inadequate, the existing system shall be enlarged as required or separate *piping* of adequate capacity shall be provided.

**401.5 Identification.** For other than steel pipe, exposed *piping* shall be identified by a yellow label marked "Gas" in black letters. The marking shall be spaced at intervals not exceeding 5 feet (1524 mm). The marking shall not be required on pipe located in the same room as the *appliance* served.

**401.6 Interconnections.** Where two or more meters are installed on the same premises but supply separate consumers, the *piping* systems shall not be interconnected on the *outlet* side of the meters.

**401.7 Piping meter identification.** *Piping* from multiple meter installations shall be marked with an *approved* permanent identification by the installer so that the *piping* system supplied by each meter is readily identifiable.

**401.8 Minimum sizes.** Pipe utilized for the installation, extension and *alteration* of any *piping* system shall be sized to supply the full number of outlets for the intended purpose and shall be sized in accordance with Section 402.

**401.9 Identification.** Each length of pipe and tubing and each pipe fitting, utilized in a fuel gas system, shall bear the identification of the manufacturer.

#### Exceptions:

1. Steel pipe sections that are 2 feet (610 mm) and less in length and are cut from longer sections of pipe.
2. Steel pipe fittings 2 inches and less in size.
3. Where identification is provided on the product packaging or crating.
4. Where other approved documentation is provided.

**401.10 Piping materials standards.** Piping, tubing and fittings shall be manufactured to the applicable referenced standards, specifications and performance criteria listed in Section 403 and shall be identified in accordance with Section 401.9.

### SECTION 402 (IFGS) PIPE SIZING

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

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

The total connected hourly load shall be used as the basis for pipe sizing, assuming that all appliances could be operating at full capacity simultaneously. Where a diversity of load can be established, pipe sizing shall be permitted to be based on such loads.

The volumetric flow rate of gas to be provided shall be adjusted for altitude where the installation is above 2,000 feet (610 m) in elevation.

**402.3 Sizing.** Gas *piping* shall be sized in accordance with one of the following:

- ④ 1. Pipe sizing tables or sizing equations in accordance with Section 402.4 or 402.5 as applicable.
2. The sizing tables included in a *listed piping* system's manufacturer's installation instructions.
3. Other *approved* engineering methods.





**402.4 Sizing tables and equations.** This section applies to piping materials other than noncorrugated stainless steel tubing. Where Tables 402.4(1) through 402.4(37) are used to size piping or tubing, the pipe length shall be determined in accordance with Section 402.4.1, 402.4.2 or 402.4.3.

Where Equations 4-1 and 4-2 are used to size piping or tubing, the pipe or tubing shall have smooth inside walls and the pipe length shall be determined in accordance with Section 402.4.1, 402.4.2 or 402.4.3.

1. Low-pressure gas equation [Less than 1½ pounds per square inch (psi) (10.3 kPa)]:

$$D = \frac{Q^{0.381}}{19.17 \left( \frac{\Delta H}{C_r \times L} \right)^{0.206}} \quad \text{(Equation 4-1)}$$

2. High-pressure gas equation [1½ psi (10.3 kPa) and above]:

$$D = \frac{Q^{0.381}}{18.93 \left[ \frac{(P_1^2 - P_2^2) \times Y}{C_r \times L} \right]^{0.206}} \quad \text{(Equation 4-2)}$$

where:

- D = Inside diameter of pipe, inches (mm).
- Q = Input rate appliance(s), cubic feet per hour at 60°F (16°C) and 30-inch mercury column.
- P<sub>1</sub> = Upstream pressure, psia (P<sub>1</sub> + 14.7).
- P<sub>2</sub> = Downstream pressure, psia (P<sub>2</sub> + 14.7).
- L = Equivalent length of pipe, feet.
- ΔH = Pressure drop, inch water column (27.7-inch water column = 1 psi).

**TABLE 402.4  
C, AND Y VALUES FOR NATURAL GAS AND  
UNDILUTED PROPANE AT STANDARD CONDITIONS**

GAS	EQUATION FACTORS	
	C <sub>r</sub>	Y
Natural gas	0.6094	0.9992
Undiluted propane	1.2462	0.9910

For SI: 1 cubic foot = 0.028 m<sup>3</sup>, 1 foot = 305 mm,  
1-inch water column = 0.2488 kPa,  
1 pound per square inch = 6.895 kPa,  
1 British thermal unit per hour = 0.293 W.

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

**402.4.2 Branch length method.** Pipe shall be sized as follows:

1. Pipe size of each section of the longest pipe run from the point of delivery to the most remote outlet

shall be determined using the longest run of piping and the load of the section.

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

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

**402.5 Noncorrugated stainless steel tubing.** Noncorrugated stainless steel tubing shall be sized in accordance with Equations 4-1 and 4-2 of Section 402.4 in conjunction with Section 402.4.1, 402.4.2 or 402.4.3.

**402.6 Allowable pressure drop.** The design pressure loss in any piping system under maximum probable flow conditions, from the point of delivery to the inlet connection of the appliance, shall be such that the supply pressure at the appliance is greater than or equal to the minimum pressure required by the appliance.

**402.7 Maximum operating pressure.** The maximum operating pressure for piping systems located inside buildings shall not exceed 5 pounds per square inch gauge (psig) (34 kPa gauge) except where one or more of the following conditions are met:

1. The piping joints are welded or brazed.
2. The piping joints are flanged and pipe-to-flange connections are made by welding or brazing.
3. The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
4. The piping is located inside buildings or separate areas of buildings used exclusively for any of the following:
  - 4.1. Industrial processing or heating.
  - 4.2. Research.
  - 4.3. Warehousing.
  - 4.4. Boiler or mechanical rooms.
5. The piping is a temporary installation for buildings under construction.
6. The piping serves appliances or equipment used for agricultural purposes.
7. The piping system is an LP-gas piping system with an operating pressure greater than 20 psi (137.9 kPa) and complies with NFPA 58.

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

**TABLE 402.4(16)**  
**CORRUGATED STAINLESS STEEL TUBING (CSST)**

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

Flow Designation Length (ft)	INTENDED USE: INITIAL SUPPLY PRESSURE OF 8.0-INCH W.C. OR GREATER													
	TUBE SIZE (EHD)													
	13	15	18	19	23	25	30	31	37	39	46	48	60	62
	120	160	277	327	529	649	1,180	1,370	2,140	2,423	4,430	5,010	8,800	10,100
5	83	112	197	231	380	462	828	958	1,530	1,740	3,200	3,560	6,270	7,160
10	67	90	161	189	313	379	673	778	1,250	1,433	2,540	2,910	5,140	5,850
15	57	78	140	164	273	329	580	672	1,090	1,249	2,200	2,530	4,460	5,070
20	51	69	125	147	245	295	518	599	978	1,123	1,960	2,270	4,000	4,540
25	46	63	115	134	225	270	471	546	895	1,029	1,790	2,070	3,660	4,140
30	39	54	100	116	196	234	407	471	778	897	1,550	1,800	3,180	3,590
40	35	48	89	104	176	210	363	421	698	806	1,380	1,610	2,850	3,210
50	32	44	82	95	161	192	330	383	639	739	1,260	1,470	2,600	2,930
60	29	41	76	88	150	178	306	355	593	686	1,170	1,360	2,420	2,720
70	27	38	71	82	141	167	285	331	555	644	1,090	1,280	2,260	2,540
80	26	36	67	77	133	157	268	311	524	609	1,030	1,200	2,140	2,400
90	24	34	63	73	126	149	254	295	498	579	974	1,140	2,030	2,280
100	19	27	52	60	104	122	206	240	409	477	793	936	1,660	1,860
150	17	23	45	52	91	106	178	207	355	415	686	812	1,440	1,610
200	15	21	40	46	82	95	159	184	319	373	613	728	1,290	1,440
250	13	19	37	42	75	87	144	168	234	342	559	665	1,180	1,320
300														

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1-inch water column = 0.2488 kPa, 1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m<sup>3</sup>/h, 1 degree = 0.01745 rad.

