PREFACE

Introduction
The Fuel Gas Code of New York State® (FGCNYS®) establishes minimum requirements for fuel gas systems and gas-fired appliances using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new fuel gas system and appliance designs. This 2020 edition was developed as a derivative work of the 2018 edition of the International Fuel Gas Code® (IFGC®) published by the International Code Council® (ICC®).

Intention
This code is founded on principles intended to establish provisions consistent with the scope of a fuel gas code that adequately protects public health, safety and welfare; provisions that do not unnecessarily increase construction costs; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction.

Letter Designations in Front of Section Numbers
The bracketed letter designations for the party responsible for portions of this code are as follows:

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<th>Bracketed Letter</th>
<th>Description</th>
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<td>A</td>
<td>Administrative Code Development Committee;</td>
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<td>BF</td>
<td>IBC—Fire Safety Code Development Committee;</td>
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<td>International Plumbing Code Development Committee</td>
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New York State Code Development

[NY] = New York State Department of State

Marginal Markings
Solid vertical lines in the margins within the body of the code indicate a technical change from the requirements of the 2015 edition of the I-Codes®. Deletion indicators in the form of an arrow (➡️) are provided in the margin where an entire section, paragraph, exception or table has been deleted or an item in a list of items or a table has been deleted.

Italicized Terms
Words and terms defined in Chapter 2, Definitions, are italicized where they appear in code text and the Chapter 2 definition applies. Where such words and terms are not italicized, common-use definitions apply. The words and terms selected have code-specific definitions that the user should read carefully to facilitate better understanding of the code.

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EFFECTIVE USE OF THE FUEL GAS CODE OF NEW YORK STATE

The Fuel Gas Code of New York State (FGCNYS) is a code that regulates the design and installation of fuel gas distribution piping and systems, appliances, appliance venting systems, combustion air provisions, gaseous hydrogen systems and motor vehicle gaseous-fuel-dispensing stations. The definition of fuel gas includes natural, liquefied petroleum and manufactured gases and mixtures of these gases.

The purpose of the code is to establish the minimum acceptable level of safety and to protect life and property from the potential dangers associated with the storage, distribution and usage of fuel gases and the byproducts of combustion of such fuels. The code also protects the personnel that install, maintain, service and replace the systems and appliances addressed by this code.

With the exception of Section 401.1.1, the FGCNYS does not address utility-owned piping and equipment (i.e., anything upstream of the point of delivery). See the definition of “Point of delivery” and Section 501.8 for other code coverage exemptions.

The FGCNYS is primarily a specification-oriented (prescriptive) code with some performance-oriented text. For example, Section 503.3.1 is a performance statement, but Chapter 5 contains prescriptive requirements that will cause Section 503.3.1 to be satisfied.

The FGCNYS applies to all occupancies including one- and two-family dwellings and townhouses. The RCNYS is referenced for coverage of one- and two-family dwellings and townhouses; however, in effect, the FGCNYS provisions are still applicable because the fuel gas chapter in the RCNYS (Chapter 24) is composed entirely of text extracted from the FGCNYS. Therefore, whether using the FGCNYS or the RCNYS, the fuel gas provisions will be identical. The FGCNYS does not apply to piping systems that operate at pressures in excess of 125 psig for natural gas and 20 psig for LP-gas (note exception in Section 402.7).

The general Section 105.2 and the specific Sections 304.8, 402.3, 503.5.5 and 503.6.10 allow combustion air provisions, pipe sizing and chimney and vent sizing to be performed by approved engineering methods as alternatives to the prescriptive methods in the code.

Arrangement and Format of the 2018 IFGC
The format of the FGCNYS allows each chapter to be devoted to a particular subject, with the exception of Chapter 3, which contains general subject matters that are not extensive enough to warrant their own independent chapter.

Chapter 1 Scope and Administration. Chapter 1 establishes the limits of applicability of the code and describes how the code is to be applied and enforced. A fuel gas code, like any other code, is intended to be adopted as a legally enforceable document, and it cannot be effective without adequate provisions for its administration and enforcement.

Chapter 2 Definitions. Chapter 2 is the repository of the definitions of terms used in the body of the code. Codes are technical documents and every word, term and punctuation mark can impact the meaning of the code text and the intended results. The code often uses terms that have a
unique meaning in the code and the code meaning can differ substantially from the ordinarily understood meaning of the term as used outside of the code.

The terms defined in Chapter 2 are deemed to be of prime importance in establishing the meaning and intent of the code text that uses the terms. The user of the code should be familiar with and consult this chapter because the definitions are essential to the correct interpretation of the code and because the user may not be aware that a term is defined.

**Chapter 3 General Regulations.** Chapter 3 contains broadly applicable requirements related to appliance location and installation, appliance and systems access, protection of structural elements and clearances to combustibles, among others. This chapter also covers combustion air provisions for gas-fired appliances.

**Chapter 4 Gas Piping Installations.** Chapter 4 covers the allowable materials for gas piping systems and the sizing and installation of such systems. It also covers pressure regulators, appliance connections and overpressure protection devices. Gas piping systems are sized to supply the maximum demand while maintaining the supply pressure necessary for safe operation of the appliances served.

**Chapter 5 Chimneys and Vents.** Chapter 5 regulates the design, construction, installation, maintenance, repair and approval of chimneys, vents, venting systems and their connections to gas-fired appliances. Properly designed chimneys, vents and venting systems are necessary to conduct to the outdoors the flue gases produced by the combustion of fuels in appliances. The provisions of this chapter are intended to minimize the hazards associated with high temperatures and potentially toxic and corrosive combustion gases. This chapter addresses all of the factory-built and site-built chimneys, vents and venting systems used to vent all types and categories of appliances. It also addresses direct-vent appliances, integral vent appliances, side-wall mechanically vented appliances and exhaust hoods that convey the combustion byproducts from cooking and other process appliances.

**Chapter 6 Specific Appliances.** Chapter 6 addresses specific appliances that the code intends to regulate. Each main section applies to a unique type of gas-fired appliance and specifies the product standards to which the appliance must be listed. The general requirements found in the previous Chapters 1 through 5 also apply and the sections in Chapter 6 add the special requirements that are specific to each type of appliance.

**Chapter 7 Gaseous Hydrogen Systems.** Chapter 7 is specific to gaseous hydrogen generation, storage, distribution and utilization systems, appliances and equipment. Note that hydrogen is not within the definition of “Fuel gas,” but it is, nonetheless, commonly used as a fuel for fuel-cell power generation and fuel-cell powered motor vehicles. The scope of Chapter 7 is not limited to any particular use of hydrogen (see Sections 633 and 635). Hydrogen systems have unique potential hazards because of the specific gravity of the gas, its chemical effect on materials and the fact that it is not odorized.

**Chapter 8 Referenced Standards.** Chapter 8 lists all of the product and installation standards and codes that are referenced throughout Chapters 1 through 7. The standards are part of the code to the extent of the reference to the standard. Chapter 8 provides the full title and edition year of the standards and codes in addition to the address of the promulgators and the section numbers in which the standards and codes are referenced.
Appendix A Sizing and Capacities of Gas Piping. This appendix is informative and not part of the code. It provides design guidance, useful facts and data and multiple examples of how to apply the sizing tables and sizing methodologies of Chapter 4.

Appendix B Sizing of Venting Systems Serving Appliances Equipped with Draft Hoods, Category I Appliances and Appliances Listed for Use with Type B Vents. This appendix is informative and not part of the code. It contains multiple examples of how to apply the vent and chimney tables and methodologies of Chapter 5.

Appendix C Exit Terminals of Mechanical Draft and Direct-vent Venting Systems. This appendix is informative and not part of the code. It consists of a figure and notes that visually depict code requirements from Chapter 5 for vent terminals with respect to the openings found in building exterior walls.

Appendix D Recommended Procedure for Safety Inspection of an Existing Appliance Installation. This appendix is informative and not part of the code. It provides recommended procedures for testing and inspecting an appliance installation to determine if the installation is operating safely and if the appliance is in a safe condition.
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[NY] CHAPTER 1
SCOPE AND ADMINISTRATION

[NY] SECTION 101
TITLE, SCOPE AND PURPOSE

[NY] 101.1 Title.
This publication shall be known as the 2020 edition of the Fuel Gas Code of New York State, hereinafter referred to as “this code.” This code is part of the New York State Uniform Fire Prevention and Building Code (the “Uniform Code”).

[NY] 101.1.1 Amendments of New York State code books.
In this Chapter 1, the term “New York State code books” shall include the Residential Code of New York State, the Building Code of New York State, the Mechanical Code of New York State, the Fuel Gas Code of New York State (i.e., this publication), the Fire Code of New York State, the Property Maintenance Code of New York State, the Existing Building Code of New York State, and the Energy Conservation Construction Code of New York State. Provisions in any one or more of the New York State code books may be amended from time to time by provisions in 19 NYCRR Parts 1220 to 1227 or 19 NYCRR Part 1240, as currently in effect and as hereafter amended from time to time. If this publication is now or hereafter so amended, references in this publication to “this code” shall be deemed to be references to this publication as so amended. If any other New York State code book is now or hereafter so amended, references in this code to such other New York State code book shall be deemed to be references to such New York State code book as so amended.

[NY] 101.2 Scope.
The provisions of this code shall apply to the design, installation, maintenance, alteration and inspection of fuel gas piping and equipment, fuel gas-fired appliances and fuel gas-fired appliance venting systems, that are permanently installed and specifically addressed herein. These requirements apply to gas piping systems extending from the point of delivery to the inlet connections of appliances, the installation and operation of residential and commercial gas appliances and related accessories, and gaseous hydrogen systems.

Exceptions:

1. Application of the provisions of the Residential Code of New York State to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, removal and demolition of the following buildings and structures is permitted, provided that such building or structure is not more than three stories above grade plane in height, and their accessory structures not more than three stories above grade plane in height:

   a. detached one-family dwellings;
   
   b. detached two-family dwellings in which each dwelling unit has a separate means of egress;

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c. townhouses;

d. bed and breakfast dwellings;

e. live/work units that (1) are located in townhouses, and (2) comply with the requirements of Section 419 of the Building Code of New York State; and

f. owner-occupied lodging houses that (1) have five or fewer guestrooms and (2) are provided with a residential fire sprinkler system complying with Section P2904 of the Residential Code of New York State.

2. Fuel gas piping systems in existing buildings that are undergoing repairs, alteration, or changes in occupancy or construction of additions shall comply with the provisions of the Existing Building Code of New York State.

[NY] 101.2.1 Facilities regulated by State Departments and Agencies.
Where a building or premises under the custody, licensure, supervision or jurisdiction of a department or agency of the State of New York is regulated as a one- or two-family dwelling or multiple single-family dwelling (townhouse), in accordance with established laws or regulations of that department or agency, said buildings or premises, such as a community residence or hospice residence, and their accessory structures shall comply with the Residential Code of New York State.

[NY] 101.2.2 Appendices.
Provisions in the following appendices are included for informational purposes:

Appendix A Sizing and Capacities of Gas Piping
Appendix B Sizing of Venting Systems Serving Appliances Equipped with Draft Hoods, Category I Appliances and Appliances Listed for Use with Type B Vents
Appendix C Exit Terminals of Mechanical Draft and Direct-Vent Venting Systems
Appendix D Recommended Procedure for Safety Inspection of an Existing Appliance Installation

[NY] 101.2.3 Gas appliances.
Requirements for gas appliances and related accessories shall include installation, combustion and ventilation air and venting and connections to piping systems.

[NY] 101.2.4 Piping Systems.
These regulations cover piping systems for natural gas with an operating pressure of 125 pounds per square inch gauge (psig) (862 kPa gauge) or less, and for LP-gas with an operating pressure of 20 psig (140 kPa gauge) or less, except as provided in Section 402.6. Coverage shall extend from the point of delivery to the outlet of the appliance shutoff valves. Piping systems requirements shall include design, materials, components, fabrication, assembly, installation, testing, inspection, operation and maintenance.
[NY] 101.2.5 Systems, appliances and equipment outside the scope.
This code shall not apply to the following:

1. Portable LP-gas appliances and equipment of all types that is not connected to a fixed fuel piping system.
2. Installation of farm appliances and equipment such as brooders, dehydrators, dryers and irrigation equipment.
3. Raw material (feedstock) applications except for piping to special atmosphere generators.
4. Oxygen-fuel gas cutting and welding systems.
5. Industrial gas applications using gases such as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen.
6. Petroleum refineries, pipeline compressor or pumping stations, loading terminals, compounding plants, refinery tank farms and natural gas processing plants.
7. Integrated chemical plants or portions of such plants where flammable or combustible liquids or gases are produced by, or used in, chemical reactions.
8. LP-gas installations at utility gas plants.
10. Fuel gas piping in power and atomic energy plants.
11. Proprietary items of equipment, apparatus or instruments such as gas-generating sets, compressors and calorimeters.
12. LP-gas equipment for vaporization, gas mixing and gas manufacturing.
13. Temporary LP-gas piping for buildings under construction or renovation that is not to become part of the permanent piping system.
15. Installation of hydrogen gas, LP-gas and compressed natural gas (CNG) systems on vehicles.
16. Except as provided in Section 401.1.1, gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in the distribution of gas, other than undiluted LP-gas.
17. Building design and construction, except as specified herein.
18. **Piping** systems for mixtures of gas and air within the flammable range with an operating pressure greater than 10 psig (69 kPa gauge).

19. Portable fuel cell appliances that are neither connected to a fixed piping system nor interconnected to a power grid.

[**NY**] 101.2.6 Other fuels.
The requirements for the design, installation, maintenance, alteration and inspection of mechanical systems operating with fuels other than fuel gas shall be regulated by the *Mechanical Code of New York State*.

[**NY**] 101.3 Purpose.
The purpose of this code is to provide minimum requirements to safeguard life or limb, health, property, and public welfare by regulating and controlling the design, construction, installation, quality of materials, location, operation and maintenance or use of fuel gas systems.

[**NY**] SECTION 102
APPLICABILITY

[**NY**] 102.1 General.
Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern. Where, in a specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

[**NY**] 102.2 Other laws and regulations.
This code is part of the New York State Uniform Fire Prevention and Building Code (the *Uniform Code*) promulgated pursuant to Article 18 of the New York State Executive Law. The provisions of this code shall not be deemed to nullify any federal, state or local law, ordinance, administrative code, rule or regulation relating to any matter as to which the *Uniform Code* does not provide.

However:

1. Pursuant to Section 383(1) of the Executive Law, and except as otherwise provided in paragraphs a, b, and c of Section 383(1) of the Executive Law, the provisions of the *Uniform Code* supersede any other provision of a general, special or local law, ordinance, administrative code, rule or regulation inconsistent or in conflict with the Uniform Code;

2. Pursuant to Section 379(3) of the Executive Law, no city, town, village, county or other municipality shall have the power to supersede, void, repeal, or make less restrictive any provision of the *Uniform Code*; and

3. The ability of any city, town, or village, or the County of Nassau, to enact or adopt, and to enforce, a local law or ordinance imposing higher or more restrictive standards for construction within the jurisdiction of such city, town, village, or county that are applicable generally to such city, town, village, or county in the *Uniform Code* is subject to the provisions and requirements of Section 379 of the Executive Law.

Nothing in this Section 102.2 shall be construed:
1. as affecting the authority of the State Labor Department to enforce a safety or health standard issued under provisions of Sections 27 and 27-a of the Labor Law;

2. to relieve a person from complying with a stricter standard issued pursuant to the Occupational Safety and Health Act of 1970, as amended; or

3. as superseding, limiting, impairing or otherwise affecting any provision the Uniform Code, as now in effect and as hereafter amended from time to time.

[NY] 102.2.1 Other New York Codes, Rules and Regulations (NYCRR).
Additional New York Codes, Rules and Regulations exist that may affect new and existing buildings, structures, systems and equipment. Such regulations include, but are not limited to:

1. 19 NYCRR Part 300 (Universal Symbol of Access),

2. 19 NYCRR Part 1261 (Recordkeeping – Smoke Detectors in Multiple Dwellings),

3. 19 NYCRR Part 1264 (Identification of Buildings Utilizing Truss Type Construction), and

4. 19 NYCRR Part 1265 (Residential Structures with Truss Type Construction, Pre-Engineered Wood Construction and/or Timber Construction).

[NY] 102.3 Existing installations.
Except as otherwise provided for in this chapter, a provision in this code shall not require the removal, alteration or abandonment of, nor prevent the continued utilization and maintenance of, existing installations lawfully in existence at the time of the adoption of this code.

[NY] 102.3.1 Existing buildings.
Additions, alterations, renovations or repairs related to building or structural issues shall be regulated by the Existing Building Code of New York State.

[NY] 102.4 Maintenance.
Installations, both existing and new, and parts thereof shall be maintained in proper operating condition in accordance with the original design and in a safe condition. Devices or safeguards that are required by this code shall be maintained in compliance with the edition of the code under which they were installed. The owner or the owner’s authorized agent shall be responsible for maintenance of installations. To determine compliance with this provision, the building official shall have the authority to require an installation to be reinspected.

[NY] 102.5 Additions, alterations or repairs.
Additions, alterations, renovations or repairs to installations shall conform to that required for new installations without requiring the existing installation to comply with all of the requirements of this code. Additions, alterations or repairs shall not cause an existing installation to become unsafe, hazardous or over loaded.

Minor additions, alterations, renovations and repairs to existing installations shall meet the provisions for new construction, unless such work is done in the same manner and arrangement as was in the existing system, is not hazardous and is approved.

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[NY] 102.6 Change in occupancy.
No change shall be made in the use or occupancy of any building or structure unless such building or structure is made to comply with the requirements of the Uniform Code and Energy Code.

[NY] 102.7 Historic buildings.
The provisions of this code relating to the construction, alteration, repair, enlargement, restoration, relocation or moving of buildings or structures shall not be mandatory for existing buildings or structures identified and classified by the state or local jurisdiction as historic buildings where such buildings or structures are judged by the building official to be safe and in the public interest of health, safety and welfare regarding any proposed construction, alteration, repair, enlargement, restoration, relocation or moving of buildings.

[NY] 102.8 Moved buildings.
Except as determined by Section 102.3, installations that are a part of buildings or structures moved into or within the jurisdiction shall comply with the provisions of this code for new installations.

[NY] 102.9 Referenced codes and standards.
The codes and standards referenced in this code shall be considered to be part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections 102.4.1 and 102.4.2.

[NY] 102.9.1 Conflicts.
Where conflicts occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

[NY] 102.10 Requirements not covered by code.
Any requirements necessary for the strength, stability or proper operation of an existing or proposed plumbing system, or for the public safety, health and general welfare, not specifically covered by this code shall be determined by the Authority Having Jurisdiction.

[NY] 102.11 Application of references.
References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this code.

[NY] 102.12 Partial invalidity.
In the event that any part or provision of this code is held by a court of competent jurisdiction to be illegal or void, this shall not have the effect of making void or illegal any of the other parts or provisions.
[NY] SECTION 103
ADMINISTRATION AND ENFORCEMENT

[NY] 103.1 Administration and enforcement.
The Uniform Code shall be administered and enforced by the Authority Having Jurisdiction. The identity of the Authority Having Jurisdiction in a given situation is determined in accordance with Article 18 of the Executive Law and the regulations promulgated by the Secretary of State pursuant to Executive Law § 381(1). In general, the Authority Having Jurisdiction is the local government (city, town or village) in which the building or structure is located. In certain situations, the Authority Having Jurisdiction may be the county in which the building or structure is located. In certain other cases, the State, the Secretary of State (acting through the Department of State) or some other State agency may be the Authority Having Jurisdiction. The Authority Having Jurisdiction responsible for administration and enforcement of the Uniform Code is also responsible for administration and enforcement of the Energy Code.

Administration and enforcement of the Uniform Code and Energy Code shall be in accordance with the following, as applicable:

1. Where a city, town, village or county is the Authority Having Jurisdiction:
   a) such county, city, town, village or county shall provide for administration and enforcement of the Uniform Code and Energy Code by local law, ordinance, other appropriate regulation, or combination thereof;
   b) the Code Enforcement Program established by such local law, ordinance or other appropriate regulation, or combination thereof, must include, at a minimum, the features described in Part 1203 and must satisfy all other requirements of Part 1203; and
   c) such city, town, village or county shall administer and enforce the Uniform Code in accordance with the Code Enforcement Program established by such local law, ordinance or other appropriate regulation, or combination thereof.

2. Where the State is the Authority Having Jurisdiction pursuant to 19 NYCRR Section 1201.2(d):
   a) the Code Enforcement Program shall be as established by Part 1204; and
   b) the State, acting through one or more State agencies, shall administer and enforce the Uniform Code and Energy Code in accordance with Part 1204.

3. Where the Department of State is the Authority Having Jurisdiction:
   a) the Code Enforcement Program shall be as established by Part 1202; and
   b) the Department of State shall administer and enforce the Uniform Code and Energy Code in accordance with Part 1202.
4. Where any governmental unit or agency not included in paragraphs 1, 2, and 3 above is the Authority Having Jurisdiction:

a) such governmental unit or agency shall provide for administration and enforcement of the Uniform Code and Energy Code by regulation;

b) the Code Enforcement Program established by such regulation must include, at a minimum, the features described Part 1203 and must satisfy all other requirements of Part 1203; and

c) such governmental unit or agency shall administer and enforce the Uniform Code and Energy Code in accordance with the Code Enforcement Program established by such regulation.

Every governmental unit or agency thereof charged with administration and enforcement of the Uniform Code shall exercise its powers in due and proper manner so as to extend to the public protection from the hazards of fire and inadequate building construction.

Any person or entity constructing or renovating a building or structure, changing the use or occupancy of a building or structure, or engaging in any other activity that is subject to the provisions of the Code Enforcement Program of the Authority Having Jurisdiction responsible for administration and enforcement of the Uniform Code with respect to such building shall comply with all applicable provisions of such Code Enforcement Program.

In addition, persons and entities who construct, renovate, use and occupy buildings and structures shall comply with all applicable provisions of Section 105 of this code.

[NY] 103.2 Due process.
Nothing in this Chapter 1, or elsewhere in the Uniform Code, or elsewhere in this code, or in any regulation promulgated pursuant to Executive Law § 381(1), shall be construed as authorizing any Authority Having Jurisdiction to administer and enforce the Uniform Code in a manner that deprives any person or entity of due process of law. In particular, but not by way of limitation, nothing in this Chapter 1, or elsewhere in this code or elsewhere in the Uniform Code, or in any regulation promulgated pursuant to Executive Law § 381(1), relating to posting, placarding and/or condemnation of buildings or structures that are unsafe, unfit for human occupancy or unlawful shall be construed as authorizing any Authority Having Jurisdiction to post, placard or condemn any such building or structure and/or to remove any owner or occupant or cause any owner or occupant to be removed from any such building or structure without providing such notice and opportunity to be heard (and, if applicable, right of appeal) as may be required under the applicable circumstances by applicable Constitutional provisions.

[NY] 103.2.1 Imminent danger.
In cases of imminent danger, posting, placarding, and condemning a building or structure and removing owners and occupants or causing owners and occupants to be removed without first providing an opportunity to be heard shall be permitted to the extent consistent with applicable Constitutional provisions, provided that the affected persons and entities are afforded the opportunity for a post-action hearing to the extent required by applicable Constitutional provisions.
[NY] 103.3 Application for variance or appeal.
An application for a variance or modification of any provision or requirement of Uniform Code shall be in accordance with the provisions of Part 1205. An appeal of any order or determination, or the failure within a reasonable time to make an order or determination, of an administrative official charged to enforce or purporting to enforce the Uniform Code may be made in accordance with the provisions of Part 1205.

[NY] SECTION 104
MATERIALS, EQUIPMENT AND METHODS OF CONSTRUCTION

[NY] 104.1 Approved materials and equipment.
Materials, equipment, and devices approved by the building official shall be constructed and installed in accordance with such approval. Materials, equipment and devices tested by an approved testing laboratory shall be permitted to be constructed and installed in accordance with such approval.

[NY] 104.1.1 Used materials and equipment.
Used materials, equipment, and devices shall not be reused unless they meet the requirements of this code for new materials.

[NY] 104.2 Waivers, variances, and modifications.
Nothing in this code shall be construed as permitting any building official or any Authority Having Jurisdiction to waive, vary, modify, or otherwise alter any provision or requirement of this code or any other provision or requirement of the Uniform Code. Provisions or requirements of the Uniform Code may be varied or modified only in accordance with procedures established by Part 1205 or by such other regulations as may hereafter be promulgated by the Secretary of State pursuant to Section 381(1)(f) of the Executive Law.

[NY] 104.3 Alternative materials, equipment, appliances, designs, and methods of construction.
The provisions of this code are not intended to prevent the installation of any materials, equipment, or appliances not specifically prescribed by this code, or to prohibit any designs or methods of construction not specifically prescribed by this code, provided that such alternative materials, equipment, appliances, designs, or methods of construction (1) are not specifically prohibited by any provision of this code, by any other provision of the Uniform Code, or by the Energy Code and (2) shall have been approved, in writing, by the building official. Alternative materials, equipment, appliances, designs, or methods of construction may be approved only when the building official shall have determined, in writing, that such alternative:

1. is satisfactory and complies with the intent of the provisions and requirements of the Uniform Code; and
2. is not less than the equivalent of that prescribed in the Uniform Code in quality, strength, effectiveness, fire resistance, durability, and safety.

Nothing in this Section 104.3 shall be construed as permitting any building official or any Authority Having Jurisdiction to waive, vary, modify or otherwise alter any provision or requirement of this code or any other provision or requirement of the Uniform Code. Provisions or requirements of the Uniform Code may be varied or modified only pursuant to procedures established Part 1205.
or by such other regulations as may hereafter be promulgated by the Secretary of State pursuant to Section 381(1)(f) of the Executive Law.

[NY] 104.4 Workmanship.
Repairs, maintenance work, alterations or installations which are caused directly or indirectly by the enforcement of the Uniform Code shall be executed and installed in a workmanlike manner and in accordance with Uniform Code and the manufacturer’s installation instructions.

[NY] SECTION 105
BUILDING PERMITS, CONSTRUCTION INSPECTIONS, STOP WORK ORDERS, AND CERTIFICATES OF OCCUPANCY

[NY] 105.1 Purpose.
The purpose of this Section 105 is to include in the Uniform Code provisions requiring persons and entities who construct, renovate, use and occupy buildings and structures to apply for and obtain building permits, to facilitate construction inspections, to obey Stop Work Orders, to obtain Certificates of Occupancy, and to obtain operating permits. The provisions in this Section 105 are considered to be integral parts of the Uniform Code’s standards for construction, maintenance, and fire protection equipment and systems.

[NY] 105.1.1 Definition.
For the purpose of this Section 105, the term “other applicable law” shall include the Authority Having Jurisdiction’s Code Enforcement Program; any local law, ordinance, or regulation establishing the Authority Having Jurisdiction’s Code Enforcement Program; and any other applicable statute, regulation, rule, local law, or ordinance.

[NY] 105.2 Building Permits.
No person or entity shall commence, perform, or continue any work that must conform with the Uniform Code and/or Energy Code unless:

1. Such person or entity has applied to the Authority Having Jurisdiction for a building permit;
2. The Authority Having Jurisdiction has issued a building permit authorizing such work,
3. Such building permit has not been revoked or suspended, and
4. Such building permit has not expired.

[NY] 105.2.1 Work exempt from building permit requirement.
A building permit shall not be required for work in any category that is excluded from the building permit requirement by the Authority Having Jurisdiction’s Code Enforcement Program, provided that Part 1203 allows an Authority Having Jurisdiction to exclude such category of work from the building permit requirement. Exemptions from building permit requirements shall not be deemed to grant authorization for any work to be done in any manner in violation of any provision the Uniform Code, any provision of the Energy Code, or any provision of any other applicable law.
[NY] 105.2.2 Applications for building permits.
A person or entity applying for a building permit shall submit an application to the Authority Having Jurisdiction. An application for a building permit shall include:

1. Construction documents that satisfy the requirements of Section 106.2;

2. Any and all other submittal documents required by Section 106;

3. Any and all other information and documentation that may be required by the stricter of the Authority Having Jurisdiction’s Code Enforcement Program or a Part 1203-Compliant Code Enforcement Program; and

4. Such other information and documentation as the Authority Having Jurisdiction may determine to be necessary to allow the Authority Having Jurisdiction to determine whether the proposed work conforms with the Uniform Code, the Energy Code, and other applicable laws.

[NY] 105.2.3 Approval of construction documents.
When the Authority Having Jurisdiction issues a building permit, the Authority Having Jurisdiction shall approve the construction documents in writing. Work shall be installed in accordance with the approved construction documents and the terms and conditions, if any, of the building permit.

[NY] 105.2.4 Validity of building permit.
The issuance or granting of a building permit shall not be construed to be a permit for, or an approval of, any violation of any provision of the Uniform Code, the Energy Code, or any other applicable law. A building permit purporting to give authority to violate or cancel any provision of the Uniform Code, the Energy Code, or any other applicable law shall not be valid. The issuance of a building permit based on construction documents and other data shall not prevent the building official from requiring the correction of errors in the construction documents and other data.

[NY] 105.2.5 Suspension or revocation of building permit.
The Authority Having Jurisdiction is authorized to suspend or revoke a building permit wherever the building permit is issued in error; or on the basis of incorrect, inaccurate or incomplete information; or in violation of any provision of the Uniform Code, the Energy Code, or any other applicable law. Any such suspension or revocation shall be in writing, signed by the building official or by his or her designated agent.

[NY] 105.2.6 Placement of building permit and approved construction documents.
The building permit, or a copy thereof, and at least one set of approved construction documents shall be kept on the site of the work until the completion of the project. The approved construction documents shall be open to inspection by any authorized representative of the Authority Having Jurisdiction.

[NY] 105.3 Construction Inspections.
Any person or entity performing work for which a building permit has been issued shall keep work accessible and exposed until the work has been inspected and accepted by the Authority Having Jurisdiction, or its authorized agent, at each element of the construction process that is applicable.
to the work and specified in the stricter of the Authority Having Jurisdiction’s Code Enforcement Program or a Part 1203-Compliant Code Enforcement Program.

[NY] 105.3.1 Inspection requests.
It shall be the duty of the holder of the building permit or their duly authorized agent to notify the building official when work is ready for inspection. It shall be the duty of the building permit holder to provide access to and means for inspections of such work that are required by this code.

[NY] 105.4 Stop Work Orders.
The Authority Having Jurisdiction is authorized to issue a Stop Work Order to halt work that is being performed without a required building permit; work that is being performed after a required building permit has been revoked or suspended or has expired; work that is being conducted in a dangerous or unsafe manner; or work that is contrary to provisions of the Uniform Code, the Energy Code, the approved construction documents, or the terms and conditions (if any) of the building permit. No person or entity shall commence, perform or continue any work if the Authority Having Jurisdiction has issued a Stop Work Order with respect to such work.

[NY] 105.5 Certificates of Occupancy.
Where the stricter of the Authority Having Jurisdiction’s Code Enforcement Program or a Part 1203-Compliant Code Enforcement Program requires a Certificate of Occupancy for permission to use or occupy a building or structure, or any portion thereof, no person or entity shall use or occupy such building or structure, or such portion thereof, unless:

1. the Authority Having Jurisdiction has issued such Certificate of Occupancy,
2. such Certificate of Occupancy has not been revoked or suspended, and
3. in the case of a temporary Certificate of Occupancy, such temporary Certificate of Occupancy has not expired.

[NY] 105.5.1 Authorized uses and occupancies.
Where a Certificate of Occupancy has been issued for a building or structure, or any portion thereof, no person or entity shall use or occupy such building or structure, or such portion thereof, for any use or occupancy other than that authorized by such Certificate of Occupancy.

[NY] 105.5.2 Change in use or occupancy.
Without regard to whether a Certificate of Occupancy shall have been issued, no person or entity shall convert the use or occupancy of a building or structure, or any portion thereof, from one use or occupancy to another without first obtaining a building permit to perform the work, if any, required for such conversion; performing such work, if any; and obtaining a Certificate of Occupancy from the Authority Having Jurisdiction.

[NY] 105.6 Operating Permits.
Where the stricter of the Authority Having Jurisdiction’s Code Enforcement Program or a Part 1203-Compliant Code Enforcement Program requires an operating permit to conduct an activity or to use a category of building, no person or entity shall conduct such activity or use such category of building without obtaining an operating permit from the Authority Having Jurisdiction. The procedures for applying for, issuing, revoking, and suspending operating permits shall be as set forth in the stricter of the Authority Having Jurisdiction’s Code Enforcement Program or a Part 1203-Compliant Code Enforcement Program.
1203-Compliant Code Enforcement Program.

[NY] 105.7 Violations.
Any violation of any provision set forth in Sections 105.2 through 105.6 shall be a violation of the Uniform Code, and any person or entity violating any such provision shall be subject to the penalties prescribed in Executive Law § 382(2). In addition, to the extent that any act or omission that violates any provision set forth in sections 105.2 through 105.6 is also a violation of any other applicable law, any person or entity guilty of such act or omission shall also be subject to the penalties prescribed in or otherwise applicable to a violation of such other applicable law.

[NY] SECTION 106
SUBMITTAL DOCUMENTS

[NY] 106.1 General.
Submittal documents consisting of construction documents, statements of special inspections, geotechnical reports, and other data shall be submitted with each application for a building permit.

[NY] 106.2 Construction documents.
Construction documents shall be in accordance with Sections 106.2.1 through 106.2.9.

[NY] 106.2.1 Information on construction documents.
Construction documents (1) shall define the scope of the proposed work; (2) shall be of sufficient clarity to indicate the location, nature and extent of the proposed work; (3) shall show in detail that the proposed work will conform to the provisions of the Uniform Code, the Energy Code, and other applicable codes, laws, ordinances, and regulations; (4) shall include all information required by any provision of this code (including but not limited to the information described in Sections 106.2.2 through 106.2.8), all information required by any other applicable provision of the Uniform Code, and all information required by any applicable provision of the Energy Code; and (5) shall include any and all additional information and documentation that may be required by the stricter of the Code Enforcement Program of the Authority Having Jurisdiction or a Part 1203-Compliant Code Enforcement Program.

[NY] 106.2.1.1 Manufacturer’s installation instructions.
Manufacturer’s installation instructions, as required by any applicable provision of the Uniform Code or by any applicable provision of the Energy Code, shall be available on the job site at the time of inspection.

[NY] 106.2.2 Fire protection system shop drawings.
Shop drawings for the fire protection system(s) shall be submitted to indicate conformance to Chapter 9, any other applicable provision of the Uniform Code, and the construction documents. Such shop drawings shall be approved prior to the start of system installation. Shop drawings shall contain all information as required by the installation standards referenced in Chapter 9 or in any other applicable provision of the Uniform Code.

[NY] 106.2.3 Means of egress.
The construction documents shall show in sufficient detail the location, construction, size and character of all portions of the means of egress including the path of the exit discharge to the public way in compliance with the provisions of the Uniform Code. In other than occupancies in Groups R-2, R-3, and I-1, the construction documents shall designate the number of occupants to be accommodated on every floor, and in all rooms and spaces.

[NY] 106.2.4 Exterior wall envelope.
Construction documents for all buildings shall describe the exterior wall envelope in sufficient detail to determine compliance with the Uniform Code and the Energy Code. The construction documents shall provide details of the exterior wall envelope as required, including flashing, intersections with dissimilar materials, corners, end details, control joints, intersections at roof, eaves or parapets, means of drainage, water-resistive membrane and details around openings.

The construction documents shall include manufacturer’s installation instructions that provide supporting documentation that the proposed penetration and opening details described in the construction documents maintain the weather resistance of the exterior wall envelope. The supporting documentation shall fully describe the exterior wall system that was tested, where applicable, as well as the test procedure used.

[NY] 106.2.5 Exterior balconies and elevated walking surfaces.
Where balconies or other elevated walking surfaces are exposed to water from direct or blowing rain, snow, or irrigation, and the structural framing is protected by an impervious moisture barrier, the construction documents shall include details for all elements of the impervious moisture barrier system. The construction documents shall include manufacturer’s installation instructions.

[NY] 106.2.6 Site plan.
The construction documents submitted with the application for a building permit shall be accompanied by a site plan showing to scale the size and location of new construction and existing structures on the site, distances from lot lines, the established street grades and the proposed finished grades and, as applicable, flood hazard areas, floodways, and design flood elevations; and it shall be drawn in accordance with an accurate boundary line survey. In the case of demolition, the site plan shall show construction to be demolished and the location and size of existing structures and construction that are to remain on the site or plot. The building official is authorized to waive or modify the requirement for a site plan where the application for a building permit is for an alteration or repair or where otherwise warranted.

[NY] 106.2.6.1 Design flood elevations.
Where design flood elevations are not specified, they shall be established in accordance with Section 1612.3.1 of the Building Code of New York State.
[NY] 106.2.6.2 Flood hazard documentation.
If located in a flood hazard area, documentation of the elevation of the lowest floor as required in Section 1612.4 of the Building Code of New York State shall be submitted to the building official prior to the final inspection.

[NY] 106.2.7 Structural information.
The construction documents shall provide the information specified in Section 1603 of the Building Code of New York State.

[NY] 106.2.8 Relocatable buildings.
Construction documents for relocatable buildings shall comply with Section 3112 of the Building Code of New York State.

[NY] 106.2.9 Design professional.
Construction documents shall be prepared by a registered design professional when required by Article 145 or Article 147 of the New York State Education Law, by the stricter of Code Enforcement Program of the Authority Having Jurisdiction or a Part 1203-Compliant Code Enforcement Program, or by any other applicable statute, regulation, or local law or ordinance.

[NY] SECTION 107
SERVICE UTILITIES

[NY] 107.1 Connection of service utilities.
Connections from a utility, source of energy, fuel or power to any building or system which is regulated by Uniform Code shall be made in accordance with the requirements of the Uniform Code; the regulations of the public utility providing such utility, source of energy, fuel or power; and the regulations of any governmental unit or agency having jurisdiction over such utility, source of energy, fuel or power.

[NY] 107.1.1 Temporary connection.
Where approved by the building official, temporary connections from a utility, source of energy, fuel or power to a building or system may be made. Temporary connections shall be made in accordance with Section 107.1.

[NY] 107.2 Notice of disconnection of service utilities.
The owner or the owner’s authorized agent shall notify the building official of the disconnection of any utility service to the building, structure, or system regulated by the Uniform Code.
CHAPTER 2
DEFINITIONS

SECTION 201
GENERAL

201.1 Scope.
Unless otherwise expressly stated, the following words and terms shall, for the purposes of this code and standard, have the meanings indicated in this chapter.

201.2 Interchangeability.
Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural, the singular.

201.3 Terms defined in other codes.
Where terms are not defined in this code and are defined in the Building Code of New York State, Fire Code of New York State, Mechanical Code of New York State or Plumbing Code of New York State, such terms shall have meanings ascribed to them as in those codes.

201.4 Terms not defined.
Where terms are not defined through the methods authorized by this section, such terms shall have ordinarily accepted meanings such as the context implies.

SECTION 202
GENERAL DEFINITIONS

[M] ACCESS (TO). That which enables a device, appliance or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel, door or similar obstruction (see also “Ready access”).

AIR CONDITIONER, GAS-FIRED. A gas-burning, automatically operated appliance for supplying cooled air, dehumidified air, or both, or chilled liquid.

[M] AIR CONDITIONING. The treatment of air so as to control simultaneously the temperature, humidity, cleanliness and distribution of the air to meet the requirements of a conditioned space.

[M] AIR, EXHAUST. Air being removed from any space or piece of equipment or appliance and conveyed directly to the atmosphere by means of openings or ducts.

[M] AIR-HANDLING UNIT. A blower or fan used for the purpose of distributing supply air to a room, space or area.

[M] AIR, MAKEUP. Any combination of outdoor and transfer air intended to replace exhaust air and exfiltration.

[A] ALTERATION. A change in a system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.
ANODELESS RISER. A transition assembly in which plastic piping is installed and terminated above ground outside of a building.

[M] APPLIANCE. Any apparatus or device that utilizes a fuel or a raw material as a fuel to produce light, heat, power, refrigeration or air conditioning. Also, an apparatus that compresses fuel gases.

APPLIANCE, AUTOMATICALLY CONTROLLED. Appliances equipped with an automatic burner ignition and safety shutoff device and other automatic devices that accomplish complete turn-on and shutoff of the gas to the main burner or burners, and graduate the gas supply to the burner or burners, but do not affect complete shutoff of the gas.

APPLIANCE, FAN-ASSISTED COMBUSTION. An appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber or heat exchanger.

APPLIANCE TYPE.

Low-heat appliance (residential appliance). Any appliance in which the products of combustion at the point of entrance to the flue under normal operating conditions have a temperature of 1,000°F (538°C) or less.

Medium-heat appliance. Any appliance in which the products of combustion at the point of entrance to the flue under normal operating conditions have a temperature of more than 1,000°F (538°C), but not greater than 2,000°F (1093°C).

APPLIANCE, UNVENTED. An appliance designed or installed in such a manner that the products of combustion are not conveyed by a vent or chimney directly to the outside atmosphere.

[M] APPLIANCE, VENTED. An appliance designed and installed in such a manner that all of the products of combustion are conveyed directly from the appliance to the outdoor atmosphere through an approved chimney or vent system.

[A] APPROVED. Acceptable to the building official.

[A] APPROVED AGENCY. An established and recognized agency that is regularly engaged in conducting tests, furnishing inspection services or furnishing certification, where such agency has been approved by the building official.

ATMOSPHERIC PRESSURE. The pressure of the weight of air and water vapor on the surface of the earth, approximately 14.7 pounds per square inch (psi) (101 kPa absolute) at sea level.

[NY] AUTHORITY HAVING JURISDICTION. The governmental unit or agency responsible for administration and enforcement of this code.

AUTOMATIC IGNITION. Ignition of gas at the burner(s) when the gas controlling device is turned on, including reignition if the flames on the burner(s) have been extinguished by means other than by the closing of the gas controlling device.
BAFFLE. An object placed in an appliance to change the direction of or retard the flow of air, air-gas mixtures or flue gases.

BAROMETRIC DRAFT REGULATOR. A balanced damper device attached to a chimney, vent connector, breeching or flue gas manifold to protect combustion appliances by controlling chimney draft. A double-acting barometric draft regulator is one whose balancing damper is free to move in either direction to protect combustion appliances from both excessive draft and backdraft.

BOILER, LOW-PRESSURE. A self-contained appliance for supplying steam or hot water.

Hot water heating boiler. A boiler in which no steam is generated, from which hot water is circulated for heating purposes and then returned to the boiler, and that operates at water pressures not exceeding 160 pounds per square inch gauge (psig) (1100 kPa gauge) and at water temperatures not exceeding 250°F (121°C) at or near the boiler outlet.

Hot water supply boiler. A boiler, completely filled with water, which furnishes hot water to be used externally to itself, and that operates at water pressures not exceeding 160 psig (1100 kPa gauge) and at water temperatures not exceeding 250°F (121°C) at or near the boiler outlet.

Steam heating boiler. A boiler in which steam is generated and that operates at a steam pressure not exceeding 15 psig (100 kPa gauge).

BONDING JUMPER. A conductor installed to electrically connect metallic gas piping to the grounding electrode system.

[M] BRAZING. A metal-joining process wherein coalescence is produced by the use of a nonferrous filler metal having a melting point above 1,000°F (538°C), but lower than that of the base metal being joined. The filler material is distributed between the closely fitted surfaces of the joint by capillary action.

BROILER. A general term including salamanders, barbecues and other appliances cooking primarily by radiated heat, excepting toasters.

BTU. Abbreviation for British thermal unit, which is the quantity of heat required to raise the temperature of 1 pound (454 g) of water 1°F (0.56°C) (1 Btu = 1055 J).


[A] BUILDING OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.

BURNER. A device for the final conveyance of the gas, or a mixture of gas and air, to the combustion zone.
Induced-draft. A burner that depends on draft induced by a fan that is an integral part of the appliance and is located downstream from the burner.

Power. A burner in which gas, air or both are supplied at pressures exceeding, for gas, the line pressure, and for air, atmospheric pressure, with this added pressure being applied at the burner.

[M] CHIMNEY. A primarily vertical structure containing one or more flues, for the purpose of carrying gaseous products of combustion and air from an appliance to the outside atmosphere.

Factory-built chimney. A listed and labeled chimney composed of factory-made components, assembled in the field in accordance with manufacturer’s instructions and the conditions of the listing.

Masonry chimney. A field-constructed chimney composed of solid masonry units, bricks, stones or concrete.

Metal chimney. A field-constructed chimney of metal.

[M] CLEARANCE. The minimum distance through air measured between the heat-producing surface of the mechanical appliance, device or equipment and the surface of the combustible material or assembly.

CLOTHES DRYER. An appliance used to dry wet laundry by means of heated air. Dryer classifications are as follows:

Type 1. Factory-built package, multiple production. Primarily used in family living environment. Usually the smallest unit physically and in function output.

Type 2. Factory-built package, multiple production. Used in business with direct intercourse of the function with the public. Not designed for use in individual family living environment.

[A] CODE. These regulations, subsequent amendments thereto or any emergency rule or regulation that the administrative authority having jurisdiction has lawfully adopted.

[NY] CODE ENFORCEMENT PROGRAM. The program under which an Authority Having Jurisdiction administers and enforces this code, as such program is currently in effect and as such program may hereafter be amended from time to time.

[M] COMBUSTIBLE ASSEMBLY. Wall, floor, ceiling or other assembly constructed of one or more component materials that are not defined as noncombustible.

[M] COMBUSTIBLE MATERIAL. Any material not defined as noncombustible.

[M] COMBUSTION. In the context of this code, refers to the rapid oxidation of fuel accompanied by the production of heat or heat and light.

[M] COMBUSTION AIR. Air necessary for complete combustion of a fuel, including theoretical air and excess air.
[M] COMBUSTION CHAMBER. The portion of an appliance within which combustion occurs.

[M] COMBUSTION PRODUCTS. Constituents resulting from the combustion of a fuel with the oxygen of the air, including inert gases, but excluding excess air.

[M] CONCEALED LOCATION. A location that cannot be accessed without damaging permanent parts of the building structure or finish surface. Spaces above, below or behind readily removable panels or doors shall not be considered as concealed.

CONCEALED PIPING. Piping that is located in a concealed location (see “Concealed location”).

CONDENSATE. The liquid that condenses from a gas (including flue gas) caused by a reduction in temperature or increase in pressure.

CONNECTOR, APPLIANCE (Fuel). Rigid metallic pipe and fittings, semirigid metallic tubing and fittings or a listed and labeled device that connects an appliance to the gas piping system.

CONNECTOR, CHIMNEY OR VENT. The pipe that connects an appliance to a chimney or vent.

[A] CONSTRUCTION DOCUMENTS. All of the written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of the project necessary for obtaining a mechanical permit.

[M] CONTROL. A manual or automatic device designed to regulate the gas, air, water or electrical supply to, or operation of, a mechanical system.

CONVERSION BURNER. A unit consisting of a burner and its controls for installation in an appliance originally utilizing another fuel.

COUNTER APPLIANCES. Appliances such as coffee brewers and coffee urns and any appurtenant water-heating appliance, food and dish warmers, hot plates, griddles, waffle bakers and other appliances designed for installation on or in a counter.

[NY] CSST. Corrugated stainless steel tubing.

[NY] LISTED ARC-RESISTANT CSST (or LISTED AR-CSST). CSST that is all of the following:

1. Encased in a conductive jacket, and

2. Listed in a currently effective evaluation report issued by a nationally recognized building product evaluation service as having been:

   i. Tested in accordance with the published National Standard ANSI LC 1-2018, including the performance criteria of Section 5.16.

   ii. Shown by such testing to satisfy such published performance criteria and to provide, without additional bonding, protection against damage from indirect lightning strikes that is at least equivalent to that provided by direct bonding as prescribed in Section 310 of this code.

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**CUBIC FOOT.** The amount of gas that occupies 1 cubic foot (0.02832 m$^3$) when at a temperature of 60°F (16°C), saturated with water vapor and under a pressure equivalent to that of 30 inches of mercury (101 kPa).

**[M] DAMPER.** A manually or automatically controlled device to regulate draft or the rate of flow of air or combustion gases.

**DECORATIVE APPLIANCE, VENTED.** A vented appliance wherein the primary function lies in the aesthetic effect of the flames.

**DECORATIVE APPLIANCES FOR INSTALLATION IN VENTED FIREPLACES.** A vented appliance designed for installation within the fire chamber of a vented fireplace, wherein the primary function lies in the aesthetic effect of the flames.

**DEMAND.** The maximum amount of gas input required per unit of time, usually expressed in cubic feet per hour, or Btu/h (1 Btu/h = 0.2931 W).

**[BS] DESIGN FLOOD ELEVATION.** The elevation of the “design flood,” including wave height, relative to the datum specified on the community’s legally designated flood hazard map. In areas designated as Zone AO, the design flood elevation shall be the elevation of the highest existing grade of the building’s perimeter plus the depth number (in feet) specified on the flood hazard map. In areas designated as Zone AO where a depth number is not specified on the map, the depth number shall be taken as being equal to 2 feet (610 mm).

**DILUTION AIR.** Air that is introduced into a draft hood and is mixed with the flue gases.

**DIRECT-VENT APPLIANCES.** Appliances that are constructed and installed so that all air for combustion is derived directly from the outdoor atmosphere and all flue gases are discharged directly to the outdoor atmosphere.

**[M] DRAFT.** The pressure difference existing between the appliance or any component part and the atmosphere, that causes a continuous flow of air and products of combustion through the gas passages of the appliance to the atmosphere.

  - **Mechanical or induced draft.** The pressure difference created by the action of a fan, blower or ejector that is located between the appliance and the chimney or vent termination.
  - **Natural draft.** The pressure difference created by a vent or chimney because of its height, and the temperature difference between the flue gases and the atmosphere.

**DRAFT HOOD.** A nonadjustable device built into an appliance, or made as part of the vent connector from an appliance, that is designed to: provide for ready escape of the flue gases from the appliance in the event of no draft, backdraft or stoppage beyond the draft hood; prevent a backdraft from entering the appliance; and neutralize the effect of stack action of the chimney or gas vent upon operation of the appliance.

**DRAFT REGULATOR.** A device that functions to maintain a desired draft in the appliance by automatically reducing the draft to the desired value.

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[M] DRIP. The container placed at a low point in a system of piping to collect condensate and from which the condensate is removable.

DRY GAS. A gas having a moisture and hydrocarbon dew point below any normal temperature to which the gas piping is exposed.

DUCT FURNACE. A warm-air furnace normally installed in an air distribution duct to supply warm air for heating. This definition shall apply only to a warm-air heating appliance that depends for air circulation on a blower not furnished as part of the furnace.

[M] DUCT SYSTEM. A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment.

[A] DWELLING UNIT. A single unit providing complete, independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.


EQUIPMENT. Apparatus and devices other than appliances.

EXCESS FLOW VALVE (EFV). A valve designed to activate when the fuel gas passing through it exceeds a prescribed flow rate.


EXTERIOR MASONRY CHIMNEYS. Masonry chimneys exposed to the outdoors on one or more sides below the roof line.


[M] FIREPLACE. A fire chamber and hearth constructed of noncombustible material for use with solid fuels and provided with a chimney.

Factory-built fireplace. A fireplace composed of listed factory-built components assembled in accordance with the terms of listing to form the completed fireplace.

Masonry fireplace. A hearth and fire chamber of solid masonry units such as bricks, stones, listed masonry units or reinforced concrete, provided with a suitable chimney.

FIRING VALVE. A valve of the plug and barrel type designed for use with gas, and equipped with a lever handle for manual operation and a dial to indicate the percentage of opening.

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FLAME SAFEGUARD. A device that will automatically shut off the fuel supply to a main burner or group of burners when the means of ignition of such burners becomes inoperative, and when flame failure occurs on the burner or group of burners.

FLASHBACK ARRESTOR CHECK VALVE. A device that will prevent the backflow of one gas into the supply system of another gas and prevent the passage of flame into the gas supply system.

[BS] FLOOD HAZARD AREA. The greater of the following two areas:

1. The area within a floodplain subject to a 1 percent or greater chance of flooding in any given year.

2. This area designated as a flood hazard area on a community’s flood hazard map, or otherwise legally designated.

FLOOR FURNACE. A completely self-contained furnace suspended from the floor of the space being heated, taking air for combustion from outside such space and with means for observing flames and lighting the appliance from such space.

   Fan type. A floor furnace equipped with a fan that provides the primary means for circulating air.

   Gravity type. A floor furnace depending primarily on circulation of air by gravity. This classification shall also include floor furnaces equipped with booster-type fans that do not materially restrict free circulation of air by gravity flow when such fans are not in operation.

FLUE, APPLIANCE. The passage(s) within an appliance through which combustion products pass from the combustion chamber of the appliance to the draft hood inlet opening on an appliance equipped with a draft hood or to the outlet of the appliance on an appliance not equipped with a draft hood.

FLUE COLLAR. That portion of an appliance designed for the attachment of a draft hood, vent connector or venting system.

FLUE GASES. Products of combustion plus excess air in appliance flues or heat exchangers.

[M] FLUE LINER (LINING). A system or material used to form the inside surface of a flue in a chimney or vent, for the purpose of protecting the surrounding structure from the effects of combustion products and for conveying combustion products without leakage to the atmosphere.

FUEL GAS. A natural gas, manufactured gas, liquefied petroleum gas or mixtures of these gases.

[M] FURNACE. A completely self-contained heating unit that is designed to supply heated air to spaces remote from or adjacent to the appliance location.

FURNACE, CENTRAL. A self-contained appliance for heating air by transfer of heat of combustion through metal to the air, and designed to supply heated air through ducts to spaces remote from or adjacent to the appliance location.
FURNACE, ENCLODED. A specific heating, or heating and ventilating, furnace incorporating an integral total enclosure and using only outside air for combustion.

FURNACE PLENUM. An air compartment or chamber to which one or more ducts are connected and that forms part of an air distribution system.

GAS CONVENIENCE OUTLET. A permanently mounted, manually operated device that provides the means for connecting an appliance to, and disconnecting an appliance from, the supply piping. The device includes an integral, manually operated valve with a nondisplaceable valve member and is designed so that disconnection of an appliance only occurs when the manually operated valve is in the closed position.

GAS PIPING. An installation of pipe, valves or fittings installed on a premises or in a building and utilized to convey fuel gas.

[F] GASEOUS HYDROGEN SYSTEM. See Section 702.1.

[M] HAZARDOUS LOCATION. Any location considered to be a fire hazard for flammable vapors, dust, combustible fibers or other highly combustible substances. The location is not necessarily categorized in the building code as a high-hazard group classification.

HOUSE PIPING. See “Piping system.”


HYDROGEN-GENERATING APPLIANCE. See Section 702.1.

IGNITION PILOT. A pilot that operates during the lighting cycle and discontinues during main burner operation.

[M] IGNITION SOURCE. A flame, spark or hot surface capable of igniting flammable vapors or fumes. Such sources include appliance burners, burner ignitors and electrical switching devices.

INCINERATOR. An appliance used to reduce combustible refuse material to ashes and that is manufactured, sold and installed as a complete unit.

INDUSTRIAL AIR HEATERS, DIRECT-FIRED NONRECIRCULATING. A heater in which all the products of combustion generated by the burners are released into the air stream being heated. The purpose of the heater is to offset building heat loss by heating only outdoor air.

INDUSTRIAL AIR HEATERS, DIRECT-FIRED RECIRCULATING. A heater in which all the products of combustion generated by the burners are released into the air stream being heated. The purpose of the heater is to offset building heat loss by heating outdoor air, and, if applicable, indoor air.

INFRARED RADIANT HEATER. A heater that directs a substantial amount of its energy output in the form of infrared radiant energy into the area to be heated. Such heaters are of either the vented or unvented type.

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[M] JOINT, FLANGED. A joint made by bolting together a pair of flanged ends.

[M] JOINT, FLARED. A metal-to-metal compression joint in which a conical spread is made on the end of a tube that is compressed by a flare nut against a mating flare.

JOINT, MECHANICAL. A general form of gas-tight joints obtained by the joining of metal parts through a positive-holding mechanical construction, such as a press joint, flanged joint, threaded joint, flared joint or compression joint.

[M] JOINT, PLASTIC ADHESIVE. A joint made in thermoset plastic piping by the use of an adhesive substance that forms a continuous bond between the mating surfaces without dissolving either one of them.

[M] JOINT, PLASTIC HEAT FUSION. A joint made in thermoplastic piping by heating the parts sufficiently to permit fusion of the materials when the parts are pressed together.

[M] JOINT, WELDED. A gas-tight joint obtained by the joining of metal parts in molten state.

[A] LABELED. Equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, approved agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

LEAK CHECK. An operation performed on a gas piping system to verify that the system does not leak.

LIMIT CONTROL. A device responsive to changes in pressure, temperature or level for turning on, shutting off or throttling the gas supply to an appliance.

LIQUEFIED PETROLEUM GAS or LPG (LP-GAS). Liquefied petroleum gas composed predominately of propane, propylene, butanes or butylenes, or mixtures thereof that is gaseous under normal atmospheric conditions, but is capable of being liquefied under moderate pressure at normal temperatures.

[A] LISTED. Equipment, materials, products or services included in a list published by an organization acceptable to the building official and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

[M] LIVING SPACE. Space within a dwelling unit utilized for living, sleeping, eating, cooking, bathing, washing and sanitation purposes.

LOG LIGHTER. A manually operated solid fuel ignition appliance for installation in a vented solid fuel-burning fireplace.
LUBRICATED PLUG-TYPE VALVE. A valve of the plug and barrel type provided with means for maintaining a lubricant between the bearing surfaces.

MAIN BURNER. A device or group of devices essentially forming an integral unit for the final conveyance of gas or a mixture of gas and air to the combustion zone, and on which combustion takes place to accomplish the function for which the appliance is designed.


METER. The instrument installed to measure the volume of gas delivered through it.

MODULATING. Modulating or throttling is the action of a control from its maximum to minimum position in either predetermined steps or increments of movement as caused by its actuating medium.

[M] NONCOMBUSTIBLE MATERIALS. Materials that, where tested in accordance with ASTM E136, have not fewer than three of four specimens tested meeting all of the following criteria:

1. The recorded temperature of the surface and interior thermocouples shall not at any time during the test rise more than 54°F (30°C) above the furnace temperature at the beginning of the test.

2. There shall not be flaming from the specimen after the first 30 seconds.

3. If the weight loss of the specimen during testing exceeds 50 percent, the recorded temperature of the surface and interior thermocouples shall not at any time during the test rise above the furnace air temperature at the beginning of the test, and there shall not be flaming of the specimen.

[A] OCCUPANCY. The purpose for which a building, or portion thereof, is utilized or occupied.

[M] OFFSET (VENT). A combination of approved bends that makes two changes in direction bringing one section of the vent out of line but into a line parallel with the other section.

ORIFICE. The opening in a cap, spud or other device whereby the flow of gas is limited and through which the gas is discharged to the burner.

OUTLET. The point at which a gas-fired appliance connects to the gas piping system.

OXYGEN DEPLETION SAFETY SHUTOFF SYSTEM (ODS). A system designed to act to shut off the gas supply to the main and pilot burners if the oxygen in the surrounding atmosphere is reduced below a predetermined level.

[NY] PART 1202. The regulations set forth in 19 NYCRR Part 1202 ("Uniform Code: Administration and Enforcement in Certain Local Governments"), as currently in effect and as hereafter amended from time to time.
[NY] PART 1203. The regulations set forth in 19 NYCRR Part 1203 (“Uniform Code: Minimum Standards for Administration and Enforcement”), as currently in effect and as hereafter amended from time to time.

[NY] PART 1203-COMPLIANT CODE ENFORCEMENT PROGRAM. A code enforcement program that includes the features required by Part 1203 and satisfies the requirements of Part 1203.

[NY] PART 1204. The regulations set forth in 19 NYCRR Part 1204 (“Uniform Code: Administration and Enforcement by State Agencies”), as currently in effect and as hereafter amended from time to time.

[NY] PART 1205. The regulations set forth in 19 NYCRR Part 1205 (“Uniform Code: Variance Procedures”), as currently in effect and as hereafter amended from time to time.

PILOT. A small flame that is utilized to ignite the gas at the main burner or burners.

[M] PIPING. Where used in this code, “piping” refers to either pipe or tubing, or both.

Pipe. A rigid conduit of iron, steel, copper, copper-alloy or plastic.

Tubing. Semirigid conduit of copper, copper-alloy aluminum, plastic or steel.

PIPING SYSTEM. The fuel piping, valves and fittings from the outlet of the point of delivery to the outlets of the appliance shutoff valves.

[M] PLASTIC, THERMOPLASTIC. A plastic that is capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.


POINT OF DELIVERY. For natural gas systems, the point of delivery is the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where a meter is not provided. Where a valve is provided at the outlet of the service meter assembly, such valve shall be considered to be downstream of the point of delivery. For undiluted liquefied petroleum gas systems, the point of delivery shall be considered to be the outlet of the service pressure regulator, exclusive of line gas regulators, in the system.

PORTABLE FUEL CELL APPLIANCE. A fuel cell generator of electricity, which is not fixed in place. A portable fuel cell appliance utilizes a cord and plug connection to a grid-isolated load and has an integral fuel supply.

PRESSURE DROP. The loss in pressure due to friction or obstruction in pipes, valves, fittings, regulators and burners.

PRESSURE TEST. An operation performed to verify the gas-tight integrity of gas piping following its installation or modification.
PURGE. To free a gas conduit of air or gas, or a mixture of gas and air.

QUICK-DISCONNECT DEVICE. A hand-operated device that provides a means for connecting and disconnecting an appliance or an appliance connector to a gas supply and that is equipped with an automatic means to shut off the gas supply when the device is disconnected.

[M] READY ACCESS (TO). That which enables a device, appliance or equipment to be directly reached, without requiring the removal or movement of any panel, door or similar obstruction (see “Access”).

[A] REGISTERED DESIGN PROFESSIONAL. An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

REGULATOR. A device for controlling and maintaining a uniform supply pressure, either pounds-to-inches water column (MP regulator) or inches-to-inches water column (appliance regulator).

REGULATOR, GAS APPLIANCE. A pressure regulator for controlling pressure to the manifold of the appliance.

REGULATOR, LINE GAS PRESSURE. A device placed in a gas line between the service pressure regulator and the appliance for controlling, maintaining or reducing the pressure in that portion of the piping system downstream of the device.

REGULATOR, MEDIUM-PRESSURE (MP Regulator). A line pressure regulator that reduces gas pressure from the range of greater than 0.5 psig (3.4 kPa) and less than or equal to 5 psig (34.5 kPa) to a lower pressure.

REGULATOR, MONITORING. A pressure regulator set in series with another pressure regulator for the purpose of automatically taking control of the pressure downstream of the monitored regulator when that pressure exceeds a set minimum.

REGULATOR, PRESSURE. A device placed in a gas line for reducing, controlling and maintaining the pressure in that portion of the piping system downstream of the device.

REGULATOR, SERIES. A pressure regulator in series with one or more other pressure regulators.

REGULATOR, SERVICE PRESSURE. For natural gas systems, a device installed by the serving gas supplier to reduce and limit the service line pressure to delivery pressure. For undiluted liquefied petroleum gas systems, the regulator located upstream from all line gas pressure regulators, where installed, and downstream from any first stage or a high pressure regulator in the system.

RELIEF OPENING. The opening provided in a draft hood to permit the ready escape to the atmosphere of the flue products from the draft hood in the event of no draft, back draft or stoppage beyond the draft hood, and to permit air into the draft hood in the event of a strong chimney updraft.
RELIEF VALVE (DEVICE). A safety valve designed to forestall the development of a dangerous condition by relieving either pressure, temperature or vacuum in the hot water supply system.

RELIEF VALVE, PRESSURE. An automatic valve that opens and closes a relief vent, depending on whether the pressure is above or below a predetermined value.

RELIEF VALVE, TEMPERATURE.

   Manual reset type. A valve that automatically opens a relief vent at a predetermined temperature and that must be manually returned to the closed position.

   Reseating or self-closing type. An automatic valve that opens and closes a relief vent, depending on whether the temperature is above or below a predetermined value.

RELIEF VALVE, VACUUM. A valve that automatically opens and closes a vent for relieving a vacuum within the hot water supply system, depending on whether the vacuum is above or below a predetermined value.


RISER, GAS. A vertical pipe supplying fuel gas.

ROOM HEATER, UNVENTED. See “Unvented room heater.”

ROOM HEATER, VENTED. A free-standing heating unit used for direct heating of the space in and adjacent to that in which the unit is located (see “Vented room heater”).

SAFETY SHUTOFF DEVICE. See “Flame safeguard.”

[BF] SHAFT. An enclosed space extending through one or more stories of a building, connecting vertical openings in successive floors, or floors and the roof.

[A] SLEEPING UNIT. A room or space in which people sleep, which can also include permanent provisions for living, eating and either sanitation or kitchen facilities, but not both. Such rooms and spaces that are also part of a dwelling unit are not sleeping units.

SPECIFIC GRAVITY. As applied to gas, specific gravity is the ratio of the weight of a given volume to that of the same volume of air, both measured under the same condition.

STATIONARY FUEL CELL POWER PLANT. A self-contained package or factory-matched packages that constitute an automatically operated assembly of integrated systems for generating electrical energy and recoverable thermal energy that is permanently connected and fixed in place.

THERMOSTAT.
**Electric switch type.** A device that senses changes in temperature and controls electrically, by means of separate components, the flow of gas to the burner(s) to maintain selected temperatures.

**[P] THIRD-PARTY CERTIFICATION AGENCY.** An approved agency operating a product or material certification system that incorporates initial product testing, assessment and surveillance of a manufacturer’s quality control system.

**[P] THIRD-PARTY CERTIFIED.** Certification obtained by the manufacturer indicating that the function and performance characteristics of a product or material have been determined by testing and ongoing surveillance by an approved third-party certification agency. Assertion of certification is in the form of identification in accordance with the requirements of the third-party certification agency.

**[P] THIRD-PARTY TESTED.** Procedure by which an approved testing laboratory provides documentation that a product, material or system conforms to specified requirements.

**TOILET, GAS-FIRED.** A packaged and completely assembled appliance containing a toilet that incinerates refuse instead of flushing it away with water.

**[M] TRANSITION FITTINGS, PLASTIC TO STEEL.** An adapter for joining plastic pipe to steel pipe. The purpose of this fitting is to provide a permanent, pressure-tight connection between two materials that cannot be joined directly one to another.

**[NY] UNIFORM CODE.** The New York State Uniform Fire Prevention and Building Code, adopted pursuant to Article 18 of the New York State Executive Law, as currently in effect and as hereafter amended from time to time.

**UNIT HEATER.** A self-contained, automatically controlled, vented, fuel-gas-burning, space-heating appliance, intended for installation in the space to be heated without the use of ducts, and having integral means for circulation of air.

**UNLISTED BOILER.** A boiler not listed by a nationally recognized testing agency.

**[NY] UNVENTED ROOM HEATER.** An unvented heating appliance designed for stationary installation and utilized to provide comfort heating. Such appliances provide radiant heat or convection heat by gravity or fan circulation directly from the heater and do not utilize ducts. A wall-mounted unvented room heater would be of the type designed for insertion in or attachment to a wall or partition. A wall-mounted unvented room heater does not incorporate concealed venting arrangements in its construction and discharges all products of combustion through the front into the room being heated.

**VALVE.** A device used in piping to control the gas supply to any section of a system of piping or to an appliance.

**Appliance shutoff.** A valve located in the piping system, used to isolate individual appliances for purposes such as service or replacement.
Automatic. An automatic or semiautomatic device consisting essentially of a valve and operator that control the gas supply to the burner(s) during operation of an appliance. The operator shall be actuated by application of gas pressure on a flexible diaphragm, by electrical means, by mechanical means, or by other approved means.

Automatic gas shutoff. A valve used in conjunction with an automatic gas shutoff device to shut off the gas supply to a water-heating system. It shall be constructed integrally with the gas shutoff device or shall be a separate assembly.

Individual main burner. A valve that controls the gas supply to an individual main burner.

Main burner control. A valve that controls the gas supply to the main burner manifold.

Manual main gas-control. A manually operated valve in the gas line for the purpose of completely turning on or shutting off the gas supply to the appliance, except to pilot or pilots that are provided with independent shutoff.

Manual reset. An automatic shutoff valve installed in the gas supply piping and set to shut off when unsafe conditions occur. The device remains closed until manually reopened.

Service shutoff. A valve, installed by the serving gas supplier between the service meter or source of supply and the customer piping system, to shut off the entire piping system.

VENT. A pipe or other conduit composed of factory-made components, containing a passageway for conveying combustion products and air to the atmosphere, listed and labeled for use with a specific type or class of appliance.

Special gas vent. A vent listed and labeled for use with listed Category II, III and IV appliances.

Type B vent. A vent listed and labeled for use with appliances with draft hoods and other Category I appliances that are listed for use with Type B vents.

Type BW vent. A vent listed and labeled for use with wall furnaces.

Type L vent. A vent listed and labeled for use with appliances that are listed for use with Type L or Type B vents.

VENT CONNECTOR. See “Connector.”

VENT GASES. Products of combustion from appliances plus excess air plus dilution air in the vent connector, gas vent or chimney above the draft hood or draft regulator.

VENT PIPING.

Breather. Piping run from a pressure-regulating device to the outdoors, designed to provide a reference to atmospheric pressure. If the device incorporates an integral pressure relief mechanism, a breather vent can also serve as a relief vent.
Relief. *Piping* run from a pressure-regulating or pressure-limiting device to the outdoors, designed to provide for the safe venting of gas in the event of excessive pressure in the gas piping system.

**VENTED APPLIANCE CATEGORIES.** Appliances that are categorized for the purpose of vent selection are classified into the following four categories:

- **Category I.** An *appliance* that operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.
- **Category II.** An *appliance* that operates with a nonpositive vent static pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent.
- **Category III.** An *appliance* that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.
- **Category IV.** An *appliance* that operates with a positive vent static pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent.

**VENTED ROOM HEATER.** A vented self-contained, freestanding, nonrecessed *appliance* for furnishing warm air to the space in which it is installed, directly from the heater without duct connections.

**VENTED WALL FURNACE.** A self-contained vented *appliance* complete with grilles or equivalent, designed for incorporation in or permanent attachment to the structure of a building, mobile home or travel trailer, and furnishing heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing. This definition shall exclude floor furnaces, unit heaters and central furnaces as herein defined.

**VENTING SYSTEM.** A continuous open passageway from the flue collar or draft hood of an *appliance* to the outdoor atmosphere for the purpose of removing flue or vent gases. A venting system is usually composed of a vent or a chimney and vent connector, if used, assembled to form the open passageway.

- **Forced-draft venting system.** A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under positive static vent pressure.
- **Induced draft venting system.** A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under nonpositive static vent pressure.
- **Mechanical draft venting system.** A venting system designed to remove flue or vent gases by mechanical means, that consists of an induced draft portion under nonpositive static pressure or a forced draft portion under positive static pressure.
- **Natural draft venting system.** A venting system designed to remove flue or vent gases under nonpositive static vent pressure entirely by natural draft.

**WALL HEATER, UNVENTED-TYPE.** A room heater of the type designed for insertion in or attachment to a wall or partition. Such heater does not incorporate concealed venting
arrangements in its construction and discharges all products of combustion through the front into the room being heated.

[M] WATER HEATER. Any heating appliance or equipment that heats potable water and supplies such water to the potable hot water distribution system.
CHAPTER 3
GENERAL REGULATIONS

SECTION 301
GENERAL

301.1 Scope.
This chapter shall govern the approval and installation of all equipment and appliances that comprise parts of the installations regulated by this code in accordance with Section 101.2.

301.1.1 Other fuels.
The requirements for combustion and dilution air for gas-fired appliances shall be governed by Section 304. The requirements for combustion and dilution air for appliances operating with fuels other than fuel gas shall be regulated by the Mechanical Code of New York State.

301.2 Energy utilization.
Heating, ventilating and air-conditioning systems of all structures shall be designed and installed for efficient utilization of energy in accordance with the Energy Conservation Construction Code of New York State.

301.3 Listed and labeled.
Appliances regulated by this code shall be listed and labeled for the application in which they are used unless otherwise approved in accordance with Section 105. The approval of unlisted appliances in accordance with Section 105 shall be based on approved engineering evaluation.

301.4 Labeling.
Labeling shall be in accordance with the procedures set forth in Sections 301.4.1 through 301.4.2.3.

301.4.1 Testing.
An approved agency shall test a representative sample of the appliances being labeled to the relevant standard or standards. The approved agency shall maintain a record of all of the tests performed. The record shall provide sufficient detail to verify compliance with the test standard.

301.4.2 Inspection and identification.
The approved agency shall periodically perform an inspection, which shall be in-plant if necessary, of the appliances to be labeled. The inspection shall verify that the labeled appliances are representative of the appliances tested.

301.4.2.1 Independent.
The agency to be approved shall be objective and competent. To confirm its objectivity, the agency shall disclose all possible conflicts of interest.

301.4.2.2 Equipment.
An approved agency shall have adequate equipment to perform all required tests. The equipment shall be periodically calibrated.
301.4.2.3 Personnel.
An approved agency shall employ experienced personnel educated in conducting, supervising and evaluating tests.

301.5 Label information.
A permanent factory-applied nameplate(s) shall be affixed to appliances on which shall appear in legible lettering, the manufacturer’s name or trademark, the model number, serial number and, for listed appliances, the seal or mark of the testing agency. A label shall include the hourly rating in British thermal units per hour (Btu/h) (W); the type of fuel approved for use with the appliance; and the minimum clearance requirements.

301.6 Plumbing connections.
Potable water supply and building drainage system connections to appliances regulated by this code shall be in accordance with the Plumbing Code of New York State.

301.7 Fuel types.
Appliances shall be designed for use with the type of fuel gas that will be supplied to them.

301.7.1 Appliance fuel conversion.
Appliances shall not be converted to utilize a different fuel gas except where complete instructions for such conversion are provided in the installation instructions, by the serving gas supplier or by the appliance manufacturer.

301.8 Vibration isolation.
Where means for isolation of vibration of an appliance is installed, an approved means for support and restraint of that appliance shall be provided.

301.9 Repair.
Defective material or parts shall be replaced or repaired in such a manner so as to preserve the original approval or listing.

301.10 Wind resistance.
Appliances and supports that are exposed to wind shall be designed and installed to resist the wind pressures determined in accordance with the Building Code of New York State.

[BS] 301.11 Flood hazard.
For structures located in flood hazard areas, the appliance, equipment and system installations regulated by this code shall be located at or above the elevation required by Section 1612 of the Building Code of New York State for utilities and attendant equipment.

Exception: The appliance, equipment and system installations regulated by this code are permitted to be located below the elevation required by Section 1612 of the Building Code of New York State for utilities and attendant equipment provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to such elevation.

301.12 Seismic resistance.
Where earthquake loads are applicable in accordance with the Building Code of New York State, the supports shall be designed and installed for the seismic forces in accordance with that code.
301.13 Ducts.
Ducts required for the installation of systems regulated by this code shall be designed and installed in accordance with the *Mechanical Code of New York State*.

301.14 Rodentproofing.
Buildings or structures and the walls enclosing habitable or occupiable rooms and spaces in which persons live, sleep or work, or in which feed, food or foodstuffs are stored, prepared, processed, served or sold, shall be constructed to protect against rodents in accordance with the *Building Code of New York State*.

301.15 Prohibited location.
The appliances, *equipment* and systems regulated by this code shall not be located in an elevator shaft.

**SECTION 302**
**STRUCTURAL SAFETY**

[BS] 302.1 Structural safety.
The building shall not be weakened by the installation of any gas piping. In the process of installing or repairing any gas piping, the finished floors, walls, ceilings, tile work or any other part of the building or premises that is required to be changed or replaced shall be left in a safe structural condition in accordance with the requirements of the *Building Code of New York State*.

[BF] 302.2 Penetrations of floor/ceiling assemblies and fire-resistance-rated assemblies.
Penetrations of floor/ceiling assemblies and assemblies required to have a fire-resistance rating shall be protected in accordance with the *Building Code of New York State*.

[BS] 302.3 Cutting, notching and boring in wood members.
The cutting, notching and boring of wood members shall comply with Sections 302.3.1 through 302.3.4.

[BS] 302.3.1 Engineered wood products.
Cuts, notches and holes bored in trusses, structural composite lumber, structural glued-laminated members and I-joists are prohibited except where permitted by the manufacturer’s recommendations or where the effects of such alterations are specifically considered in the design of the member by a registered design professional.

[BS] 302.3.2 Joist notching and boring.
Notching at the ends of joists shall not exceed one-fourth the joist depth. Holes bored in joists shall not be within 2 inches (51 mm) of the top and bottom of the joist and their diameters shall not exceed one-third the depth of the member. Notches in the top or bottom of the joist shall not exceed one-sixth the depth and shall not be located in the middle one-third of the span.

[BS] 302.3.3 Stud cutting and notching.
In exterior walls and bearing partitions, any wood stud is permitted to be cut or notched to a depth not exceeding 25 percent of its width. Cutting or notching of studs to a depth not greater than 40 percent of the width of the stud is permitted in nonload-bearing partitions supporting no loads other than the weight of the partition.

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[BS] 302.3.4 Bored holes.
The diameter of bored holes in wood studs shall not exceed 40 percent of the stud depth. The diameter of bored holes in wood studs shall not exceed 60 percent of the stud depth in nonbearing partitions. The diameter of bored holes in wood studs shall not exceed 60 percent of the stud depth in any wall where each stud is doubled, provided that not more than two such successive doubled studs are so bored. The edge of the bored hole shall be not closer than $\frac{5}{8}$ inch (15.9 mm) to the edge of the stud. Bored holes shall not be located at the same section of stud as a cut or notch.

[BS] 302.4 Alterations to trusses.
Truss members and components shall not be cut, drilled, notched, spliced or otherwise altered in any way without the written concurrence and approval of a registered design professional. Alterations resulting in the addition of loads to any member, such as HVAC equipment and water heaters, shall not be permitted without verification that the truss is capable of supporting such additional loading.

[BS] 302.5 Cutting, notching and boring holes in structural steel framing.
The cutting, notching and boring of holes in structural steel framing members shall be as prescribed by the registered design professional.

[BS] 302.6 Cutting, notching and boring holes in cold-formed steel framing.
Flanges and lips of load-bearing, cold-formed steel framing members shall not be cut or notched. Holes in webs of load-bearing, cold-formed steel framing members shall be permitted along the centerline of the web of the framing member and shall not exceed the dimensional limitations, penetration spacing or minimum hole edge distance as prescribed by the registered design professional. Cutting, notching and boring holes of steel floor/roof decking shall be as prescribed by the registered design professional.

[BS] 302.7 Cutting, notching and boring holes in nonstructural cold-formed steel wall framing.
Flanges and lips of nonstructural cold-formed steel wall studs shall be permitted along the centerline of the web of the framing member, shall not exceed $1\frac{1}{2}$ inches (38 mm) in width or 4 inches (102 mm) in length, and the holes shall not be spaced less than 24 inches (610 mm) center to center from another hole or less than 10 inches (254 mm) from the bearing end.

SECTION 303
APPLIANCE LOCATION

303.1 General.
Appliances shall be located as required by this section, specific requirements elsewhere in this code and the conditions of the equipment and appliance listing.