**Notes:**

1. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends or fittings shall be increased by an equivalent length of tubing to the following equation:  
 $L = 1.3n$  where  $L$  is additional length (feet) of tubing and  $n$  is the number of additional fittings or bends.
2. EHD—Equivalent Hydraulic Diameter, which is a measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.
3. Table entries have been rounded to three significant digits.

**TABLE 402.4(17)**  
**CORRUGATED STAINLESS STEEL TUBING (CSST)**

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

Flow Designation Length (ft)	INTENDED USE: INITIAL SUPPLY PRESSURE OF 11.0-INCH W.C. OR GREATER													
	TUBE SIZE (EHD)													
	13	15	18	19	23	25	30	31	37	39	46	48	60	62
	Capacity in Cubic Feet of Gas Per Hour													
5	173	229	389	461	737	911	1,690	1,950	3,000	3,375	6,280	7,050	12,400	14,260
10	120	160	277	327	529	649	1,180	1,370	2,140	2,423	4,430	5,010	8,800	10,100
15	96	130	227	267	436	532	960	1,110	1,760	1,996	3,610	4,100	7,210	8,260
20	83	112	197	231	380	462	828	958	1,530	1,740	3,120	3,560	6,270	7,160
25	74	99	176	207	342	414	739	855	1,370	1,564	2,790	3,190	5,620	6,400
30	67	90	161	189	313	379	673	778	1,250	1,433	2,540	2,910	5,140	5,850
40	57	78	140	164	273	329	580	672	1,090	1,249	2,200	2,530	4,460	5,070
50	51	69	125	147	245	295	518	599	978	1,123	1,960	2,270	4,000	4,540
60	46	63	115	134	225	270	471	546	895	1,029	1,790	2,070	3,660	4,140
70	42	58	106	124	209	250	435	505	830	956	1,660	1,920	3,390	3,840
80	39	54	100	116	196	234	407	471	778	897	1,550	1,800	3,180	3,590
90	37	51	94	109	185	221	383	444	735	848	1,460	1,700	3,000	3,390
100	35	48	89	104	176	210	363	421	698	806	1,380	1,610	2,850	3,210
150	28	39	73	85	145	172	294	342	573	664	1,130	1,320	2,340	2,630
200	24	34	63	73	126	149	254	295	498	579	974	1,140	2,030	2,280
250	21	30	57	66	114	134	226	263	447	520	870	1,020	1,820	2,040
300	19	27	52	60	104	122	206	240	409	477	793	936	1,660	1,860

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1-inch water column = 0.2488 kPa.

1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m<sup>3</sup>/h, 1 degree = 0.01745 rad.

**Notes:**

1. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends or fittings shall be increased by an equivalent length of tubing to the following equation:  
 $L = 1.3n$  where  $L$  is additional length (feet) of tubing and  $n$  is the number of additional fittings or bends.
2. EHD—Equivalent Hydraulic Diameter, which is a measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.
3. Table entries have been rounded to three significant digits.

## SECTION 403 (IFGS) PIPING MATERIALS

**403.1 General.** Materials used for *pipng* systems shall comply with the requirements of this chapter or shall be *approved*.

**403.2 Used materials.** Pipe, fittings, valves and other materials shall not be used again except where they are free of foreign materials and have been ascertained to be adequate for the service intended.

**403.3 Other materials.** Material not covered by the standards specifications listed herein shall be investigated and tested to determine that it is safe and suitable for the proposed service, and, in addition, shall be recommended for that service by the manufacturer and shall be *approved* by the code official.

**403.4 Metallic pipe.** Metallic pipe shall comply with Sections 403.4.1 through 403.4.4.

**403.4.1 Cast iron.** Cast-iron pipe shall not be used.

**403.4.2 Steel.** Steel, stainless steel and wrought-iron pipe shall be not lighter than Schedule 10 and shall comply with the dimensional standards of ASME B36.10M and one of the following standards:

1. ASTM A53/A53M.
2. ASTM A106.
3. ASTM A312.

**403.4.3 Copper and copper alloy.** Copper and copper alloy pipe shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet of gas (0.7 milligrams per 100 liters). Threaded copper, copper alloy and aluminum-alloy pipe shall not be used with gases corrosive to such materials.

**403.4.4 Aluminum.** Aluminum-alloy pipe shall comply with ASTM B241 except that the use of alloy 5456 is prohibited. Aluminum-alloy pipe shall be marked at each end of each length indicating compliance. Aluminum-alloy pipe shall be coated to protect against external corrosion where it is in contact with masonry, plaster or insulation, or is subject to repeated wettings by such liquids as water, detergents or sewage. Aluminum-alloy pipe shall not be used in exterior locations or underground.

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

**403.5.1 Steel tubing.** Steel tubing shall comply with ASTM A254.

**403.5.2 Stainless steel.** Stainless steel tubing shall comply with ASTM A268 or ASTM A269.

**403.5.3 Copper and copper alloy tubing.** Copper tubing shall comply with Standard Type K or L of ASTM B88 or ASTM B280.


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 standard cubic feet of gas (0.7 milligrams per 100 liters).

**403.5.4 Aluminum tubing.** Aluminum-alloy tubing shall comply with ASTM B210 or ASTM B241. Aluminum-alloy tubing shall be coated to protect against external corrosion where it is in contact with masonry, plaster or insulation, or is subject to repeated wettings by such liquids as water, detergent or sewage.

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

**403.5.5 Corrugated stainless steel tubing.** Corrugated stainless steel tubing shall be *listed* in accordance with ANSI LC 1/CSA 6.26.

**403.6 Plastic pipe, tubing and fittings.** Polyethylene plastic pipe, tubing and fittings used to supply fuel gas shall conform to ASTM D2513. Such pipe shall be marked "Gas" and "ASTM D2513."

 Polyamide pipe, tubing and fittings shall be identified and conform to ASTM F2945. Such pipe shall be marked "Gas" and "ASTM F2945."

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

**403.6.1 Anodeless risers.** Plastic pipe, tubing and anodeless risers shall comply with the following:

1. Factory-assembled anodeless risers shall be recommended by the manufacturer for the gas used and shall be leak tested by the manufacturer in accordance with written procedures.
2. Service head adapters and field-assembled anodeless risers incorporating service head adapters shall be recommended by the manufacturer for the gas used, and shall be designed and certified to meet the requirements of Category I of ASTM D2513, and U.S. Department of Transportation, Code of Federal Regulations, Title 49, Part 192.281(e). The manufacturer shall provide the user with qualified installation instructions as prescribed by the U.S. Department of Transportation, Code of Federal Regulations, Title 49, Part 192.283(b).

**403.6.2 LP-gas systems.** The use of plastic pipe, tubing and fittings in undiluted liquefied petroleum gas *pipng* systems shall be in accordance with NFPA 58.

**403.6.3 Regulator vent piping.** Plastic pipe and fittings used to connect regulator vents to remote vent terminations shall be PVC conforming to ANSI/UL 651. PVC vent *pipng* shall not be installed indoors.

**403.7 Workmanship and defects.** Pipe, tubing and fittings shall be clear and free from cutting burrs and defects in structure or threading, and shall be thoroughly brushed, and chip and scale blown.

Defects in pipe, tubing and fittings shall not be repaired. Defective pipe, tubing and fittings shall be replaced.

**403.8 Protective coating.** Where in contact with material or atmosphere exerting a corrosive action, metallic *pipng* and fittings coated with a corrosion-resistant material shall be used. External or internal coatings or linings used on *pipng* or components shall not be considered as adding strength.

**403.9 Metallic pipe threads.** Metallic pipe and fitting threads shall be taper pipe threads and shall comply with ASME B1.20.1.

**403.9.1 Damaged threads.** Pipe with threads that are stripped, chipped, corroded or otherwise damaged shall not be used. Where a weld opens during the operation of cutting or threading, that portion of the pipe shall not be used.