303.2 Hazardous locations.
Appliances shall not be located in a hazardous location unless listed and approved for the specific installation.
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. Combustion air shall be taken directly from the outdoors in accordance with Section 304.6.

6. A 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 (0.06 m²) that communicates with a space outside of a sleeping room, bathroom, toilet room or storage closet.

303.3.1 Fireplaces and decorative appliances in Group I-2, Condition 2 occupancies.
Gas fireplace appliances and decorative gas appliances shall be prohibited in Group I-2, Condition 2 occupancies except where such appliances are direct-vent appliances installed in public lobby and waiting areas that are not within smoke compartments containing patient sleeping areas. The appliance controls shall be located where they can be accessed only by facility staff. Such fireplaces shall comply with Sections 501.2 and 604.1 and Section 915 of the Fire Code of New York State.

303.4 Protection from vehicle impact damage.
Appliances shall not be installed in a location subject to vehicle impact damage except where protected by an approved means.

303.5 Indoor locations.
Furnaces and boilers installed in closets and alcoves shall be listed for such installation.

303.6 Outdoor locations.
Appliances installed in outdoor locations shall be either listed for outdoor installation or provided
with protection from outdoor environmental factors that influence the operability, durability and safety of the appliances.

303.7 Pit locations.
Appliances installed in pits or excavations shall not come in direct contact with the surrounding soil. The sides of the pit or excavation shall be held back not less than 12 inches (305 mm) from the appliance. Where the depth exceeds 12 inches (305 mm) below adjoining grade, the walls of the pit or excavation shall be lined with concrete or masonry, such concrete or masonry shall extend not less than 4 inches (102 mm) above adjoining grade and shall have sufficient lateral load-bearing capacity to resist collapse. The appliance shall be protected from flooding in an approved manner.

SECTION 304
COMBUSTION, VENTILATION AND DILUTION AIR

304.1 General.
Air for combustion, ventilation and dilution of flue gases for appliances installed in buildings shall be provided by application of one of the methods prescribed in Sections 304.5 through 304.9. Where the requirements of Section 304.5 are not met, outdoor air shall be introduced in accordance with one of the methods prescribed in Sections 304.6 through 304.9. Direct-vent appliances, gas appliances of other than natural draft design, vented gas appliances not designated as Category I and appliances equipped with power burners shall be provided with combustion, ventilation and dilution air in accordance with the appliance manufacturer's instructions.

   Exception: Type 1 clothes dryers that are provided with makeup air in accordance with Section 614.6.

304.2 Appliance location.
Appliances shall be located so as not to interfere with proper circulation of combustion, ventilation and dilution air.

304.3 Draft hood/regulator location.
Where used, a draft hood or a barometric draft regulator shall be installed in the same room or enclosure as the appliance served to prevent any difference in pressure between the hood or regulator and the combustion air supply.

304.4 Makeup air provisions.
Where exhaust fans, clothes dryers and kitchen ventilation systems interfere with the operation of appliances, makeup air shall be provided.

304.5 Indoor combustion air.
The required volume of indoor air shall be determined in accordance with Section 304.5.1 or 304.5.2, except that where the air infiltration rate is known to be less than 0.40 air changes per hour (ACH), Section 304.5.2 shall be used. The total required volume shall be the sum of the required volume calculated for all appliances located within the space. Rooms communicating directly with the space in which the appliances are installed through openings not furnished with doors, and through combustion air openings sized and located in accordance with Section 304.5.3, are considered to be part of the required volume.
304.5.1 Standard method.
The minimum required volume shall be 50 cubic feet per 1,000 Btu/h (4.8 m$^3$/kW) of the appliance input rating.

304.5.2 Known air-infiltration-rate method.
Where the air infiltration rate of a structure is known, the minimum required volume shall be determined as follows:

For appliances other than fan-assisted, calculate volume using Equation 3-1.

\[
\text{Required Volume}_{other} \geq 21 \text{ ft}^3 \left( \frac{I_{other}}{ACH \times 1000 \text{ Btu/h}} \right)
\]

(Equation 3-1)

For fan-assisted appliances, calculate volume using Equation 3-2.

\[
\text{Required Volume}_{fan} \geq 15 \text{ ft}^3 \left( \frac{I_{fan}}{ACH \times 1000 \text{ Btu/h}} \right)
\]

(Equation 3-2)

where:

- \(I_{other}\) = All appliances other than fan assisted (input in Btu/h).
- \(I_{fan}\) = Fan-assisted appliance (input in Btu/h).
- \(ACH\) = Air change per hour (percent of volume of space exchanged per hour, expressed as a decimal).

For purposes of this calculation, an infiltration rate greater than 0.60ACH 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\(^2\)/kW) of the total input rating of all appliances in the space, but not less than 100 square inches (0.06 m\(^2\)). 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\(^2\)/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 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$^2$/kW) of total input rating of all appliances in the enclosure [see
Figures 304.6.1(1) and 304.6.1(2)].

Where communicating with the outdoors through horizontal ducts, each opening shall
have a minimum free area of not less than 1 square inch per 2,000 Btu/h (1100 mm$^2$/kW) of
total input rating of all appliances in the enclosure [see Figure 304.6.1(3)].

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

FIGURE 304.6.1(3)
ALL AIR FROM OUTDOORS

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304.6.2 One-permanent-opening method.
One permanent opening, commencing within 12 inches (305 mm) of the top of the enclosure, shall be provided. The appliance shall have clearances of not less than 1 inch (25 mm) from the sides and back and 6 inches (152 mm) from the front of the appliance. The opening shall directly communicate with the outdoors, or through a vertical or horizontal duct, to the outdoors or spaces that freely communicate with the outdoors (see Figure 304.6.2) and shall have a minimum free area of 1 square inch per 3,000 Btu/h (734 mm²/kW) of the total input rating of all appliances located in the enclosure and not less than the sum of the areas of all vent connectors in the space.

**FIGURE 304.6.2**
SINGLE COMBUSTION AIR OPENING, ALL AIR FROM THE OUTDOORS
(see Section 304.6.2)

304.7 Combination indoor and outdoor combustion air.
The use of a combination of indoor and outdoor combustion air shall be in accordance with Sections 304.7.1 through 304.7.3.

304.7.1 Indoor openings.
Where used, openings connecting the interior spaces shall comply with Section 304.5.3.

304.7.2 Outdoor opening location.
Outdoor opening(s) shall be located in accordance with Section 304.6.
304.7.3 Outdoor opening(s) size.
The outdoor opening(s) size shall be calculated in accordance with the following:

1. The ratio of interior spaces shall be the available volume of all communicating spaces divided by the required volume.
2. The outdoor size reduction factor shall be one minus the ratio of interior spaces.
3. The minimum size of outdoor opening(s) shall be the full size of outdoor opening(s) calculated in accordance with Section 304.6, multiplied by the reduction factor. The minimum dimension of air openings shall be not less than 3 inches (76 mm).

304.8 Engineered installations.
Engineered combustion air installations shall provide an adequate supply of combustion, ventilation and dilution air and shall be approved.

304.9 Mechanical combustion air supply.
Where all combustion air is provided by a mechanical air supply system, the combustion air shall be supplied from the outdoors at a rate not less than 0.35 cubic feet per minute per 1,000 Btu/h (0.034 m³/min per kW) of total input rating of all appliances located within the space.

304.9.1 Makeup air.
Where exhaust fans are installed, makeup air shall be provided to replace the exhausted air.

304.9.2 Appliance interlock.
Each of the appliances served shall be interlocked with the mechanical air supply system to prevent main burner operation when the mechanical air supply system is not in operation.

304.9.3 Combined combustion air and ventilation air system.
Where combustion air is provided by the building’s mechanical ventilation system, the system shall provide the specified combustion air rate in addition to the required ventilation air.

304.10 Louvers and grilles.
The required size of openings for combustion, ventilation and dilution air shall be based on the net free area of each opening. Where the free area through a design of louver, grille or screen is known, it shall be used in calculating the size opening required to provide the free area specified. Where the design and free area of louvers and grilles 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. Screens shall have a mesh size not smaller than $\frac{1}{4}$ inch (6.4 mm). Nonmotorized louvers and grilles shall be fixed in the open position. Motorized louvers shall be interlocked with the appliance so that they are proven to be in the full open position prior to main burner ignition and during main burner operation. Means shall be provided to prevent the main burner from igniting if the louvers fail to open during burner start-up and to shut down the main burner if the louvers close during operation.

304.11 Combustion air ducts.
Combustion air ducts shall comply with all of the following:
1. Ducts shall be constructed of galvanized steel complying with Chapter 6 of the *Mechanical Code of New York State* or of a material having equivalent corrosion resistance, strength and rigidity.

   **Exception:** Within dwellings units, unobstructed stud and joist spaces shall not be prohibited from conveying combustion air, provided that not more than one required fireblock is removed.

2. Ducts shall terminate in an unobstructed space allowing free movement of combustion air to the appliances.

3. Ducts shall serve a single enclosure.

4. Ducts shall not serve both upper and lower combustion air openings where both such openings are used. The separation between ducts serving upper and lower combustion air openings shall be maintained to the source of combustion air.

5. Ducts shall not be screened where terminating in an attic space.

6. Horizontal upper combustion air ducts shall not slope downward toward the source of combustion air.

7. The remaining space surrounding a chimney liner, gas vent, special gas vent or plastic piping installed within a masonry, metal or factory-built chimney shall not be used to supply combustion air.

   **Exception:** Direct-vent gas-fired appliances designed for installation in a solid fuel-burning fireplace where installed in accordance with the manufacturer’s instructions.

8. Combustion air intake openings located on the exterior of a building shall have the lowest side of such openings located not less than 12 inches (305 mm) vertically from the adjoining finished ground level.

**304.12 Protection from fumes and gases.**

Where corrosive or flammable process fumes or gases, other than products of combustion, are present, means for the disposal of such fumes or gases shall be provided. Such fumes or gases include carbon monoxide, hydrogen sulfide, ammonia, chlorine and halogenated hydrocarbons.

In barbershops, beauty shops and other facilities where chemicals that generate corrosive or flammable products, such as aerosol sprays, are routinely used, nondirect vent-type appliances shall be located in a mechanical room separated or partitioned off from other areas with provisions for combustion air and dilution air from the outdoors. Direct-vent appliances shall be installed in accordance with the appliance manufacturer’s instructions.

**SECTION 305**

**INSTALLATION**

**305.1 General.**

*Equipment* and appliances shall be installed as required by the terms of their approval, in
accordance with the conditions of listing, the manufacturer’s instructions and this code. Manufacturers’ installation instructions shall be available on the job site at the time of inspection. Where a code provision is less restrictive than the conditions of the listing of the equipment or appliance or the manufacturer’s installation instructions, the conditions of the listing and the manufacturer’s installation instructions shall apply.

Unlisted appliances approved in accordance with Section 301.3 shall be limited to uses recommended by the manufacturer and shall be installed in accordance with the manufacturer’s instructions, the provisions of this code and the requirements determined by the building official.

305.2 Hazardous area.
Equipment and appliances having an ignition source shall not be installed in Group H occupancies or control areas where open use, handling or dispensing of combustible, flammable or explosive materials occurs.

305.3 Elevation of ignition source.
Equipment and appliances having an ignition source shall be elevated such that the source of ignition is not less than 18 inches (457 mm) above the floor in hazardous locations and public garages, private garages, repair garages, motor fuel-dispensing facilities and parking garages. 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.

Exception: Elevation of the ignition source is not required for appliances that are listed as flammable vapor ignition resistant.

305.3.1 Installation in residential garages.
In residential garages where appliances are installed in a separate, enclosed space having access only from outside of the garage, such appliances shall be permitted to be installed at floor level, provided that the required combustion air is taken from the exterior of the garage.

305.3.2 Parking garages.
Connection of a parking garage with any room in which there is a fuel-fired appliance shall be by means of a vestibule providing a two-doorway separation, except that a single door is permitted where the sources of ignition in the appliance are elevated in accordance with Section 305.3.

Exception: This section shall not apply to appliance installations complying with Section 305.4.

305.4 Public garages.
Appliances located in public garages, motor fuel-dispensing facilities, repair garages or other areas frequented by motor vehicles shall be installed not less than 8 feet (2438 mm) above the floor. Where motor vehicles are capable of passing under an appliance, the appliance shall be installed at the clearances required by the appliance manufacturer and not less than 1 foot (305 mm) higher than the tallest vehicle garage door opening.

Exception: The requirements of this section shall not apply where the appliances are protected from motor vehicle impact and installed in accordance with Section 305.3 and NFPA 30A.
305.5 Private garages.
Appliances located in private garages shall be installed with a minimum clearance of 6 feet (1829 mm) above the floor.

**Exception:** The requirements of this section shall not apply where the appliances are protected from motor vehicle impact and installed in accordance with Section 305.3.

305.6 Construction and protection.
Boiler rooms and furnace rooms shall be protected as required by the *Building Code of New York State*.

305.7 Clearances from grade.
*Equipment* and appliances installed at grade level shall be supported on a level concrete slab or other approved material extending not less than 3 inches (76 mm) above adjoining grade or shall be suspended not less than 6 inches (152 mm) above adjoining grade. Such supports shall be installed in accordance with the manufacturer’s instructions.

305.8 Clearances to combustible construction.
Heat-producing *equipment* and appliances shall be installed to maintain the required clearances to combustible construction as specified in the listing and manufacturer’s instructions. Such clearances shall be reduced only in accordance with Section 308. Clearances to combustibles shall include such considerations as door swing, drawer pull, overhead projections or shelving and window swing. Devices, such as door stops or limits and closers, shall not be used to provide the required clearances.

305.9 Parking structures.
Appliances installed in enclosed, basement and underground parking structures shall be installed in accordance with NFPA 88A.

305.10 Repair garages.
Appliances installed in repair garages shall be installed in accordance with NFPA 30A.

305.11 Installation in aircraft hangars.
Heaters in aircraft hangars shall be installed in accordance with NFPA 409.

305.12 Avoid strain on gas piping.
Appliances shall be supported and connected to the *piping* so as not to exert undue strain on the connections.

**SECTION 306**
ACCESS AND SERVICE SPACE

Appliances, control devices, heat exchangers and HVAC components that utilize energy shall be accessible for inspection, service, repair and replacement without disabling the function of a fire-resistance-rated assembly or removing permanent construction, other appliances, or any other piping or ducts not connected to the *appliance* being inspected, serviced, repaired or replaced. A
level working space not less than 30 inches (762 mm) deep and 30 inches (762 mm) wide shall be provided in front of the control side to service an appliance.

[M] 306.2 Appliances in rooms.
Rooms containing appliances shall be provided with a door and an unobstructed passageway measuring not less than 36 inches (914 mm) wide and 80 inches (2032 mm) high.

Exception: Within a dwelling unit, appliances installed in a compartment, alcove, basement or similar space shall be provided with access by an opening or door and an unobstructed passageway measuring not less than 24 inches (610 mm) wide and large enough to allow removal of the largest appliance in the space, provided that a level service space of not less than 30 inches (762 mm) deep and the height of the appliance, but not less than 30 inches (762 mm), is present at the front or service side of the appliance with the door open.

[M] 306.3 Appliances in attics.
Attics containing appliances shall be provided with an opening and unobstructed passageway large enough to allow removal of the largest appliance. The passageway shall be not less than 30 inches (762 mm) high and 22 inches (559 mm) wide and not more than 20 feet (6096 mm) in length measured along the centerline of the passageway from the opening to the appliance. The passageway shall have continuous solid flooring not less than 24 inches (610 mm) wide. A level service space not less than 30 inches (762 mm) deep and 30 inches (762 mm) wide shall be present at the front or service side of the appliance. The clear access opening dimensions shall be not less than 20 inches by 30 inches (508 mm by 762 mm) and large enough to allow removal of the largest appliance.

Exceptions:

1. The passageway and level service space are not required where the appliance is capable of being serviced and removed through the required opening.

2. Where the passageway is not less than 6 feet (1829 mm) high for its entire length, the passageway shall be not greater than 50 feet (15 250 mm) in length.

[M] 306.3.1 Electrical requirements.
A luminaire controlled by a switch located at the required passageway opening and a receptacle outlet shall be provided at or near the appliance location in accordance with NFPA 70.

[M] 306.4 Appliances under floors.
Under-floor spaces containing appliances shall be provided with an access opening and unobstructed passageway large enough to remove the largest appliance. The passageway shall be not less than 30 inches (762 mm) high and 22 inches (559 mm) wide, nor more than 20 feet (6096 mm) in length measured along the centerline of the passageway from the opening to the appliance. A level service space not less than 30 inches (762 mm) deep and 30 inches (762 mm) wide shall be present at the front or service side of the appliance. If the depth of the passageway or the service space exceeds 12 inches (305 mm) below the adjoining grade, the walls of the passageway shall be lined with concrete or masonry extending 4 inches (102 mm) above the adjoining grade and having sufficient lateral-bearing capacity to resist collapse. The clear access opening dimensions shall be not less than 22 inches by 30 inches (559 mm by 762 mm), and large enough to allow removal of the largest appliance.
Exceptions:

1. The passageway is not required where the level service space is present when the access is open and the appliance is capable of being serviced and removed through the required opening.

2. Where the passageway is not less than 6 feet high (1829 mm) for its entire length, the passageway shall not be limited in length.

[M] 306.4.1 Electrical requirements.
A luminaire controlled by a switch located at the required passageway opening and a receptacle outlet shall be provided at or near the appliance location in accordance with NFPA 70.

[M] 306.5 Equipment and appliances on roofs or elevated structures.
Where equipment requiring access or appliances are located on an elevated structure or the roof of a building such that personnel will have to climb higher than 16 feet (4877 mm) above grade to access such equipment or appliances, an interior or exterior means of access shall be provided. Such access shall not require climbing over obstructions greater than 30 inches (762 mm) in height or walking on roofs having a slope greater than 4 units vertical in 12 units horizontal (33-percent slope). Such access shall not require the use of portable ladders.

Permanent ladders installed to provide the required access shall comply with the following minimum design criteria:

1. The side railing shall extend above the parapet or roof edge not less than 30 inches (762 mm).

2. Ladders shall have rung spacing not to exceed 14 inches (356 mm) on center. The uppermost rung shall be not more than 24 inches (610 mm) below the upper edge of the roof hatch, roof or parapet, as applicable.

3. Ladders shall have a toe spacing not less than 6 inches (152 mm) deep.

4. There shall be not less than 18 inches (457 mm) between rails.

5. Rungs shall have a diameter not less than 0.75-inch (19 mm) and be capable of withstanding a 300-pound (136.1 kg) load.

6. Ladders over 30 feet (9144 mm) in height shall be provided with offset sections and landings capable of withstanding 100 pounds per square foot (488.2 kg/m²). Landing dimensions shall be not less than 18 inches (457 mm) and not less than the width of the ladder served. A guard rail shall be provided on all open sides of the landing.

7. Climbing clearance. The distance from the centerline of the rungs to the nearest permanent object on the climbing side of the ladder shall be not less than 30 inches (762 mm) measured perpendicular to the rungs. This distance shall be maintained from the point of ladder access to the bottom of the roof hatch. A minimum clear width of 15 inches.
(381 mm) shall be provided on both sides of the ladder measured from the midpoint of and parallel with the rungs, except where cages or wells are installed.

8. Landing required. The ladder shall be provided with a clear and unobstructed bottom landing area having a minimum dimension of 30 inches by 30 inches (762 mm by 762 mm) centered in front of the ladder.

9. Ladders shall be protected against corrosion by approved means.

10. Access to ladders shall be provided at all times.

Catwalks installed to provide the required access shall be not less than 24 inches (610 mm) wide and shall have railings as required for service platforms.

**Exception:** This section shall not apply to Group R-3 occupancies.

**[M] 306.5.1 Sloped roofs.**
Where appliances, equipment, fans or other components that require service are installed on a roof having a slope of 3 units vertical in 12 units horizontal (25-percent slope) or greater and having an edge more than 30 inches (762 mm) above grade at such edge, a level platform shall be provided on each side of the appliance or equipment to which access is required for service, repair or maintenance. The platform shall be not less than 30 inches (762 mm) in any dimension and shall be provided with guards. The guards shall extend not less than 42 inches (1067 mm) above the platform, shall be constructed so as to prevent the passage of a 21-inch-diameter (533 mm) sphere and shall comply with the loading requirements for guards specified in the Building Code of New York State. Access shall not require walking on roofs having a slope greater than 4 units vertical in 12 units horizontal (33-percent slope). Where access involves obstructions greater than 30 inches (762 mm) in height, such obstructions shall be provided with ladders installed in accordance with Section 306.5 or stairways installed in accordance with the requirements specified in the Building Code of New York State in the path of travel to and from appliances, fans or equipment requiring service.

**[M] 306.5.2 Electrical requirements.**
A receptacle outlet shall be provided at or near the appliance location in accordance with NFPA 70.

**[M] 306.6 Guards.**
Guards shall be provided where various components that require service and roof hatch openings are located within 10 feet (3048 mm) of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches (762 mm) above the floor, roof, or grade below. The guard shall extend not less than 30 inches (762 mm) beyond each end of components that require service. The top of the guard shall be located not less than 42 inches (1067 mm) above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 21-inch-diameter (533 mm) sphere and shall comply with the loading requirements for guards specified in the Building Code of New York State.

**Exception:** Guards are not required where permanent fall arrest/restraint anchorage connector devices that comply with ANSI/ASSE Z 359.1 are affixed for use during the entire lifetime of the roof covering. The devices shall be reevaluated for possible replacement when the entire roof covering is replaced. The devices shall be placed not more than 10 feet (3048 mm) above the floor, roof, or grade below.
mm) on center along hip and ridge lines and placed not less than 10 feet (3048 mm) from roof edges and the open sides of walking surfaces.

SECTION 307
CONDENSATE DISPOSAL

307.1 Evaporators and cooling coils.
Condensate drainage systems shall be provided for equipment and appliances containing evaporators and cooling coils in accordance with the Mechanical Code of New York State.

307.2 Fuel-burning appliances.
Liquid combustion byproducts of condensing appliances shall be collected and discharged to an approved plumbing fixture or disposal area in accordance with the manufacturer’s instructions. Condensate piping shall be of approved corrosion-resistant material and shall be not smaller than the drain connection on the appliance. Such piping shall maintain a minimum slope in the direction of discharge of not less than one-eighth unit vertical in 12 units horizontal (1-percent slope).

[M] 307.3 Drain pipe materials and sizes.
Components of the condensate disposal system shall be cast iron, galvanized steel, copper, cross-linked polyethylene, polyethylene, ABS, CPVC, PVC or polypropylene pipe or tubing. Components shall be selected for the pressure and temperature rating of the installation. Joints and connections shall be made in accordance with the applicable provisions of Chapter 7 of the Plumbing Code of New York State relative to the material type. Condensate waste and drain line size shall be not less than \( \frac{3}{4} \) -inch (19 mm) internal diameter and shall not decrease in size from the drain pan connection to the place of condensate disposal. Where the drain pipes from more than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with an approved method.

307.4 Traps.
Condensate drains shall be trapped as required by the equipment or appliance manufacturer.

307.5 Auxiliary drain pan.
Category IV condensing appliances shall be provided with an auxiliary drain pan where damage to any building component will occur as a result of stoppage in the condensate drainage system. Such pan shall be installed in accordance with the applicable provisions of Section 307 of the Mechanical Code of New York State.

Exception: An auxiliary drain pan shall not be required for appliances that automatically shut down operation in the event of a stoppage in the condensate drainage system.

307.6 Condensate pumps.
Condensate pumps located in uninhabitable spaces, such as attics and crawl spaces, shall be connected to the appliance or equipment served such that when the pump fails, the appliance or equipment will be prevented from operating. Pumps shall be installed in accordance with the manufacturer’s instructions.

SECTION 308
CLEARANCE REDUCTION

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308.1 Scope.
This section shall govern the reduction in required clearances to combustible materials, including gypsum board, and combustible assemblies for chimneys, vents, appliances, devices and equipment. Clearance requirements for air-conditioning equipment and central heating boilers and furnaces shall comply with Sections 308.3 and 308.4.

308.2 Reduction table.
The allowable clearance reduction shall be based on one of the methods specified in Table 308.2 or shall utilize a reduced clearance protective assembly listed and labeled in accordance with UL 1618. Where required clearances are not listed in Table 308.2, the reduced clearances shall be determined by linear interpolation between the distances listed in the table. Reduced clearances shall not be derived by extrapolation below the range of the table. The reduction of the required clearances to combustibles for listed and labeled appliances and equipment shall be in accordance with the requirements of this section, except that such clearances shall not be reduced where reduction is specifically prohibited by the terms of the appliance or equipment listing [see Figures 308.2(1) through 308.2(3)].

<p>| TYPE OF PROTECTION APPLIED TO AND COVERING ALL SURFACES OF COMBUSTIBLE MATERIAL WITHIN THE DISTANCE SPECIFIED AS THE REQUIRED CLEARANCE WITH NO PROTECTION [see Figures 308.2(1), 308.2(2), and 308.2(3)] | WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION FROM APPLIANCE, VENT CONNECTOR, OR SINGLE-WALL METAL PIPE IS: (inches) |
| --- | --- | --- | --- | --- | --- | --- |
| | 36 | 18 | 12 | 9 | 6 |
| Allowable clearances with specified protection (inches) | Use Column 1 for clearances above appliance or horizontal connector. Use Column 2 for clearances from appliance, vertical connector and single-wall metal pipe. |
| 1 3/8-inch-thick masonry wall without ventilated airspace | — | 24 | — | 12 | — | 9 | — | 6 | — | 5 |</p>
<table>
<thead>
<tr>
<th>2.</th>
<th>1/2-inch insulation board over 1-inch glass fiber or mineral wool batts</th>
<th>24</th>
<th>18</th>
<th>12</th>
<th>9</th>
<th>9</th>
<th>6</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>0.024-inch (nominal 24 gage) sheet metal over 1-inch glass fiber or mineral wool batts reinforced with wire on rear face with ventilated airspace</td>
<td>18</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>1/2-inch thick masonry wall with ventilated airspace</td>
<td>—</td>
<td>12</td>
<td>—</td>
<td>6</td>
<td>—</td>
<td>6</td>
<td>—</td>
<td>6</td>
<td>—</td>
<td>6</td>
</tr>
<tr>
<td>5.</td>
<td>0.024-inch (nominal 24 gage) sheet metal with ventilated airspace</td>
<td>18</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>1/2-inch-thick insulation board with ventilated airspace</td>
<td>18</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>0.024-inch (nominal 24 gage) sheet metal with ventilated airspace over 0.024-inch (nominal 24 gage) sheet metal with ventilated airspace</td>
<td>18</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

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8. 1-inch glass fiber or mineral wool batts sandwiched between two sheets 0.024-inch (nominal 24 gage) sheet metal with ventilated airspace

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th>6</th>
<th>4</th>
<th>5</th>
<th>3</th>
<th>3</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>12</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, °C = [(°F) – 32] / 1.8, 1 pound per cubic foot = 16.02 kg/m³, 1 Btu per inch per square foot per hour per °F = 0.144 W/m² • K.

a. Reduction of clearances from combustible materials shall not interfere with combustion air, draft hood clearance and relief, and accessibility of servicing.

b. Clearances shall be measured from the outer surface of the combustible material to the nearest point on the surface of the appliance, disregarding any intervening protection applied to the combustible material.

c. Spacers and ties shall be of noncombustible material. No spacer or tie shall be used directly opposite an appliance or connector.

d. For all clearance reduction systems using a ventilated airspace, adequate provision for air circulation shall be provided as described [see Figures 308.2(2) and 308.2(3)].

e. There shall be not less than 1 inch between clearance reduction systems and combustible walls and ceilings for reduction systems using ventilated airspace.

f. Where a wall protector is mounted on a single flat wall away from corners, it shall have a minimum 1-inch air gap. To provide air circulation, the bottom and top edges, or only the side and top edges, or all edges shall be left open.

g. Mineral wool batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot and a minimum melting point of 1500°F.

h. Insulation material used as part of a clearance reduction system shall have a thermal conductivity of 1.0 Btu per inch per square foot per hour per °F or less.

i. There shall be not less than 1 inch between the appliance and the protector. In no case shall the clearance between the appliance and the combustible surface be reduced below that allowed in this table.

j. Clearances and thicknesses are minimum; larger clearances and thicknesses are acceptable.

k. Listed single-wall connectors shall be installed in accordance with the manufacturer’s instructions.

A = the clearance with no protection.

B = the reduced clearance permitted in accordance with Table 308.2. The protection applied to the construction using combustible material shall extend far enough in each direction to make “C” equal to “A.”
FIGURE 308.2(1)
EXTENT OF PROTECTION NECESSARY TO REDUCE CLEARANCES FROM APPLIANCE OR VENT CONNECTIONS

For SI: 1 inch = 25.4 mm.

FIGURE 308.2(2)
WALL PROTECTOR CLEARANCE REDUCTION SYSTEM

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308.3 Clearances for indoor air-conditioning appliances.
Clearance requirements for indoor air-conditioning appliances shall comply with Sections 308.3.1 through 308.3.4.

308.3.1 Appliance clearances.
Air-conditioning appliances shall be installed with clearances in accordance with the manufacturer’s instructions.

308.3.2 Clearance reduction.
Air-conditioning appliances shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material or appliance is protected as described in Table 308.2 and such reduction is allowed by the manufacturer’s instructions.

308.3.3 Plenum clearances.
Where the furnace plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish where the clearance specified is 2 inches (51 mm) or less.

308.3.4 Clearance from supply ducts.
Supply air ducts connecting to listed central heating furnaces shall have the same minimum clearance to combustibles as required for the furnace supply plenum for a distance of not less than 3 feet (914 mm) from the supply plenum. Clearance is not required beyond the 3-foot (914 mm) distance.

308.4 Central-heating boilers and furnaces.
Clearance requirements for central-heating boilers and furnaces shall comply with Sections 308.4.1 through 308.4.5. The clearance to these appliances shall not interfere with combustion air; draft hood clearance and relief; and accessibility for servicing.

308.4.1 Appliance clearances.
Central-heating furnaces and low-pressure boilers shall be installed with clearances in accordance with the manufacturer’s instructions.

308.4.2 Clearance reduction.
Central-heating furnaces and low-pressure boilers shall be permitted to be installed with reduced clearances to combustible material provided that the combustible material or appliance is protected as described in Table 308.2 and such reduction is allowed by the manufacturer’s instructions.

308.4.3 Clearance for servicing appliances.
Front clearance shall be sufficient for servicing the burner and the furnace or boiler.

308.4.4 Plenum clearances.
Where the furnace plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish where the clearance specified is 2 inches (51 mm) or less.
308.4.5 Clearance from supply ducts.
Supply air ducts connecting to listed central heating furnaces shall have the same minimum clearance to combustibles as required for the furnace supply plenum for a distance of not less than 3 feet (914 mm) from the supply plenum. Clearance is not required beyond the 3-foot (914 mm) distance.

SECTION 309
ELECTRICAL

309.1 Grounding.
Gas piping shall not be used as a grounding electrode.

309.2 Connections.
Electrical connections between appliances and the building wiring, including the grounding of the appliances, shall conform to NFPA 70.

SECTION 310
ELECTRICAL BONDING

310.1 Pipe and tubing other than CSST.
Each aboveground portion of a gas piping system other than corrugated stainless steel tubing (CSST) that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping other than CSST shall be considered to be bonded where it is connected to an appliance that is connected to the equipment grounding conductor of the circuit that supplies that appliance.

[NY] 310.2 Gas pipe bonding – CSST.
A gas piping system that contains any CSST shall be electrically continuous and shall be directly bonded to the electrical service grounding electrode system. No portion of the gas piping system shall be used as or considered to be a grounding electrode or a grounding electrode conductor. CSST shall be installed and bonded in accordance with Section 310.2, and the stricter of:

1. The requirements set forth in the CSST manufacturer’s installation instructions.

2. The requirements set forth in Sections 310.2.1, 310.2.2, 310.2.3, and 404.7 of this code.

Exception: Where all of the CSST contained in a gas piping system is listed AR-CSST and the gas piping system satisfies all of the other criteria set forth in Section 310.3 of this code, such gas piping system shall comply with said Section 310.3.

[NY] 310.2.1 Bonding jumper.
Where the electric service for the individual installation is 200 amperes or less, the bonding jumper shall not be smaller than 6 AWG copper wire or 4 AWG aluminum or copper-clad aluminum wire, and shall be permanently connected to the grounding electrode system. Where the electric service for the individual installation is more than 200 amperes, the bonding jumper size shall be determined in accordance with Table 250.66 and Sections 250.66(A) through 250.66(C) of NFPA 70, and shall be permanently connected to the grounding electrode system.
[NY] 310.2.2 Bonding clamp.
The bonding jumper shall be connected to the gas piping system with a bonding clamp that is listed for the material of the bonding jumper and for the material of the component of the gas piping system to which the bonding clamp is attached. The bonding clamp shall be attached to the gas piping system, on the downstream side of the gas meter or regulator in an unconcealed and readily accessible space, and as close as practical to the point where the bonding jumper is connected to the electrical service grounding electrode system, and shall not exceed 75 feet. Any additional grounding electrodes used shall be bonded to the electrical service grounding electrode system.

[NY] 310.2.2.1 Bonding connections.
Bonding connections shall be in accordance with NFPA 70.

[NY] 310.2.2.2 Connection devices.
Devices used for making the bonding connections shall be listed for the application in accordance with UL 467.

[NY] 310.2.3 Prohibited uses.
CSST shall not be supported on or by other electrically conductive systems including copper water pipe, electric power cables, air-conditioning and heating ducts, communication cables and structural steel beams. Electrical wiring, including the bonding conductor, shall be supported and secured independently of the CSST so that it does not come in contact with the CSST.

[NY] 310.2.4 Reserved.

[NY] 310.2.5 Reserved.

[NY] 310.3 Gas pipe bonding - listed AR-CSST. Where all of the following apply:

1. All of the CSST contained in a gas piping system consists of listed AR-CSST.

2. Such gas piping system is electrically continuous.

3. At least one appliance is:
   
   i. Connected to such gas piping system,

   ii. Connected to a grounded electrical circuit, and

   iii. Connected to the equipment grounding conductor of such electrical circuit by a bonding conductor that is 14 AWG (or larger) copper,

Such gas piping system shall be installed and bonded in accordance with the stricter of the following:

1. The requirements set forth in the listed AR-CSST manufacturer’s installation instructions.
2. The requirements set forth in Sections 310.3.1, 310.3.2, 310.3.3, and 404.7 of this code.

[NY] 310.3.1 Bonding.
A gas piping system that contains only listed AR-CSST and satisfies all of the other criteria specified in Section 310.3 of this code shall be considered to be bonded to an effective ground-fault current path, and shall not be required to be directly bonded as prescribed by Section 310.2 of this code. However, nothing in this section shall prohibit the bonding of any such gas piping system in any manner described in Section 250.104(B) of NFPA 70.

Where no equipment grounding conductor is present, AR-CSST shall be bonded in accordance with Section 310.2

[NY] 310.3.2 Grounding electrodes.
No portion of the gas piping system shall be used as or considered to be a grounding electrode or a grounding electrode conductor.

[NY] 310.3.3 Reserved.
CHAPTER 4
GAS PIPING INSTALLATIONS

SECTION 401
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 Building Code of New York State.

401.2 Liquefied petroleum gas storage.
The storage system for liquefied petroleum gas shall be designed and installed in accordance with the Fire Code of New York State 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
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:
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 $1\frac{1}{2}$ pounds per square inch (psi) (10.3 kPa)]:

$$D = \frac{Q^{0.381}}{19.17 \left( \frac{\Delta H}{C_r \times L} \right)^{0.206}}$$

(Equation 4-1)

2. High-pressure gas equation [$1\frac{1}{2}$ psi (10.3 kPa) and above]:

$$D = \frac{Q^{0.381}}{18.93 \left( \frac{(P_1^2 - P_2^2) \times 1}{C_r \times L} \right)^{0.206}}$$

(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.
- $P_1$ = Upstream pressure, psia ($P_1 + 14.7$).
- $P_2$ = Downstream pressure, psia ($P_2 + 14.7$).
- $L$ = Equivalent length of pipe, feet.
- $\Delta H$ = 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

<table>
<thead>
<tr>
<th>GAS</th>
<th>( C_r )</th>
<th>( Y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas</td>
<td>0.6094</td>
<td>0.9922</td>
</tr>
<tr>
<td>Undiluted propane</td>
<td>1.2462</td>
<td>0.9910</td>
</tr>
</tbody>
</table>

For SI: 1 cubic foot = 0.028 m³, 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.

**TABLE 402.4(1)**

SCHEDULE 40 METALLIC PIPE

<table>
<thead>
<tr>
<th>Gas</th>
<th>Inlet Pressure</th>
<th>Pressure Drop</th>
<th>Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>Less than 2 psi</td>
<td>0.3 in. w.c.</td>
<td>0.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PIPE SIZE (inch)</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal</strong></td>
<td><strong>1/2</strong></td>
</tr>
<tr>
<td><strong>Actual ID</strong></td>
<td>0.622</td>
</tr>
<tr>
<td><strong>Length (ft)</strong></td>
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<tr>
<td></td>
<td>20</td>
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<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>40</td>
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<tr>
<td></td>
<td>50</td>
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<td>60</td>
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<td>70</td>
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<tr>
<td></td>
<td>650</td>
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<tr>
<td></td>
<td>700</td>
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</tbody>
</table>

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For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m³/h, 1 degree = 0.01745 rad.

Notes:
1. NA means a flow of less than 10 cfm.
2. Table entries have been rounded to three significant digits.

### TABLE 402.4(2)
**SCHEDULE 40 METALLIC PIPE**

<table>
<thead>
<tr>
<th>PIPE SIZE (inch)</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (ft)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>172 360 678 1,390 2,090 4,020 6,400 11,300 23,100 41,800 67,600 139,000 252,000 399,000</td>
</tr>
<tr>
<td>20</td>
<td>118 247 466 957 1,430 2,760 4,400 7,780 15,900 28,700 46,500 95,500 173,000 275,000</td>
</tr>
<tr>
<td>30</td>
<td>95 199 374 768 1,150 2,220 3,530 6,250 12,700 23,000 37,300 76,700 139,000 220,000</td>
</tr>
<tr>
<td>40</td>
<td>81 170 320 657 985 1,900 3,020 5,350 10,900 19,700 31,900 65,800 119,000 189,000</td>
</tr>
<tr>
<td>50</td>
<td>72 151 284 583 873 1,680 2,680 4,740 9,660 17,500 28,300 58,200 106,000 167,000</td>
</tr>
<tr>
<td>60</td>
<td>65 137 257 528 791 1,520 2,430 4,290 8,760 15,800 25,600 52,700 95,700 152,000</td>
</tr>
<tr>
<td>70</td>
<td>60 126 237 486 728 1,400 2,230 3,950 8,050 14,600 23,600 48,500 88,100 139,000</td>
</tr>
<tr>
<td>80</td>
<td>56 117 220 452 677 1,300 2,080 3,670 7,490 13,600 22,000 45,100 81,900 130,000</td>
</tr>
<tr>
<td>90</td>
<td>52 110 207 424 635 1,220 1,950 3,450 7,030 12,700 20,600 42,300 76,900 122,000</td>
</tr>
<tr>
<td>100</td>
<td>50 104 195 400 600 1,160 1,840 3,260 6,640 12,000 19,500 40,000 72,600 115,000</td>
</tr>
<tr>
<td>125</td>
<td>44 92 173 355 532 1,020 1,630 2,890 5,890 10,600 17,200 35,400 64,300 102,000</td>
</tr>
<tr>
<td>150</td>
<td>40 83 157 322 482 928 1,480 2,410 4,910 8,880 14,400 29,500 53,600 84,900</td>
</tr>
<tr>
<td>175</td>
<td>37 77 144 296 443 854 1,360 2,140 4,630 8,140 13,400 27,500 49,900 79,000</td>
</tr>
<tr>
<td>200</td>
<td>34 71 134 275 412 794 1,270 2,240 4,560 8,260 13,400 27,500 49,900 79,000</td>
</tr>
<tr>
<td>250</td>
<td>30 63 119 244 366 704 1,120 1,980 4,050 7,320 11,900 24,300 44,200 70,000</td>
</tr>
<tr>
<td>300</td>
<td>27 57 108 221 331 638 1,020 1,800 3,670 6,630 10,700 22,100 40,100 63,400</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>PIPE SIZE (inch)</th>
<th>Actual ID</th>
<th>Nominal 1 / 2</th>
<th>3 / 4</th>
<th>1</th>
<th>1 1 / 4</th>
<th>1 1 / 2</th>
<th>2</th>
<th>2 1 / 2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.622</td>
<td>0.824</td>
<td>1.049</td>
<td>1.380</td>
<td>1.610</td>
<td>2.067</td>
<td>2.469</td>
<td>3.068</td>
<td>4.026</td>
<td></td>
</tr>
</tbody>
</table>

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3

1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m³/h, 1 degree = 0.01745 rad.