**403.9.2 Number of threads.** Field threading of metallic pipe shall be in accordance with Table 403.9.2.

**TABLE 403.9.2  
SPECIFICATIONS FOR THREADING METALLIC PIPE**

IRON PIPE SIZE (inches)	APPROXIMATE LENGTH OF THREADED PORTION (inches)	APPROXIMATE NUMBER OF THREADS TO BE CUT
1/2	3/4	10
3/4	3/4	10
1	7/8	10
1 1/4	1	11
1 1/2	1	11
2	1	11
2 1/2	1 1/2	12
3	1 1/2	12
4	1 5/8	13

For SI: 1 inch = 25.4 mm.

**403.9.3 Thread joint compounds.** Thread joint compounds shall be resistant to the action of liquefied petroleum gas or to any other chemical constituents of the gases to be conducted through the piping.

**403.10 Metallic piping joints and fittings.** The type of piping joint used shall be suitable for the pressure-temperature conditions and shall be selected giving consideration to joint tightness and mechanical strength under the service conditions. The joint shall be able to sustain the maximum end force caused by the internal pressure and any additional forces caused by temperature expansion or contraction, vibration, fatigue or the weight of the pipe and its contents.

**403.10.1 Pipe joints.** Schedule 40 and heavier pipe joints shall be threaded, flanged, brazed, welded or assembled with press-connect fittings listed in accordance with ANSI LC4/CSA 6.32. Pipe lighter than Schedule 40 shall be connected using press-connect fittings, flanges, brazing or welding. Where nonferrous pipe is brazed, the brazing materials shall have a melting point in excess of 1,000°F (538°C). Brazing alloys shall not contain more than 0.05-percent phosphorus.

**403.10.2 Copper tubing joints.** Copper tubing joints shall be assembled with approved gas tubing fittings, shall be brazed with a material having a melting point in excess of 1,000°F (538°C) or assembled with press-connect fittings listed in accordance with ANSI LC-4/CSA 6.32. Brazing alloys shall not contain more than 0.05-percent phosphorus.

**403.10.3 Stainless steel tubing joints.** Stainless steel tubing joints shall be welded, assembled with approved tubing fittings, brazed with a material having a melting point

in excess of 1,000°F (578°C), or assembled with press-connect fittings listed in accordance with ANSI LC4/CSA 6.32.

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

**403.10.5 Metallic fittings.** Metallic fittings shall comply with the following:

1. Threaded fittings in sizes larger than 4 inches (102 mm) shall not be used.
2. Fittings used with steel, stainless steel or wrought-iron pipe shall be steel, stainless steel, copper alloy, malleable iron or cast iron.
3. Fittings used with copper or copper alloy pipe shall be copper or copper alloy.
4. Fittings used with aluminum-alloy pipe shall be of aluminum alloy.
5. Cast-iron fittings:
  - 5.1. Flanges shall be permitted.
  - 5.2. Bushings shall not be used.
  - 5.3. Fittings shall not be used in systems containing flammable gas-air mixtures.
  - 5.4. Fittings in sizes 4 inches (102 mm) and larger shall not be used indoors except where approved.
  - 5.5. Fittings in sizes 6 inches (152 mm) and larger shall not be used except where approved.
6. Aluminum-alloy fittings. Threads shall not form the joint seal.
7. Zinc aluminum-alloy fittings. Fittings shall not be used in systems containing flammable gas-air mixtures.
8. Special fittings. Fittings such as couplings, proprietary-type joints, saddle tees, gland-type compression fittings and flared, flareless and compression-type tubing fittings shall be: used within the fitting manufacturer's pressure-temperature recommendations; used within the service conditions anticipated with respect to vibration, fatigue, thermal expansion and contraction; and shall be approved.
9. Where pipe fittings are drilled and tapped in the field, the operation shall be in accordance with all of the following:
  - 9.1. The operation shall be performed on systems having operating pressures of 5 psi (34.5 kPa) or less.
  - 9.2. The operation shall be performed by the gas supplier or the gas supplier's designated representative.
  - 9.3. The drilling and tapping operation shall be performed in accordance with written procedures prepared by the gas supplier.

**405.3 Plastic pipe.** Plastic pipe bends shall comply with the following:

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

**405.4 Elbows.** Factory-made welding elbows or transverse segments cut therefrom shall have an arc length measured along the crotch of not less than 1 inch (25 mm) in pipe sizes 2 inches (51 mm) and larger.

### SECTION 406 (IFGS) INSPECTION, TESTING AND PURGING

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

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

**406.1.2 Repairs and additions.** In the event repairs or additions are made after the pressure test, the affected *pipng* shall be tested.

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

**406.1.3 New branches.** Where new branches are installed to new *appliances*, only the newly installed branches shall be required to be pressure tested. Connections between the new *pipng* and the existing *pipng* shall be tested with a noncorrosive leak-detecting fluid or other *approved* leak-detecting methods.

**406.1.4 Section testing.** A *pipng* system shall be permitted to be tested as a complete unit or in sections. A valve in a line shall not be used as a bulkhead between gas in one section of the *pipng* system and test medium in an adjacent section, except where a double block and bleed valve system is installed. A valve shall not be subjected to the test pressure unless it can be determined that the valve, including the valve-closing mechanism, is designed to safely withstand the test pressure.

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

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

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

**406.3 Test preparation.** Pipe joints, including welds, shall be left exposed for examination during the test.

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

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

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

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

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

**406.3.5 Testing precautions.** Testing of *pipng* systems shall be performed in a manner that protects the safety of employees and the public during the test.

**406.4 Test pressure measurement.** 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 caused by leakage during the pressure test period. The source of pressure shall be isolated before the pressure tests are made. Mechanical gauges used to measure test pressures shall have a range such that the highest end of the scale is not greater than five times the test pressure.

**406.4.1 Test pressure.** The test pressure to be used shall be not less than 1½ times the proposed maximum working pressure, but not less than 3 psig (20 kPa gauge), irrespective of design pressure. Where the test pressure exceeds 125 psig (862 kPa gauge), the test pressure shall not exceed a value that produces a hoop stress in the *pipng* greater than 50 percent of the specified minimum yield strength of the pipe.

**406.4.2 Test duration.** Test duration shall be not less than ½ hour for each 500 cubic feet (14 m³) of pipe volume or fraction thereof. When testing a system having a volume less than 10 cubic feet (0.28 m³) or a system in a single-family dwelling, the test duration shall be not less than 10 minutes. The duration of the test shall not be required to exceed 24 hours.

### SECTION 413 (IFGC) COMPRESSED NATURAL GAS MOTOR VEHICLE FUEL-DISPENSING FACILITIES

[F] 413.1 **General.** Motor fuel-dispensing facilities for CNG fuel shall be in accordance with this section and the *International Fire Code*. The operation of CNG motor fuel-dispensing facilities shall be regulated by the *International Fire Code*.

[F] 413.2 **General.** Storage vessels and *equipment* used for the storage, compression or dispensing of CNG shall be *approved* or *listed* in accordance with Sections 413.2.1 through 413.2.3.

[F] 413.2.1 **Approved equipment.** Containers; compressors; pressure-relief devices, including pressure-relief valves; and pressure regulators and *pipng* used for CNG shall be *approved*.

[F] 413.2.2 **Listed equipment.** Hoses, hose connections, dispensers, gas detection systems and electrical *equipment* used for CNG shall be *listed*. Vehicle fueling connections shall be *listed* and *labeled*.

[F] 413.2.3 **General.** Residential fueling *appliances* shall be in accordance with Section 413.4.

[F] 413.3 **Location of dispensing operations and equipment.** Compression, storage and dispensing *equipment* shall be located outdoors, above ground.

#### Exceptions:

1. Compression, storage or dispensing *equipment* is not prohibited in buildings where such buildings are of noncombustible construction as set forth in the *International Building Code* and are unenclosed for not less than three-quarters of their perimeter.
2. Compression, storage and dispensing *equipment* is allowed to be located indoors or in vaults in accordance with the *International Fire Code*.