Notes:
1. NA means a flow of less than 10 cfh.
2. Table entries have been rounded to three significant digits.
### TABLE 402.4(4)

**SCHEDULE 40 METALLIC PIPE**

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
<th>Inlet Pressure</th>
<th>Less than 2 psi</th>
<th>Pressure Drop</th>
<th>6.0 in. w.c.</th>
<th>Specific Gravity</th>
<th>0.60</th>
</tr>
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**INTENDED USE:** INITIAL SUPPLY PRESSURE OF 8.0-INCH W.C. OR GREATER

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 m³/h, 1 degree = 0.01745 rad.

**Note:** Table entries have been rounded to three significant digits.
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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 m³/h, 1 degree = 0.01745 rad.

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Note: Table entries have been rounded to three significant digits.

**TABLE 402.4(5)**

**SCHEDULE 40 METALLIC PIPE**

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<td>5,510</td>
<td>8,790</td>
<td>15,500</td>
<td>31,700</td>
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</table>

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 m³/h, 1 degree = 0.01745 rad.

Note: Table entries have been rounded to three significant digits.

**TABLE 402.4(6)**

**SCHEDULE 40 METALLIC PIPE**

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>3.0 psi</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>2.0 psi</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.60</td>
</tr>
</tbody>
</table>

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### TABLE 402.4(7)
**SCHEDULE 40 METALLIC PIPE**

<table>
<thead>
<tr>
<th>Gas Type</th>
<th>Natural</th>
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</thead>
<tbody>
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<td>Inlet Pressure</td>
<td>5.0 psi</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>3.5 psi</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pipe Size (inch)</th>
<th>Actual ID</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/2</td>
<td>3/4</td>
</tr>
<tr>
<td>10</td>
<td>3,190</td>
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<td>979</td>
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<tr>
<td>175</td>
<td>728</td>
<td>1,470</td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

Note: Table entries have been rounded to three significant digits.
<table>
<thead>
<tr>
<th>Length (ft)</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10/20/42/85/148/210/448/806/1,270/2,650</td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

Note: Table entries have been rounded to three significant digits.

<table>
<thead>
<tr>
<th>TABLE 402.4(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEMIRIGID COPPER TUBING</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TUBE SIZE (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal</td>
</tr>
</tbody>
</table>

<table>
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<th>1/4</th>
<th>3/8</th>
<th>5/8</th>
<th>3/4</th>
<th>1</th>
<th>1/4</th>
<th>1/2</th>
<th>2</th>
</tr>
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<tbody>
<tr>
<td>ACR</td>
<td>3/8</td>
<td>1/4</td>
<td>3/8</td>
<td>1/2</td>
<td>5/8</td>
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<td>Outside</td>
<td>0.375</td>
<td>0.500</td>
<td>0.625</td>
<td>0.750</td>
<td>0.875</td>
<td>1.125</td>
<td>1.375</td>
<td>1.625</td>
<td>2.125</td>
<td></td>
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<td>0.305</td>
<td>0.402</td>
<td>0.527</td>
<td>0.652</td>
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<td>0.995</td>
<td>1.245</td>
<td>1.481</td>
<td>1.959</td>
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<td>25</td>
<td>46</td>
<td>72</td>
<td>151</td>
<td></td>
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</tbody>
</table>

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$^3$/h, 1 degree = 0.01745 rad.

Notes:
1. Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.
2. NA means a flow of less than 10 cfh.
3. Table entries have been rounded to three significant digits.
### TABLE 402.4(9)

**SEMRIGID COPPER TUBING**

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
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</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>Less than 2 psi</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>0.5 in. w.c.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.60</td>
</tr>
</tbody>
</table>

#### TUBE SIZE (inch)

<table>
<thead>
<tr>
<th>Nominal</th>
<th>K &amp; L</th>
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<th>(\frac{3}{8})</th>
<th>(\frac{1}{2})</th>
<th>(\frac{5}{8})</th>
<th>(\frac{3}{4})</th>
<th>1</th>
<th>(\frac{1}{2})</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ACR</td>
<td>(\frac{3}{8})</td>
<td>(\frac{1}{2})</td>
<td>(\frac{5}{8})</td>
<td>(\frac{3}{4})</td>
<td>(\frac{1}{4})</td>
<td>1</td>
<td>(\frac{1}{2})</td>
<td>—</td>
</tr>
<tr>
<td>Outside</td>
<td></td>
<td>0.375</td>
<td>0.500</td>
<td>0.625</td>
<td>0.750</td>
<td>0.875</td>
<td>1.125</td>
<td>1.375</td>
<td>1.625</td>
</tr>
<tr>
<td>Inside</td>
<td></td>
<td>0.305</td>
<td>0.402</td>
<td>0.527</td>
<td>0.652</td>
<td>0.745</td>
<td>0.995</td>
<td>1.245</td>
<td>1.481</td>
</tr>
</tbody>
</table>

#### Length (ft)  
Capacity in Cubic Feet of Gas Per Hour

| Length (ft) | 10  | 20  | 30  | 40  | 50  | 60  | 70  | 80  | 90  | 100 | 125 | 150 | 175 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 600 | 650 | 700 | 750 | 800 | 850 | 900 | 950 | 1,000 | 1,100 | 1,200 | 1,300 | 1,400 | 1,500 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|-------|-------|-------|-------|
| Capacity    | 27  | 38  | 51  | 61  | 71  | 84  | 92  | 116 | 137 | 152 | 168 | 195 | 225 | 251 | 262 | 306 | 326 | 350 | 381 | 411 | 455 | 482 | 510 | 544 | 586 | 606 | 642 | 690 | 762 | 820 | 884 | 952 | 1,060 | 1,245 | 1,460 | 1,650 | 1,860 | 2,080 |

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<table>
<thead>
<tr>
<th>Nominal</th>
<th>K &amp; L</th>
<th>1/4</th>
<th>3/8</th>
<th>1/2</th>
<th>5/8</th>
<th>3/4</th>
<th>1</th>
<th>1/4</th>
<th>1/2</th>
<th>2</th>
</tr>
</thead>
</table>

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

**TABLE 402.4(10)**

**SEMI-RIGID COPPER TUBING**

<table>
<thead>
<tr>
<th>Inlet Pressure</th>
<th>Less than 2 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Drop</td>
<td>1.0 in. w.c.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**INTENDED USE: SIZING BETWEEN HOUSE LINE REGULATOR AND THE APPLIANCE**

<table>
<thead>
<tr>
<th>Length (ft)</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>39</td>
</tr>
<tr>
<td>20</td>
<td>55</td>
</tr>
<tr>
<td>30</td>
<td>44</td>
</tr>
<tr>
<td>40</td>
<td>38</td>
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<tr>
<td>50</td>
<td>33</td>
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<tr>
<td>60</td>
<td>30</td>
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<td>70</td>
<td>28</td>
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<tr>
<td>80</td>
<td>26</td>
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<tr>
<td>90</td>
<td>24</td>
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<tr>
<td>100</td>
<td>23</td>
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<tr>
<td>125</td>
<td>20</td>
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<tr>
<td>150</td>
<td>18</td>
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<td>175</td>
<td>17</td>
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<tr>
<td>200</td>
<td>16</td>
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<tr>
<td>250</td>
<td>14</td>
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<tr>
<td>300</td>
<td>13</td>
</tr>
<tr>
<td>350</td>
<td>12</td>
</tr>
<tr>
<td>400</td>
<td>11</td>
</tr>
<tr>
<td>450</td>
<td>10</td>
</tr>
</tbody>
</table>

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$^3$/h, 1 degree = 0.01745 rad.

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<table>
<thead>
<tr>
<th>Inlet Pressure</th>
<th>Pressure Drop</th>
<th>Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 psi</td>
<td>17.0 in. w.c.</td>
<td>0.60</td>
</tr>
</tbody>
</table>

### TABLE 402.4(11)

**SEMRIGID COPPER TUBING**

<table>
<thead>
<tr>
<th>TUBE SIZE (inch)</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal</strong></td>
<td><strong>Length (ft)</strong></td>
</tr>
<tr>
<td>K &amp; L</td>
<td></td>
</tr>
<tr>
<td>1/4</td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td></td>
</tr>
<tr>
<td>5/8</td>
<td></td>
</tr>
<tr>
<td>3/4</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1/4</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>ACR</td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td></td>
</tr>
<tr>
<td>5/8</td>
<td></td>
</tr>
<tr>
<td>3/4</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td></td>
</tr>
<tr>
<td>1/4</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

**Notes:**
1. Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.
2. NA means a flow of less than 10 cfh.
3. Table entries have been rounded to three significant digits.
<table>
<thead>
<tr>
<th>Inlet Pressure</th>
<th>Pressure Drop</th>
<th>Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0 psi</td>
<td>1.0 psi</td>
<td>0.60</td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

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

### TABLE 402.4(12)
SEMIRIGID COPPER TUBING
<table>
<thead>
<tr>
<th>Nominal</th>
<th>K &amp; L</th>
<th>( \frac{1}{4} )</th>
<th>( \frac{3}{8} )</th>
<th>( \frac{1}{2} )</th>
<th>( \frac{5}{8} )</th>
<th>( \frac{3}{4} )</th>
<th>1</th>
<th>( \frac{1}{4} )</th>
<th>( \frac{1}{2} )</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ACR</td>
<td>( \frac{3}{8} )</td>
<td>( \frac{1}{2} )</td>
<td>( \frac{5}{8} )</td>
<td>( \frac{3}{4} )</td>
<td>( \frac{7}{8} )</td>
<td>1</td>
<td>( \frac{3}{8} )</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Outside</td>
<td></td>
<td>0.375</td>
<td>0.500</td>
<td>0.625</td>
<td>0.750</td>
<td>0.875</td>
<td>1.125</td>
<td>1.375</td>
<td>1.625</td>
<td>2.125</td>
</tr>
<tr>
<td>Inside</td>
<td></td>
<td>0.305</td>
<td>0.402</td>
<td>0.527</td>
<td>0.652</td>
<td>0.745</td>
<td>0.995</td>
<td>1.245</td>
<td>1.481</td>
<td>1.959</td>
</tr>
</tbody>
</table>

**Length (ft)**

<table>
<thead>
<tr>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>70</td>
</tr>
<tr>
<td>80</td>
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<td>90</td>
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<tr>
<td>100</td>
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<td>125</td>
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<td>175</td>
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<td>400</td>
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<tr>
<td>450</td>
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<td>500</td>
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<td>1,700</td>
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<tr>
<td>1,800</td>
</tr>
<tr>
<td>1,900</td>
</tr>
<tr>
<td>2,000</td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

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

TABLE 402.4(13)
SEMIRIGID COPPER TUBING

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>2.0 psi</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>1.5 psi</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTENDED USE</th>
<th>Pipe sizing between point of delivery and the house line regulator. Total load supplied by a single house line regulator not exceeding 150 cubic feet per hour.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUBE SIZE (inch)</td>
<td></td>
</tr>
<tr>
<td>Nominal K &amp; L</td>
<td>1/4</td>
</tr>
<tr>
<td>Outside</td>
<td>0.37</td>
</tr>
<tr>
<td>Inside</td>
<td>0.30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length (ft)</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>303</td>
</tr>
<tr>
<td>20</td>
<td>208</td>
</tr>
<tr>
<td>30</td>
<td>167</td>
</tr>
<tr>
<td>40</td>
<td>143</td>
</tr>
<tr>
<td>50</td>
<td>127</td>
</tr>
<tr>
<td>60</td>
<td>115</td>
</tr>
<tr>
<td>70</td>
<td>106</td>
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<td>150</td>
<td>70</td>
</tr>
<tr>
<td>175</td>
<td>64</td>
</tr>
<tr>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>250</td>
<td>53</td>
</tr>
<tr>
<td>300</td>
<td>48</td>
</tr>
<tr>
<td>350</td>
<td>44</td>
</tr>
<tr>
<td>400</td>
<td>41</td>
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<tr>
<td>450</td>
<td>39</td>
</tr>
<tr>
<td>500</td>
<td>36</td>
</tr>
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<td>600</td>
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<td>650</td>
<td>32</td>
</tr>
<tr>
<td>700</td>
<td>30</td>
</tr>
<tr>
<td>750</td>
<td>29</td>
</tr>
<tr>
<td>800</td>
<td>28</td>
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</tbody>
</table>

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### TABLE 402.4(14)
**SEMIRIGID COPPER TUBING**

<table>
<thead>
<tr>
<th>Inlet Pressure</th>
<th>Pressure Drop</th>
<th>Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural 5.0 psi</td>
<td>3.5 psi</td>
<td>0.60</td>
</tr>
</tbody>
</table>

#### TUBE SIZE (inch)

<table>
<thead>
<tr>
<th>Nominal</th>
<th>K &amp; L</th>
<th>ACR</th>
<th>Outside</th>
<th>Inside</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1/4</td>
<td>3/8</td>
<td>1/2</td>
</tr>
<tr>
<td></td>
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<td>1/4</td>
<td>3/8</td>
<td>5/8</td>
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<td>3/8</td>
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<td></td>
<td></td>
<td>1/4</td>
<td>3/8</td>
<td>1/8</td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

**Notes:**
1. Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.
2. Where this table is used to size the tubing upstream of a line pressure regulator, the pipe or tubing downstream of the line pressure regulator shall be sized using a pressure drop not greater than 1 inch w.c.
3. Table entries have been rounded to three significant digits.

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<table>
<thead>
<tr>
<th>Length (ft)</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>118 243 495 866 1,230 2,620 4,720 7,450 15,500</td>
</tr>
<tr>
<td>175</td>
<td>109 224 456 796 1,130 2,410 4,350 6,850 14,300</td>
</tr>
<tr>
<td>200</td>
<td>101 208 424 741 1,050 2,250 4,040 6,370 13,300</td>
</tr>
<tr>
<td>250</td>
<td>90 185 376 657 932 1,990 3,580 5,650 11,800</td>
</tr>
<tr>
<td>300</td>
<td>81 167 340 595 844 1,800 3,250 5,120 10,700</td>
</tr>
<tr>
<td>350</td>
<td>75 154 313 547 777 1,660 2,990 4,710 9,810</td>
</tr>
<tr>
<td>400</td>
<td>69 143 291 509 722 1,540 2,780 4,380 9,120</td>
</tr>
<tr>
<td>450</td>
<td>65 134 273 478 678 1,450 2,610 4,110 8,560</td>
</tr>
<tr>
<td>500</td>
<td>62 127 258 451 640 1,370 2,460 3,880 8,090</td>
</tr>
<tr>
<td>550</td>
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<td>48 98 200 350 497 1,060 1,910 3,010 6,270</td>
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<tr>
<td>850</td>
<td>46 95 194 339 481 1,030 1,850 2,910 6,070</td>
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<tr>
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<td>45 92 188 328 466 1,000 1,790 2,820 5,880</td>
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<tr>
<td>950</td>
<td>43 90 182 319 452 967 1,740 2,740 5,710</td>
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<td>38 79 161 281 399 852 1,530 2,420 5,040</td>
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<tr>
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<td>37 76 154 269 382 816 1,470 2,320 4,820</td>
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<td>33 68 138 241 341 729 1,310 2,070 4,310</td>
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<td>32 65 133 233 330 705 1,270 2,000 4,170</td>
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<td>1,800</td>
<td>31 63 129 226 320 684 1,230 1,940 4,040</td>
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<td>30 62 125 219 311 664 1,200 1,890 3,930</td>
</tr>
<tr>
<td>2,000</td>
<td>29 60 122 213 302 646 1,160 1,830 3,820</td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

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

**TABLE 402.4(15)**

**CORRUGATED STAINLESS STEEL TUBING (CSST)**

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>Less than 2 psi</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>0.5 in. w.c.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flow Designation</th>
<th>1 3</th>
<th>1 5</th>
<th>18</th>
<th>19</th>
<th>23</th>
<th>25</th>
<th>30</th>
<th>31</th>
<th>37</th>
<th>39</th>
<th>46</th>
<th>48</th>
<th>60</th>
<th>62</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (ft)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity in Cubic Feet of Gas Per Hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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| EHD (inch) | L (feet) | n | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 150 | 200 | 250 | 300 |
|-----------|----------|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1         | 2        | 5 | 6  | 2  | 4  | 3  | 1  | 2  | 3  | 1  | 2  | 3  | 1  | 2  | 3  | 1  | 2  | 3  | 1  |
| 2         | 4        | 2  | 6  | 2  | 4  | 3  | 1  | 2  | 3  | 1  | 2  | 3  | 1  | 2  | 3  | 1  | 2  | 3  | 1  |
| 3         | 1        | 9  | 7  | 8  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 4         | 2        | 1  | 7  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 5         | 1        | 6  | 3  | 2  | 1  | 2  | 3  | 1  | 2  | 3  | 1  | 2  | 3  | 1  | 2  | 3  | 1  | 2  | 3  |
| 6         | 2        | 5  | 3  | 2  | 1  | 2  | 3  | 1  | 2  | 3  | 1  | 2  | 3  | 1  | 2  | 3  | 1  | 2  | 3  |
| 7         | 1        | 9  | 7  | 8  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 8         | 1        | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 9         | 1        | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 10        | 1        | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |

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 m³/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(16)
CORRUGATED STAINLESS STEEL TUBING (CSST)

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>Less than 2 psi</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>3.0 in. w.c.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.60</td>
</tr>
</tbody>
</table>

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## INTENDED USE: INITIAL SUPPLY PRESSURE OF 8.0-INCH W.C. OR GREATER

### TUBE SIZE (EHD)

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<th>18</th>
<th>19</th>
<th>23</th>
<th>25</th>
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<th>31</th>
<th>37</th>
<th>46</th>
<th>48</th>
<th>60</th>
<th>62</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (ft)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
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<td>27</td>
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<td>559</td>
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</tr>
</tbody>
</table>

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 m³/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.

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

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>Less than 2 psi</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>6.0 in. w.c.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**INTENDED USE: INITIAL SUPPLY PRESSURE OF 11.0-INCH W.C. OR GREATER**

<table>
<thead>
<tr>
<th>TUBE SIZE (EHD)</th>
<th>Flow Designation</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Length (ft)</td>
<td></td>
<td></td>
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<tr>
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<td>173</td>
<td>229</td>
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<tr>
<td>300</td>
<td>19</td>
<td>27</td>
</tr>
</tbody>
</table>

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$^3$/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.
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### TABLE 402.4(18)
CORRUGATED STAINLESS STEEL TUBING (CSST)

<table>
<thead>
<tr>
<th>Flow Designation</th>
<th>13</th>
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<th>18</th>
<th>19</th>
<th>23</th>
<th>25</th>
<th>30</th>
<th>31</th>
<th>37</th>
<th>39</th>
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<th>48</th>
<th>60</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Length (ft)</td>
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<td>445</td>
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<td>302</td>
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<td>14</td>
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<td>236</td>
<td>284</td>
<td>0,02</td>
<td>1,09</td>
<td>1,89</td>
<td>2,18</td>
<td>3,85</td>
<td>4,36</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>44</td>
<td>61</td>
<td>11</td>
<td>12</td>
<td>9</td>
<td>217</td>
<td>260</td>
<td>0,01</td>
<td>1,09</td>
<td>1,89</td>
<td>2,18</td>
<td>3,85</td>
<td>4,36</td>
</tr>
<tr>
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<td>38</td>
<td>52</td>
<td>96</td>
<td>11</td>
<td>1</td>
<td>189</td>
<td>225</td>
<td>0,00</td>
<td>1,09</td>
<td>1,89</td>
<td>2,18</td>
<td>3,85</td>
<td>4,36</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>34</td>
<td>46</td>
<td>86</td>
<td>10</td>
<td>0</td>
<td>170</td>
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<td>1,09</td>
<td>1,89</td>
<td>2,18</td>
<td>3,85</td>
<td>4,36</td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

**Notes:**

1. Table does not include effect of pressure drop across the line regulator. Where regulator loss exceeds 3/4 psi, DO NOT USE THIS TABLE. Consult with the regulator manufacturer for pressure drops and capacity factors. Pressure drops across a regulator may vary with flow rate.

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

3. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends 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.

4. EHD—Equivalent Hydraulic Diameter, which is a measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.

5. Table entries have been rounded to three significant digits.

### TABLE 402.4(19)
CORRUGATED STAINLESS STEEL TUBING (CSST)

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>5.0 psi</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>3.5 psi</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TUBE SIZE (EHD)</th>
<th>Capacity in Cubic Feet of Gas Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Designation</td>
<td>13</td>
</tr>
<tr>
<td>Length (ft)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>52</td>
</tr>
<tr>
<td>25</td>
<td>32</td>
</tr>
<tr>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>50</td>
<td>22</td>
</tr>
<tr>
<td>75</td>
<td>18</td>
</tr>
<tr>
<td>80</td>
<td>17</td>
</tr>
<tr>
<td>100</td>
<td>15</td>
</tr>
<tr>
<td>150</td>
<td>12</td>
</tr>
<tr>
<td>200</td>
<td>10</td>
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<tr>
<td>250</td>
<td>9</td>
</tr>
<tr>
<td>300</td>
<td>8</td>
</tr>
<tr>
<td>400</td>
<td>7</td>
</tr>
<tr>
<td>500</td>
<td>6</td>
</tr>
</tbody>
</table>

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.

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1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m³/h, 1 degree = 0.01745 rad.

Notes:
1. Table does not include effect of pressure drop across the line regulator. Where regulator loss exceeds 3/4 psi, DO NOT USE THIS TABLE. Consult with the regulator manufacturer for pressure drops and capacity factors. Pressure drops across a regulator may vary with flow rate.
2. CAUTION: Capacities shown in the table might exceed maximum capacity for a selected regulator. Consult with the regulator or tubing manufacturer for guidance.
3. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends 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.
4. EHD—Equivalent Hydraulic Diameter, which is a measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.
5. Table entries have been rounded to three significant digits.

### TABLE 402.4(20)
POLYETHYLENE PLASTIC PIPE

<table>
<thead>
<tr>
<th>Nominal OD</th>
<th>1/4</th>
<th>3/4</th>
<th>1</th>
<th>1 1/4</th>
<th>1 1/2</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designation</td>
<td>SDR 9</td>
<td>SDR 11</td>
<td>SDR 11</td>
<td>SDR 10</td>
<td>SDR 11</td>
<td>SDR 11</td>
<td>SDR 11</td>
<td>SDR 11</td>
</tr>
<tr>
<td>Actual ID</td>
<td>0.660</td>
<td>0.860</td>
<td>1.077</td>
<td>1.328</td>
<td>1.554</td>
<td>1.943</td>
<td>2.864</td>
<td>3.682</td>
</tr>
<tr>
<td>Length (ft)</td>
<td>Capacity in Cubic Feet of Gas per Hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>153</td>
<td>305</td>
<td>551</td>
<td>955</td>
<td>1,440</td>
<td>2,590</td>
<td>7,170</td>
<td>13,900</td>
</tr>
<tr>
<td>20</td>
<td>105</td>
<td>210</td>
<td>379</td>
<td>656</td>
<td>991</td>
<td>1,780</td>
<td>4,920</td>
<td>9,520</td>
</tr>
<tr>
<td>30</td>
<td>84</td>
<td>169</td>
<td>304</td>
<td>527</td>
<td>796</td>
<td>1,430</td>
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<td>7,640</td>
</tr>
<tr>
<td>40</td>
<td>72</td>
<td>144</td>
<td>260</td>
<td>451</td>
<td>681</td>
<td>1,220</td>
<td>3,380</td>
<td>6,540</td>
</tr>
<tr>
<td>50</td>
<td>64</td>
<td>128</td>
<td>231</td>
<td>400</td>
<td>604</td>
<td>1,080</td>
<td>3,000</td>
<td>5,800</td>
</tr>
<tr>
<td>60</td>
<td>58</td>
<td>116</td>
<td>209</td>
<td>362</td>
<td>547</td>
<td>983</td>
<td>2,720</td>
<td>5,250</td>
</tr>
<tr>
<td>70</td>
<td>53</td>
<td>107</td>
<td>192</td>
<td>333</td>
<td>503</td>
<td>904</td>
<td>2,500</td>
<td>4,830</td>
</tr>
<tr>
<td>80</td>
<td>50</td>
<td>99</td>
<td>179</td>
<td>310</td>
<td>468</td>
<td>841</td>
<td>2,330</td>
<td>4,500</td>
</tr>
<tr>
<td>90</td>
<td>46</td>
<td>93</td>
<td>168</td>
<td>291</td>
<td>439</td>
<td>789</td>
<td>2,180</td>
<td>4,220</td>
</tr>
<tr>
<td>100</td>
<td>44</td>
<td>88</td>
<td>159</td>
<td>275</td>
<td>415</td>
<td>745</td>
<td>2,060</td>
<td>3,990</td>
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<tr>
<td>125</td>
<td>39</td>
<td>78</td>
<td>141</td>
<td>243</td>
<td>368</td>
<td>661</td>
<td>1,830</td>
<td>3,530</td>
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<tr>
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<td>35</td>
<td>71</td>
<td>127</td>
<td>221</td>
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<td>598</td>
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<td>3,200</td>
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<tr>
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<td>32</td>
<td>65</td>
<td>117</td>
<td>203</td>
<td>306</td>
<td>551</td>
<td>1,520</td>
<td>2,940</td>
</tr>
<tr>
<td>200</td>
<td>30</td>
<td>60</td>
<td>109</td>
<td>189</td>
<td>285</td>
<td>512</td>
<td>1,420</td>
<td>2,740</td>
</tr>
<tr>
<td>250</td>
<td>27</td>
<td>54</td>
<td>97</td>
<td>167</td>
<td>253</td>
<td>454</td>
<td>1,260</td>
<td>2,430</td>
</tr>
<tr>
<td>300</td>
<td>24</td>
<td>48</td>
<td>88</td>
<td>152</td>
<td>229</td>
<td>411</td>
<td>1,140</td>
<td>2,200</td>
</tr>
<tr>
<td>350</td>
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<td>81</td>
<td>139</td>
<td>211</td>
<td>378</td>
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<td>2,020</td>
</tr>
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<td>400</td>
<td>21</td>
<td>42</td>
<td>75</td>
<td>130</td>
<td>196</td>
<td>352</td>
<td>974</td>
<td>1,880</td>
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<td>450</td>
<td>19</td>
<td>39</td>
<td>70</td>
<td>122</td>
<td>184</td>
<td>330</td>
<td>914</td>
<td>1,770</td>
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<td>37</td>
<td>66</td>
<td>115</td>
<td>174</td>
<td>312</td>
<td>863</td>
<td>1,670</td>
</tr>
</tbody>
</table>
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$^3$/h, 1 degree = 0.01745 rad.

Note: Table entries have been rounded to three significant digits.

**TABLE 402.4(21)**
POLYETHYLENE PLASTIC PIPE

<table>
<thead>
<tr>
<th>Pipe Size (inch)</th>
<th>Nominal OD</th>
<th>Capacity in Cubic Feet of Gas per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/2</td>
<td>3/4</td>
</tr>
<tr>
<td>Designation</td>
<td>SDR 9</td>
<td>SDR 11</td>
</tr>
<tr>
<td>Actual ID</td>
<td>0.660</td>
<td>0.860</td>
</tr>
<tr>
<td>Length (ft)</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>70</td>
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<td>90</td>
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<td></td>
<td>100</td>
<td>125</td>
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<td>150</td>
<td>175</td>
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<tr>
<td></td>
<td>200</td>
<td>250</td>
</tr>
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<td></td>
<td>300</td>
<td>350</td>
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<td></td>
<td>400</td>
<td>450</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>Inlet Pressure</td>
<td>Less than 2 psi</td>
<td>0.5 in. w.c.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.60</td>
<td></td>
</tr>
</tbody>
</table>

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$^3$/h, 1 degree = 0.01745 rad.

Note: Table entries have been rounded to three significant digits.

**TABLE 402.4(22)**
POLYETHYLENE PLASTIC PIPE

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>2.0 psi</td>
</tr>
<tr>
<td>Nominal OD</td>
<td>$\frac{1}{2}$</td>
</tr>
<tr>
<td>------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Designation</td>
<td>SDR 9</td>
</tr>
<tr>
<td>Actual ID</td>
<td>0.660</td>
</tr>
<tr>
<td>Length (ft)</td>
<td>Capacity in Cubic Feet of Gas per Hour</td>
</tr>
<tr>
<td>10</td>
<td>1,860</td>
</tr>
<tr>
<td>20</td>
<td>1,280</td>
</tr>
<tr>
<td>30</td>
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<td>350</td>
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<td>400</td>
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<td>900</td>
<td>163</td>
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<td>950</td>
<td>158</td>
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<tr>
<td>1,000</td>
<td>154</td>
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<td>1,100</td>
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<td>1,200</td>
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<td>134</td>
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<td>1,400</td>
<td>128</td>
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<td>1,500</td>
<td>124</td>
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<tr>
<td>1,600</td>
<td>119</td>
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<tr>
<td>1,700</td>
<td>115</td>
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<tr>
<td>1,800</td>
<td>112</td>
</tr>
<tr>
<td>1,900</td>
<td>109</td>
</tr>
<tr>
<td>2,000</td>
<td>106</td>
</tr>
</tbody>
</table>

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.

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1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m³/h, 1 degree = 0.01745 rad.

**Note:** Table entries have been rounded to three significant digits.

### TABLE 402.4(23)
**POLYETHYLENE PLASTIC TUBING**

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inlet Pressure</strong></td>
<td>Less than 2.0 psi</td>
</tr>
<tr>
<td><strong>Pressure Drop</strong></td>
<td>0.3 in. w.c.</td>
</tr>
<tr>
<td><strong>Specific Gravity</strong></td>
<td>0.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>PLASTIC TUBING SIZE (CTS) (inch)</strong></th>
<th><strong>Nominal OD</strong></th>
<th><strong>Designation</strong></th>
<th><strong>Actual ID</strong></th>
<th><strong>Length (ft)</strong></th>
<th><strong>Capacity in Cubic Feet of Gas per Hour</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/2</td>
<td>SDR 7</td>
<td>0.445</td>
<td>10</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td></td>
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</table>

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 m³/h, 1 degree = 0.01745 rad.

**Notes:**
1. NA means a flow of less than 10 cfh.
2. Table entries have been rounded to three significant digits.

### TABLE 402.4(24)
### POLYETHYLENE PLASTIC TUBING

<table>
<thead>
<tr>
<th>Gas</th>
<th>Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inlet Pressure</strong></td>
<td>Less than 2.0 psi</td>
</tr>
<tr>
<td><strong>Pressure Drop</strong></td>
<td>0.5 in. w.c.</td>
</tr>
<tr>
<td><strong>Specific Gravity</strong></td>
<td>0.60</td>
</tr>
</tbody>
</table>

**PLASTIC TUBING SIZE (CTS) (inch)**

<table>
<thead>
<tr>
<th>Nominal OD</th>
<th>Designation</th>
<th>Actual ID</th>
<th>Length (ft)</th>
<th>Capacity in Cubic Feet of Gas per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SDR 7</td>
<td>0.445</td>
<td>10</td>
<td>72</td>
</tr>
<tr>
<td>1/2</td>
<td>SDR 7</td>
<td>0.445</td>
<td>20</td>
<td>49</td>
</tr>
<tr>
<td>3/4</td>
<td>SDR 11</td>
<td>0.927</td>
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<td>39</td>
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<tr>
<td>1</td>
<td>SDR 7</td>
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<td>34</td>
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<td>30</td>
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<tr>
<td>3/4</td>
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<td>275</td>
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<td>400</td>
<td>NA</td>
</tr>
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<td>3/4</td>
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<td>NA</td>
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<td>3/4</td>
<td>SDR 11</td>
<td>0.927</td>
<td></td>
<td>NA</td>
</tr>
</tbody>
</table>

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$^3$/h, 1 degree = 0.01745 rad.

**Notes:**
1. NA means a flow of less than 10 cfh.
2. Table entries have been rounded to three significant digits.

### TABLE 402.4(25) SCHEDULE 40 METALLIC PIPE

<table>
<thead>
<tr>
<th>Gas</th>
<th>Undiluted Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inlet Pressure</strong></td>
<td>10.0 psi</td>
</tr>
<tr>
<td><strong>Pressure Drop</strong></td>
<td>1.0 psi</td>
</tr>
</tbody>
</table>

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### Specific Gravity

<table>
<thead>
<tr>
<th>INTENDED USE</th>
<th>Pipe sizing between first stage (high-pressure regulator) and second stage (low-pressure regulator).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal</strong></td>
<td><strong>PIPE SIZE (inch)</strong></td>
</tr>
<tr>
<td><strong>Actual ID</strong></td>
<td><strong>Length (ft)</strong>                                    <strong>Capacity in Thousands of Btu per Hour</strong></td>
</tr>
<tr>
<td><strong>1</strong>/2</td>
<td><strong>3</strong>/4                                           <strong>1</strong>                                              <strong>1</strong>/2</td>
</tr>
<tr>
<td><strong>1</strong>/4</td>
<td><strong>1</strong>/2                                           <strong>2</strong>/2                                            <strong>3</strong></td>
</tr>
<tr>
<td><strong>2</strong></td>
<td><strong>2</strong>/2                                           <strong>3</strong>                                               <strong>4</strong></td>
</tr>
<tr>
<td>10</td>
<td>0.622                                            0.824                                             1.049</td>
</tr>
<tr>
<td>20</td>
<td>1.380                                            1.570                                             1.900</td>
</tr>
<tr>
<td>30</td>
<td>2.280                                            2.560                                             3.000</td>
</tr>
<tr>
<td>40</td>
<td>3.200                                            3.660                                             4.300</td>
</tr>
<tr>
<td>50</td>
<td>4.200                                            4.950                                             6.000</td>
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<td>8.300                                            9.800                                             13.200</td>
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<td>9.300                                            11.100                                            15.000</td>
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<td>125</td>
<td>12.100                                           15.300                                            20.000</td>
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<td>150</td>
<td>15.100                                           19.500                                            25.000</td>
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<td>175</td>
<td>18.100                                           23.500                                            30.000</td>
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<td>21.100                                           28.000                                            35.000</td>
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<td>250</td>
<td>26.100                                           35.000                                            43.000</td>
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<td>300</td>
<td>31.100                                           43.000                                            53.000</td>
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<td>36.100                                           49.000                                            65.000</td>
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<td>400</td>
<td>41.100                                           58.000                                            75.000</td>
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<td>450</td>
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<td>51.100                                           82.000                                            102.000</td>
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<td>56.100                                           95.000                                            119.000</td>
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<td>600</td>
<td>61.100                                           109.000                                           137.000</td>
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<td>650</td>
<td>66.100                                           124.000                                           159.000</td>
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<td>700</td>
<td>71.100                                           140.000                                           187.000</td>
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<td>750</td>
<td>76.100                                           157.000                                           219.000</td>
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<td>800</td>
<td>81.100                                           174.000                                           248.000</td>
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<td>850</td>
<td>86.100                                           191.000                                           279.000</td>
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<td>900</td>
<td>91.100                                           208.000                                           302.000</td>
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<tr>
<td>950</td>
<td>96.100                                           225.000                                           325.000</td>
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<td>1,000</td>
<td>101.100                                          242.000                                           348.000</td>
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<td>1,050</td>
<td>106.100                                          259.000                                           374.000</td>
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<td>1,350</td>
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<td>141.100                                          378.000                                           556.000</td>
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<td>1,450</td>
<td>146.100                                          395.000                                           582.000</td>
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<td>1,650</td>
<td>166.100                                          463.000                                           686.000</td>
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<td>1,700</td>
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<td>1,750</td>
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<tr>
<td>1,850</td>
<td>186.100                                          531.000                                           790.000</td>
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<td>1,900</td>
<td>191.100                                          548.000                                           816.000</td>
</tr>
<tr>
<td>2,000</td>
<td>196.100                                          565.000                                           842.000</td>
</tr>
</tbody>
</table>

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.

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1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m³/h, 1 degree = 0.01745 rad.

Note: Table entries have been rounded to three significant digits.

### TABLE 402.4(26)
**SCHEDULE 40 METALLIC PIPE**

<table>
<thead>
<tr>
<th>Gas</th>
<th>Undiluted Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inlet Pressure</strong></td>
<td>10.0 psi</td>
</tr>
<tr>
<td><strong>Pressure Drop</strong></td>
<td>3.0 psi</td>
</tr>
<tr>
<td><strong>Specific Gravity</strong></td>
<td>1.50</td>
</tr>
</tbody>
</table>

#### INTENDED USE
Pipe sizing between first stage (high-pressure regulator) and second stage (low-pressure regulator).

<table>
<thead>
<tr>
<th>Nominal Pipe Size</th>
<th>1/2</th>
<th>3/4</th>
<th>1</th>
<th>1 1/4</th>
<th>1 1/2</th>
<th>2</th>
<th>2 1/2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual ID Length (ft)</td>
<td>0.622</td>
<td>0.824</td>
<td>1.049</td>
<td>1.380</td>
<td>1.610</td>
<td>2.067</td>
<td>2.469</td>
<td>3.068</td>
<td>4.026</td>
</tr>
<tr>
<td>Capacity in Thousands of Btu per Hour</td>
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<td></td>
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</tbody>
</table>

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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 m³/h, 1 degree = 0.01745 rad.

Note: Table entries have been rounded to three significant digits.

<table>
<thead>
<tr>
<th>TABLE 402.4(27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHEDULE 40 METALLIC PIPE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intended Use</th>
<th>Pipe sizing between 2 psig service and line pressure regulator.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal</strong></td>
<td><strong>1/2</strong></td>
</tr>
<tr>
<td><strong>Actual ID</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Length (ft)</strong></td>
<td>10</td>
</tr>
<tr>
<td><strong>Capacity in Thousands of Btu per Hour</strong></td>
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</tr>
</tbody>
</table>

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### TABLE 402.4(28)
**SCHEDULE 40 METALLIC PIPE**

<table>
<thead>
<tr>
<th>INTENDED USE</th>
<th>Pipe sizing between single- or second-stage (low pressure) regulator and appliance.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal</strong></td>
<td><strong>1/2</strong></td>
</tr>
<tr>
<td>Actual ID</td>
<td>0.622</td>
</tr>
<tr>
<td>Length (ft)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>291</td>
</tr>
<tr>
<td>20</td>
<td>200</td>
</tr>
<tr>
<td>30</td>
<td>160</td>
</tr>
<tr>
<td>40</td>
<td>137</td>
</tr>
<tr>
<td>50</td>
<td>122</td>
</tr>
<tr>
<td>60</td>
<td>110</td>
</tr>
<tr>
<td>80</td>
<td>101</td>
</tr>
<tr>
<td>100</td>
<td>94</td>
</tr>
<tr>
<td>125</td>
<td>89</td>
</tr>
<tr>
<td>150</td>
<td>84</td>
</tr>
<tr>
<td>175</td>
<td>74</td>
</tr>
<tr>
<td>200</td>
<td>67</td>
</tr>
<tr>
<td>250</td>
<td>62</td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

**Note:** Table entries have been rounded to three significant digits.
### TABLE 402.4(29)
**SEMIRIGID COPPER TUBING**

<table>
<thead>
<tr>
<th>Gas</th>
<th>Undiluted Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>10.0 psi</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>1.0 psi</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal</th>
<th>Sizing between first stage (high-pressure regulator) and second stage (low-pressure regulator).</th>
</tr>
</thead>
<tbody>
<tr>
<td>K &amp; L</td>
<td>TUBE SIZE (in.)</td>
</tr>
<tr>
<td></td>
<td>1/4</td>
</tr>
<tr>
<td>ACR</td>
<td>3/8</td>
</tr>
<tr>
<td>Outside</td>
<td>0.375</td>
</tr>
<tr>
<td>Inside</td>
<td>0.305</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length (ft)</th>
<th>Capacity in Thousands of Btu per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>513</td>
</tr>
<tr>
<td>20</td>
<td>352</td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

**Note:** Table entries have been rounded to three significant digits.
| 30 | 283 | 584 | 1,190 | 2,080 | 2,940 | 6,290 | 11,300 | 17,900 | 37,200 |
| 40 | 242 | 500 | 1,020 | 1,780 | 2,520 | 5,380 | 9,690 | 15,300 | 31,800 |
| 50 | 215 | 443 | 901   | 1,570 | 2,230 | 4,770 | 8,590 | 13,500 | 28,200 |
| 60 | 194 | 401 | 816   | 1,430 | 2,020 | 4,320 | 7,780 | 12,300 | 25,600 |
| 70 | 179 | 369 | 751   | 1,310 | 1,860 | 3,980 | 7,160 | 11,300 | 23,500 |
| 80 | 166 | 343 | 699   | 1,220 | 1,730 | 3,700 | 6,660 | 10,500 | 21,900 |
| 90 | 156 | 322 | 655   | 1,150 | 1,630 | 3,470 | 6,250 | 9,850  | 20,500 |
| 100| 147 | 304 | 619   | 1,080 | 1,540 | 3,280 | 5,900 | 9,310  | 19,400 |
| 125| 131 | 270 | 549   | 1,220 | 1,730 | 3,700 | 6,660 | 10,500 | 21,900 |
| 150| 118 | 244 | 497   | 1,230 | 2,630 | 4,740 | 7,470 | 15,600 |
| 175| 109 | 225 | 457   | 1,130 | 2,420 | 4,360 | 6,880 | 14,300 |
| 200| 101 | 209 | 426   | 1,060 | 2,250 | 4,060 | 6,400 | 13,300 |
| 250| 90   | 185 | 377   | 935   | 2,000 | 3,600 | 5,670 | 11,800 |
| 300| 81   | 168 | 342   | 847   | 1,810 | 3,260 | 5,140 | 10,700 |
| 350| 75   | 155 | 314   | 779   | 1,660 | 3,000 | 4,730 | 9,840  |
| 400| 70   | 144 | 292   | 725   | 1,550 | 2,790 | 4,400 | 9,160  |
| 450| 65   | 135 | 274   | 680   | 1,450 | 2,620 | 4,130 | 8,590  |
| 500| 62   | 127 | 259   | 643   | 1,370 | 2,470 | 3,900 | 8,120  |
| 550| 59   | 121 | 246   | 610   | 1,300 | 2,350 | 3,700 | 7,710  |
| 600| 56   | 115 | 235   | 582   | 1,240 | 2,240 | 3,530 | 7,350  |
| 650| 54   | 111 | 225   | 558   | 1,190 | 2,140 | 3,380 | 7,040  |
| 700| 51   | 106 | 216   | 536   | 1,140 | 2,060 | 3,250 | 6,770  |
| 750| 50   | 102 | 208   | 516   | 1,100 | 1,980 | 3,130 | 6,520  |
| 800| 48   | 99  | 201   | 498   | 1,060 | 1,920 | 3,020 | 6,290  |
| 850| 46   | 96  | 195   | 482   | 1,030 | 1,850 | 2,920 | 6,090  |
| 900| 45   | 93  | 189   | 468   | 1,000 | 1,800 | 2,840 | 5,910  |
| 950| 44   | 90  | 183   | 454   | 970   | 1,750 | 2,750 | 5,730  |
| 1,000| 42  | 88  | 178   | 442   | 944   | 1,700 | 2,680 | 5,580  |
| 1,100| 40  | 83  | 169   | 420   | 896   | 1,610 | 2,540 | 5,300  |
| 1,200| 38  | 79  | 161   | 400   | 855   | 1,540 | 2,430 | 5,050  |
| 1,300| 37  | 76  | 155   | 383   | 819   | 1,470 | 2,320 | 4,840  |
| 1,400| 35  | 73  | 148   | 368   | 787   | 1,420 | 2,230 | 4,650  |
| 1,500| 34  | 70  | 143   | 355   | 758   | 1,360 | 2,150 | 4,480  |
| 1,600| 33  | 68  | 138   | 343   | 732   | 1,320 | 2,080 | 4,330  |
| 1,700| 32  | 66  | 134   | 331   | 708   | 1,270 | 2,010 | 4,190  |
| 1,800| 31  | 64  | 130   | 321   | 687   | 1,240 | 1,950 | 4,060  |
| 1,900| 30  | 62  | 126   | 312   | 667   | 1,200 | 1,890 | 3,940  |
| 2,000| 29  | 60  | 122   | 304   | 648   | 1,170 | 1,840 | 3,830  |

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 m³/h, 1 degree = 0.01745 rad.

Notes:
1. Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.
2. Table entries have been rounded to three significant digits.
### TABLE 402.4(30)
SEMIRIGID COPPER TUBING

<table>
<thead>
<tr>
<th>Nominal</th>
<th>K &amp; L</th>
<th>ACR</th>
<th>TUBE SIZE (inch)</th>
<th>Sizing between single or second stage (low-pressure regulator) and appliance.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 / 4</td>
<td>3 / 8</td>
<td>1 / 2</td>
<td>5 / 8</td>
</tr>
<tr>
<td><strong>Length (ft)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>45</td>
<td>93</td>
<td>188</td>
<td>329</td>
</tr>
<tr>
<td>20</td>
<td>31</td>
<td>64</td>
<td>129</td>
<td>226</td>
</tr>
<tr>
<td>30</td>
<td>25</td>
<td>51</td>
<td>104</td>
<td>182</td>
</tr>
<tr>
<td>40</td>
<td>21</td>
<td>44</td>
<td>89</td>
<td>155</td>
</tr>
<tr>
<td>50</td>
<td>19</td>
<td>39</td>
<td>79</td>
<td>138</td>
</tr>
<tr>
<td>60</td>
<td>17</td>
<td>35</td>
<td>71</td>
<td>125</td>
</tr>
<tr>
<td>70</td>
<td>16</td>
<td>32</td>
<td>66</td>
<td>115</td>
</tr>
<tr>
<td>80</td>
<td>15</td>
<td>30</td>
<td>61</td>
<td>107</td>
</tr>
<tr>
<td>90</td>
<td>14</td>
<td>28</td>
<td>57</td>
<td>100</td>
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<tr>
<td>100</td>
<td>13</td>
<td>27</td>
<td>54</td>
<td>95</td>
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<tr>
<td>125</td>
<td>11</td>
<td>24</td>
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<td>84</td>
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<tr>
<td>150</td>
<td>10</td>
<td>21</td>
<td>44</td>
<td>76</td>
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<tr>
<td>175</td>
<td>NA</td>
<td>20</td>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>200</td>
<td>NA</td>
<td>18</td>
<td>37</td>
<td>65</td>
</tr>
<tr>
<td>250</td>
<td>NA</td>
<td>16</td>
<td>33</td>
<td>58</td>
</tr>
<tr>
<td>300</td>
<td>NA</td>
<td>15</td>
<td>30</td>
<td>52</td>
</tr>
<tr>
<td>350</td>
<td>NA</td>
<td>14</td>
<td>28</td>
<td>48</td>
</tr>
<tr>
<td>400</td>
<td>NA</td>
<td>13</td>
<td>26</td>
<td>45</td>
</tr>
<tr>
<td>450</td>
<td>NA</td>
<td>12</td>
<td>24</td>
<td>42</td>
</tr>
<tr>
<td>500</td>
<td>NA</td>
<td>11</td>
<td>23</td>
<td>40</td>
</tr>
<tr>
<td>550</td>
<td>NA</td>
<td>11</td>
<td>22</td>
<td>38</td>
</tr>
<tr>
<td>600</td>
<td>NA</td>
<td>10</td>
<td>21</td>
<td>36</td>
</tr>
<tr>
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<td>34</td>
</tr>
<tr>
<td>700</td>
<td>NA</td>
<td>10</td>
<td>19</td>
<td>33</td>
</tr>
<tr>
<td>750</td>
<td>NA</td>
<td>10</td>
<td>18</td>
<td>32</td>
</tr>
<tr>
<td>800</td>
<td>NA</td>
<td>10</td>
<td>18</td>
<td>31</td>
</tr>
<tr>
<td>850</td>
<td>NA</td>
<td>10</td>
<td>17</td>
<td>30</td>
</tr>
<tr>
<td>900</td>
<td>NA</td>
<td>10</td>
<td>17</td>
<td>29</td>
</tr>
<tr>
<td>950</td>
<td>NA</td>
<td>10</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
<td>1,000</td>
<td>NA</td>
<td>9</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td>1,100</td>
<td>NA</td>
<td>9</td>
<td>15</td>
<td>26</td>
</tr>
<tr>
<td>1,200</td>
<td>NA</td>
<td>9</td>
<td>14</td>
<td>25</td>
</tr>
<tr>
<td>1,300</td>
<td>NA</td>
<td>9</td>
<td>14</td>
<td>24</td>
</tr>
</tbody>
</table>

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1,400 | NA | NA | 13 | 23 | 32 | 69 | 124 | 195 | 407  
1,500 | NA | NA | 13 | 22 | 31 | 66 | 119 | 188 | 392  
1,600 | NA | NA | 12 | 21 | 30 | 64 | 115 | 182 | 378  
1,700 | NA | NA | 12 | 20 | 29 | 62 | 112 | 176 | 366  
1,800 | NA | NA | 11 | 20 | 28 | 60 | 108 | 170 | 355  
1,900 | NA | NA | 11 | 19 | 27 | 58 | 105 | 166 | 345  
2,000 | NA | NA | 11 | 19 | 27 | 57 | 102 | 161 | 335  

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 m³/h, 1 degree = 0.01745 rad.

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

### TABLE 402.4(31)
**SEMIRIGID COPPER TUBING**

<table>
<thead>
<tr>
<th>INTEGRATED USE</th>
<th>Tube sizing between 2 psig service and line pressure regulator.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TUBE SIZE (inch)</strong></td>
<td>K &amp; L 1/4</td>
</tr>
<tr>
<td>ACR 3/8 1/2</td>
<td>5/8 3/4 7/8</td>
</tr>
<tr>
<td>Outside</td>
<td>0.375</td>
</tr>
<tr>
<td>Inside</td>
<td>0.305</td>
</tr>
<tr>
<td><strong>Length (ft)</strong></td>
<td>Capacity in Thousands of Btu per Hour</td>
</tr>
<tr>
<td>10</td>
<td>413</td>
</tr>
<tr>
<td>20</td>
<td>284</td>
</tr>
<tr>
<td>30</td>
<td>228</td>
</tr>
<tr>
<td>40</td>
<td>195</td>
</tr>
<tr>
<td>50</td>
<td>173</td>
</tr>
<tr>
<td>60</td>
<td>157</td>
</tr>
<tr>
<td>70</td>
<td>144</td>
</tr>
<tr>
<td>80</td>
<td>134</td>
</tr>
<tr>
<td>90</td>
<td>126</td>
</tr>
<tr>
<td>100</td>
<td>119</td>
</tr>
<tr>
<td>125</td>
<td>105</td>
</tr>
<tr>
<td>150</td>
<td>95</td>
</tr>
<tr>
<td>175</td>
<td>88</td>
</tr>
<tr>
<td>200</td>
<td>82</td>
</tr>
<tr>
<td>250</td>
<td>72</td>
</tr>
<tr>
<td>300</td>
<td>66</td>
</tr>
<tr>
<td>350</td>
<td>60</td>
</tr>
</tbody>
</table>
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 m³/h, 1 degree = 0.01745 rad.

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

### TABLE 402.4(32)
CORRUGATED STAINLESS STEEL TUBING (CSST)

<table>
<thead>
<tr>
<th>Gas</th>
<th>Undiluted Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>11.0 in. w.c.</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>0.5 in. w.c.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.50</td>
</tr>
</tbody>
</table>

**INTENDED USE: SIZING BETWEEN SINGLE- OR SECOND-STAGE (Low-Pressure) REGULATOR AND THE APPLIANCE SHUTOFF VALVE**

<table>
<thead>
<tr>
<th>TUBE SIZE (EHD)</th>
<th>Capacity in Thousands of Btu per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Designation</td>
<td>1 3 1 5 18 19 23 25 30 31 37 39 46 48 60 62</td>
</tr>
<tr>
<td>Length (ft)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>7 9 18 21 35 42 74 86 1,42 1,63 2,83 3,27 5,78 6,55 0</td>
</tr>
<tr>
<td>10</td>
<td>5 6 12 15 25 30 52 60 971 1,17 1,99 2,32 4,11 4,64 0</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>TUBE SIZE (EHD)</th>
<th>INTENDED USE: SIZING BETWEEN 2 PSI SERVICE AND THE LINE PRESSURE REGULATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gas</td>
</tr>
<tr>
<td></td>
<td>Inlet Pressure</td>
</tr>
<tr>
<td></td>
<td>Pressure Drop</td>
</tr>
<tr>
<td></td>
<td>Specific Gravity</td>
</tr>
</tbody>
</table>

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 m³/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>
<thead>
<tr>
<th>Flow Designation</th>
<th>Capacity in Thousands of Btu per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (ft)</td>
<td>13</td>
</tr>
<tr>
<td>10</td>
<td>42 6</td>
</tr>
<tr>
<td>25</td>
<td>26 2</td>
</tr>
<tr>
<td>30</td>
<td>23 8</td>
</tr>
<tr>
<td>40</td>
<td>20 3</td>
</tr>
<tr>
<td>50</td>
<td>18 1</td>
</tr>
<tr>
<td>75</td>
<td>14 7</td>
</tr>
<tr>
<td>100</td>
<td>12 4</td>
</tr>
<tr>
<td>150</td>
<td>10 1</td>
</tr>
<tr>
<td>200</td>
<td>86 11</td>
</tr>
<tr>
<td>250</td>
<td>77 10</td>
</tr>
<tr>
<td>300</td>
<td>69 17</td>
</tr>
<tr>
<td>400</td>
<td>60 15</td>
</tr>
<tr>
<td>500</td>
<td>53 13</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895kPa, 1-inch water column = 24.88 kPa,

1 British thermal unit per hour = 0.293 1 W, 1 cubic foot per hour = 0.0283 m³/h, 1 inch water column = 24.88 kPa,

Notes:
1. Table does not include effect of pressure drop across the line regulator. Where regulator loss exceeds $1/2$ psi (based on 13 in. w.c. outlet pressure), DO NOT USE THIS TABLE. Consult with the regulator manufacturer for pressure drops and capacity factors. Pressure drops across a regulator may vary with flow rate.
2. CAUTION: Capacities shown in the table might exceed maximum capacity for a selected regulator. Consult with the regulator or tubing manufacturer for guidance.
3. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends 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.
4. EHD—Equivalent Hydraulic Diameter, which is a measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.
5. Table entries have been rounded to three significant digits.

**TABLE 402.4(34)**

**CORRUGATED STAINLESS STEEL TUBING (CSST)**

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### Designation

<table>
<thead>
<tr>
<th>Flow</th>
<th>Length (ft)</th>
<th>Capacity in Thousands of Btu per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>500</td>
<td>7.830</td>
</tr>
<tr>
<td>400</td>
<td>300</td>
<td>8.950</td>
</tr>
<tr>
<td>350</td>
<td>250</td>
<td>13.100</td>
</tr>
<tr>
<td>300</td>
<td>200</td>
<td>14.441</td>
</tr>
<tr>
<td>250</td>
<td>150</td>
<td>28.600</td>
</tr>
<tr>
<td>200</td>
<td>100</td>
<td>54.400</td>
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<td>150</td>
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<td>19.600</td>
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<td>100</td>
<td>25</td>
<td>30.400</td>
</tr>
<tr>
<td>50</td>
<td>10</td>
<td>13.100</td>
</tr>
</tbody>
</table>

Notes:
1. Table does not include effect of pressure drop across line regulator. Where regulator loss exceeds 1 psi, DO NOT USE THIS TABLE. Consult with the regulator manufacturer for pressure drops and capacity factors. Pressure drop across regulator may vary with the flow rate.
2. CAUTION: Capacities shown in the table might exceed maximum capacity of selected regulator. Consult with the tubing manufacturer for guidance.
3. 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.
4. EHD—Equivalent Hydraulic Diameter, which is a measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.
5. Table entries have been rounded to three significant digits.

### Gas

| Unidiluted Propane |

<table>
<thead>
<tr>
<th>Inlet Pressure</th>
<th>Pressure Drop</th>
<th>Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 psi</td>
<td>3.5 psi</td>
<td>1.50</td>
</tr>
</tbody>
</table>

### TABLE 402.4(35)

#### POLYETHYLENE PLASTIC PIPE

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 m³/h, 1 degree = 0.01745 rad.

### TUBE SIZE (EHD)

<table>
<thead>
<tr>
<th>Flow Designation</th>
<th>13</th>
<th>15</th>
<th>18</th>
<th>19</th>
<th>23</th>
<th>25</th>
<th>30</th>
<th>31</th>
<th>37</th>
<th>39</th>
<th>46</th>
<th>48</th>
<th>60</th>
<th>62</th>
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<tbody>
<tr>
<td>Length (ft)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>826</td>
<td>1,070</td>
<td>1,710</td>
<td>2,060</td>
<td>3,150</td>
<td>4,000</td>
<td>7,830</td>
<td>8,950</td>
<td>13,100</td>
<td>14,441</td>
<td>28,600</td>
<td>31,200</td>
<td>54,400</td>
<td>63,800</td>
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<tr>
<td>25</td>
<td>509</td>
<td>664</td>
<td>1,090</td>
<td>1,310</td>
<td>2,040</td>
<td>2,550</td>
<td>4,860</td>
<td>5,600</td>
<td>8,400</td>
<td>9,339</td>
<td>18,000</td>
<td>19,900</td>
<td>34,700</td>
<td>40,400</td>
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<tr>
<td>30</td>
<td>461</td>
<td>603</td>
<td>999</td>
<td>1,190</td>
<td>1,870</td>
<td>2,340</td>
<td>4,430</td>
<td>5,100</td>
<td>7,680</td>
<td>8,564</td>
<td>16,400</td>
<td>18,200</td>
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<td>36,900</td>
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<tr>
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<td>396</td>
<td>520</td>
<td>867</td>
<td>1,030</td>
<td>1,630</td>
<td>2,030</td>
<td>3,820</td>
<td>4,400</td>
<td>6,680</td>
<td>7,469</td>
<td>14,200</td>
<td>15,800</td>
<td>27,600</td>
<td>32,000</td>
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<tr>
<td>50</td>
<td>352</td>
<td>463</td>
<td>777</td>
<td>926</td>
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<td>1,820</td>
<td>3,410</td>
<td>3,930</td>
<td>5,990</td>
<td>6,717</td>
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<td>28,600</td>
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<tr>
<td>75</td>
<td>284</td>
<td>376</td>
<td>637</td>
<td>757</td>
<td>1,210</td>
<td>1,490</td>
<td>2,770</td>
<td>3,190</td>
<td>4,920</td>
<td>5,539</td>
<td>10,300</td>
<td>11,600</td>
<td>20,300</td>
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<tr>
<td>80</td>
<td>275</td>
<td>363</td>
<td>618</td>
<td>731</td>
<td>1,170</td>
<td>1,450</td>
<td>2,680</td>
<td>3,090</td>
<td>4,770</td>
<td>5,372</td>
<td>9,990</td>
<td>11,200</td>
<td>19,600</td>
<td>22,700</td>
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<td>100</td>
<td>243</td>
<td>324</td>
<td>553</td>
<td>656</td>
<td>1,050</td>
<td>1,300</td>
<td>2,390</td>
<td>2,760</td>
<td>4,280</td>
<td>4,830</td>
<td>8,930</td>
<td>10,000</td>
<td>17,600</td>
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<td>3,983</td>
<td>7,270</td>
<td>8,210</td>
<td>14,400</td>
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<td>200</td>
<td>169</td>
<td>226</td>
<td>393</td>
<td>464</td>
<td>755</td>
<td>923</td>
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<td>3,474</td>
<td>6,290</td>
<td>7,130</td>
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<td>14,400</td>
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<tr>
<td>250</td>
<td>150</td>
<td>202</td>
<td>352</td>
<td>415</td>
<td>679</td>
<td>828</td>
<td>1,490</td>
<td>1,730</td>
<td>2,740</td>
<td>3,124</td>
<td>5,620</td>
<td>6,390</td>
<td>11,200</td>
<td>12,900</td>
</tr>
<tr>
<td>300</td>
<td>136</td>
<td>183</td>
<td>322</td>
<td>379</td>
<td>622</td>
<td>757</td>
<td>1,360</td>
<td>1,570</td>
<td>2,510</td>
<td>2,865</td>
<td>5,120</td>
<td>5,840</td>
<td>10,300</td>
<td>11,700</td>
</tr>
<tr>
<td>400</td>
<td>117</td>
<td>158</td>
<td>279</td>
<td>328</td>
<td>542</td>
<td>657</td>
<td>1,170</td>
<td>1,360</td>
<td>2,180</td>
<td>2,498</td>
<td>4,430</td>
<td>5,070</td>
<td>8,920</td>
<td>10,200</td>
</tr>
<tr>
<td>500</td>
<td>104</td>
<td>140</td>
<td>251</td>
<td>294</td>
<td>509</td>
<td>589</td>
<td>1,050</td>
<td>1,210</td>
<td>1,950</td>
<td>2,247</td>
<td>3,960</td>
<td>4,540</td>
<td>8,000</td>
<td>9,110</td>
</tr>
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</table>

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### TABLE 402.4(36)  
**POLYETHYLENE PLASTIC PIPE**

<table>
<thead>
<tr>
<th>Designation</th>
<th>SDR 9</th>
<th>SDR 11</th>
<th>SDR 11</th>
<th>SDR 10</th>
<th>SDR 11</th>
<th>SDR 11</th>
<th>SDR 11</th>
<th>SDR 11</th>
</tr>
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<tbody>
<tr>
<td>Actual ID</td>
<td>0.660</td>
<td>0.860</td>
<td>1.077</td>
<td>1.328</td>
<td>1.554</td>
<td>1.943</td>
<td>2.864</td>
<td>3.682</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length (ft)</th>
<th>Capacity in Thousands of Btu per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>233 468 844 1.460 2.210 3.970 11.000 21.200</td>
</tr>
<tr>
<td>30</td>
<td>187 375 677 1.170 1.770 3.180 8.810 17.000</td>
</tr>
<tr>
<td>40</td>
<td>160 321 580 1.000 1.520 2.730 7.540 14.600</td>
</tr>
<tr>
<td>50</td>
<td>142 285 514 0.890 1.340 2.420 6.680 12.900</td>
</tr>
<tr>
<td>60</td>
<td>129 258 466 0.807 1.220 2.190 6.050 11.700</td>
</tr>
<tr>
<td>70</td>
<td>119 237 428 0.742 1.120 2.010 5.570 10.800</td>
</tr>
<tr>
<td>80</td>
<td>110 221 398 0.690 1.040 1.870 5.180 10.000</td>
</tr>
<tr>
<td>90</td>
<td>103 207 374 0.648 0.978 1.760 4.860 9.400</td>
</tr>
<tr>
<td>100</td>
<td>98 196 353 0.612 0.924 1.660 4.590 8.900</td>
</tr>
<tr>
<td>125</td>
<td>87 173 313 0.542 0.819 1.470 4.070 7.900</td>
</tr>
<tr>
<td>150</td>
<td>78 157 284 0.491 0.742 1.330 3.690 7.130</td>
</tr>
<tr>
<td>175</td>
<td>72 145 261 0.452 0.683 1.230 3.390 6.560</td>
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<tr>
<td>200</td>
<td>67 135 243 0.420 0.635 1.140 3.160 6.100</td>
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<tr>
<td>250</td>
<td>60 119 215 0.373 0.563 1.010 2.800 5.410</td>
</tr>
<tr>
<td>300</td>
<td>54 108 195 0.338 0.510 0.916 2.530 4.900</td>
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<tr>
<td>350</td>
<td>50 99 179 0.311 0.469 0.843 2.330 4.510</td>
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<tr>
<td>400</td>
<td>46 92 167 0.289 0.436 0.784 2.170 4.190</td>
</tr>
<tr>
<td>450</td>
<td>43 87 157 0.271 0.409 0.736 2.040 3.930</td>
</tr>
<tr>
<td>500</td>
<td>41 82 148 0.256 0.387 0.695 1.920 3.720</td>
</tr>
</tbody>
</table>

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 m³/h, 1 degree = 0.01745 rad.

**Note:** Table entries have been rounded to three significant digits.

<table>
<thead>
<tr>
<th>Gas</th>
<th>Undiluted Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pressure</td>
<td>2.0 psi</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>1.0 psi</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.50</td>
</tr>
</tbody>
</table>

**INTENDED USE**  
PE pipe sizing between 2 psig service regulator and line pressure regulator.

<table>
<thead>
<tr>
<th>Nominal OD</th>
<th>SDR 9</th>
<th>SDR 11</th>
<th>SDR 11</th>
<th>SDR 10</th>
<th>SDR 11</th>
<th>SDR 11</th>
<th>SDR 11</th>
<th>SDR 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designation</td>
<td>0.660</td>
<td>0.860</td>
<td>1.077</td>
<td>1.328</td>
<td>1.554</td>
<td>1.943</td>
<td>2.864</td>
<td>3.682</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length (ft)</th>
<th>Capacity in Thousands of Btu per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>3,130 6,260 11,300 19,600 29,500 53,100 147,000 284,000</td>
</tr>
<tr>
<td>20</td>
<td>2,150 4,300 7,760 13,400 20,300 36,500 101,000 195,000</td>
</tr>
<tr>
<td>30</td>
<td>1,730 3,450 6,230 10,800 16,300 29,300 81,100 157,000</td>
</tr>
<tr>
<td>40</td>
<td>1,480 2,960 5,330 9,240 14,000 25,100 69,400 134,100</td>
</tr>
<tr>
<td>50</td>
<td>1,310 2,620 4,730 8,190 12,400 22,200 61,500 119,000</td>
</tr>
<tr>
<td>60</td>
<td>1,190 2,370 4,280 7,420 11,200 20,100 55,700 108,000</td>
</tr>
</tbody>
</table>

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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 m³/h, 1 degree = 0.01745 rad.

Note: Table entries have been rounded to three significant digits.

TABLE 402.4(37)
POLYETHYLENE PLASTIC TUBING

<table>
<thead>
<tr>
<th>INTENDED USE</th>
<th>PE pipe sizing between integral two-stage regulator at tank or second stage (low-pressure regulator) and building.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic Tubing Size (CTS) (inch)</td>
<td></td>
</tr>
</tbody>
</table>

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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.
SECTION 403
PIPING MATERIALS

403.1 General.
Materials used for piping 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 building 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.

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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 piping 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 piping 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 piping and fittings coated with a corrosion-resistant material shall be used. External or internal coatings or linings used on piping 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

<table>
<thead>
<tr>
<th>IRON PIPE SIZE (inches)</th>
<th>APPROXIMATE LENGTH OF THREADED PORTION (inches)</th>
<th>APPROXIMATE NUMBER OF THREADS TO BE CUT</th>
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</thead>
<tbody>
<tr>
<td>1/2</td>
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<td>10</td>
</tr>
<tr>
<td>3/4</td>
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<td>10</td>
</tr>
<tr>
<td>1</td>
<td>7/8</td>
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<td>1/2</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
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<td></td>
<td>11</td>
</tr>
<tr>
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<td>1 1/2</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>1 1/2</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>5 1/8</td>
<td>13</td>
</tr>
</tbody>
</table>

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.

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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.

9.4. The fittings shall be located outdoors.

9.5. The tapped fitting assembly shall be inspected and proven to be free of leakage.

403.11 Plastic pipe, joints and fittings.
Plastic pipe, tubing and fittings shall be joined in accordance with the manufacturer’s instructions. Such joint shall comply with the following:

1. The joint shall be designed and installed so that the longitudinal pull-out resistance of the joint will be greater than or equal to the tensile strength of the plastic piping material.

2. Heat-fusion joints shall be made in accordance with qualified procedures that have been established and proven by test to produce gas-tight joints as strong as or stronger than the pipe or tubing being joined. Joints shall be made with the joining method recommended by the pipe manufacturer. Heat fusion fittings shall be marked “ASTM D2513.”

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

4. Plastic piping joints and fittings for use in liquefied petroleum gas piping systems shall be in accordance with NFPA 58.

403.12 Flanges.
Flanges and flange gaskets shall comply with Sections 403.12.1 through 403.12.7.

403.12.1 Cast iron.
Cast-iron flanges shall be in accordance with ASME B16.1.

403.12.2 Steel.
Steel flanges shall be in accordance with ASME B16.5 or ASME B16.47.
403.12.3 Nonferrous.
Nonferrous flanges shall be in accordance with ASME B16.24.

403.12.4 Ductile iron.
Ductile-iron flanges shall be in accordance with ASME B16.42.

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

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

403.12.7 Lapped flanges.
Lapped flanges shall be used only above ground or in exposed locations accessible for inspection.

403.13 Flange gaskets.
Material for gaskets shall be capable of withstanding the design temperature and pressure of the piping system, and the chemical constituents of the gas being conducted, without change to its chemical and physical properties. The effects of fire exposure to the joint shall be considered in choosing material. Acceptable materials include metal (plain or corrugated), composition, aluminum “O” rings, spiral wound metal gaskets, rubber-faced phenolic and elastomeric. Where a flanged joint is opened, the gasket shall be replaced. Full-face flange gaskets shall be used with all nonsteel flanges.

403.13.1 Metallic gaskets.
Metallic flange gaskets shall be in accordance with ASME B16.20.

403.13.2 Nonmetallic gaskets.
Nonmetallic flange gaskets shall be in accordance with ASME B16.21.

SECTION 404
PIPING SYSTEM INSTALLATION

404.1 Installation of materials.
Materials used shall be installed in strict accordance with the standards under which the materials are accepted and approved. In the absence of such installation procedures, the manufacturer’s instructions shall be followed. Where the requirements of referenced standards or manufacturer’s instructions do not conform to minimum provisions of this code, the provisions of this code shall apply.

404.2 CSST.
CSST piping systems shall be installed in accordance with the terms of their approval, the conditions of listing, the manufacturer’s instructions and this code.

404.3 Prohibited locations.
_Piping_ shall not be installed in or through a ducted supply, return or exhaust, or a clothes chute,
chimney or gas vent, dumbwaiter or elevator shaft. Piping installed downstream of the point of delivery shall not extend through any townhouse unit other than the unit served by such piping.

404.4 Piping in solid partitions and walls.
Concealed piping shall not be located in solid partitions and solid walls, unless installed in a chase or casing.

404.5 Fittings in concealed locations.
Fittings installed in concealed locations shall be limited to the following types:

1. Threaded elbows, tees and couplings.
2. Brazed fittings.
3. Welded fittings.
4. Fittings listed to ANSI LC-1/CSA 6.26 or ANSI LC-4.

404.6 Underground penetrations prohibited.
Gas piping shall not penetrate building foundation walls at any point below grade. Gas piping shall enter and exit a building at a point above grade and the annular space between the pipe and the wall shall be sealed.

[NY] 404.7 Protection against physical damage.
In concealed locations, where piping other than black or galvanized steel is installed through holes or notches in wood studs, joists, rafters or similar members less than 1 ¾ inches (44.45 mm) from the nearest edge of the member, the pipe shall be protected by shield plates. Such shield plates shall comply with the requirements of Section 404.7.1, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 4 inches (102 mm) above sole plates, below top plates and to each side of a stud, joist or rafter. The movement of piping made of CSST (including, but not limited to, piping made of listed AR-CSST) shall not be otherwise constrained by straps, clips or other support devices. In addition, where CSST (including, but not limited to, listed AR-CSST) is installed in a concealed location and parallel to any joist, rafter, or similar member, the CSST shall be protected by shield plates in any area where the CSST is not:

1. Physically supported in a manner that ensures the CSST will always be at least 1 ¾ inches (44.45 mm) away from the nearest edge of any member, or
2. Encased in a protective metal pipe made of schedule 40 steel or iron pipe or in a protective pipe sleeve made of a material approved by the code enforcement official as the equivalent of schedule 40 steel or iron pipe.

Such shield plates shall comply with the requirements of Section 404.7.1, shall cover the area the where the CSST is located, and shall extend a minimum of 4 inches (102 mm) to each side of the CSST.

[NY] 404.7.1 Shield plates.
In all cases, shield plates shall be certified or listed as complying with ANSI LC-1. In addition, in the case of piping made of CSST, shield plates shall be listed for use with the
404.8 Piping in solid floors.
Piping in solid floors shall be laid in channels in the floor and covered in a manner that will allow access to the piping with a minimum amount of damage to the building. Where such piping is subject to exposure to excessive moisture or corrosive substances, the piping shall be protected in an approved manner. As an alternative to installation in channels, the piping shall be installed in a conduit of Schedule 40 steel, wrought iron, PVC or ABS pipe in accordance with Section 404.8.1 or 404.8.2.

404.8.1 Conduit with one end terminating outdoors.
The conduit shall extend into an occupiable portion of the building and, at the point where the conduit terminates in the building, the space between the conduit and the gas piping shall be sealed to prevent the possible entrance of any gas leakage. The conduit shall extend not less than 2 inches (51 mm) beyond the point where the pipe emerges from the floor. If the end sealing is capable of withstanding the full pressure of the gas pipe, the conduit shall be designed for the same pressure as the pipe. Such conduit shall extend not less than 4 inches (102 mm) outside the building, shall be vented above grade to the outdoors and shall be installed so as to prevent the entrance of water and insects.

404.8.2 Conduit with both ends terminating indoors.
Where the conduit originates and terminates within the same building, the conduit shall originate and terminate in an accessible portion of the building and shall not be sealed. The conduit shall extend not less than 2 inches (51 mm) beyond the point where the pipe emerges from the floor.

404.9 Above-ground outdoor piping.
Piping installed outdoors shall be elevated not less than $3\frac{1}{2}$ inches (89 mm) above ground and where installed across roof surfaces, shall be elevated not less than $3\frac{1}{2}$ inches (89 mm) above the roof surface. Piping installed above ground, outdoors, and installed across the surface of roofs shall be securely supported and located where it will be protected from physical damage. Where passing through an outside wall, the piping shall be protected against corrosion by coating or wrapping with an inert material. Where piping is encased in a protective pipe sleeve, the annular space between the piping and the sleeve shall be sealed.

404.10 Isolation.
Metallic piping and metallic tubing that conveys fuel gas from an LP-gas storage container shall be provided with an approved dielectric fitting to electrically isolate the underground portion of the pipe or tube from the above-ground portion that enters a building. Such dielectric fitting shall be installed above ground, outdoors.
404.11 Protection against corrosion.
Steel pipe or tubing exposed to corrosive action, such as soil conditions or moisture, shall be protected in accordance Sections 404.11.1 through 404.11.5.

404.11.1 Galvanizing.
Zinc coating shall not be deemed adequate protection for underground gas piping.

404.11.2 Protection methods.
Underground piping shall comply with one or more of the following:

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

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

3. The piping shall have a cathodic protection system installed and the system shall be monitored and maintained in accordance with an approved program.

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

404.11.4 Protection of risers.
Steel risers connected to plastic piping shall be cathodically protected by means of a welded anode, except where such risers are anodeless risers.

404.11.5 Prohibited use.
Uncoated threaded or socket-welded joints shall not be used in piping in contact with soil or where internal or external crevice corrosion is known to occur.

404.12 Minimum burial depth.
Underground piping systems shall be installed a minimum depth of 12 inches (305 mm) below grade, except as provided for in Section 404.12.1.

404.12.1 Individual outdoor appliances.
Individual lines to outdoor lights, grills and other appliances shall be installed not less than 8 inches (203 mm) below finished grade, provided that such installation is approved and is installed in locations not susceptible to physical damage.

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

404.14 Piping underground beneath buildings.
Piping installed underground beneath buildings is prohibited except where the piping is encased in a conduit of wrought iron, plastic pipe, steel pipe, a piping or encasement system listed for installation beneath buildings, or other approved conduit material designed to withstand the superimposed loads. The conduit shall be protected from corrosion in accordance with Section 404.11 and shall be installed in accordance with Section 404.14.1 or 404.14.2.

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404.14.1 Conduit with one end terminating outdoors.
The conduit shall extend into an occupiable portion of the building and, at the point where the
conduit terminates in the building, the space between the conduit and the gas piping shall be
sealed to prevent the possible entrance of any gas leakage. The conduit shall extend not less
than 2 inches (51 mm) beyond the point where the pipe emerges from the floor. Where the
end sealing is capable of withstanding the full pressure of the gas pipe, the conduit shall be
designed for the same pressure as the pipe. Such conduit shall extend not less than 4 inches
(102 mm) outside of the building, shall be vented above grade to the outdoors and shall be
installed so as to prevent the entrance of water and insects.

404.14.2 Conduit with both ends terminating indoors.
Where the conduit originates and terminates within the same building, the conduit shall
originate and terminate in an accessible portion of the building and shall not be sealed. The
conduit shall extend not less than 2 inches (51 mm) beyond the point where the pipe emerges
from the floor.

404.15 Outlet closures.
Gas outlets that do not connect to appliances shall be capped gas tight.

Exception: Listed and labeled flush-mounted-type quick-disconnect devices and listed and
labeled gas convenience outlets shall be installed in accordance with the manufacturer’s
instructions.

404.16 Location of outlets.
The unthreaded portion of piping outlets shall extend not less than 1 inch (25 mm) through finished
ceilings and walls and where extending through floors or outdoor patios and slabs, shall be not
less than 2 inches (51 mm) above them. The outlet fitting or piping shall be securely supported.
Outlets shall not be placed behind doors. Outlets shall be located in the room or space where the
appliance is installed.

Exception: Listed and labeled flush-mounted-type quick-disconnect devices and listed and
labeled gas convenience outlets shall be installed in accordance with the manufacturer’s
instructions.

404.17 Plastic pipe.
The installation of plastic pipe shall comply with Sections 404.17.1 through 404.17.3.

404.17.1 Limitations.
Plastic pipe shall be installed outdoors underground only. Plastic pipe shall not be used within
or under any building or slab or be operated at pressures greater than 100 psig (689 kPa) for
natural gas or 30 psig (207 kPa) for LP-gas.

Exceptions:

1. Plastic pipe shall be permitted to terminate above ground outside of buildings
where installed in premanufactured anodeless risers or service head adapter risers
that are installed in accordance with the manufacturer’s instructions.
2. Plastic pipe shall be permitted to terminate with a wall head adapter within buildings where the plastic pipe is inserted in a piping material for fuel gas use in buildings.

3. Plastic pipe shall be permitted under outdoor patio, walkway and driveway slabs provided that the burial depth complies with Section 404.12.

404.17.2 Connections.
Connections made outdoors and underground between metallic and plastic piping shall be made only with transition fittings conforming to ASTM D2513 Category I or ASTM F1973.