[F] 413.3.1 **Location on property.** In addition to the fuel-dispensing requirements of the *International Fire Code*, compression, storage and dispensing *equipment* not located in vaults complying with the *International Fire Code* and other than residential fueling appliances shall not be installed:

1. Beneath power lines.
2. Less than 10 feet (3048 mm) from the nearest building or property that could be built on, public street, sidewalk or source of ignition.

**Exception:** Dispensing *equipment* need not be separated from canopies that provide weather protection for the dispensing *equipment* and are constructed in accordance with the *International Building Code*.

3. Less than 25 feet (7620 mm) from the nearest rail of any railroad track.
4. Less than 50 feet (15 240 mm) from the nearest rail of any railroad main track or any railroad or transit line where power for train propulsion is provided by an outside electrical source, such as third rail or overhead catenary.
5. Less than 50 feet (15 240 mm) from the vertical plane below the nearest overhead wire of a trolley bus line.

[F] 413.4 **Residential fueling appliance installation.** Residential fueling *appliances* shall be installed in accordance with Sections 413.4.1 through 413.4.3.

[F] 413.4.1 **Listing and installation.** Residential fueling appliances shall be listed in accordance with ANSI NGV 5.1. Residential fueling appliances shall be installed in accordance with the appliance manufacturer's installation instructions.

[F] 413.4.2 **Gas connection.** Residential fueling appliances shall not be rigidly connected to the gas supply piping.

[F] 413.4.3 **Indoor installation.** A residential fueling appliance installed indoors or used for indoor fueling shall comply with all of the following:

1. The capacity shall not exceed 5 cubic feet per minute (0.14 m<sup>3</sup>/min) of natural gas.
2. Fuel gas from the pressure relief and blowdown systems shall be vented to the outdoors.
3. A methane gas detector shall be installed in the room or space containing the appliance or where fueling occurs and shall be located not lower than 6 inches (152 mm) from the highest point in the room or space. The detector shall be set to activate at one-fifth of the lower limit of flammability of natural gas and shall be interlocked with the residential fuel appliance to stop or prevent its operation upon activation. The detector shall have an audible or visible alarm.
4. The capacity of a residential fueling appliance installed outdoors for outdoor fueling shall not exceed 10 feet cubic per minute (0.28 m<sup>3</sup>/min) of natural gas. Residential fueling appliances located outdoors shall be installed on a firm, noncombustible base.

[F] 413.5 **Private fueling of motor vehicles.** Self-service CNG-dispensing systems, including key, code and card lock dispensing systems, shall be limited to the filling of permanently mounted fuel containers on CNG-powered vehicles.

In addition to the requirements in the *International Fire Code*, the owner of a self-service CNG-dispensing facility shall ensure the safe operation of the system and the training of users.

[F] 413.6 **Pressure regulators.** Pressure regulators shall be designed, installed or protected so their operation will not be affected by the elements (freezing rain, sleet, snow, ice, mud or debris). This protection is allowed to be integral with the regulator.

[F] 413.7 **Valves.** *Piping to equipment* shall be provided with a remote manual shutoff valve. Such valve shall be provided with ready access.

[F] 413.8 **Emergency shutdown control.** An emergency shutdown device shall be located within 75 feet (22 860 mm) of, but not less than 25 feet (7620 mm) from, dispensers and shall also be provided in the compressor area. Upon activation, the emergency shutdown system shall automatically shut off the power supply to the compressor and close valves between the main gas supply and the compressor and between the storage containers and dispensers.

[F] 413.9 **Discharge of CNG from motor vehicle fuel storage containers.** The discharge of CNG from motor vehicle

## SECTION 416 (IFGS) OVERPRESSURE PROTECTION DEVICES

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

**416.2 Pressure limitation requirements.** The requirements for pressure limitation shall be in accordance with Sections 416.2.1 through 416.2.5.

**416.2.1 Pressure under 14 inches w.c.** Where piping systems serving appliances designed to operate with a gas supply pressure of 14 inches w.c. or less are required to be equipped with overpressure protection by Section 416.1, each overpressure protection device shall be adjusted to limit the gas pressure to each connected appliance to 2 psi or less upon a failure of the line pressure regulator.

**416.2.2 Pressure over 14 inches w.c.** Where piping systems serving appliances designed to operate with a gas supply pressure greater than 14 inches w.c. are required to be equipped with overpressure protection by Section 416.1, each overpressure protection device shall be adjusted to limit the gas pressure to each connected appliance as required by the appliance manufacturer's installation instructions.

**416.2.3 Device capability.** Each overpressure protection device installed to meet the requirements of this section shall be capable of limiting the pressure to its connected appliance(s) as required by this Section 416.2.1, independently of any other pressure control equipment in the piping system.

**416.2.4 Failure detection.** Each gas piping system for which an overpressure protection device is required by Section 416 shall be designed and installed so that a failure of the primary pressure control device(s) is detectable.

**416.2.5 Relief valve.** Where a pressure relief valve is used to meet the requirements of Section 416, it shall have a flow capacity such that the pressure in the protected system is maintained at or below the limits specified in Section 416.2.1 under all of the following conditions:

1. The line pressure regulator for which the relief valve is providing overpressure protection has failed wide open.
2. The gas pressure at the inlet of the line pressure regulator for which the relief valve is providing overpressure protection is not less than the regulator's normal operating inlet pressure.

**416.3 Overpressure protection devices.** Overpressure protection devices shall be one of the following:

1. Pressure relief valve.
2. Monitoring regulator.
3. Series regulator installed upstream from the line regulator and set to continuously limit the pressure on the

inlet of the line regulator to the maximum values specified by Section 416.2.1.

4. Automatic shutoff device installed in series with the line pressure regulator and set to shut off when the pressure on the downstream *piping* system reaches the maximum values specified by Section 416.2.1. This device shall be designed so that it will remain closed until manually reset.

The devices specified in this section 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 Sections 416.3.1 through 416.3.6.

**416.3.1 Construction and installation.** Overpressure protection devices shall be constructed of materials so that the operation of the devices will not be impaired by corrosion of external parts by the atmosphere or of internal parts by the gas. Overpressure protection devices shall be designed and installed so that they can be operated to determine whether the valve is free. The devices shall be designed and installed so that they can be tested to determine the pressure at which they will operate and examined for leakage when in the closed position.

**416.3.2 External control piping.** External control *piping* shall be designed and installed so that damage to the control *piping* of one device will not render both the regulator and the overpressure protection device inoperative.

**416.3.3 Setting.** Each overpressure protection device shall be set so that the gas pressure supplied to the connected appliances does not exceed the limits specified in Sections 416.2.1 and 416.2.2.

**416.3.4 Unauthorized operation.** Where unauthorized operation of any shutoff valve could render an overpressure protection device inoperative, one of the following shall be accomplished:

1. The valve shall be locked in the open position. Authorized personnel shall be instructed in the importance of leaving the shutoff valve open and of being present while the shutoff valve is closed so that it can be locked in the open position before leaving the premises.
2. Duplicate relief valves shall be installed, each having adequate capacity to protect the system, and the isolating valves and three-way valves shall be arranged so that only one relief valve can be rendered inoperative at a time.

**416.3.5 Vents.** The discharge stacks, vents and outlet parts of all overpressure protection devices shall be located so that gas is safely discharged to the outdoors. Discharge stacks and vents shall be designed to prevent the entry of water, insects and other foreign material that could cause blockage. The discharge stack or vent line shall be not less than the same size as the outlet of the pressure-relieving device.



**502.5 Installation.** Vent systems shall be sized, installed and terminated in accordance with the vent and *appliance* manufacturer's installation instructions and Section 503.

**502.6 Support of vents.** All portions of vents shall be adequately supported for the design and weight of the materials employed.