404.17.3 Tracer.
A yellow insulated copper tracer wire or other approved conductor, or a product specifically designed for that purpose, shall be installed adjacent to underground nonmetallic piping. Access shall be provided to the tracer wire or the tracer wire shall terminate above ground at each end of the nonmetallic piping. The tracer wire size shall be not less than 18 AWG and the insulation type shall be suitable for direct burial.

404.18 Pipe cleaning.
The use of a flammable or combustible gas to clean or remove debris from a piping system shall be prohibited.

404.19 Prohibited devices.
A device shall not be placed inside the piping or fittings that will reduce the cross-sectional area or otherwise obstruct the free flow of gas.

Exceptions:

1. Approved gas filters.

2. An approved fitting or device where the gas piping system has been sized to accommodate the pressure drop of the fitting or device.

404.20 Testing of piping.
Before any system of piping is put in service or concealed, it shall be tested to ensure that it is gas tight. Testing, inspection and purging of piping systems shall comply with Section 406.

SECTION 405
PIPING BENDS AND CHANGES IN DIRECTION

405.1 General.
Changes in direction of pipe shall be permitted to be made by the use of fittings, factory bends or field bends.

405.2 Metallic pipe.
Metallic pipe bends shall comply with the following:

1. Bends shall be made only with bending tools and procedures intended for that purpose.
2. Bends shall be smooth and free from buckling, cracks or other evidence of mechanical damage.

3. The longitudinal weld of the pipe shall be near the neutral axis of the bend.

4. Pipe shall not be bent through an arc of more than 90 degrees (1.6 rad).

5. The inside radius of a bend shall be not less than six times the outside diameter of the pipe.

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 piping 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
INSPECTION, TESTING AND PURGING

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

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

406.1.4 Section testing.
A piping 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 piping 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 piping system in which they are to be installed shall be permitted to be tested with inert gas or air at the time of fabrication.

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 piping or isolated by blanks, blind flanges or caps. Flanged joints at which blinds are inserted to blank off other equipment during the test shall not be required to be tested.

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

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

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406.3.5 Testing precautions.
Testing of piping 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 \(1 \frac{1}{2}\) 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 piping 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 \(\frac{1}{2}\) hour for each 500 cubic feet \((14 \text{ m}^3)\) of pipe volume or fraction thereof. When testing a system having a volume less than 10 cubic feet \((0.28 \text{ m}^3)\) 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.

406.5 Detection of leaks and defects.
The piping system shall withstand the test pressure specified without showing any evidence of leakage or other defects.

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

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

406.5.2 Corrections.
Where leakage or other defects are located, the affected portion of the piping system shall be repaired or replaced and retested.

406.6 Piping system and equipment leakage check.
Leakage checking of systems and equipment shall be in accordance with Sections 406.6.1 through 406.6.4.

406.6.1 Test gases.
Leak checks using fuel gas shall be permitted in piping systems that have been pressure tested in accordance with Section 406.
406.6.2 Before turning gas on.
During the process of turning gas on into a system of new gas piping, the entire system shall be inspected to determine that there are no open fittings or ends and that all valves at unused outlets are closed and plugged or capped.

406.6.3 Leak check.
Immediately after the gas is turned on into a new system or into a system that has been initially restored after an interruption of service, the piping system shall be checked for leakage. Where leakage is indicated, the gas supply shall be shut off until the necessary repairs have been made.

406.6.4 Placing appliances and equipment in operation.
Appliances and equipment shall not be placed in operation until after the piping system has been checked for leakage in accordance with Section 406.6.3, the piping system has been purged in accordance with Section 406.7 and the connections to the appliances have been checked for leakage.

406.7 Purging.
The purging of piping shall be in accordance with Sections 406.7.1 through 406.7.3.

406.7.1 Piping systems required to be purged outdoors.
The purging of piping systems shall be in accordance with the provisions of Sections 406.7.1.1 through 406.7.1.4 where the piping system meets either of the following:

1. The design operating gas pressure is greater than 2 psig (13.79 kPa).
2. The piping being purged contains one or more sections of pipe or tubing meeting the size and length criteria of Table 406.7.1.1.

406.7.1.1 Removal from service.
Where existing gas piping is opened, the section that is opened shall be isolated from the gas supply and the line pressure vented in accordance with Section 406.7.1.3. Where gas piping meeting the criteria of Table 406.7.1.1 is removed from service, the residual fuel gas in the piping shall be displaced with an inert gas.

<table>
<thead>
<tr>
<th>NOMINAL PIPE SIZE (inches)</th>
<th>LENGTH OF PIPING (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 2 / &lt; 3</td>
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<td>≥ 3 &lt; 4</td>
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</tr>
<tr>
<td>≥ 4 &lt; 6</td>
<td>&gt; 15</td>
</tr>
<tr>
<td>≥ 6 &lt; 8</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>≥ 8</td>
<td>Any length</td>
</tr>
</tbody>
</table>

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

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406.7.1.2 Placing in operation.
Where gas piping containing air and meeting the criteria of Table 406.7.1.1 is placed in operation, the air in the piping shall first be displaced with an inert gas. The inert gas shall then be displaced with fuel gas in accordance with Section 406.7.1.3.

406.7.1.3 Outdoor discharge of purged gases.
The open end of a piping system being pressure vented or purged shall discharge directly to an outdoor location. Purging operations shall comply with all of the following requirements:

1. The point of discharge shall be controlled with a shutoff valve.
2. The point of discharge shall be located not less than 10 feet (3048 mm) from sources of ignition, not less than 10 feet (3048 mm) from building openings and not less than 25 feet (7620 mm) from mechanical air intake openings.
3. During discharge, the open point of discharge shall be continuously attended and monitored with a combustible gas indicator that complies with Section 406.7.1.4.
4. Purging operations introducing fuel gas shall be stopped when 90 percent fuel gas by volume is detected within the pipe.
5. Persons not involved in the purging operations shall be evacuated from all areas within 10 feet (3048 mm) of the point of discharge.

406.7.1.4 Combustible gas indicator.
Combustible gas indicators shall be listed and shall be calibrated in accordance with the manufacturer’s instructions. Combustible gas indicators shall numerically display a volume scale from zero percent to 100 percent in 1-percent or smaller increments.

406.7.2 Piping systems allowed to be purged indoors or outdoors.
The purging of piping systems shall be in accordance with the provisions of Section 406.7.2.1 where the piping system meets both of the following:

1. The design operating gas pressure is 2 psig (13.79 kPa) or less.
2. The piping being purged is constructed entirely from pipe or tubing not meeting the size and length criteria of Table 406.7.1.1.

406.7.2.1 Purging procedure.
The piping system shall be purged in accordance with one or more of the following:

1. The piping shall be purged with fuel gas and shall discharge to the outdoors.
2. The piping shall be purged with fuel gas and shall discharge to the indoors or outdoors through an appliance burner not located in a combustion chamber. Such burner shall be provided with a continuous source of ignition.
3. The piping shall be purged with fuel gas and shall discharge to the indoors or outdoors through a burner that has a continuous source of ignition and that is designed for such purpose.

4. The piping shall be purged with fuel gas that is discharged to the indoors or outdoors, and the point of discharge shall be monitored with a listed combustible gas detector in accordance with Section 406.7.2.2. Purging shall be stopped when fuel gas is detected.

5. The piping shall be purged by the gas supplier in accordance with written procedures.

406.7.2.2 Combustible gas detector.
Combustible gas detectors shall be listed and shall be calibrated or tested in accordance with the manufacturer's instructions. Combustible gas detectors shall be capable of indicating the presence of fuel gas.

406.7.3 Purging appliances and equipment.
After the piping system has been placed in operation, appliances and equipment shall be purged before being placed into operation.

SECTION 407
PIPING SUPPORT

407.1 General.
Piping shall be provided with support in accordance with Section 407.2.

407.2 Design and installation.
Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers or building structural components, suitable for the size of piping, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration. Piping shall be anchored to prevent undue strains on connected appliances and shall not be supported by other piping. Pipe hangers and supports shall conform to the requirements of MSS SP-58 and shall be spaced in accordance with Section 415. Supports, hangers and anchors shall be installed so as not to interfere with the free expansion and contraction of the piping between anchors. The components of the supporting equipment shall be designed and installed so that they will not be disengaged by movement of the supported piping.

SECTION 408
DRIPS AND SLOPED PIPING

408.1 Slopes.
Piping for other than dry gas conditions shall be sloped not less than \( \frac{1}{4} \) inch in 15 feet (6.3 mm in 4572 mm) to prevent traps.

408.2 Drips.
Where wet gas exists, a drip shall be provided at any point in the line of pipe where condensate
could collect. A drip shall be provided at the outlet of the meter and shall be installed so as to constitute a trap wherein an accumulation of condensate will shut off the flow of gas before the condensate will run back into the meter.

408.3 Location of drips.
Drips shall be provided with ready access to permit cleaning or emptying. A drip shall not be located where the condensate is subject to freezing.

408.4 Sediment trap.
Where a sediment trap is not incorporated as part of the appliance, a sediment trap shall be installed downstream of the appliance shutoff valve as close to the inlet of the appliance as practical. The sediment trap shall be either a tee fitting having a capped nipple of any length installed vertically in the bottommost opening of the tee as illustrated in Figure 408.4 or other device approved as an effective sediment trap. Illuminating appliances, ranges, clothes dryers, decorative vented appliances for installation in vented fireplaces, gas fireplaces and outdoor grills need not be so equipped.

FIGURE 408.4
METHOD OF INSTALLING A TEE FITTING SEDIMENT TRAP

SECTION 409
SHUTOFF VALVES

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409.1 General.
_Piping_ systems shall be provided with shutoff valves in accordance with this section.

409.1.1 Valve approval.
Shutoff valves shall be of an _approved_ type; shall be constructed of materials compatible with the _piping_; and shall comply with the standard that is applicable for the pressure and application, in accordance with Table 409.1.1.

<table>
<thead>
<tr>
<th>VALVE STANDARDS</th>
<th>APPLIANCE SHUTOFF VALVE APPLICATION UP TO $\frac{1}{2}$ psig PRESSURE</th>
<th>OTHER VALVE APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI Z21.15/CGA 9.1</td>
<td>X</td>
<td>—</td>
</tr>
<tr>
<td>ASME B16.44</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ASME B16.33</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

For SI: 1 pound per square inch gauge = 6.895 kPa.

a. If labeled 2G.
b. If labeled 5G.

409.1.2 Prohibited locations.
Shutoff valves shall be prohibited in concealed locations and _furnace plenums_.

409.1.3 Access to shutoff valves.
Shutoff valves shall be located in places so as to provide access for operation and shall be installed so as to be protected from damage.

409.2 Meter valve.
Every meter shall be equipped with a shutoff valve located on the supply side of the meter.

409.3 Shutoff valves for multiple-house line systems.
Where a single meter is used to supply gas to more than one building or tenant, a separate shutoff valve shall be provided for each building or tenant.

409.3.1 Multiple tenant buildings.
In multiple tenant buildings, where a common _piping_ system is installed to supply other than one- and two-family dwellings, shutoff valves shall be provided for each tenant. Each tenant shall have access to the shutoff valve serving that tenant’s space.
409.3.2 Individual buildings.
In a common system serving more than one building, shutoff valves shall be installed outdoors at each building.

409.3.3 Identification of shutoff valves.
Each house line shutoff valve shall be plainly marked with an identification tag attached by the installer so that the piping systems supplied by such valves are readily identified.

409.4 MP regulator valves.
A listed shutoff valve shall be installed immediately ahead of each MP regulator.

409.5 Appliance shutoff valve.
Each appliance shall be provided with a shutoff valve in accordance with Section 409.5.1, 409.5.2 or 409.5.3.

409.5.1 Located within same room.
The shutoff valve shall be located in the same room as the appliance. The shutoff valve shall be within 6 feet (1829 mm) of the appliance, and shall be installed upstream of the union, connector or quick disconnect device it serves. Such shutoff valves shall be provided with access. Shutoff valves serving movable appliances, such as cooking appliances and clothes dryers, shall be considered to be provided with access where installed behind such appliances. Appliance shutoff valves located in the firebox of a fireplace shall be installed in accordance with the appliance manufacturer’s instructions.

409.5.2 Vented decorative appliances and room heaters.
Shutoff valves for vented decorative appliances, room heaters and decorative appliances for installation in vented fireplaces shall be permitted to be installed in an area remote from the appliances where such valves are provided with ready access. Such valves shall be permanently identified and shall not serve another appliance. The piping from the shutoff valve to within 6 feet (1829 mm) of the appliance shall be designed, sized and installed in accordance with Sections 401 through 408.

409.5.3 Located at manifold.
Where the appliance shutoff valve is installed at a manifold, such shutoff valve shall be located within 50 feet (15 240 mm) of the appliance served and shall be readily accessible and permanently identified. The piping from the manifold to within 6 feet (1829 mm) of the appliance shall be designed, sized and installed in accordance with Sections 401 through 408.

409.6 Shutoff valve for laboratories.
Where provided with two or more fuel gas outlets, including table-, bench- and hood-mounted outlets, each laboratory space in educational, research, commercial and industrial occupancies shall be provided with a single dedicated shutoff valve through which all such gas outlets shall be supplied. The dedicated shutoff valve shall be readily accessible, located within the laboratory space served, located adjacent to the egress door from the space and shall be identified by approved signage stating “Gas Shutoff.”

409.7 Shutoff valves in tubing systems.
Shutoff valves installed in tubing systems shall be rigidly and securely supported independently of the tubing.
SECTION 410
FLOW CONTROLS

410.1 Pressure regulators.
A line pressure regulator shall be installed where the appliance is designed to operate at a lower pressure than the supply pressure. Line gas pressure regulators shall be listed as complying with ANSI Z21.80/CSA 6.22. Access shall be provided to pressure regulators. Pressure regulators shall be protected from physical damage. Regulators installed on the exterior of the building shall be approved for outdoor installation.

410.2 MP regulators.
MP pressure regulators shall comply with the following:

1. The MP regulator shall be approved and shall be suitable for the inlet and outlet gas pressures for the application.

2. The MP regulator shall maintain a reduced outlet pressure under lock-up (no-flow) conditions.

3. The capacity of the MP regulator, determined by published ratings of its manufacturer, shall be adequate to supply the appliances served.

4. The MP pressure regulator shall be provided with access. Where located indoors, the regulator shall be vented to the outdoors or shall be equipped with a leak-limiting device, in either case complying with Section 410.3.

5. A tee fitting with one opening capped or plugged shall be installed between the MP regulator and its upstream shutoff valve. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument and to serve as a sediment trap.

6. A tee fitting with one opening capped or plugged shall be installed not less than 10 pipe diameters downstream of the MP regulator outlet. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument. The tee fitting is not required where the MP regulator serves an appliance that has a pressure test port on the gas control inlet side and the appliance is located in the same room as the MP regulator.

7. Where connected to rigid piping, a union shall be installed within 1 foot (304 mm) of either side of the MP regulator.

410.3 Venting of regulators.
Pressure regulators that require a vent shall be vented directly to the outdoors. The vent shall be designed to prevent the entry of insects, water and foreign objects.

Exception: A vent to the outdoors is not required for regulators equipped with and labeled for utilization with an approved vent-limiting device installed in accordance with the manufacturer’s instructions.

410.3.1 Vent piping.
Vent piping for relief vents and breather vents shall be constructed of materials allowed for
gas piping in accordance with Section 403. Vent piping shall be not smaller than the vent connection on the pressure-regulating device. Vent piping serving relief vents and combination relief and breather vents shall be run independently to the outdoors and shall serve only a single device vent. Vent piping serving only breather vents is permitted to be connected in a manifold arrangement where sized in accordance with an approved design that minimizes backpressure in the event of diaphragm rupture. Regulator vent piping shall not exceed the length specified in the regulator manufacturer’s instructions.

410.4 Excess flow valves.
Where automatic excess flow valves are installed, they shall be listed in accordance with ANSI Z21.93/CSA 6.30 and shall be sized and installed in accordance with the manufacturer’s instructions.

410.5 Flashback arrestor check valve.
Where fuel gas is used with oxygen in any hot work operation, a listed protective device that serves as a combination flashback arrestor and backflow check valve shall be installed at an approved location on both the fuel gas and oxygen supply lines. Where the pressure of the piped fuel gas supply is insufficient to ensure such safe operation, approved equipment shall be installed between the gas meter and the appliance that increases pressure to the level required for such safe operation.

SECTION 411
APPLIANCE AND MANUFACTURED HOME CONNECTIONS

411.1 Connecting appliances.
Except as required by Section 411.1.1, appliances shall be connected to the piping system by one of the following:

1. Rigid metallic pipe and fittings.

2. Corrugated stainless steel tubing (CSST) where installed in accordance with the manufacturer’s instructions.

3. Semirigid metallic tubing and metallic fittings. Lengths shall not exceed 6 feet (1829 mm) and shall be located entirely in the same room as the appliance. Semirigid metallic tubing shall not enter a motor-operated appliance through an unprotected knockout opening.

4. Listed and labeled appliance connectors in compliance with ANSI Z21.24/CGA 6.10 and installed in accordance with the manufacturer’s instructions and located entirely in the same room as the appliance.

5. Listed and labeled quick-disconnect devices used in conjunction with listed and labeled appliance connectors.

6. Listed and labeled convenience outlets used in conjunction with listed and labeled appliance connectors.

7. Listed and labeled outdoor appliance connectors in compliance with ANSI Z21.75/CSA 6.27 and installed in accordance with the manufacturer’s instructions.
8. Listed outdoor gas hose connectors in compliance with ANSI Z21.54 used to connect portable outdoor appliances. The gas hose connection shall be made only in the outdoor area where the appliance is used, and shall be to the gas piping supply at an appliance shutoff valve, a listed quick-disconnect device or listed gas convenience outlet.

9. Gas hose connectors for use in laboratories and educational facilities in accordance with Section 411.4.

411.1.1 Commercial cooking appliances.
Commercial cooking appliances installed on casters and appliances that are moved for cleaning and sanitation purposes shall be connected to the piping system with an appliance connector listed as complying with ANSI Z21.69/CSA 6.16. The commercial cooking appliance connector installation shall be configured in accordance with the manufacturer’s instructions. Movement of appliances with casters shall be limited by a restraining device installed in accordance with the connector and appliance manufacturer’s instructions.

411.1.2 Protection against damage.
Connectors and tubing shall be installed so as to be protected against physical damage.

411.1.3 Connector installation.
Appliance fuel connectors shall be installed in accordance with the manufacturer’s instructions and Sections 411.1.3.1 through 411.1.3.4.

411.1.3.1 Maximum length.
Connectors shall have an overall length not to exceed 6 feet (1829 mm). Measurement shall be made along the centerline of the connector. Only one connector shall be used for each appliance.

Exception: Rigid metallic piping used to connect an appliance to the piping system shall be permitted to have a total length greater than 6 feet (1829 mm), provided that the connecting pipe is sized as part of the piping system in accordance with Section 402 and the location of the appliance shutoff valve complies with Section 409.5.

411.1.3.2 Minimum size.
Connectors shall have the capacity for the total demand of the connected appliance.

411.1.3.3 Prohibited locations and penetrations.
Connectors shall not be concealed within, or extended through, walls, floors, partitions, ceilings or appliance housings.

Exceptions:

1. Connectors constructed of materials allowed for piping systems in accordance with Section 403 shall be permitted to pass through walls, floors, partitions and ceilings where installed in accordance with Section 409.5.2 or 409.5.3.

2. Rigid steel pipe connectors shall be permitted to extend through openings in appliance housings.
3. **Fireplace** inserts that are factory equipped with grommets, sleeves or other means of protection in accordance with the listing of the *appliance*.

4. Semirigid tubing and *listed* connectors shall be permitted to extend through an opening in an *appliance* housing, cabinet or casing where the tubing or connector is protected against damage.

**411.1.3.4 Shutoff valve.**
A shutoff valve not less than the nominal size of the connector shall be installed ahead of the connector in accordance with Section 409.5.

**411.1.4 Movable appliances.**
Where appliances are equipped with casters or are otherwise subject to periodic movement or relocation for purposes such as routine cleaning and maintenance, such appliances shall be connected to the supply system *piping* by means of an *appliance* connector listed as complying with ANSI Z21.69/CSA 6.16 or by means of Item 1 of Section 411.1. Such flexible connectors shall be installed and protected against physical damage in accordance with the manufacturer’s instructions.

**411.1.5 Connection of gas engine-powered air conditioners.**
Internal combustion engines shall not be rigidly connected to the gas supply *piping*.

**411.1.6 Unions.**
A union fitting shall be provided for *appliances* connected by rigid metallic pipe. Such unions shall be accessible and located within 6 feet (1829 mm) of the *appliance*.

**411.2 Manufactured home connections.**
Manufactured homes shall be connected to the distribution *piping* system by one of the following materials:

1. Metallic pipe in accordance with Section 403.4.

2. Metallic tubing in accordance with Section 403.5.

3. *Listed* and *labeled* connectors in compliance with ANSI Z21.75/CSA 6.27 and installed in accordance with the manufacturer’s instructions.

**411.3 Suspended low-intensity infrared tube heaters.**
Suspended low-intensity infrared tube heaters shall be connected to the building *piping* system with a connector *listed* for the application complying with ANSI Z21.24/CGA 6.10. The connector shall be installed as specified by the tube heater manufacturer’s instructions.

**411.4 Injection Bunsen-type burners.**
Injection Bunsen-type burners used in laboratories and educational facilities shall be connected to the gas supply system by either a listed or unlisted hose.

**SECTION 412**
**LIQUEFIED PETROLEUM GAS MOTOR VEHICLE FUEL-DISPENSING FACILITIES**

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[F] 412.1 General.
Motor fuel-dispensing facilities for LP-gas fuel shall be in accordance with this section and the Fire Code of New York State. The operation of LP-gas motor fuel-dispensing facilities shall be regulated by the Fire Code of New York State.

[F] 412.2 Storage and dispensing.
Storage vessels and equipment used for the storage or dispensing of LP-gas shall be approved or listed in accordance with Sections 412.3 and 412.4.

[F] 412.3 Approved equipment.
Containers; pressure-relief devices, including pressure-relief valves; and pressure regulators and piping used for LP-gas shall be approved.

[F] 412.4 Listed equipment.
Hoses, hose connections, vehicle fuel connections, dispensers, LP-gas pumps and electrical equipment used for LP-gas shall be listed.

[F] 412.5 Attendants.
Motor vehicle fueling operations shall be conducted by qualified attendants or in accordance with Section 412.9 by persons trained in the proper handling of LP-gas.

[F] 412.6 Location.
The point of transfer for LP-gas dispensing operations shall be separated from buildings and other exposures in accordance with the following:

1. Not less than 25 feet (7620 mm) from buildings where the exterior wall is not part of a fire-resistance-rated assembly having a rating of 1 hour or greater.
2. Not less than 25 feet (7620 mm) from combustible overhangs on buildings, measured from a vertical line dropped from the face of the overhang at a point nearest the point of transfer.
3. Not less than 25 feet (7620 mm) from the lot line of property that can be built upon.
4. Not less than 25 feet (7620 mm) from the centerline of the nearest mainline railroad track.
5. Not less than 10 feet (3048 mm) from public streets, highways, thoroughfares, sidewalks and driveways.
6. Not less than 10 feet (3048 mm) from buildings where the exterior wall is part of a fire-resistance-rated assembly having a rating of 1 hour or greater.

Exception: The point of transfer for LP-gas dispensing operations need not be separated from canopies that are constructed in accordance with the Building Code of New York State and that provide weather protection for the dispensing equipment.

Liquefied petroleum gas containers shall be located in accordance with the Fire Code of New York State. Liquefied petroleum gas storage and dispensing equipment shall be located outdoors and in accordance with the Fire Code of New York State.

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[F] 412.7 Additional requirements for LP-gas dispensers and equipment.
LP-gas dispensers and related equipment shall comply with the following provisions:

1. Pumps shall be fixed in place and shall be designed to allow control of the flow and to prevent leakage and accidental discharge.

2. Dispensing devices installed within 10 feet (3048 mm) of where vehicle traffic occurs shall be protected against physical damage by mounting on a concrete island 6 inches (152 mm) or more in height, or shall be protected in accordance with Section 312 of the Fire Code of New York State.

3. Dispensing devices shall be securely fastened to their mounting surface in accordance with the dispenser manufacturer's instructions.

[F] 412.8 Installation of dispensing devices and equipment.
The installation and operation of LP-gas dispensing systems shall be in accordance with this section and the Fire Code of New York State. Liquefied petroleum gas dispensers and dispensing stations shall be installed in accordance with manufacturers' specifications and their listing.

[F] 412.8.1 Product control valves.
The dispenser system piping shall be protected from uncontrolled discharge in accordance with the following:

1. Where mounted on a concrete base, a means shall be provided and installed within \(\frac{1}{2}\) inch (12.7 mm) of the top of the concrete base that will prevent flow from the supply piping in the event that the dispenser is displaced from its mounting.

2. A manual shutoff valve and an excess flow-control check valve shall be located in the liquid line between the pump and the dispenser inlet where the dispensing device is installed at a remote location and is not part of a complete storage and dispensing unit mounted on a common base.

3. An excess flow-control check valve or an emergency shutoff valve shall be installed in or on the dispenser at the point where the dispenser hose is connected to the liquid piping.

4. A listed automatic-closing-type hose nozzle valve with or without a latch-open device shall be provided on island-type dispensers.

[F] 412.8.2 Hoses.
Hoses and piping for the dispensing of LP-gas shall be provided with hydrostatic relief valves. The hose length shall not exceed 18 feet (5486 mm). An approved method shall be provided to protect the hose against mechanical damage.

[F] 412.8.3 Vehicle impact protection.
Where installed within 10 feet (3048 mm) of vehicle traffic, LP-gas storage containers, pumps
and dispensers shall be protected in accordance with Section 2307.5, Item 2 of the Fire Code of New York State.

[F] 412.8.4 Breakaway protection.
Dispenser hoses shall be equipped with a listed emergency breakaway device designed to retain liquid on both sides of the breakaway point. Where hoses are attached to hose-retrieving mechanisms, the emergency breakaway device shall be located such that the breakaway device activates to protect the dispenser from displacement.

[F] 412.9 Public fueling of motor vehicles.
Self-service LP-gas dispensing systems, including key, code and card lock dispensing systems, shall be limited to the filling of permanently mounted containers providing fuel to the LP-gas-powered vehicle.

The requirements for self-service LP-gas dispensing systems shall be in accordance with the following:

1. The arrangement and operation of the transfer of product into a vehicle shall be in accordance with this section and Chapter 61 of the Fire Code of New York State.

2. The system shall be provided with an emergency shutoff switch located within 100 feet (30 480 mm) of, but not less than 20 feet (6096 mm) from, dispensers.

3. The owner of the LP-gas motor fuel-dispensing facility or the owner’s designee shall provide for the safe operation of the system and the training of users.

4. The dispenser and hose-end valve shall release not more than 4 cubic centimeters of liquid to the atmosphere upon breaking of the connection with the fill valve on the vehicle.

5. Fire extinguishers shall be provided in accordance with Section 2305.5 of the Fire Code of New York State.

6. Warning signs shall be provided in accordance with Section 2305.6 of the Fire Code of New York State.

7. The area around the dispenser shall be maintained in accordance with Section 2305.7 of the Fire Code of New York State.

SECTION 413
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 Fire Code of New York State. The operation of CNG motor fuel-dispensing facilities shall be regulated by the Fire Code of New York State.
[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 piping 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 Building Code of New York State 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 Fire Code of New York State.

[F] 413.3.1 Location on property.
In addition to the fuel-dispensing requirements of the Fire Code of New York State, compression, storage and dispensing equipment not located in vaults complying with the Fire Code of New York State 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 Building Code of New York State.

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$^3$/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$^3$/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 *Fire Code of New York State*, 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.

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[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 fuel cylinders for the purposes of maintenance, cylinder certification, calibration of dispensers or other activities shall be in accordance with this section. The discharge of CNG from motor vehicle fuel cylinders shall be accomplished through a closed transfer system or an approved method of atmospheric venting in accordance with Section 413.9.1 or 413.9.2.

[F] 413.9.1 Closed transfer system.
A documented procedure that explains the logical sequence for discharging the cylinder shall be provided to the building official for review and approval. The procedure shall include what actions the operator will take in the event of a low-pressure or high-pressure natural gas release during the discharging activity. A drawing illustrating the arrangement of piping, regulators and equipment settings shall be provided to the building official for review and approval. The drawing shall illustrate the piping and regulator arrangement and shall be shown in spatial relation to the location of the compressor, storage vessels and emergency shutdown devices.

[F] 413.9.2 Atmospheric venting.
Atmospheric venting of motor vehicle fuel cylinders shall be in accordance with Sections 413.9.2.1 through 413.9.2.6.

[F] 413.9.2.1 Plans and specifications.
A drawing illustrating the location of the vessel support, piping, the method of grounding and bonding, and other requirements specified herein shall be provided to the building official for review and approval.

[F] 413.9.2.2 Cylinder stability.
A method of rigidly supporting the vessel during the venting of CNG shall be provided. The selected method shall provide not less than two points of support and shall prevent horizontal and lateral movement of the vessel. The system shall be designed to prevent movement of the vessel based on the highest gas-release velocity through valve orifices at the vessel's rated pressure and volume. The structure or appurtenance shall be constructed of noncombustible materials.

[F] 413.9.2.3 Separation.
The structure or appurtenance used for stabilizing the cylinder shall be separated from the site equipment, features and exposures and shall be located in accordance with Table 413.9.2.3.

[F] TABLE 413.9.2.3
SEPARATION DISTANCE FOR ATMOSPHERIC VENTING OF CNG

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EQUIPMENT OR FEATURE | MINIMUM SEPARATION (feet)
---|---
Buildings | 25
Building openings | 25
Lot lines | 15
Public ways | 15
Vehicles | 25
CNG compressor and storage vessels | 25
CNG dispensers | 25

For SI: 1 foot = 304.8 mm.

[F] 413.9.2.4 Grounding and bonding.
The structure or appurtenance used for supporting the cylinder shall be grounded in accordance with NFPA 70. The cylinder valve shall be bonded prior to the commencement of venting operations.

[F] 413.9.2.5 Vent tube.
A vent tube that will divert the gas flow to the atmosphere shall be installed on the cylinder prior to the commencement of the venting and purging operation. The vent tube shall be constructed of pipe or tubing materials approved for use with CNG in accordance with the Fire Code of New York State.

The vent tube shall be capable of dispersing the gas not less than 10 feet (3048 mm) above grade level. The vent tube shall not be provided with a rain cap or other feature that would limit or obstruct the gas flow.

At the connection fitting of the vent tube and the CNG cylinder, a listed bidirectional detonation flame arrester shall be provided.

[F] 413.9.2.6 Signage.
Approved NO SMOKING signs shall be posted within 10 feet (3048 mm) of the cylinder support structure or appurtenance. Approved CYLINDER SHALL BE BONDED signs shall be posted on the cylinder support structure or appurtenance.

SECTION 414
SUPPLEMENTAL AND STANDBY GAS SUPPLY

414.1 Use of air or oxygen under pressure.
Where air or oxygen under pressure is used in connection with the gas supply, effective means such as a backpressure regulator and relief valve shall be provided to prevent air or oxygen from passing back into the gas piping. Where oxygen is used, installation shall be in accordance with NFPA 51.

414.2 Interconnections for standby fuels.
Where supplementary gas for standby use is connected downstream from a meter or a service regulator where a meter is not provided, a device to prevent backflow shall be installed. A three-way valve installed to admit the standby supply and at the same time shut off the regular supply shall be permitted to be used for this purpose.

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SECTION 415
PIPING SUPPORT INTERVALS

415.1 Interval of support.
Piping shall be supported at intervals not exceeding the spacing specified in Table 415.1. Spacing of supports for CSST shall be in accordance with the CSST manufacturer’s instructions.

TABLE 415.1
SUPPORT OF PIPING

<table>
<thead>
<tr>
<th>STEEL PIPE, NOMINAL SIZE OF PIPE (inches)</th>
<th>SPACING OF SUPPORTS (feet)</th>
<th>NOMINAL SIZE OF TUBING (SMOOTH-WALL) (inch O.D.)</th>
<th>SPACING OF SUPPORTS (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>6</td>
<td>1/2</td>
<td>4</td>
</tr>
<tr>
<td>3/4 or 1</td>
<td>8</td>
<td>5/8 or 3/4</td>
<td>6</td>
</tr>
<tr>
<td>1 1/4 or larger (horizontal)</td>
<td>10</td>
<td>7/8 or 1 8</td>
<td>8</td>
</tr>
<tr>
<td>1 3/4 or larger (vertical)</td>
<td>Every floor level</td>
<td>1 or larger (vertical)</td>
<td>Every floor level</td>
</tr>
</tbody>
</table>

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

SECTION 416
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.


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.

416.3.6 Size of fittings, pipe and openings.
The fittings, pipe and openings located between the system to be protected and the pressure-relieving device shall be sized to prevent hammering of the valve and to prevent impairment of relief capacity.
CHAPTER 5
CHIMNEYS AND VENTS

SECTION 501
GENERAL

501.1 Scope.
This chapter shall govern the installation, maintenance, repair and approval of factory-built chimneys, chimney liners, vents and connectors and the utilization of masonry chimneys serving gas-fired appliances. The requirements for the installation, maintenance, repair and approval of factory-built chimneys, chimney liners, vents and connectors serving appliances burning fuels other than fuel gas shall be regulated by the Mechanical Code of New York State. The construction, repair, maintenance and approval of masonry chimneys shall be regulated by the Building Code of New York State.

501.2 General.
Every appliance shall discharge the products of combustion to the outdoors, except for appliances exempted by Section 501.8.

501.3 Masonry chimneys.
Masonry chimneys shall be constructed in accordance with Section 503.5.3 and the Building Code of New York State.

501.4 Minimum size of chimney or vent.
Chimneys and vents shall be sized in accordance with Sections 503 and 504.

501.5 Abandoned inlet openings.
Abandoned inlet openings in chimneys and vents shall be closed by an approved method.

501.6 Positive pressure.
Where an appliance equipped with a mechanical forced draft system creates a positive pressure in the venting system, the venting system shall be designed for positive pressure applications.

501.7 Connection to fireplace.
Connection of appliances to chimney flues serving fireplaces shall be in accordance with Sections 501.7.1 through 501.7.3.

501.7.1 Closure and access.
A noncombustible seal shall be provided below the point of connection to prevent entry of room air into the flue. Means shall be provided for access to the flue for inspection and cleaning.

501.7.2 Connection to factory-built fireplace flue.
An appliance shall not be connected to a flue serving a factory-built fireplace unless the appliance is specifically listed for such installation. The connection shall be made in accordance with the appliance manufacturer’s installation instructions.

501.7.3 Connection to masonry fireplace flue.
A connector shall extend from the appliance to the flue serving a masonry fireplace such that
the flue gases are exhausted directly into the flue. The connector shall be accessible or removable for inspection and cleaning of both the connector and the flue. Listed direct connection devices shall be installed in accordance with their listing.

501.8 Appliances not required to be vented.
The following appliances shall not be required to be vented:

1. Ranges.
2. Built-in domestic cooking units listed and marked for optional venting.
3. Hot plates and laundry stoves.
4. Type 1 clothes dryers (Type 1 clothes dryers shall be exhausted in accordance with the requirements of Section 614).
5. A single booster-type automatic instantaneous water heater, where designed and used solely for the sanitizing rinse requirements of a dishwashing machine, provided that the heater is installed in a commercial kitchen having a mechanical exhaust system. Where installed in this manner, the draft hood, if required, shall be in place and unaltered and the draft hood outlet shall be not less than 36 inches (914 mm) vertically and 6 inches (152 mm) horizontally from any surface other than the heater.
6. Refrigerators.
7. Counter appliances.
8. Room heaters listed for unvented use.
10. Other appliances listed for unvented use and not provided with flue collars.
11. Specialized appliances of limited input such as laboratory burners and gas lights.

Where the appliances listed in Items 5 through 11 are installed so that the aggregate input rating exceeds 20 British thermal units (Btu) per hour per cubic foot (207 watts per m$^3$) of volume of the room or space in which such appliances are installed, one or more shall be provided with venting systems or other approved means for conveying the vent gases to the outdoor atmosphere so that the aggregate input rating of the remaining unvented appliances does not exceed 20 Btu per hour per cubic foot (207 watts per m$^3$). Where the room or space in which the appliance is installed is directly connected to another room or space by a doorway, archway or other opening of comparable size that cannot be closed, the volume of such adjacent room or space shall be permitted to be included in the calculations.

501.9 Chimney entrance.
Connectors shall connect to a masonry chimney flue at a point not less than 12 inches (305 mm) above the lowest portion of the interior of the chimney flue.
501.10 Connections to exhauster. 
Appliance connections to a chimney or vent equipped with a power exhauster shall be made on the inlet side of the exhauster. Joints on the positive pressure side of the exhauster shall be sealed to prevent flue-gas leakage as specified by the manufacturer’s installation instructions for the exhauster.

501.11 Masonry chimneys. 
Masonry chimneys utilized to vent appliances shall be located, constructed and sized as specified in the manufacturer’s installation instructions for the appliances being vented and Section 503.

501.12 Residential and low-heat appliances flue lining systems. 
Flue lining systems for use with residential-type and low-heat appliances shall be limited to the following:

1. Clay flue lining complying with the requirements of ASTM C315 or equivalent. Clay flue lining shall be installed in accordance with the Building Code of New York State.

2. Listed chimney lining systems complying with UL 1777.

3. Other approved materials that will resist, without cracking, softening or corrosion, flue gases and condensate at temperatures up to 1,800°F (982°C).

501.13 Category I appliance flue lining systems. 
Flue lining systems for use with Category I appliances shall be limited to the following:

1. Flue lining systems complying with Section 501.12.

2. Chimney lining systems listed and labeled for use with gas appliances with draft hoods and other Category I gas appliances listed and labeled for use with Type B vents.

501.14 Category II, III and IV appliance venting systems. 
The design, sizing and installation of vents for Category II, III and IV appliances shall be in accordance with the appliance manufacturer’s instructions.

501.15 Existing chimneys and vents. 
Where an appliance is permanently disconnected from an existing chimney or vent, or where an appliance is connected to an existing chimney or vent during the process of a new installation, the chimney or vent shall comply with Sections 501.15.1 through 501.15.4.

501.15.1 Size. 
The chimney or vent shall be resized as necessary to control flue gas condensation in the interior of the chimney or vent and to provide the appliance or appliances served with the required draft. For Category I appliances, the resizing shall be in accordance with Section 502.

501.15.2 Flue passageways. 
The flue gas passageway shall be free of obstructions and combustible deposits and shall be cleaned if previously used for venting a solid or liquid fuel-burning appliance or fireplace. The flue liner, chimney inner wall or vent inner wall shall be continuous and shall be free of cracks,
gaps, perforations or other damage or deterioration that would allow the escape of combustion products, including gases, moisture and creosote.

501.15.3 Cleanout.
Masonry chimney flues shall be provided with a cleanout opening having a minimum height of 6 inches (152 mm). The upper edge of the opening shall be located not less than 6 inches (152 mm) below the lowest chimney inlet opening. The cleanout shall be provided with a tight-fitting, noncombustible cover.

501.15.4 Clearances.
Chimneys and vents shall have airspace clearance to combustibles in accordance with the Building Code of New York State and the chimney or vent manufacturer’s installation instructions.

Exception: Masonry chimneys without the required airspace clearances shall be permitted to be used if lined or relined with a chimney lining system listed for use in chimneys with reduced clearances in accordance with UL 1777. The chimney clearance shall be not less than permitted by the terms of the chimney liner listing and the manufacturer’s instructions.

501.15.4.1 Fireblocking.
Noncombustible fireblocking shall be provided in accordance with the Building Code of New York State.