**502.7 Protection against physical damage.** In concealed locations, where a vent is installed through holes or notches in studs, joists, rafters or similar members less than 1½ inches (38 mm) from the nearest edge of the member, the vent shall be protected by shield plates. Protective steel shield plates having a minimum thickness of 0.0575 inch (1.463 mm) (No. 16 gage) shall cover the area of the vent where the member is notched or bored and shall extend not less than 4 inches (102 mm) above sole plates, below top plates and to each side of a stud, joist or rafter.

**502.7.1 Door swing.** Appliance and equipment vent terminals shall be located such that doors cannot swing within 12 inches (305 mm) horizontally of the vent terminal. Door stops or closers shall not be installed to obtain this clearance.

### SECTION 503 (IFGS) VENTING OF APPLIANCES

**503.1 General.** The venting of appliances shall be in accordance with Sections 503.2 through 503.16.

**503.2 Venting systems required.** Except as permitted in Sections 501.8 and 503.2.1 through 503.2.4, all appliances shall be connected to venting systems.

**503.2.1 Ventilating hoods.** The use of ventilating hoods and exhaust systems to vent appliances shall be limited to industrial appliances and appliances installed in commercial applications.

**503.2.2 Well-ventilated spaces.** The flue gases from industrial-type appliances shall not be required to be vented to the outdoors where such gases are discharged into a large and well-ventilated industrial space.

**503.2.3 Direct-vent appliances.** *Listed direct-vent appliances* shall be installed in accordance with the manufacturer's instructions and Section 503.8, Item 3.

**503.2.4 Appliances with integral vents.** Appliances incorporating integral venting means shall be installed in accordance with the manufacturer's instructions and Section 503.8, Items 1 and 2.

**503.2.5 Incinerators.** Commercial-industrial-type incinerators shall be vented in accordance with NFPA 82.

**503.3 Design and construction.** Venting systems shall be designed and constructed so as to convey all flue and vent gases to the outdoors.

**503.3.1 Appliance draft requirements.** A venting system shall satisfy the draft requirements of the *appliance* in accordance with the manufacturer's instructions.

**503.3.2 Design and construction.** Appliances required to be vented shall be connected to a venting system designed

and installed in accordance with the provisions of Sections 503.4 through 503.16.

**503.3.3 Mechanical draft systems.** Mechanical draft systems shall comply with the following:

1. Mechanical draft systems shall be *listed* in accordance with UL 378 and shall be installed in accordance with the manufacturer's instructions for both the *appliance* and the mechanical draft system.
2. Appliances requiring venting shall be permitted to be vented by means of mechanical draft systems of either forced or induced draft design.
3. Forced draft systems and all portions of induced draft systems under positive pressure during operation shall be designed and installed so as to prevent leakage of flue or vent gases into a building.
4. Vent connectors serving appliances vented by natural draft shall not be connected to any portion of mechanical draft systems operating under positive pressure.
5. Where a mechanical draft system is employed, provisions shall be made to prevent the flow of gas to the main burners when the draft system is not performing so as to satisfy the operating requirements of the *appliance* for safe performance.
6. The exit terminals of mechanical draft systems shall be not less than 7 feet (2134 mm) above finished ground level where located adjacent to public walkways and shall be located as specified in Section 503.8, Items 1 and 2.

**503.3.4 Ventilating hoods and exhaust systems.** Where automatically operated appliances, other than commercial cooking appliances, are vented through a ventilating hood or exhaust system equipped with a damper or with a power means of exhaust, provisions shall be made to allow the flow of gas to the main burners only when the damper is open to a position to properly vent the *appliance* and when the power means of exhaust is in operation.

**503.3.5 Air ducts and furnace plenums.** Venting systems shall not extend into or pass through any fabricated air duct or *furnace plenum*.

**503.3.6 Above-ceiling air-handling spaces.** Where a venting system passes through an above-ceiling air-handling space or other nonducted portion of an air-handling system, the venting system shall conform to one of the following requirements:

1. The venting system shall be a *listed* special gas vent; other venting system serving a Category III or Category IV *appliance*; or other positive pressure vent, with joints sealed in accordance with the *appliance* or vent manufacturer's instructions.
2. The venting system shall be installed such that fittings and joints between sections are not installed in the above-ceiling space.
3. The venting system shall be installed in a conduit or enclosure with sealed joints separating the interior of the conduit or enclosure from the ceiling space.

**503.4 Type of venting system to be used.** The type of venting system to be used shall be in accordance with Table 503.4.

**503.4.1 Plastic piping.** Where plastic piping is used to vent an appliance, the appliance shall be listed for use with such venting materials and the appliance manufacturer's installation instructions shall identify the specific plastic piping material. The plastic pipe venting materials shall be labeled in accordance with the product standards specified by the appliance manufacturer or shall be listed and labeled in accordance with UL 1738.

**503.4.1.1 Plastic vent joints.** Plastic pipe and fittings used to vent appliances shall be installed in accordance with the appliance manufacturer's instructions. Plastic pipe venting materials listed and labeled in accordance with UL 1738 shall be installed in accordance with the vent manufacturer's instructions. Where a primer is required, it shall be of a contrasting color.

**503.4.2 Special gas vent.** Special gas vent shall be listed and labeled in accordance with UL 1738 and installed in accordance with the special gas vent manufacturer's instructions.

**503.5 Masonry, metal and factory-built chimneys.** Masonry, metal and factory-built chimneys shall comply with Sections 503.5.1 through 503.5.11.

**503.5.1 Factory-built chimneys.** Factory-built chimneys shall be listed in accordance with UL 103 and installed in accordance with the manufacturer's instructions. Factory-built chimneys used to vent appliances that operate at a positive vent pressure shall be listed for such application.

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

**503.5.3 Masonry chimneys.** Masonry chimneys shall be built and installed in accordance with NFPA 211 and shall

be lined with an *approved* clay flue lining, a chimney lining system *listed* and labeled in accordance with UL 1777 or other *approved* material that will resist corrosion, erosion, softening or cracking from vent gases at temperatures up to 1,800°F (982°C).

**Exception:** Masonry chimney flues serving *listed* gas appliances with draft hoods, Category I appliances and other gas appliances *listed* for use with Type B vents shall be permitted to be lined with a chimney lining system specifically *listed* for use only with such appliances. The liner shall be installed in accordance with the liner manufacturer's instructions. A permanent identifying label shall be attached at the point where the connection is to be made to the liner. The label shall read: "This chimney liner is for appliances that burn gas only. Do not connect to solid or liquid fuel-burning appliances or incinerators."

For installation of gas vents in existing masonry chimneys, see Section 503.6.4.

**503.5.4 Chimney termination.** Chimneys for residential-type or low-heat appliances shall extend not less than 3 feet (914 mm) above the highest point where they pass through a roof of a building and not less than 2 feet (610 mm) higher than any portion of a building within a horizontal distance of 10 feet (3048 mm). Chimneys for medium-heat appliances shall extend not less than 10 feet (3048 mm) higher than any portion of any building within 25 feet (7620 mm). Chimneys shall extend not less than 5 feet (1524 mm) above the highest connected *appliance* draft hood outlet or flue collar. Decorative shrouds shall not be installed at the termination of factory-built chimneys except where such shrouds are *listed* and *labeled* for use with the specific factory-built chimney system and are installed in accordance with the manufacturer's instructions.

**TABLE 503.4  
TYPE OF VENTING SYSTEM TO BE USED**

APPLIANCES	TYPE OF VENTING SYSTEM
Listed Category I appliances Listed appliances equipped with draft hood Appliances listed for use with Type B gas vent	Type B gas vent (Section 503.6) Chimney (Section 503.5) Single-wall metal pipe (Section 503.7) Listed chimney lining system for gas venting (Section 503.5.3) Special gas vent listed for these appliances (Section 503.4.2)
Listed vented wall furnaces	Type B-W gas vent (Sections 503.6, 608)
Category II, Category III and Category IV appliances	As specified or furnished by manufacturers of listed appliances (Sections 503.4.1, 503.4.2)
Incinerators	In accordance with NFPA 82
Appliances that can be converted for use with solid fuel	Chimney (Section 503.5)
Unlisted combination gas and oil-burning appliances	Chimney (Section 503.5)
Listed combination gas and oil-burning appliances	Type L vent (Section 503.6) or chimney (Section 503.5)
Combination gas and solid fuel-burning appliances	Chimney (Section 503.5)
Appliances listed for use with chimneys only	Chimney (Section 503.5)
Unlisted appliances	Chimney (Section 503.5)
Decorative appliances in vented fireplaces	Chimney
Gas-fired toilets	Single-wall metal pipe (Section 626)
Direct-vent appliances	See Section 503.2.3
Appliances with integral vent	See Section 503.2.4

**503.5.5 Size of chimneys.** The effective area of a chimney venting system serving *listed* appliances with draft hoods, Category I appliances and other appliances *listed* for use with Type B vents shall be determined in accordance with one of the following methods:

1. The provisions of Section 504.
2. For sizing an individual chimney venting system for a single *appliance* with a draft hood, the effective areas of the vent connector and chimney flue shall be not less than the area of the *appliance* flue collar or draft hood outlet, nor greater than seven times the draft hood outlet area.
3. For sizing a chimney venting system connected to two appliances with draft hoods, the effective area of the chimney flue shall be not less than the area of the larger draft hood outlet plus 50 percent of the area of the smaller draft hood outlet, nor greater than seven times the smallest draft hood outlet area.
4. Chimney venting systems using mechanical draft shall be sized in accordance with *approved* engineering methods.
5. Other *approved* engineering methods.

**503.5.6 Inspection of chimneys.** Before replacing an existing *appliance* or connecting a vent connector to a chimney, the chimney passageway shall be examined to ascertain that it is clear and free of obstructions and it shall be cleaned if previously used for venting solid or liquid fuel-burning appliances or fireplaces.

**503.5.6.1 Chimney lining.** Chimneys shall be lined in accordance with NFPA 211.

**Exception:** Where an existing chimney complies with Sections 503.5.6 through 503.5.6.3 and its sizing is in accordance with Section 503.5.5, its continued use shall be allowed where the *appliance* vented by such chimney is replaced by an *appliance* of similar type, input rating and efficiency.

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

**503.5.6.3 Unsafe chimneys.** Where inspection reveals that an existing chimney is not safe for the intended application, it shall be repaired, rebuilt, lined, relined or replaced with a vent or chimney to conform to NFPA 211 and it shall be suitable for the appliances to be vented.

**503.5.7 Chimneys serving appliances burning other fuels.** Chimneys serving *appliances* burning other fuels shall comply with Sections 503.5.7.1 through 503.5.7.4.

**503.5.7.1 Solid fuel-burning appliances.** An *appliance* shall not be connected to a chimney flue serving a separate *appliance* designed to burn solid fuel.

**503.5.7.2 Liquid fuel-burning appliances.** Where one chimney flue serves gas appliances and liquid fuel-burning appliances, the appliances shall be connected through separate openings or shall be connected through a single opening where joined by a suitable fit-

ting located as close as practical to the chimney. Where two or more openings are provided into one chimney flue, they shall be at different levels. Where the appliances are automatically controlled, they shall be equipped with safety shutoff devices.

**503.5.7.3 Combination gas- and solid fuel-burning appliances.** A combination gas- and solid fuel-burning *appliance* shall be permitted to be connected to a single chimney flue where equipped with a manual reset device to shut off gas to the main burner in the event of sustained backdraft or flue gas spillage. The chimney flue shall be sized to properly vent the *appliance*.

**503.5.7.4 Combination gas- and oil fuel-burning appliances.** Where a single chimney flue serves a *listed* combination gas- and oil fuel-burning *appliance*, such flue shall be sized in accordance with appliance manufacturer's instructions.

**503.5.8 Support of chimneys.** All portions of chimneys shall be supported for the design and weight of the materials employed. Factory-built chimneys shall be supported and spaced in accordance with the manufacturer's installation instructions.

**503.5.9 Cleanouts.** Where a chimney that formerly carried flue products from liquid or solid fuel-burning appliances is used with an *appliance* using fuel gas, an accessible cleanout shall be provided. The cleanout shall have a tight-fitting cover and shall be installed so its upper edge is not less than 6 inches (152 mm) below the lower edge of the lowest chimney inlet opening.

**503.5.10 Space surrounding lining or vent.** The remaining space surrounding a chimney liner, gas vent, special gas vent or plastic *pipng* installed within a masonry chimney flue shall not be used to vent another *appliance*. The insertion of another liner or vent within the chimney as provided in this code and the liner or vent manufacturer's instructions shall not be prohibited.

The remaining space surrounding a chimney liner, gas vent, special gas vent or plastic *pipng* installed within a masonry, metal or factory-built chimney shall not be used to supply *combustion air*. Such space shall not be prohibited from supplying *combustion air* to *direct-vent appliances* designed for installation in a solid fuel-burning *fireplace* and installed in accordance with the manufacturer's instructions.

**503.5.11 Insulation shield.** Where a factory-built chimney passes through insulated assemblies, an insulation shield constructed of steel having a thickness of not less than 0.0187 inch (0.475 mm) shall be installed to provide clearance between the chimney and the insulation material. The clearance shall be not less than the clearance to combustibles specified by the chimney manufacturer's installation instructions. Where chimneys pass through attic space, the shield shall terminate not less than 2 inches (51 mm) above the installation materials and shall be secured in place to prevent displacement. Insulation shields provided as part of a listed chimney system shall be installed in accordance with the manufacturer's installation instructions.

## CHIMNEYS AND VENTS

**503.6 Gas vents.** Gas vents shall comply with Sections 503.6.1 through 503.6.14 (see Section 202, General Definitions).

**503.6.1 Materials.** Type B and BW gas vents shall be listed in accordance with UL 441. Vents for listed combination gas- and oil-burning appliances shall be listed in accordance with UL 641.

**503.6.2 Installation, general.** Gas vents shall be installed in accordance with the manufacturer's instructions.

**503.6.3 Type B-W vent capacity.** A Type B-W gas vent shall have a *listed* capacity not less than that of the *listed* vented wall furnace to which it is connected.

**503.6.4 Gas vents installed within masonry chimneys.** Gas vents installed within masonry chimneys shall be installed in accordance with the manufacturer's instructions. Gas vents installed within masonry chimneys shall be identified with a permanent label installed at the point where the vent enters the chimney. The label shall contain the following language: "This gas vent is for appliances that burn gas. Do not connect to solid or liquid fuel-burning appliances or incinerators."

**503.6.5 Gas vent terminations.** A gas vent shall terminate in accordance with one of the following:

1. Gas vents that are 12 inches (305 mm) or less in size and located not less than 8 feet (2438 mm) from a vertical wall or similar obstruction shall terminate above the roof in accordance with Figure 503.6.5.
2. Gas vents that are over 12 inches (305 mm) in size or are located less than 8 feet (2438 mm) from a vertical wall or similar obstruction shall terminate not less than 2 feet (610 mm) above the highest point where they pass through the roof and not less than 2 feet (610 mm) above any portion of a building within 10 feet (3048 mm) horizontally.
3. As provided for industrial appliances in Section 503.2.2.
4. As provided for direct-vent systems in Section 503.2.3.
5. As provided for appliances with integral vents in Section 503.2.4.
6. As provided for mechanical draft systems in Section 503.3.3.
7. As provided for ventilating hoods and exhaust systems in Section 503.3.4.

**503.6.5.1 Decorative shrouds.** Decorative shrouds shall not be installed at the termination of gas vents except where such shrouds are *listed* for use with the specific gas venting system and are installed in accordance with manufacturer's instructions.