SECTION 502
VENTS

502.1 General.
Vents, except as provided in Section 503.7, shall be listed and labeled. Type B and BW vents shall be tested in accordance with UL 441. Type L vents shall be tested in accordance with UL 641. Vents for Category II and III appliances shall be tested in accordance with UL 1738. Plastic vents for Category IV appliances shall not be required to be listed and labeled where such vents are as specified by the appliance manufacturer and are installed in accordance with the appliance manufacturer’s instructions.

502.2 Connectors required.
Connectors shall be used to connect appliances to the vertical chimney or vent, except where the chimney or vent is attached directly to the appliance. Vent connector size, material, construction and installation shall be in accordance with Section 503.

502.3 Vent application.
The application of vents shall be in accordance with Table 503.4.

502.4 Insulation shield.
Where vents pass through insulated assemblies, an insulation shield constructed of steel having a minimum thickness of 0.0187 inch (0.4712 mm) (No. 26 gage) shall be installed to provide clearance between the vent and the insulation material. The clearance shall be not less than the clearance to combustibles specified by the vent manufacturer’s installation instructions. Where vents pass through attic space, the shield shall terminate not less than 2 inches (51 mm) above the insulation materials and shall be secured in place to prevent displacement. Insulation shields

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provided as part of a listed vent system shall be installed in accordance with the manufacturer’s instructions.

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 \(1\frac{1}{2}\) 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
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

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

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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.

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 fitting located as close as practical to the chimney. Where two or more openings are provided into one chimney flue, they shall be at different levels. Where the 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 piping 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 piping 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.

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.

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

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 AT LEAST 8 FEET FROM A VERTICAL WALL

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.

503.6.10.1 Category I appliances.
The sizing of natural draft venting systems serving one or more *listed* appliances equipped with a draft hood or appliances *listed* for use with Type B gas vent, installed in a single story of a building, shall be in accordance with one of the following methods:

1. The provisions of Section 504.

2. For sizing an individual gas vent for a single, draft-hood-equipped *appliance*, the effective area of the vent connector and the gas vent shall be not less than the area of the *appliance* draft hood outlet, nor greater than seven times the draft hood outlet area.

3. For sizing a gas vent connected to two appliances with draft hoods, the effective area of the vent shall be not less than the area of the larger draft hood outlet plus 50 percent of the area of the smaller draft hood outlet, nor greater than seven times the smaller draft hood outlet area.

4. *Approved* engineering practices.

503.6.10.2 Vent offsets.
Type B and L vents sized in accordance with Item 2 or 3 of Section 503.6.10.1 shall extend in a generally vertical direction with offsets not exceeding 45 degrees (0.79 rad), except that a vent system having not more than one 60-degree (1.04 rad) offset shall be permitted. Any angle greater than 45 degrees (0.79 rad) from the vertical is considered horizontal. The total horizontal distance of a vent plus the horizontal vent connector...
serving draft-hood-equipped appliances shall be not greater than 75 percent of the vertical height of the vent.

503.6.10.3 Category II, III and IV appliances.
The sizing of gas vents for Category II, III and IV appliances shall be in accordance with the appliance manufacturer’s instructions. The sizing of plastic pipe that is specified by the appliance manufacturer as a venting material for Category II, III and IV appliances shall be in accordance with the manufacturer’s instructions.

503.6.10.4 Mechanical draft.
Chimney venting systems using mechanical draft shall be sized in accordance with approved engineering methods.

503.6.11 Gas vents serving appliances on more than one floor.
A common vent shall be permitted in multistory installations to vent Category I appliances located on more than one floor level, provided that the venting system is designed and installed in accordance with approved engineering methods. For the purpose of this section, crawl spaces, basements and attics shall be considered to be floor levels.

503.6.11.1 Appliance separation.
Appliances connected to the common vent shall be located in rooms separated from occupiable space. Each of these rooms shall have provisions for an adequate supply of combustion, ventilation and dilution air that is not supplied from an occupiable space.

503.6.11.2 Sizing.
The size of the connectors and common segments of multistory venting systems for appliances listed for use with Type B double-wall gas vents shall be in accordance with Table 504.3(1), provided that:

1. The available total height ($H$) for each segment of a multistory venting system is the vertical distance between the level of the highest draft hood outlet or flue collar on that floor and the centerline of the next highest interconnection tee.

2. The size of the connector for a segment is determined from the appliance input rating and available connector rise and shall be not smaller than the draft hood outlet or flue collar size.

3. The size of the common vertical segment, and of the interconnection tee at the base of that segment, shall be based on the total appliance input rating entering that segment and its available total height.

503.6.12 Support of gas vents.
Gas vents shall be supported and spaced in accordance with the manufacturer’s installation instructions.

503.6.13 Marking.
In those localities where solid and liquid fuels are used extensively, gas vents shall be permanently identified by a label attached to the wall or ceiling at a point where the vent connector enters the gas vent. The determination of where such localities exist shall be made by the building official. The label shall read:

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“This gas vent is for appliances that burn gas. Do not connect to solid or liquid fuel-burning appliances or incinerators.”

503.6.14 Fastener penetrations.
Screws, rivets and other fasteners shall not penetrate the inner wall of double-wall gas vents, except at the transition from an appliance draft hood outlet, a flue collar or a single-wall metal connector to a double-wall vent.

503.7 Single-wall metal pipe.
Single-wall metal pipe vents shall comply with Sections 503.7.1 through 503.7.13.

503.7.1 Construction.
Single-wall metal pipe shall be constructed of galvanized sheet steel not less than 0.0304 inch (0.7 mm) thick, or other approved, noncombustible, corrosion-resistant material.

503.7.2 Cold climate.
Uninsulated single-wall metal pipe shall not be used outdoors for venting appliances in regions where the 99-percent winter design temperature is below 32°F (0°C).

503.7.3 Termination.
Single-wall metal pipe shall terminate not less than 5 feet (1524 mm) in vertical height above the highest connected appliance draft hood outlet or flue collar. Single-wall metal pipe shall extend not less than 2 feet (610 mm) above the highest point where it passes 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). An approved cap or roof assembly shall be attached to the terminus of a single-wall metal pipe.

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) |

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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 singlewall 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:

<table>
<thead>
<tr>
<th>Clearance</th>
<th>Clearances Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10,000</td>
<td>6</td>
</tr>
<tr>
<td>≥ 10,000  ≤ 50,000</td>
<td>9</td>
</tr>
<tr>
<td>&gt; 50,000  ≤ 150,000</td>
<td>12</td>
</tr>
<tr>
<td>&gt; 150,000</td>
<td>In accordance with the appliance manufacturer’s instructions and not less than the clearances specified in Section 503.8, Item 2</td>
</tr>
</tbody>
</table>
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*

<table>
<thead>
<tr>
<th>Diameter of Connector (inches)</th>
<th>Minimum Thickness (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 6</td>
<td>0.019</td>
</tr>
<tr>
<td>6 to less than 10</td>
<td>0.023</td>
</tr>
<tr>
<td>10 to 12 inclusive</td>
<td>0.029</td>
</tr>
<tr>
<td>14 to 16 inclusive</td>
<td>0.034</td>
</tr>
<tr>
<td>Over 16</td>
<td>0.056</td>
</tr>
</tbody>
</table>

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 $2\frac{1}{2}$ inches (64 mm) thick for a vent connector having a diameter or greatest cross-sectional dimension of 18 inches (457 mm) or less.

3. The lining shall be not less than $4\frac{1}{2}$ inches (114 mm) thick laid on the $4\frac{1}{2}$-inch (114 mm) bed for a vent connector having a diameter or greatest cross-sectional dimension greater than 18 inches (457 mm).

4. Factory-built chimney sections, if employed, shall be joined together in accordance with the chimney manufacturer’s instructions.

### TABLE 503.10.2.5
**MINIMUM THICKNESS FOR STEEL VENT CONNECTORS FOR MEDIUM-HEAT APPLIANCES**

<table>
<thead>
<tr>
<th>VENT CONNECTOR SIZE</th>
<th>MINIMUM THICKNESS (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 14 (inches)</td>
<td>Up to 154 (square inches)</td>
</tr>
<tr>
<td>Over 14 to 16</td>
<td>154 to 201 (square inches)</td>
</tr>
<tr>
<td>Over 16 to 18</td>
<td>201 to 254 (square inches)</td>
</tr>
<tr>
<td>Over 18</td>
<td>Larger than 254 (square inches)</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm$^2$.

**503.10.3 Size of vent connector.**

Vents shall be sized in accordance with Sections 503.10.3.1 through 503.10.3.5.

**503.10.3.1 Single draft hood and fan-assisted.**

A vent connector for an *appliance* with a single draft hood or for a Category I fan-assisted combustion system *appliance* shall be sized and installed in accordance with Section 504 or other approved engineering methods.

**503.10.3.2 Multiple draft hood.**

For a single *appliance* having more than one draft hood outlet or flue collar, the manifold shall be constructed according to the instructions of the *appliance* manufacturer. Where there are no instructions, the manifold shall be designed and constructed in accordance with approved engineering practices. As an alternate method, the effective area of the manifold shall equal the combined area of the flue collars or draft hood outlets and the vent connectors shall have a minimum 1-foot (305 mm) rise.

**503.10.3.3 Multiple appliances.**

Where two or more appliances are connected to a common vent or chimney, each vent
connector shall be sized in accordance with Section 504 or other approved engineering methods.

As an alternative method applicable only where all of the appliances are draft hood equipped, each vent connector shall have an effective area not less than the area of the draft hood outlet of the appliance to which it is connected.

503.10.3.4 Common connector/ manifold.
Where two or more appliances are vented through a common vent connector or vent manifold, the common vent connector or vent manifold shall be located at the highest level consistent with available headroom and the required clearance to combustible materials and shall be sized in accordance with Section 504 or other approved engineering methods.

As an alternate method applicable only where there are two draft hood-equipped appliances, the effective area of the common vent connector or vent manifold and all junction fittings shall be not less than the area of the larger vent connector plus 50 percent of the area of the smaller flue collar outlet.

503.10.3.5 Size increase
Where the size of a vent connector is increased to overcome installation limitations and obtain connector capacity equal to the appliance input, the size increase shall be made at the appliance draft hood outlet.

503.10.4 Two or more appliances connected to a single vent or chimney.
Where two or more vent connectors enter a common vent, chimney flue or single-wall metal pipe, the smaller connector shall enter at the highest level consistent with the available headroom or clearance to combustible material. Vent connectors serving Category I appliances shall not be connected to any portion of a mechanical draft system operating under positive static pressure, such as those serving Category III or IV appliances.

503.10.4.1 Two or more openings
Where two or more openings are provided into one chimney flue or vent, the openings shall be at different levels, or the connectors shall be attached to the vertical portion of the chimney or vent at an angle of 45 degrees (0.79 rad) or less relative to the vertical.

503.10.5 Clearance.
Minimum clearances from vent connectors to combustible material shall be in accordance with Table 503.10.5.

Exception: The clearance between a vent connector and combustible material shall be permitted to be reduced where the combustible material is protected as specified for vent connectors in Table 308.2.

**TABLE 503.10.5**
CLEARANCES FOR CONNECTORS
<table>
<thead>
<tr>
<th>APPLIANCE</th>
<th>MINIMUM DISTANCE FROM COMBUSTIBLE MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listed appliances with draft hoods and appliances listed for use with Type B gas vents</td>
<td>Listed Type B gas vent material</td>
</tr>
<tr>
<td>Residential boilers and furnaces with listed gas conversion burner and with draft hood</td>
<td>6 inches</td>
</tr>
<tr>
<td>Residential appliances listed for use with Type L vents</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Listed gas-fired toilets</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Unlisted residential appliances with draft hood</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Residential and low-heat appliances other than above</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Medium-heat appliances</td>
<td>Not permitted</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

a. These clearances shall apply unless the manufacturer's installation instructions for a listed appliance or connector specify different clearances, in which case the listed clearances shall apply.

503.10.6 Joints.
Joints between sections of connector piping and connections to flue collars and draft hood outlets shall be fastened by one of the following methods:

1. Sheet metal screws.
2. Vent connectors of listed vent material assembled and connected to flue collars or draft hood outlets in accordance with the manufacturers’ instructions.
3. Other approved means.

503.10.7 Slope.
A vent connector shall be installed without dips or sags and shall slope upward toward the vent or chimney not less than $\frac{1}{4}$ inch per foot (21 mm/m).

Exception: Vent connectors attached to a mechanical draft system installed in accordance with the appliance and draft system manufacturers’ instructions.

503.10.8 Length of vent connector.
The maximum horizontal length of a single-wall connector shall be 75 percent of the height of the chimney or vent except for engineered systems. The maximum horizontal length of a Type B double-wall connector shall be 100 percent of the height of the chimney or vent except for engineered systems.
503.10.9 Support.
A vent connector shall be supported for the design and weight of the material employed to maintain clearances and prevent physical damage and separation of joints.

503.10.10 Chimney connection.
Where entering a flue in a masonry or metal chimney, the vent connector shall be installed above the extreme bottom to avoid stoppage. Where a thimble or slip joint is used to facilitate removal of the connector, the connector shall be firmly attached to or inserted into the thimble or slip joint to prevent the connector from falling out. Means shall be employed to prevent the connector from entering so far as to restrict the space between its end and the opposite wall of the chimney flue (see Section 501.9).

503.10.11 Inspection.
The entire length of a vent connector shall be provided with ready access for inspection, cleaning and replacement.

503.10.12 Fireplaces.
A vent connector shall not be connected to a chimney flue serving a fireplace unless the fireplace flue opening is permanently sealed.

503.10.13 Passage through ceilings, floors or walls.
Single-wall metal pipe connectors shall not pass through any wall, floor or ceiling except as permitted by Section 503.7.4.

503.10.14 Medium-heat connectors.
Vent connectors for medium-heat appliances shall not pass through walls or partitions constructed of combustible material.

503.11 Vent connectors for Category II, III and IV appliances.
Vent connectors for Category II, III and IV appliances shall be as specified for the venting systems in accordance with Section 503.4.

503.12 Draft hoods and draft controls.
The installation of draft hoods and draft controls shall comply with Sections 503.12.1 through 503.12.7.

503.12.1 Appliances requiring draft hoods.
Vented appliances shall be installed with draft hoods.

Exception: Dual oven-type combination ranges; direct-vent appliances; fan-assisted combustion system appliances; appliances requiring chimney draft for operation; single firebox boilers equipped with conversion burners with inputs greater than 400,000 Btu per hour (117 kW); appliances equipped with blast, power or pressure burners that are not listed for use with draft hoods; and appliances designed for forced venting.

503.12.2 Installation.
A draft hood supplied with or forming a part of a listed vented appliance shall be installed without alteration, exactly as furnished and specified by the appliance manufacturer.

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503.12.2.1 Draft hood required.
If a draft hood is not supplied by the appliance manufacturer where one is required, a draft hood shall be installed, shall be of a listed or approved type and, in the absence of other instructions, shall be of the same size as the appliance flue collar. Where a draft hood is required with a conversion burner, it shall be of a listed or approved type.

503.12.2.2 Special design draft hood.
Where it is determined that a draft hood of special design is needed or preferable for a particular installation, the installation shall be in accordance with the recommendations of the appliance manufacturer and shall be approved.

503.12.3 Draft control devices.
Where a draft control device is part of the appliance or is supplied by the appliance manufacturer, it shall be installed in accordance with the manufacturer’s instructions. In the absence of manufacturer’s instructions, the device shall be attached to the flue collar of the appliance or as near to the appliance as practical.

503.12.4 Additional devices.
Appliances requiring a controlled chimney draft shall be permitted to be equipped with a listed double-acting barometric-draft regulator installed and adjusted in accordance with the manufacturer’s instructions.

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

503.12.6 Positioning.
Draft hoods and draft regulators shall be installed in the position for which they were designed with reference to the horizontal and vertical planes and shall be located so that the relief opening is not obstructed by any part of the appliance or adjacent construction. The appliance and its draft hood shall be located so that the relief opening is accessible for checking vent operation.

503.12.7 Clearance.
A draft hood shall be located so its relief opening is not less than 6 inches (152 mm) from any surface except that of the appliance it serves and the venting system to which the draft hood is connected. Where a greater or lesser clearance is indicated on the appliance label, the clearance shall be not less than that specified on the label. Such clearances shall not be reduced.

503.13 Manually operated dampers.
A manually operated damper shall not be placed in the vent connector for any appliance. Fixed baffles shall not be classified as manually operated dampers.

503.14 Automatically operated vent dampers.
An automatically operated vent damper shall be of a listed type.
503.15 Obstructions.
Devices that retard the flow of vent gases shall not be installed in a vent connector, chimney or vent. The following shall not be considered as obstructions:

1. Draft regulators and safety controls specifically *listed* for installation in venting systems and installed in accordance with the manufacturer’s instructions.

2. *Approved* draft regulators and safety controls that are designed and installed in accordance with *approved* engineering methods.

3. *Listed* heat reclaimers and automatically operated vent dampers installed in accordance with the manufacturer’s instructions.

4. *Approved* economizers, heat reclaimers and recuperators installed in venting systems of appliances not required to be equipped with draft hoods, provided that the appliance manufacturer’s instructions cover the installation of such a device in the venting system and performance in accordance with Sections 503.3 and 503.3.1 is obtained.

5. Vent dampers serving *listed* appliances installed in accordance with Sections 504.2.1 and 504.3.1 or other *approved* engineering methods.

503.16 Outside wall penetrations.
Where vents, including those for *direct-vent appliances*, penetrate outside walls of buildings, the annular spaces around such penetrations shall be permanently sealed using *approved* materials to prevent entry of combustion products into the building.

SECTION 504
SIZING OF CATEGORY I APPLIANCE VENTING SYSTEMS

504.1 Definitions.
The following definitions apply to the tables in this section.

**APPLIANCE CATEGORIZED VENT DIAMETER/AREA.** The minimum vent area/diameter permissible for Category I appliances to maintain a nonpositive vent static pressure when tested in accordance with nationally recognized standards.

**FAN-ASSISTED COMBUSTION SYSTEM.** An *appliance* equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber or heat exchanger.

**FAN Min.** The minimum input rating of a Category I fan-assisted appliance attached to a vent or connector.

**FAN Max.** The maximum input rating of a Category I fan-assisted appliance attached to a vent or connector.

**FAN + FAN.** The maximum combined *appliance* input rating of two or more Category I fan-assisted appliances attached to the common vent.

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FAN + NAT. The maximum combined appliance input rating of one or more Category I fan-assisted appliances and one or more Category I draft-hood-equipped appliances attached to the common vent.

NA. Vent configuration is not allowed due to potential for condensate formation or pressurization of the venting system, or not applicable due to physical or geometric restraints.

NAT Max. The maximum input rating of a Category I draft-hood-equipped appliance attached to a vent or connector.

NAT + NAT. The maximum combined appliance input rating of two or more Category I draft-hood-equipped appliances attached to the common vent.

504.2 Application of single-appliance vent Tables 504.2(1) through 504.2(6).

The application of Tables 504.2(1) through 504.2(6) shall be subject to the requirements of Sections 504.2.1 through 504.2.17.

### TABLE 504.2(1)

**TYPE B DOUBLE-WALL GAS VENT**

<table>
<thead>
<tr>
<th>HEIGHT (ft)</th>
<th>LATERAL (in)</th>
<th>VENT DIAMETER (in)</th>
<th>APPLIANCE INPUT RATING IN THOUSANDS OF BTUH</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Min</td>
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<td>88</td>
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<td>61</td>
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<td>57</td>
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<td>42</td>
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<td>52</td>
<td>39</td>
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</tbody>
</table>

(continued)
### TABLE 504.2(1)—continued

#### TYPE B DOUBLE-WALL GAS VENT

<table>
<thead>
<tr>
<th>HEIGHT (H) (feet)</th>
<th>LATERAL (L) (feet)</th>
<th>VENT DIAMETER—(D) inches</th>
<th>APPLIANCE INPUT RATING IN THOUSANDS OF BTU</th>
<th>APPLIANCE VENT CONNECTION</th>
<th>CONNECTED directly to vent</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>H</td>
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<td>Max</td>
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<td>30</td>
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<tr>
<td>15</td>
<td>0</td>
<td>100</td>
<td>64</td>
<td>0</td>
<td>213</td>
</tr>
</tbody>
</table>

(continued)

### TABLE 504.2(1)—continued

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### TYPE B DOUBLE-WALL GAS VENT

#### TABLE 504.2(2) TYPE B DOUBLE-WALL GAS VENT

<table>
<thead>
<tr>
<th>Height (H) (feet)</th>
<th>Fan</th>
<th>Nat.</th>
<th>Fan</th>
<th>Nat.</th>
<th>Fan</th>
<th>Nat.</th>
<th>Fan</th>
<th>Nat.</th>
<th>Fan</th>
<th>Nat.</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<th>10</th>
<th>12</th>
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</thead>
<tbody>
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<td>6</td>
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</table>

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### TABLE 504.2(2)-continued
**TYPE B DOUBLE-WALL GAS VENT**

<table>
<thead>
<tr>
<th>Number of Appliances</th>
<th>Single Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appliance Type</strong></td>
<td><strong>Category I</strong></td>
</tr>
<tr>
<td><strong>Appliance Vent Connection</strong></td>
<td><strong>Single-wall metal connector</strong></td>
</tr>
</tbody>
</table>

#### TABLE 504.2(2)-continued
**VENT DIAMETER—(–) Inches**

<table>
<thead>
<tr>
<th>Height (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lateral (z)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
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<tr>
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<tr>
<td>7</td>
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<td>8</td>
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<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>12</td>
</tr>
</tbody>
</table>

<p>| Appliance Input Rating in Thousands of Btu |</p>
<table>
<thead>
<tr>
<th>Min</th>
<th>Max</th>
<th>Min</th>
<th>Max</th>
<th>Min</th>
<th>Max</th>
<th>Min</th>
<th>Max</th>
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</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

### TABLE 504.2(3)
**MASONRY CHIMNEY**
### TABLE 504.2(3) — continued

**MASONRY CHIMNEY**

<table>
<thead>
<tr>
<th>Height (ft)</th>
<th>Lateral (ft)</th>
<th>Appliance Input Rating in Thousands of BTU/hr</th>
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</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm², 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

### TABLE 504.2(4)

**MASONRY CHIMNEY**

<table>
<thead>
<tr>
<th>Height (ft)</th>
<th>Lateral (ft)</th>
<th>Appliance Input Rating in Thousands of BTU/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>3</td>
<td>20, 30</td>
</tr>
<tr>
<td>50</td>
<td>3</td>
<td>20, 30</td>
</tr>
</tbody>
</table>

Minimum Inner Area of Chimney (square inches): 12
Maximum Inner Area of Chimney (square inches): 132
### TABLE 504.2(4)—continued

#### TABLE 504.2(4)—continued

<table>
<thead>
<tr>
<th>Height (h) (in.)</th>
<th>Lateral (L) (feet)</th>
<th>Appliance Input Rating in Thousands of BTU/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>30</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Minimum Internal Area of Chimney (square inches)</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Maximum Internal Area of Chimney (square inches)</td>
<td>12</td>
<td>19</td>
</tr>
</tbody>
</table>

Serves times the listed appliance categorized vent area, flue collar area or draft hood outlet area.
TABLE 504.2(5)
SINGLE-WALL METAL PIPE OR TYPE B ASBESTOS CEMENT VENT

<table>
<thead>
<tr>
<th>HEIGHT (H) (feet)</th>
<th>LATERAL (L) (feet)</th>
<th>VENT DIAMETER (D) inches</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
<td>MAXIMUM APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>39  70  116</td>
<td>170  232  312  500  750</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>31  55  94</td>
<td>141  194  260  415  620</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>28  51  88</td>
<td>128  177  242  390  600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>02  87  126  185  252  340  542  815</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>32  61  102</td>
<td>154  210  284  451  680</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>29  56  95</td>
<td>141  194  264  430  648</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>24  49  86</td>
<td>131  180  250  406  625</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>05  91  111  168  233  311  505  760</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>35  67  110</td>
<td>186  260  350  570  865</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>32  61  104</td>
<td>153  215  289  480  724</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>27  54  94</td>
<td>143  200  274  455  700</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>NA  46  84</td>
<td>130  186  258  432  666</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>NA  NA  82</td>
<td>132  195  273  466  726</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>53  101  163</td>
<td>252  342  470  770  1,190</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>42  80  136</td>
<td>210  286  392  641  990</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>38  74  123</td>
<td>192  264  364  610  945</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>10</td>
<td>32  65  115</td>
<td>178  246  345  571  910</td>
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</tr>
<tr>
<td>15</td>
<td>NA  55  104</td>
<td>163  228  326  550  870</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>NA  NA  82</td>
<td>132  195  273  466  726</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>05  108  183  276  384  529  878  1,370</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>0</td>
<td>56  108  183</td>
<td>276  384  529  878  1,370</td>
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</tr>
<tr>
<td>2</td>
<td>44  84  148</td>
<td>230  320  441  730  1,140</td>
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</tr>
<tr>
<td>5</td>
<td>NA  78  137</td>
<td>210  296  410  694  1,080</td>
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<td>NA  68  125</td>
<td>196  274  388  656  1,050</td>
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<tr>
<td>15</td>
<td>NA  NA  113</td>
<td>177  258  366  625  1,000</td>
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<tr>
<td>20</td>
<td>NA  NA  99</td>
<td>163  240  344  596  960</td>
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<td>30</td>
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<td>NA  120  210</td>
<td>310  443  590  980  1,550</td>
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<td>NA  95  171</td>
<td>260  370  492  820  1,350</td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td>NA  NA  159</td>
<td>234  342  474  730  1,150</td>
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<td></td>
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<tr>
<td>10</td>
<td>NA  NA  146</td>
<td>221  318  456  730  1,150</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>NA  NA  NA</td>
<td>NA  NA  200  292  407  705  1,130</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>NA  NA  NA</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>NA  NA  NA</td>
<td>NA  NA  170  263  350  605  1,010</td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

TABLE 504.2(6)
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# EXTERIOR MASONRY CHIMNEY

<table>
<thead>
<tr>
<th>Number of Appliances</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appliance Type</td>
<td>NAT</td>
</tr>
<tr>
<td>Appliance Vent Connection</td>
<td>Type B double-wall connector</td>
</tr>
</tbody>
</table>

## Minimum Allowable Input Rating of Space-Heating Appliance in Thousands of BTU per Hour

<table>
<thead>
<tr>
<th>Vent Height (feet)</th>
<th>Internal Area of Chimney (square inches)</th>
<th>12</th>
<th>19</th>
<th>28</th>
<th>38</th>
<th>50</th>
<th>63</th>
<th>78</th>
<th>113</th>
</tr>
</thead>
<tbody>
<tr>
<td>57°F or Greater</td>
<td>Local 90% Winter Design Temperature: 57°F or Greater</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>27 to 35°F</td>
<td>Local 90% Winter Design Temperature: 27 to 35°F</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>17 to 26°F</td>
<td>Local 90% Winter Design Temperature: 17 to 26°F</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>215</td>
<td>259</td>
<td>349</td>
<td></td>
</tr>
<tr>
<td>5 to 16°F</td>
<td>Local 90% Winter Design Temperature: 5 to 16°F</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>416</td>
<td></td>
</tr>
<tr>
<td>-10 to 4°F</td>
<td>Local 90% Winter Design Temperature: -10 to 4°F</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>484</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-11°F or Lower</td>
<td>Local 90% Winter Design Temperature: -11°F or Lower</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>792</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI: °C = (°F - 32)/1.8, 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

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Note: See Figure B-19 in Appendix B for a map showing local 99-percent winter design temperatures in the United States.

504.2.1 Vent obstructions.
These venting tables shall not be used where obstructions, as described in Section 503.15, are installed in the venting system. The installation of vents serving listed appliances with vent dampers shall be in accordance with the appliance manufacturer’s instructions or in accordance with the following:

1. The maximum capacity of the vent system shall be determined using the “NAT Max” column.

2. The minimum capacity shall be determined as if the appliance were a fan-assisted appliance, using the “FAN Min” column to determine the minimum capacity of the vent system. Where the corresponding “FAN Min” is “NA,” the vent configuration shall not be permitted and an alternative venting configuration shall be utilized.

504.2.2 Minimum size.
Where the vent size determined from the tables is smaller than the appliance draft hood outlet or flue collar, the smaller size shall be permitted to be used provided that all of the following requirements are met:

1. The total vent height \( H \) is not less than 10 feet (3048 mm).

2. Vents for appliance draft hood outlets or flue collars 12 inches (305 mm) in diameter or smaller are not reduced more than one table size.

3. Vents for appliance draft hood outlets or flue collars larger than 12 inches (305 mm) in diameter are not reduced more than two table sizes.

4. The maximum capacity listed in the tables for a fan-assisted appliance is reduced by 10 percent \((0.90 \times \text{maximum table capacity})\).

5. The draft hood outlet is greater than 4 inches (102 mm) in diameter. Do not connect a 3-inch-diameter (76 mm) vent to a 4-inch-diameter (102 mm) draft hood outlet. This provision shall not apply to fan-assisted appliances.

504.2.3 Vent offsets.
Single-appliance venting configurations with zero \((0)\) lateral lengths in Tables 504.2(1), 504.2(2) and 504.2(5) shall not have elbows in the venting system. Single-appliance venting configurations with lateral lengths include two 90-degree \((1.57 \text{ rad})\) elbows. For each additional elbow up to and including 45 degrees \((0.79 \text{ rad})\), the maximum capacity listed in the venting tables shall be reduced by 5 percent. For each additional elbow greater than 45 degrees \((0.79 \text{ rad})\) up to and including 90 degrees \((1.57 \text{ rad})\), the maximum capacity listed in the venting tables shall be reduced by 10 percent. Where multiple offsets occur in a vent, the total lateral length of all offsets combined shall not exceed that specified in Tables 504.2(1) through 504.2(5).
504.2.4 Zero lateral.
Zero (0) lateral (L) shall apply only to a straight vertical vent attached to a top outlet draft hood or flue collar.

504.2.5 High-altitude installations.
Sea-level input ratings shall be used when determining maximum capacity for high altitude installation. Actual input (derated for altitude) shall be used for determining minimum capacity for high altitude installation.

504.2.6 Multiple input rate appliances.
For appliances with more than one input rate, the minimum vent capacity (FAN Min) determined from the tables shall be less than the lowest appliance input rating, and the maximum vent capacity (FAN Max/NAT Max) determined from the tables shall be greater than the highest appliance rating input.

504.2.7 Liner system sizing and connections.
Listed corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Table 504.2(1) or 504.2(2) for Type B vents with the maximum capacity reduced by 20 percent (0.80 × maximum capacity) and the minimum capacity as shown in Table 504.2(1) or 504.2(2). Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with Section 504.2.3. The 20-percent reduction for corrugated metallic chimney liner systems includes an allowance for one long-radius 90-degree (1.57 rad) turn at the bottom of the liner.

Connections between chimney liners and listed double wall connectors shall be made with listed adapters designed for such purpose.

504.2.8 Vent area and diameter.
Where the vertical vent has a larger diameter than the vent connector, the vertical vent diameter shall be used to determine the minimum vent capacity, and the connector diameter shall be used to determine the maximum vent capacity. The flow area of the vertical vent shall not exceed seven times the flow area of the listed appliance categorized vent area, flue collar area or draft hood outlet area unless designed in accordance with approved engineering methods.

504.2.9 Chimney and vent locations.
Tables 504.2(1), 504.2(2), 504.2(3), 504.2(4) and 504.2(5) shall be used only for chimneys and vents not exposed to the outdoors below the roof line. A Type B vent or listed chimney lining system passing through an unused masonry chimney flue shall not be considered to be exposed to the outdoors. Where vents extend outdoors above the roof more than 5 feet (1524 mm) higher than required by Figure 503.6.5, and where vents terminate in accordance with Section 503.6.5, Item 2, the outdoor portion of the vent shall be enclosed as required by this section for vents not considered to be exposed to the outdoors or such venting system shall be engineered. A Type B vent shall not be considered to be exposed to the outdoors where it passes through an unventilated enclosure or chase insulated to a value of not less than R8.

Table 504.2(3) in combination with Table 504.2(6) shall be used for clay-tile-lined exterior masonry chimneys, provided that all of the following are met:

1. Vent connector is a Type B double wall.

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2. Vent connector length is limited to $1 \frac{1}{2}$ feet for each inch (18 mm per mm) of vent connector diameter.

3. The appliance is draft hood equipped.

4. The input rating is less than the maximum capacity given by Table 504.2(3).

5. For a water heater, the outdoor design temperature is not less than 5°F (-15°C).

6. For a space-heating appliance, the input rating is greater than the minimum capacity given by Table 504.2(6).

504.2.10 Corrugated vent connector size.
Corrugated vent connectors shall be not smaller than the listed appliance categorized vent diameter, flue collar diameter or draft hood outlet diameter.

504.2.11 Vent connector size limitation.
Vent connectors shall not be increased in size more than two sizes greater than the listed appliance categorized vent diameter, flue collar diameter or draft hood outlet diameter.

504.2.12 Component commingling.
In a single run of vent or vent connector, different diameters and types of vent and connector components shall be permitted to be used, provided that all such sizes and types are permitted by the tables.

504.2.13 Draft hood conversion accessories.
Draft hood conversion accessories for use with masonry chimneys venting listed Category I fan-assisted appliances shall be listed and installed in accordance with the manufacturer’s instructions for such listed accessories.

504.2.14 Table interpolation.
Interpolation shall be permitted in calculating capacities for vent dimensions that fall between the table entries.

504.2.15 Extrapolation prohibited.
Extrapolation beyond the table entries shall not be permitted.

504.2.16 Engineering calculations.
For vent heights less than 6 feet (1829 mm) and greater than shown in the tables, engineering methods shall be used to calculate vent capacities.

504.2.17 Height entries.
Where the actual height of a vent falls between entries in the height column of the applicable table in Tables 504.2(1) through 504.2(6), either interpolation shall be used or the lower appliance input rating shown in the table entries shall be used for FAN MAX and NAT MAX column values and the higher appliance input rating shall be used for the FAN MIN column values.
504.3 Application of multiple appliance vent Tables 504.3(1) through 504.3(7).
The application of Tables 504.3(1) through 504.3(7b) shall be subject to the requirements of Sections 504.3.1 through 504.3.28.
### TABLE 504.3(1) TYPE B DOUBLE-WALL VENT CONNECTOR CAPACITY

<table>
<thead>
<tr>
<th>VENT HEIGHT (H) (feet)</th>
<th>CONNECTOR RISE (R) (feet)</th>
<th>TYPE B DOUBLE-WALL VENT AND CONNECTOR DIAMETER — (Q) inches</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>APPLIANCE INPUT RATING LIMITS IN THOUSANDS OF BTU/H</td>
<td>Fan</td>
<td>Nat</td>
<td>Fan</td>
<td>Nat</td>
<td>Fan</td>
<td>Nat</td>
<td>Fan</td>
<td>Nat</td>
</tr>
<tr>
<td>6</td>
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<td></td>
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<td>26</td>
<td>35</td>
<td>28</td>
<td>46</td>
<td>106</td>
<td>52</td>
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<tr>
<td>8</td>
<td></td>
<td></td>
<td>23</td>
<td>41</td>
<td>31</td>
<td>37</td>
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### COMMON VENT CAPACITY

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### TYPE B DOUBLE-WALL VENT

**VENT CONNECTOR CAPACITY**

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**APPLIANCE INPUT RATING LIMITS IN THOUSANDS OF BTU**

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**COMMON VENT CAPACITY**

<table>
<thead>
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<th>VENT HEIGHT (H) (feet)</th>
<th>COMBINED APPLIANCE INPUT RATING (in thousands of BTU)</th>
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### TABLE 504.3(2)  
**TYPE B DOUBLE-WALL VENT**

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<th>SINGLE-WALL METAL VENT CONNECTOR DIAMETER—(D) inches</th>
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<td>FAN Min</td>
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**COMMON VENT CAPACITY**

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<th>VENT HEIGHT (H) (feet)</th>
<th>TYPE B DOUBLE-WALL COMMON VENT DIAMETER—(D) inches</th>
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**COMBINED APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H:**

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

### TABLE 504.3(3)

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### MASONRY CHIMNEY

#### VENT CONNECTOR CAPACITY

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**APPLIANCE INPUT RATING LIMITS IN THOUSANDS OF BTU**

- **3**
- **4**
- **5**
- **6**
- **7**
- **8**
- **9**
- **10**

#### COMMON VENT CAPACITY

<table>
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<th>VENT Height (feet)</th>
<th>Minimum Internal Area of Masonry Chimney Flue (square inches)</th>
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**COMBINED APPLIANCE INPUT RATING IN THOUSANDS OF BTU**

- **12**
- **19**
- **26**
- **39**
- **56**
- **76**
- **113**

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For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm², 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

**TABLE 504.3(4)**

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### MASONRY CHIMNEY

#### VENT CONNECTOR CAPACITY

<table>
<thead>
<tr>
<th>VENT HEIGHT (ft)</th>
<th>CONNECTOR RISE (ft)</th>
<th>SINGLE-WALL METAL VENT CONNECTOR DIAMETER—(D) inches</th>
<th>APPLIANCE INPUT RATING LIMITS IN THOUSANDS OF BTU/H</th>
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<td>FAN</td>
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#### COMMON VENT CAPACITY

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<th>VENT HEIGHT (ft)</th>
<th>MINIMUM INTERNAL AREA OF MASONRY CHIMNEY FLUE (square inches)</th>
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For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm², 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.l

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### TABLE 504.3(5)  
SINGLE-WALL METAL PIPE OR TYPE ASBESTOS CEMENT VENT

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<th>Number of Appliances</th>
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<td>Draft hood-equipped</td>
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<tr>
<td>Appliance Vent Connection</td>
<td>Direct to pipe or vent</td>
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</tbody>
</table>

#### VENT CONNECTOR CAPACITY

<table>
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<th>TOTAL VENT HEIGHT (H) (feet)</th>
<th>CONNECTOR RISE (R) (feet)</th>
<th>VENT CONNECTOR DIAMETER—(D) inches</th>
<th>MAXIMUM APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H</th>
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<td>53  86 124 178 235</td>
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<tr>
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<td>34</td>
<td>61  98 147 204 275</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>23</td>
<td>44  77 117 179 240</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>30</td>
<td>56  92 134 194 265</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>35</td>
<td>64  102 155 216 298</td>
</tr>
<tr>
<td>30 and up</td>
<td>1</td>
<td>25</td>
<td>49  84 129 190 270</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>31</td>
<td>58  97 145 211 295</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>36</td>
<td>68  107 164 232 321</td>
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#### COMMON VENT CAPACITY

<table>
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<tr>
<th>TOTAL VENT HEIGHT (H) (feet)</th>
<th>COMMON VENT DIAMETER—(D) inches</th>
<th>COMBINED APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H</th>
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<tbody>
<tr>
<td>4</td>
<td>5</td>
<td>6  7  8  10  12</td>
</tr>
<tr>
<td>6</td>
<td>48</td>
<td>78  111 155 205 320  NA</td>
</tr>
<tr>
<td>8</td>
<td>55</td>
<td>89  128 175 234 365  505</td>
</tr>
<tr>
<td>10</td>
<td>59</td>
<td>95  136 190 250 395  560</td>
</tr>
<tr>
<td>15</td>
<td>71</td>
<td>115 168 228 305 480  690</td>
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<tr>
<td>20</td>
<td>80</td>
<td>129 186 260 340 550  790</td>
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<tr>
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<td>NA</td>
<td>147 215 300 400 650  940</td>
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<td>NA  360 490 810 1,190</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.
### TABLE 504.3(6a)
**EXTERIOR MASONRY CHIMNEY**