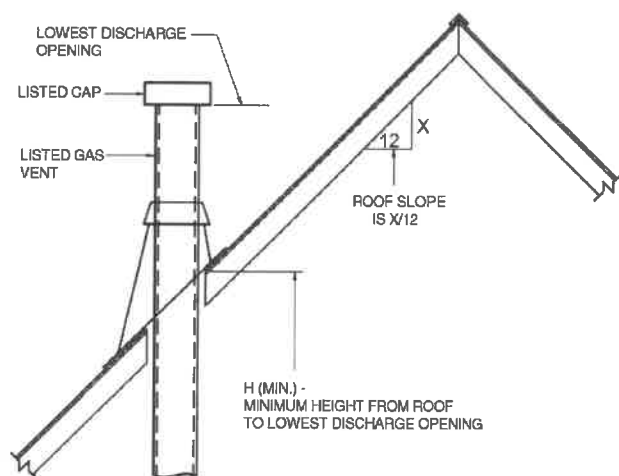
**503.6.6 Minimum height.** A Type B or L gas vent shall terminate not less than 5 feet (1524 mm) in vertical height above the highest connected *appliance* draft hood or flue collar. A Type B-W gas vent shall terminate not less than 12 feet (3658 mm) in vertical height above the bottom of the wall furnace.

**503.6.7 Roof terminations.** Gas vents shall extend through the roof flashing, roof jack or roof thimble and terminate with a *listed* cap or *listed* roof assembly.

**503.6.8 Forced air inlets.** Gas vents shall terminate not less than 3 feet (914 mm) above any forced air inlet located within 10 feet (3048 mm).

**503.6.9 Exterior wall penetrations.** A gas vent extending through an exterior wall shall not terminate adjacent to the wall or below eaves or parapets, except as provided in Sections 503.2.3 and 503.3.3.

**503.6.10 Size of gas vents.** Venting systems shall be sized and constructed in accordance with Sections 503.6.10.1 through 503.6.10.4 and the *appliance* manufacturer's installation instructions.



ROOF SLOPE	H (min) ft
Flat to 6/12	1.0
Over 6/12 to 7/12	1.25
Over 7/12 to 8/12	1.5
Over 8/12 to 9/12	2.0
Over 9/12 to 10/12	2.5
Over 10/12 to 11/12	3.25
Over 11/12 to 12/12	4.0
Over 12/12 to 14/12	5.0
Over 14/12 to 16/12	6.0
Over 16/12 to 18/12	7.0
Over 18/12 to 20/12	7.5
Over 20/12 to 21/12	8.0

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

**FIGURE 503.6.5**  
TERMINATION LOCATIONS FOR GAS VENTS WITH LISTED CAPS 12 INCHES OR LESS IN SIZE NOT LESS THAN 8 FEET FROM A VERTICAL WALL

**503.7.4 Limitations of use.** 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 outdoor atmosphere.

**503.7.5 Roof penetrations.** A pipe passing through a roof shall extend without interruption through the roof flashing, roof jack or roof thimble. Where a single-wall metal pipe passes through a roof constructed of *combustible material*, a noncombustible, nonventilating thimble shall be used at the point of passage. The thimble shall extend not less than 18 inches (457 mm) above and 6 inches (152 mm) below the roof with the annular space open at the bottom and closed only at the top. The thimble shall be sized in accordance with Section 503.7.7.

**503.7.6 Installation.** Single-wall metal pipe shall not originate in any unoccupied attic or concealed space and shall not pass through any attic, inside wall, concealed space or floor. The installation of a single-wall metal pipe through an exterior combustible wall shall comply with Section 503.7.7.

**503.7.7 Single-wall penetrations of combustible walls.** A 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 not less than 4 inches (102 mm) larger in diameter than the metal pipe. Where there is a run of not less than 6 feet (1829 mm) of metal pipe in the open between the draft hood outlet and the thimble, the thimble shall be permitted to be not less than 2 inches (51 mm) larger in diameter than the metal pipe.
2. For unlisted appliances having draft hoods, the thimble shall be not less than 6 inches (152 mm) larger in diameter than the metal pipe.
3. For residential and low-heat appliances, the thimble shall be not less than 12 inches (305 mm) larger in diameter than the metal pipe.

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

**503.7.8 Clearances.** Minimum clearances from single-wall metal pipe to *combustible material* shall be in accordance with Table 503.10.5. The *clearance* from single-wall metal pipe to *combustible material* shall be permitted to be reduced where the *combustible material* is protected as specified for vent connectors in Table 308.2.

**503.7.9 Size of single-wall metal pipe.** A venting system constructed of single-wall metal pipe shall be sized in accordance with one of the following methods and the appliance manufacturer's instructions:

1. For a draft-hood-equipped *appliance*, in accordance with Section 504.

2. For a venting system for a single *appliance* with a draft hood, the areas of the connector and the pipe each shall be not less than the area of the *appliance* flue collar or draft hood outlet, whichever is smaller. The vent area shall be not greater than seven times the draft hood outlet area.

3. Other *approved* engineering methods.

**503.7.10 Pipe geometry.** Any shaped single-wall metal pipe shall be permitted to be used, provided that its equivalent effective area is equal to the effective area of the round pipe for which it is substituted, and provided that the minimum internal dimension of the pipe is not less than 2 inches (51 mm).

**503.7.11 Termination capacity.** The vent cap or a roof assembly shall have a venting capacity of not less than that of the pipe to which it is attached.

**503.7.12 Support of single-wall metal pipe.** All portions of single-wall metal pipe shall be supported for the design and weight of the material employed.

**503.7.13 Marking.** Single-wall metal pipe shall comply with the marking provisions of Section 503.6.13.

**503.8 Venting system termination location.** The location of venting system terminations shall comply with the following (see Appendix C):

1. A mechanical draft venting system shall terminate not less than 3 feet (914 mm) above any forced-air inlet located within 10 feet (3048 mm).

**Exceptions:**

1. This provision shall not apply to the *combustion air* intake of a direct-vent *appliance*.
2. This provision shall not apply to the separation of the integral outdoor air inlet and flue gas discharge of *listed* outdoor appliances.
2. A mechanical draft venting system, excluding *direct-vent appliances*, shall terminate not less than 4 feet (1219 mm) below, 4 feet (1219 mm) horizontally from, or 1 foot (305 mm) above any door, operable window or gravity air inlet into any building. The bottom of the vent terminal shall be located not less than 12 inches (305 mm) above finished ground level.
3. The clearances for through-the-wall, direct-vent terminals shall be in accordance with Table 503.8. The bottom of the vent terminal and the air intake shall be located not less than 12 inches (305 mm) above finished ground level.
4. Through-the-wall vents for Category II and IV appliances and noncategorized condensing appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves or other *equipment*. Where local experience indicates that condensate is a problem with Category I and III appliances, this provision shall also apply. Drains for condensate shall be installed in accordance with the appliance and vent manufacturers' instructions.
5. Vent systems for Category IV appliances that terminate through an outside wall of a building and discharge flue

gases perpendicular to the adjacent wall shall be located not less than 10 feet (3048 mm) horizontally from an operable opening in an adjacent building. This requirement shall not apply to vent terminals that are 2 feet (607 mm) or more above or 25 feet (7620 mm) or more below operable openings.

**TABLE 503.8  
THROUGH-THE-WALL,  
DIRECT-VENT TERMINATION CLEARANCES**

DIRECT-VENT APPLIANCE INPUT RATING (Btu/hr)	THROUGH-THE-WALL VENT TERMINAL CLEARANCE FROM ANY AIR OPENING INTO THE BUILDING (inches)
< 10,000	6
≥ 10,000 ≤ 50,000	9
> 50,000 ≤ 150,000	12
> 150,000	In accordance with the appliance manufacturer's instructions and not less than the clearances specified in Section 503.8, Item 2

For SI: 1 inch = 25.4 mm, 1 Btu/h = 0.2931 W.

**503.9 Condensation drainage.** Provisions shall be made to collect and dispose of condensate from venting systems serving Category II and IV appliances and noncategorized condensing appliances in accordance with Section 503.8, Item 4. Where local experience indicates that condensation is a problem, provisions shall be made to drain off and dispose of condensate from venting systems serving Category I and III appliances in accordance with Section 503.8, Item 4.

**503.10 Vent connectors for Category I appliances.** Vent connectors for Category I appliances shall comply with Sections 503.10.1 through 503.10.14.

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

**503.10.2 Materials.** Vent connectors shall be constructed in accordance with Sections 503.10.2.1 through 503.10.2.5.

**503.10.2.1 General.** A vent connector shall be made of noncombustible corrosion-resistant material capable of withstanding the vent gas temperature produced by the appliance and of sufficient thickness to withstand physical damage.

**503.10.2.2 Vent connectors located in unconditioned areas.** Where the vent connector used for an appliance having a draft hood or a Category I appliance is located in or passes through attics, crawl spaces or other unconditioned spaces, that portion of the vent connector shall be listed Type B, Type L or listed vent material having equivalent insulation properties.

**Exception:** Single-wall metal pipe located within the exterior walls of the building in areas having a local 99-percent winter design temperature of 5°F (-15°C) or higher shall be permitted to be used in unconditioned spaces other than attics and crawl spaces.

**503.10.2.3 Residential-type appliance connectors.** Where vent connectors for residential-type appliances are not installed in attics or other unconditioned spaces, connectors for listed appliances having draft hoods, appliances having draft hoods and equipped with listed conversion burners and Category I appliances shall be one of the following:

1. Type B or L vent material.
2. Galvanized sheet steel not less than 0.018 inch (0.46 mm) thick.
3. Aluminum (1100 or 3003 alloy or equivalent) sheet not less than 0.027 inch (0.69 mm) thick.
4. Stainless steel sheet not less than 0.012 inch (0.31 mm) thick.
5. Smooth interior wall metal pipe having resistance to heat and corrosion equal to or greater than that of Item 2, 3 or 4.
6. A listed vent connector.

Vent connectors shall not be covered with insulation.

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

**503.10.2.4 Low-heat equipment.** 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 503.10.2.4. Factory-built chimney sections shall be joined together in accordance with the chimney manufacturer's instructions.

**TABLE 503.10.2.4  
MINIMUM THICKNESS FOR GALVANIZED STEEL VENT  
CONNECTORS FOR LOW-HEAT APPLIANCES**

DIAMETER OF CONNECTOR (inches)	MINIMUM THICKNESS (inch)
Less than 6	0.019
6 to less than 10	0.023
10 to 12 inclusive	0.029
14 to 16 inclusive	0.034
Over 16	0.056

For SI: 1 inch = 25.4 mm.

**503.10.2.5 Medium-heat appliances.** 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 503.10.2.5 and shall comply with the following:

1. A steel vent connector for an appliance with a vent gas temperature in excess of 1,000°F (538°C) measured at the entrance to the connector shall be lined with medium-duty fire brick (ASTM C64, Type F), or the equivalent.
2. The lining shall be not less than 2½ inches (64 mm) thick for a vent connector having a diameter

**SPECIFIC APPLIANCES**

steel or aluminum of the thickness specified in Table 603.4 of the *International Mechanical Code* and the fire-resistance rating is maintained in accordance with the *International Building Code*. Fire dampers shall not be installed in clothes dryer exhaust duct systems.

**[M] 614.3 Cleaning access.** Each vertical duct riser for dryers listed to ANSI Z21.5.2/CSA 7.2 shall be provided with a cleanout or other means for cleaning the interior of the duct.

**[M] 614.4 Exhaust installation.** Exhaust ducts for clothes dryers shall terminate on the outside of the building and shall be equipped with a backdraft damper. Screens shall not be installed at the duct termination. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums. Clothes dryer exhaust ducts shall be sealed in accordance with Section 603.9 of the *International Mechanical Code*.

**614.4.1 Exhaust termination outlet and passageway.** The passageway of dryer exhaust duct terminals shall be undiminished in size and shall provide an open area of not less than 12.5 square inches (8065 mm<sup>2</sup>).

**[M] 614.5 Dryer exhaust duct power ventilators.** Domestic dryer exhaust duct power ventilators shall be listed and labeled to UL 705 for use in dryer exhaust duct systems. The dryer exhaust duct power ventilator shall be installed in accordance with the manufacturer's instructions.

**[M] 614.6 Makeup air.** Installations exhausting more than 200 cfm (0.09 m<sup>3</sup>/s) shall be provided with makeup air. Where a closet is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches (645 mm<sup>2</sup>) for makeup air shall be provided in the closet enclosure, or makeup air shall be provided by other approved means.

**[M] 614.7 Protection required.** Protective shield plates shall be placed where nails or screws from finish or other work are likely to penetrate the clothes dryer exhaust duct. Shield plates shall be placed on the finished face of all framing members where there is less than 1¼ inches (32 mm) between the duct and the finished face of the framing member. Protective shield plates shall be constructed of steel, shall have a minimum thickness of 0.062 inch (1.6 mm) and shall

extend not less than 2 inches (51 mm) above sole plates and below top plates.

**[M] 614.8 Domestic clothes dryer exhaust ducts.** Exhaust ducts for domestic clothes dryers shall conform to the requirements of Sections 614.8.1 through 614.8.6.

**[M] 614.8.1 Material and size.** Exhaust ducts shall have a smooth interior finish and shall be constructed of metal not less than 0.016 inch (0.4 mm) in thickness. The exhaust duct size shall be 4 inches (102 mm) nominal in diameter.

**[M] 614.8.2 Duct installation.** Exhaust ducts shall be supported at 4-foot (1219 mm) intervals and secured in place. The insert end of the duct shall extend into the adjoining duct or fitting in the direction of airflow. Ducts shall not be joined with screws or similar fasteners that protrude more than 1/8 inch (3.2 mm) into the inside of the duct. Where dryer exhaust ducts are enclosed in wall or ceiling cavities, such cavities shall allow the installation of the duct without deformation.

**[M] 614.8.3 Transition ducts.** Transition ducts used to connect the dryer to the exhaust duct system shall be a single length that is listed and labeled in accordance with UL 2158A. Transition ducts shall be not more than 8 feet (2438 mm) in length, and shall not be concealed within construction.

**[M] 614.8.4 Duct length.** The maximum allowable exhaust duct length shall be determined by one of the methods specified in Sections 614.8.4.1 through 614.8.4.3.

**[M] 614.8.4.1 Specified length.** The maximum length of the exhaust duct shall be 35 feet (10 668 mm) from the connection to the transition duct from the dryer to the outlet terminal. Where fittings are utilized, the maximum length of the exhaust duct shall be reduced in accordance with Table 614.8.4.1.

**[M] 614.8.4.2 Manufacturer's instructions.** The maximum length of the exhaust duct shall be determined by the dryer manufacturer's installation instructions. The code official shall be provided with a copy of the installation instructions for the make and model of the dryer. Where the exhaust duct is to be concealed, the installation instructions shall be provided to the code official prior to the concealment inspection. In the absence of fitting equivalent length calculations from the clothes dryer manufacturer, Table 614.8.4.1 shall be utilized.

**[M] TABLE 614.8.4.1  
DRYER EXHAUST DUCT FITTING EQUIVALENT LENGTH**

DRYER EXHAUST DUCT FITTING TYPE	EQUIVALENT LENGTH
4 inch radius mitered 45-degree elbow	2 feet, 6 inches
4 inch radius mitered 90-degree elbow	5 feet
6 inch radius smooth 45-degree elbow	1 foot
6 inch radius smooth 90-degree elbow	1 foot, 9 inches
8 inch radius smooth 45-degree elbow	1 foot
8 inch radius smooth 90-degree elbow	1 foot, 7 inches
10 inch radius smooth 45-degree elbow	9 inches
10 inch radius smooth 90-degree elbow	1 foot, 6 inches

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.01745 rad.