<table>
<thead>
<tr>
<th>Number of Appliances</th>
<th>Two or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appliance Type</td>
<td>NAT + NAT</td>
</tr>
<tr>
<td>Appliance Vent</td>
<td>Type B</td>
</tr>
<tr>
<td>Connection</td>
<td>double-wall</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VENT HEIGHT (feet)</th>
<th>INTERNAL AREA OF CHIMNEY (square inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
</tr>
<tr>
<td>8</td>
<td>28</td>
</tr>
<tr>
<td>10</td>
<td>31</td>
</tr>
<tr>
<td>15</td>
<td>NA</td>
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<td>NA</td>
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<td>30</td>
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</tr>
<tr>
<td>50</td>
<td>NA</td>
</tr>
<tr>
<td>100</td>
<td>NA</td>
</tr>
</tbody>
</table>

### TABLE 504.3(6b)
**EXTERIOR MASONRY CHIMNEY**

<table>
<thead>
<tr>
<th>Number of Appliances</th>
<th>Two or more</th>
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<tbody>
<tr>
<td>Appliance Type</td>
<td>NAT + NAT</td>
</tr>
<tr>
<td>Appliance Vent</td>
<td>Type B</td>
</tr>
<tr>
<td>Connection</td>
<td>double-wall</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Allowable Input Rating of Space-heating Appliance in Thousands of Btu per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>VENT HEIGHT (feet)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>37°F or Greater</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>20</td>
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<tr>
<td>30</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>27 to 36°F</th>
<th>Local 99% Winter Design Temperature: 27 to 36°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

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### TABLE 504.3(6b)  
**EXTERIOR MASONRY CHIMNEY-continued**

<table>
<thead>
<tr>
<th>VENT HEIGHT (feet)</th>
<th>INTERNAL AREA OF CHIMNEY (square inches)</th>
</tr>
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<tbody>
<tr>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>17 to 26°F Local 99% Winter Design Temperature: 17 to 26°F</td>
<td></td>
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<tr>
<td>6</td>
<td>NA</td>
</tr>
<tr>
<td>8</td>
<td>NA</td>
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<td>10</td>
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<td>NA</td>
</tr>
<tr>
<td>50</td>
<td>NA</td>
</tr>
<tr>
<td>100</td>
<td>NA</td>
</tr>
<tr>
<td>5 to 16°F Local 99% Winter Design Temperature: 5 to 16°F</td>
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</tr>
<tr>
<td>6</td>
<td>NA</td>
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<td>8</td>
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<tr>
<td>15</td>
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<td>NA</td>
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<td>NA</td>
</tr>
<tr>
<td>50</td>
<td>NA</td>
</tr>
<tr>
<td>100</td>
<td>NA</td>
</tr>
<tr>
<td>4°F or Lower Local 99% Winter Design Temperature: 4°F or Lower</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not recommended for any vent configurations</td>
</tr>
</tbody>
</table>

For SI: °C = (°F - 32)/1.8, 1 inch = 25.4 mm, 1 square inch = 645.16 mm$^2$, 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

**Note:** See Figure B-19 in Appendix B for a map showing local 99-percent winter design temperatures in the United States.
<table>
<thead>
<tr>
<th>Number of Appliances</th>
<th>Two or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appliance Type</td>
<td>FAN + NAT</td>
</tr>
<tr>
<td>Appliance Vent Connection</td>
<td>Type B double-wall connector</td>
</tr>
</tbody>
</table>

**TABLE 504.3(7a)**
**EXTERIOR MASONRY CHIMNEY**

<table>
<thead>
<tr>
<th>VENT HEIGHT (feet)</th>
<th>12</th>
<th>19</th>
<th>28</th>
<th>38</th>
<th>50</th>
<th>63</th>
<th>78</th>
<th>113</th>
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</thead>
<tbody>
<tr>
<td>6</td>
<td>74</td>
<td>119</td>
<td>178</td>
<td>257</td>
<td>351</td>
<td>458</td>
<td>582</td>
<td>853</td>
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<td>130</td>
<td>193</td>
<td>279</td>
<td>384</td>
<td>501</td>
<td>636</td>
<td>937</td>
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<td>84</td>
<td>138</td>
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<td>409</td>
<td>538</td>
<td>686</td>
<td>1,010</td>
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<td>15</td>
<td>NA</td>
<td>152</td>
<td>233</td>
<td>334</td>
<td>467</td>
<td>611</td>
<td>781</td>
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<td>NA</td>
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<td>668</td>
<td>858</td>
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<td>NA</td>
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**TABLE 504.3(7b)**
**EXTERIOR MASONRY CHIMNEY**

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<th>Number of Appliances</th>
<th>Two or more</th>
</tr>
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<tbody>
<tr>
<td>Appliance Type</td>
<td>FAN + NAT</td>
</tr>
<tr>
<td>Appliance Vent Connection</td>
<td>Type B double-wall connector</td>
</tr>
</tbody>
</table>

**Minimum Allowable Input Rating of**
**Space-heating Appliance in Thousands of Btu per Hour**

<table>
<thead>
<tr>
<th>VENT HEIGHT (feet)</th>
<th>12</th>
<th>19</th>
<th>28</th>
<th>38</th>
<th>50</th>
<th>63</th>
<th>78</th>
<th>113</th>
</tr>
</thead>
<tbody>
<tr>
<td>37°F or Greater</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>15</td>
<td>NA</td>
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<td>0</td>
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<td>0</td>
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<td>0</td>
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<td>0</td>
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<td>NA</td>
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<td>NA</td>
<td>NA</td>
<td>1600</td>
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<td>27 to 36°F</td>
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<tr>
<td>8</td>
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<td>0</td>
<td>82</td>
<td>127</td>
<td>167</td>
<td>187</td>
<td>214</td>
<td>263</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>51</td>
<td>97</td>
<td>141</td>
<td>183</td>
<td>201</td>
<td>225</td>
<td>265</td>
</tr>
<tr>
<td>15</td>
<td>NA</td>
<td>111</td>
<td>142</td>
<td>183</td>
<td>233</td>
<td>253</td>
<td>274</td>
<td>305</td>
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<td>284</td>
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<td>330</td>
<td>362</td>
</tr>
</tbody>
</table>

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### Minimum Allowable Input Rating of Space-heating Appliance in Thousands of Btu per Hour

<table>
<thead>
<tr>
<th>VENT HEIGHT (feet)</th>
<th>12</th>
<th>19</th>
<th>28</th>
<th>38</th>
<th>50</th>
<th>63</th>
<th>78</th>
<th>113</th>
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</thead>
<tbody>
<tr>
<td>17 to 26°F</td>
<td></td>
<td></td>
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<td>278</td>
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<td>NA</td>
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<td>331</td>
<td>398</td>
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<td>5 to 16°F</td>
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<tr>
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<td>NA</td>
<td>159</td>
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<td>269</td>
<td>320</td>
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<td>NA</td>
<td>NA</td>
<td>175</td>
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<td>339</td>
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</tr>
</tbody>
</table>

**For SI:** °C = (°F - 32)/1.8, 1 inch = 25.4 mm, 1 square inch = 645.16 mm², 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

**Note:** See Figure B-19 in Appendix B for a map showing local 99-percent winter design temperatures in the United States.

### 504.3.1 Vent obstructions.

These venting tables shall not be used where obstructions, as described in Section 503.15, are installed in the venting system. The installation of vents serving listed appliances with vent dampers shall be in accordance with the appliance manufacturer’s instructions or in accordance with the following:

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1. The maximum capacity of the vent connector shall be determined using the NAT Max column.

2. The maximum capacity of the vertical vent or chimney shall be determined using the FAN+NAT column where the second appliance is a fan-assisted appliance, or the NAT+NAT column where the second appliance is equipped with a draft hood.

3. The minimum capacity shall be determined as if the appliance were a fan-assisted appliance.

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

   3.2. The FAN+FAN column shall be used where the second appliance is a fan-assisted appliance, and the FAN+NAT column shall be used where the second appliance is equipped with a draft hood, to determine whether the vertical vent or chimney configuration is not permitted (NA). Where the vent configuration is NA, the vent configuration shall not be permitted and an alternative venting configuration shall be utilized.

504.3.2 Connector length limit.
The vent connector shall be routed to the vent utilizing the shortest possible route. Except as provided in Section 504.3.3, the maximum vent connector horizontal length shall be $1\frac{1}{2}$ feet for each inch (18 mm per mm) of connector diameter as shown in Table 504.3.2

<table>
<thead>
<tr>
<th>CONNECTOR DIAMETER (inches)</th>
<th>CONNECTOR MAXIMUM HORIZONTAL LENGTH (feet)</th>
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<tbody>
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<td>3</td>
<td>$1\frac{1}{2}$</td>
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<tr>
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</tbody>
</table>

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504.3.3 Connectors with longer lengths.
Connectors with longer horizontal lengths than those listed in Section 504.3.2 are permitted under the following conditions:

1. The maximum capacity (FAN Max or NAT Max) of the vent connector shall be reduced 10 percent for each additional multiple of the length allowed by Section 504.3.2. For example, the maximum length listed in Table 504.3.2 for a 4-inch (102 mm) connector is 6 feet (1829 mm). With a connector length greater than 6 feet (1829 mm) but not exceeding 12 feet (3658 mm), the maximum capacity must be reduced by 10 percent (0.90 × maximum vent connector capacity). With a connector length greater than 12 feet (3658 mm) but not exceeding 18 feet (5486 mm), the maximum capacity must be reduced by 20 percent (0.80 × maximum vent capacity).

2. For a connector serving a fan-assisted appliance, the minimum capacity (FAN Min) of the connector shall be determined by referring to the corresponding single-appliance table. For Type B double-wall connectors, Table 504.2(1) shall be used. For single-wall connectors, Table 504.2(2) shall be used. The height (H) and lateral (L) shall be measured according to the procedures for a single-appliance vent, as if the other appliances were not present.

504.3.4 Vent connector manifold.
Where the vent connectors are combined prior to entering the vertical portion of the common vent to form a common vent manifold, the size of the common vent manifold and the common vent shall be determined by applying a 10-percent reduction (0.90 × maximum common vent capacity) to the common vent capacity part of the common vent tables. The length of the common vent connector manifold (Lm) shall not exceed $1\frac{1}{2}$ feet for each inch (18 mm per mm) of common vent connector manifold diameter (D).

504.3.5 Common vertical vent offset.
Where the common vertical vent is offset, the maximum capacity of the common vent shall be reduced in accordance with Section 504.3.6. The horizontal length of the common vent offset (Lo) shall not exceed $1\frac{1}{2}$ feet for each inch (18 mm per mm) of common vent diameter (D).
Where multiple offsets occur in a common vent, the total horizontal length of all offsets combined shall not exceed $1\frac{1}{2}$ feet for each inch (18 mm per mm) of common vent diameter (D).

504.3.6 Elbows in vents.
For each elbow up to and including 45 degrees (0.79 rad) in the common vent, the maximum common vent capacity listed in the venting tables shall be reduced by 5 percent. For each elbow greater than 45 degrees (0.79 rad) up to and including 90 degrees (1.57 rad), the maximum common vent capacity listed in the venting tables shall be reduced by 10 percent.
504.3.7 Elbows in connectors.
The vent connector capacities listed in the common vent sizing tables include allowance for two 90-degree (1.57 rad) elbows. For each additional elbow up to and including 45 degrees (0.79 rad), the maximum vent connector capacity listed in the venting tables shall be reduced by 5 percent. For each elbow greater than 45 degrees (0.79 rad) up to and including 90 degrees (1.57 rad), the maximum vent connector capacity listed in the venting tables shall be reduced by 10 percent.

504.3.8 Common vent minimum size.
The cross-sectional area of the common vent shall be equal to or greater than the cross-sectional area of the largest connector.

504.3.9 Common vent fittings.
At the point where tee or wye fittings connect to a common vent, the opening size of the fitting shall be equal to the size of the common vent. Such fittings shall not be prohibited from having reduced-size openings at the point of connection of appliance vent connectors.

504.3.9.1 Tee and wye fittings.
Tee and wye fittings connected to a common gas vent shall be considered to be part of the common gas vent and shall be constructed of materials consistent with that of the common gas vent.

504.3.10 High-altitude installations.
Sea-level input ratings shall be used when determining maximum capacity for high-altitude installation. Actual input (derated for altitude) shall be used for determining minimum capacity for high-altitude installation.

504.3.11 Connector rise measurement.
Connector rise \((R)\) for each appliance connector shall be measured from the draft hood outlet or flue collar to the centerline where the vent gas streams come together.

504.3.12 Vent height measurement.
For multiple appliances all located on one floor, available total height \((H)\) shall be measured from the highest draft hood outlet or flue collar up to the level of the outlet of the common vent.

504.3.13 Multistory height measurement.
For multistory installations, available total height \((H)\) for each segment of the system shall be the vertical distance between the highest draft hood outlet or flue collar entering that segment and the centerline of the next higher interconnection tee.

504.3.14 Multistory lowest portion sizing.
The size of the lowest connector and of the vertical vent leading to the lowest interconnection of a multistory system shall be in accordance with Table 504.2(1) or 504.2(2) for available total height \((H)\) up to the lowest interconnection.

504.3.15 Multistory common vents.
Where used in multistory systems, vertical common vents shall be Type B double wall and shall be installed with a listed vent cap.
504.3.16 Multistory common vent offsets.  
Offsets in multistory common vent systems shall be limited to a single offset in each system, and systems with an offset shall comply with all of the following:

1. The offset angle shall not exceed 45 degrees (0.79 rad) from vertical.

2. The horizontal length of the offset shall not exceed \( \frac{1}{2} \) feet for each inch (18 mm per mm) of common vent diameter of the segment in which the offset is located.

3. For the segment of the common vertical vent containing the offset, the common vent capacity listed in the common venting tables shall be reduced by 20 percent (0.80 × maximum common vent capacity).

4. A multistory common vent shall not be reduced in size above the offset.

504.3.17 Vertical vent maximum size.  
Where two or more appliances are connected to a vertical vent or chimney, the flow area of the largest section of vertical vent or chimney shall not exceed seven times the smallest listed appliance categorized vent areas, flue collar area or draft hood outlet area unless designed in accordance with approved engineering methods.

504.3.18 Multiple input rate appliances.  
For appliances with more than one input rate, the minimum vent connector capacity (FAN Min) determined from the tables shall be less than the lowest appliance input rating, and the maximum vent connector capacity (FAN Max or NAT Max) determined from the tables shall be greater than the highest appliance input rating.

504.3.19 Liner system sizing and connections.  
Listed, corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Table 504.3(1) or 504.3(2) for Type B vents, with the maximum capacity reduced by 20 percent (0.80 × maximum capacity) and the minimum capacity as shown in Table 504.3(1) or 504.3(2). Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with Sections 504.3.5 and 504.3.6. The 20-percent reduction for corrugated metallic chimney liner systems includes an allowance for one long-radius 90-degree (1.57 rad) turn at the bottom of the liner. Where double-wall connectors are required, tee and wye fittings used to connect to the common vent chimney liner shall be listed double-wall fittings. Connections between chimney liners and listed double-wall fittings shall be made with listed adapter fittings designed for such purpose.

504.3.20 Chimney and vent location.  
Tables 504.3(1), 504.3(2), 504.3(3), 504.3(4) and 504.3(5) shall be used only for chimneys and vents not exposed to the outdoors below the roof line. A Type B vent or listed chimney lining system passing through an unused masonry chimney flue shall not be considered to be exposed to the outdoors. Where vents extend outdoors above the roof more than 5 feet (1524 mm) higher than required by Figure 503.6.5 and where vents terminate in accordance with Section 503.6.5, Item 2, the outdoor portion of the vent shall be enclosed as required by this section for vents not considered to be exposed to the outdoors or such venting system shall be engineered. A Type B vent shall not be considered to be exposed to the outdoors where it passes through an unventilated enclosure or chase insulated to a value of not less than R8.
Tables 504.3(6a), 504.3(6b), 504.3(7a) and 504.3(7b) shall be used for clay-tile-lined exterior masonry chimneys, provided that all of the following conditions are met:

1. Vent connectors are Type B double wall.

2. Not less than one appliance is draft hood equipped.

3. The combined appliance input rating is less than the maximum capacity given by Table 504.3(6a) for NAT+NAT or Table 504.3(7a) for FAN+NAT.

4. The input rating of each space-heating appliance is greater than the minimum input rating given by Table 504.3(6b) for NAT+NAT or Table 504.3(7b) for FAN+NAT.

5. The vent connector sizing is in accordance with Table 504.3(3).

504.3.21 Connector maximum and minimum size.
Vent connectors shall not be increased in size more than two sizes greater than the listed appliance categorized vent diameter, flue collar diameter or draft hood outlet diameter. Vent connectors for draft hood-equipped appliances shall not be smaller than the draft hood outlet diameter. Where a vent connector size(s) determined from the tables for a fan-assisted appliance(s) is smaller than the flue collar diameter, the use of the smaller size(s) shall be permitted provided that the installation complies with all of the following conditions:

1. Vent connectors for fan-assisted appliance flue collars 12 inches (305mm) in diameter or smaller are not reduced by more than one table size [for example, 12 inches to 10 inches (305 mm to 254 mm) is a one-size reduction] and those larger than 12 inches (305 mm) in diameter are not reduced more than two table sizes [e.g., 24 inches to 20 inches (610 mm to 508 mm) is a two-size reduction].

2. The fan-assisted appliance(s) is common vented with a draft-hood-equipped appliance(s).

3. The vent connector has a smooth interior wall.

504.3.22 Component commingling.
Combinations of pipe sizes and combinations of single-wall and double-wall metal pipe shall be allowed within any connector run(s) or within the common vent, provided that all of the appropriate tables permit all of the desired sizes and types of pipe, as if they were used for the entire length of the subject connector or vent. Where single-wall and Type B double-wall metal pipes are used for vent connectors within the same venting system, the common vent must be sized using Table 504.3(2) or 504.3(4), as appropriate.

504.3.23 Draft hood conversion accessories.
Draft hood conversion accessories for use with masonry chimneys venting listed Category I fan-assisted appliances shall be listed and installed in accordance with the manufacturer's instructions for such listed accessories.
504.3.24 Multiple sizes permitted.
Where a table permits more than one diameter of pipe to be used for a connector or vent, all the permitted sizes shall be permitted to be used.

504.3.25 Table interpolation.
Interpolation shall be permitted in calculating capacities for vent dimensions that fall between table entries.

504.3.26 Extrapolation prohibited.
Extrapolation beyond the table entries shall not be permitted.

504.3.27 Engineering calculations.
For vent heights less than 6 feet (1829 mm) and greater than shown in the tables, engineering methods shall be used to calculate vent capacities.

504.3.28 Height entries.
Where the actual height of a vent falls between entries in the height column of the applicable table in Tables 504.3(1) through 504.3(7b), either interpolation shall be used or the lower appliance input rating shown in the table shall be used for FAN MAX and NAT MAX column values and the higher appliance input rating shall be used for the FAN MIN column values.

SECTION 505
DIRECT-VENT, INTEGRAL VENT, MECHANICAL VENT AND VENTILATION/EXHAUST HOOD VENTING

505.1 General.
The installation of direct-vent and integral vent appliances shall be in accordance with Section 503. Mechanical venting systems and exhaust hood venting systems shall be designed and installed in accordance with Section 503.

505.1.1 Commercial cooking appliances vented by exhaust hoods.
Where commercial cooking appliances are vented by means of the Type I or II kitchen exhaust hood system that serves such appliances, the exhaust system shall be fan powered and the appliances shall be interlocked with the exhaust hood system to prevent appliance operation when the exhaust hood system is not operating. The method of interlock between the exhaust hood system and the appliances equipped with standing pilot burner ignition systems shall not cause such pilots to be extinguished. Where a solenoid valve is installed in the gas piping as part of an interlock system, gas piping shall not be installed to bypass such valve. Dampers shall not be installed in the exhaust system.

Exception: An interlock between the cooking appliance(s) and the exhaust hood system shall not be required where heat sensors or other approved methods automatically activate the exhaust hood system when cooking operations occur.
SECTION 506
FACTORY-BUILT CHIMNEYS

506.1 Building heating appliances.
Factory-built chimneys for building heating appliances producing flue gases having a temperature not greater than 1,000°F (538°C), measured at the entrance to the chimney, shall be listed and labeled in accordance with UL 103 and shall be installed and terminated in accordance with the manufacturer's instructions.

506.2 Support.
Where factory-built chimneys are supported by structural members, such as joists and rafters, such members shall be designed to support the additional load.

506.3 Medium-heat appliances.
Factory-built chimneys for medium-heat appliances producing flue gases having a temperature above 1,000°F (538°C), measured at the entrance to the chimney, shall be listed and labeled in accordance with UL 959 and shall be installed and terminated in accordance with the manufacturer's instructions.
CHAPTER 6
SPECIFIC APPLIANCES

SECTION 601
GENERAL

601.1 Scope.
This chapter shall govern the approval, design, installation, construction, maintenance, alteration and repair of the appliances and equipment specifically identified herein.

SECTION 602
DECORATIVE APPLIANCES
FOR INSTALLATION IN FIREPLACES

602.1 General.
Decorative appliances for installation in approved solid fuel-burning fireplaces shall be tested in accordance with ANSI Z21.60/CSA 6.26 and shall be installed in accordance with the manufacturer’s instructions. Manually lighted natural gas decorative appliances shall be tested in accordance with ANSI Z21.84.

602.2 Flame safeguard device.
Decorative appliances for installation in approved solid fuel-burning fireplaces, with the exception of those tested in accordance with ANSI Z21.84, shall utilize a direct ignition device, an ignitor or a pilot flame to ignite the fuel at the main burner, and shall be equipped with a flame safeguard device. The flame safeguard device shall automatically shut off the fuel supply to a main burner or group of burners when the means of ignition of such burners becomes inoperative.

602.3 Prohibited installations.
Decorative appliances for installation in fireplaces shall not be installed where prohibited by Section 303.3.

SECTION 603
LOG LIGHTERS

603.1 General.
Log lighters shall be tested in accordance with CSA 8 and installed in accordance with the manufacturer’s instructions.

SECTION 604
VENTED GAS FIREPLACES
(DECORATIVE APPLIANCES)

604.1 General.
Vented gas fireplaces shall be tested in accordance with ANSI Z21.50/CSA 2.22, shall be installed in accordance with the manufacturer’s instructions and shall be designed and equipped as specified in Section 602.2.

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604.2 Access.
Panels, grilles and access doors that are required to be removed for normal servicing operations shall not be attached to the building.

SECTION 605
VENTED GAS FIREPLACE HEATERS

605.1 General.
Vented gas fireplace heaters shall be installed in accordance with the manufacturer’s instructions, shall be tested in accordance with ANSI Z21.88/CSA 2.33 and shall be designed and equipped as specified in Section 602.2.

SECTION 606
INCINERATORS AND CREMATORIES

606.1 General.
Incinerators and crematories shall be installed in accordance with the manufacturer’s instructions.

SECTION 607
COMMERCIAL-INDUSTRIAL INCINERATORS

607.1 Incinerators, commercial-industrial.
Commercial-industrial-type incinerators shall be constructed and installed in accordance with NFPA 82.

SECTION 608
VENTED WALL FURNACES

608.1 General.
Vented wall furnaces shall be tested in accordance with ANSI Z21.86/CSA 2.32 and shall be installed in accordance with the manufacturer’s instructions.

608.2 Venting.
Vented wall furnaces shall be vented in accordance with Section 503.

608.3 Location.
Vented wall furnaces shall be located so as not to cause a fire hazard to walls, floors, combustible furnishings or doors. Vented wall furnaces installed between bathrooms and adjoining rooms shall not circulate air from bathrooms to other parts of the building.

608.4 Door swing.
Vented wall furnaces shall be located so that a door cannot swing within 12 inches (305 mm) of an air inlet or air outlet of such furnace measured at right angles to the opening. Doorstops or door closers shall not be installed to obtain this clearance.

608.5 Ducts prohibited.
Ducts shall not be attached to wall furnaces. Casing extension boots shall not be installed unless listed as part of the appliance.

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608.6 Access.
Vented wall furnaces shall be provided with access for cleaning of heating surfaces, removal of burners, replacement of sections, motors, controls, filters and other working parts, and for adjustments and lubrication of parts requiring such attention. Panels, grilles and access doors that are required to be removed for normal servicing operations shall not be attached to the building construction.

SECTION 609
FLOOR FURNACES

609.1 General.
Floor furnaces shall be tested in accordance with ANSI Z21.86/CSA 2.32 and shall be installed in accordance with the manufacturer’s instructions.

609.2 Placement.
The following provisions apply to floor furnaces:

1. Floors. Floor furnaces shall not be installed in the floor of any doorway, stairway landing, aisle or passageway of any enclosure, public or private, or in an exitway from any such room or space.

2. Walls and corners. The register of a floor furnace with a horizontal warm-air outlet shall not be placed closer than 6 inches (152 mm) to the nearest wall. A distance of not less than 18 inches (457 mm) from two adjoining sides of the floor furnace register to walls shall be provided to eliminate the necessity of occupants walking over the warm-air discharge. The remaining sides shall be permitted to be placed not closer than 6 inches (152 mm) to a wall. Wall-register models shall not be placed closer than 6 inches (152 mm) to a corner.

3. Draperies. The furnace shall be placed so that a door, drapery or similar object cannot be nearer than 12 inches (305 mm) to any portion of the register of the furnace.

4. Floor construction. Floor furnaces shall not be installed in concrete floor construction built on grade.

5. Thermostat. The controlling thermostat for a floor furnace shall be located within the same room or space as the floor furnace or shall be located in an adjacent room or space that is permanently open to the room or space containing the floor furnace.

609.3 Bracing.
The floor around the furnace shall be braced and headed with a support framework designed in accordance with the Building Code of New York State.

609.4 Clearance.
The lowest portion of the floor furnace shall have not less than a 6-inch (152 mm) clearance from the grade level; except where the lower 6-inch (152 mm) portion of the floor furnace is sealed by the manufacturer to prevent entrance of water, the minimum clearance shall be not less than 2 inches (51 mm). Where such clearances cannot be provided, the ground below and to the sides
shall be excavated to form a pit under the furnace so that the required clearance is provided beneath the lowest portion of the furnace. A 12-inch (305 mm) minimum clearance shall be provided on all sides except the control side, which shall have an 18-inch (457 mm) minimum clearance.

**609.5 First floor installation.**
Where the basement story level below the floor in which a floor furnace is installed is utilized as habitable space, such floor furnaces shall be enclosed as specified in Section 609.6 and shall project into a nonhabitable space.

**609.6 Upper floor installations.**
Floor furnaces installed in upper stories of buildings shall project below into nonhabitable space and shall be separated from the nonhabitable space by an enclosure constructed of noncombustible materials. The floor furnace shall be provided with access, clearance to all sides and bottom of not less than 6 inches (152 mm) and combustion air in accordance with Section 304.

**SECTION 610**
**DUCT FURNACES**

**610.1 General.**
Duct furnaces shall be tested in accordance with ANSI Z83.8/CSA 2.6 or UL 795 and shall be installed in accordance with the manufacturer’s instructions.

**610.2 Access panels.**
Ducts connected to duct furnaces shall have removable access panels on both the upstream and downstream sides of the furnace.

**610.3 Location of draft hood and controls.**
The controls, combustion air inlets and draft hoods for duct furnaces shall be located outside of the ducts. The draft hood shall be located in the same enclosure from which combustion air is taken.

**610.4 Circulating air.**
Where a duct furnace is installed so that supply ducts convey air to areas outside the space containing the furnace, the return air shall be conveyed by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.

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

**SECTION 611**
**NONRECIRCULATING DIRECT-FIRED INDUSTRIAL AIR HEATERS**

**611.1 General.**
Nonrecirculating direct-fired industrial air heaters shall be listed to ANSI Z83.4/CSA 3.7 and shall be installed in accordance with the manufacturer’s instructions.
611.2 Installation.  
Nonrecirculating direct-fired industrial air heaters shall not be used to supply any area containing sleeping quarters. Nonrecirculating direct-fired industrial air heaters shall be installed only in industrial or commercial occupancies. Nonrecirculating direct-fired industrial air heaters shall be permitted to provide ventilation air.

611.3 Clearance from combustible materials.  
Nonrecirculating direct-fired industrial air heaters shall be installed with a clearance from combustible materials of not less than that shown on the rating plate and in the manufacturer’s instructions.

611.4 Supply air.  
All air handled by a nonrecirculating direct-fired industrial air heater, including combustion air, shall be ducted directly from the outdoors.

611.5 Outdoor air louvers.  
If outdoor air louvers of either the manual or automatic type are used, such devices shall be proven to be in the open position prior to allowing the main burners to operate.

611.6 Atmospheric vents and gas reliefs or bleeds.  
Nonrecirculating direct-fired industrial air heaters with valve train components equipped with atmospheric vents or gas reliefs or bleeds shall have their atmospheric vent lines or gas reliefs or bleeds lead to the outdoors. Means shall be employed on these lines to prevent water from entering and to prevent blockage by insects and foreign matter. An atmospheric vent line shall not be required to be provided on a valve train component equipped with a listed vent limiter.

611.7 Relief opening.  
The design of the installation shall include provisions to permit nonrecirculating direct-fired industrial air heaters to operate at rated capacity without overpressurizing the space served by the heaters by taking into account the structure’s designed infiltration rate, providing properly designed relief openings or an interlocked power exhaust system, or a combination of these methods. The structure’s designed infiltration rate and the size of relief openings shall be determined by approved engineering methods. Relief openings shall be permitted to be louvers or counterbalanced gravity dampers. Where motorized dampers or closable louvers are used, they shall be verified to be in their full open position prior to main burner operation.

611.8 Access.  
Nonrecirculating direct-fired industrial air heaters shall be provided with access for removal of burners; replacement of motors, controls, filters and other working parts; and for adjustment and lubrication of parts requiring maintenance.

611.9 Purging.  
Inlet ducting, where used, shall be purged by not less than four air changes prior to an ignition attempt.

SECTION 612  
RECIRCULATING DIRECT-FIRED  
INDUSTRIAL AIR HEATERS
612.1 General. 
Recirculating direct-fired industrial air heaters shall be listed to ANSI Z83.18 and shall be installed in accordance with the manufacturer’s instructions.

612.2 Location. 
Recirculating direct-fired industrial air heaters shall be installed only in industrial and commercial occupancies. Recirculating direct-fired air heaters shall not serve any area containing sleeping quarters. Recirculating direct-fired industrial air heaters shall not be installed in hazardous locations or in buildings that contain flammable solids, liquids or gases, explosive materials or substances that can become toxic when exposed to flame or heat.

612.3 Installation.
Direct-fired industrial air heaters shall be permitted to be installed in accordance with their listing and the manufacturer’s instructions. Direct-fired industrial air heaters shall be installed only in industrial or commercial occupancies. Direct-fired industrial air heaters shall be permitted to provide fresh air ventilation.

612.4 Clearance from combustible materials.
Direct-fired industrial air heaters shall be installed with a clearance from combustible material of not less than that shown on the label and in the manufacturer’s instructions.

612.5 Air supply.
Air to direct-fired industrial air heaters shall be taken from the building, ducted directly from outdoors, or a combination of both. Direct-fired industrial air heaters shall incorporate a means to supply outside ventilation air to the space at a rate of not less than 4 cubic feet per minute per 1,000 Btu per hour (0.38 m\(^3\) per min per kW) of rated input of the heater. If a separate means is used to supply ventilation air, an interlock shall be provided so as to lock out the main burner operation until the mechanical means is verified. Where outside air dampers or closing louvers are used, they shall be verified to be in the open position prior to main burner operation.

612.6 Atmospheric vents, gas reliefs or bleeds.
Direct-fired industrial air heaters with valve train components equipped with atmospheric vents, gas reliefs or bleeds shall have their atmospheric vent lines and gas reliefs or bleeds lead to the outdoors.

Means shall be employed on these lines to prevent water from entering and to prevent blockage by insects and foreign matter. An atmospheric vent line shall not be required to be provided on a valve train component equipped with a listed vent limiter.

612.7 Relief opening.
The design of the installation shall include adequate provision to permit direct-fired industrial air heaters to operate at rated capacity by taking into account the structure’s designed infiltration rate, providing properly designed relief openings or an interlocked power exhaust system, or a combination of these methods. The structure’s designed infiltration rate and the size of relief openings shall be determined by approved engineering methods. Relief openings shall be permitted to be louvers or counterbalanced gravity dampers. Where motorized dampers or closable louvers are used, they shall be verified to be in their full open position prior to main burner operation.
SECTION 613
CLOTHES DRYERS

613.1 General.
Clothes dryers shall be tested in accordance with ANSI Z21.5.1/CSA 7.1 or ANSI Z21.5.2/CSA 7.2 and shall be installed in accordance with the manufacturer’s instructions.

SECTION 614
CLOTHES DRYER EXHAUST

[M] 614.1 Installation.
Clothes dryers shall be exhausted in accordance with the manufacturer’s instructions. Dryer exhaust systems shall be independent of all other systems, and shall convey the moisture and any products of combustion to the outside of the building.

[M] 614.2 Duct penetrations.
Ducts that exhaust clothes dryers shall not penetrate or be located within any fireblocking, draftstopping or any wall, floor/ceiling or other assembly required by the Building Code of New York State to be fire-resistance rated, unless such duct is constructed of galvanized steel or aluminum of the thickness specified in Table 603.4 of the Mechanical Code of New York State and the fire-resistance rating is maintained in accordance with the Building Code of New York State. 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 Mechanical Code of New York State.

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 mm²).

[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 m³/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$^2$) 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 $1 \frac{1}{4}$ 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.

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 $\frac{1}{8}$ 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] TABLE 614.8.4.1
DRYER EXHAUST DUCT FITTING EQUIVALENT LENGTH

<table>
<thead>
<tr>
<th>DRYER EXHAUST DUCT FITTING TYPE</th>
<th>EQUIVALENT LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 inch radius mitered 45-degree elbow</td>
<td>2 feet, 6 inches</td>
</tr>
</tbody>
</table>

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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.

[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 building 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 building 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] 614.8.4.3 Dryer exhaust duct power ventilator length.
The maximum length of the exhaust duct shall be determined by the dryer exhaust duct power ventilator manufacturer’s installation instructions.

[M] 614.8.5 Length identification.
Where the exhaust duct equivalent length exceeds 35 feet (10 668 mm), the equivalent length of the exhaust duct shall be identified on a permanent label or tag. The label or tag shall be located within 6 feet (1829 mm) of the exhaust duct connection.

[M] 614.8.6 Exhaust duct required.
Where space for a clothes dryer is provided, an exhaust duct system shall be installed.

Where the clothes dryer is not installed at the time of occupancy, the exhaust duct shall be capped at the location of the future dryer.

Exception: Where a listed condensing clothes dryer is installed prior to occupancy of the structure.

[M] 614.9 Commercial clothes dryers.
The installation of dryer exhaust ducts serving Type 2 clothes dryers shall comply with the appliance manufacturer’s instructions. Exhaust fan motors installed in exhaust systems shall be located outside of the airstream. In multiple installations, the fan shall operate continuously or be interlocked to operate when any individual unit is operating. Ducts shall have a minimum clearance of 6 inches (152 mm) to combustible materials.

[M] 614.10 Common exhaust systems for clothes dryers located in multistory structures.
Where a common multistory duct system is designed and installed to convey exhaust from multiple clothes dryers, the construction of such system shall be in accordance with all of the following:

1. The shaft in which the duct is installed shall be constructed and fire-resistance rated as required by the Building Code of New York State.

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2. Dampers shall be prohibited in the exhaust duct. Penetrations of the shaft and ductwork shall be protected in accordance with Section 607.5.5, Exception 2, of the Mechanical Code of New York State.

3. Rigid metal ductwork shall be installed within the shaft to convey the exhaust. The ductwork shall be constructed of sheet steel having a minimum thickness of 0.0187 inch (0.471 mm) (No. 26 gage) and in accordance with SMACNA Duct Construction Standards.

4. The ductwork within the shaft shall be designed and installed without offsets.

5. The exhaust fan motor design shall be in accordance with Section 503.2 of the Mechanical Code of New York State.

6. The exhaust fan motor shall be located outside of the airstream.

7. The exhaust fan shall run continuously, and shall be connected to a standby power source.

8. The exhaust fan operation shall be monitored in an approved location and shall initiate an audible or visual signal when the fan is not in operation.

9. Makeup air shall be provided for the exhaust system.

10. A cleanout opening shall be located at the base of the shaft to provide access to the duct to allow for cleaning and inspection. The finished opening shall be not less than 12 inches by 12 inches (305 mm by 305 mm).

11. Screens shall not be installed at the termination.

SECTION 615
SAUNA HEATERS

615.1 General.
Sauna heaters shall be installed in accordance with the manufacturer's instructions.

615.2 Location and protection.
Sauna heaters shall be located so as to minimize the possibility of accidental contact by a person in the room.

615.2.1 Guards.
Sauna heaters shall be protected from accidental contact by an approved guard or barrier of material having a low coefficient of thermal conductivity. The guard shall not substantially affect the transfer of heat from the heater to the room.

615.3 Access.
Panels, grilles and access doors that are required to be removed for normal servicing operations shall not be attached to the building.
615.4 Combustion and dilution air intakes.
Sauna heaters of other than the direct-vent type shall be installed with the draft hood and combustion air intake located outside the sauna room. Where the combustion air inlet and the draft hood are in a dressing room adjacent to the sauna room, there shall be provisions to prevent physically blocking the combustion air inlet and the draft hood inlet, and to prevent physical contact with the draft hood and vent assembly, or warning notices shall be posted to avoid such contact. Any warning notice shall be easily readable, shall contrast with its background and the wording shall be in letters not less than 1/4 inch (6.4 mm) high.

615.5 Combustion and ventilation air.
Combustion air shall not be taken from inside the sauna room. Combustion and ventilation air for a sauna heater not of the direct-vent type shall be provided to the area in which the combustion air inlet and draft hood are located in accordance with Section 304.

615.6 Heat and time controls.
Sauna heaters shall be equipped with a thermostat that will limit room temperature to 194°F (90°C). If the thermostat is not an integral part of the sauna heater, the heat-sensing element shall be located within 6 inches (152 mm) of the ceiling. If the heat-sensing element is a capillary tube and bulb, the assembly shall be attached to the wall or other support, and shall be protected against physical damage.

615.6.1 Timers.
A timer, if provided to control main burner operation, shall have a maximum operating time of 1 hour. The control for the timer shall be located outside the sauna room.

615.7 Sauna room.
A ventilation opening into the sauna room shall be provided. The opening shall be not less than 4 inches by 8 inches (102 mm by 203 mm) located near the top of the door into the sauna room.

615.7.1 Warning notice.
The following permanent notice, constructed of approved material, shall be mechanically attached to the sauna room on the outside:

WARNING: DO NOT EXCEED 30 MINUTES IN SAUNA. EXCESSIVE EXPOSURE CAN BE HARMFUL TO HEALTH. ANY PERSON WITH POOR HEALTH SHOULD CONSULT A PHYSICIAN BEFORE USING SAUNA.

The words shall contrast with the background and the wording shall be in letters not less than 1/4 inch (6.4 mm) high.

Exception: This section shall not apply to one- and two-family dwellings.

SECTION 616
ENGINE AND GAS
TURBINE-POWERED EQUIPMENT

616.1 Powered equipment.
Permanently installed equipment powered by internal combustion engines and turbines shall be
installed in accordance with the manufacturer’s instructions and NFPA 37. Stationary engine generator assemblies shall meet the requirements of UL 2200.

616.2 Gas supply connection. Equipment powered by internal combustion engines and turbines shall not be rigidly connected to the gas supply piping.

SECTION 617 
POOL AND SPA HEATERS

617.1 General. Pool and spa heaters shall be tested in accordance with ANSI Z21.56/CSA 4.7 and shall be installed in accordance with the manufacturer’s instructions.

SECTION 618 
FORCED-AIR WARM-AIR FURNACES

618.1 General. Forced-air warm-air furnaces shall be tested in accordance with ANSI Z21.47/CSA 2.3 or UL 795 and shall be installed in accordance with the manufacturer’s instructions.

618.2 Dampers. Volume dampers shall not be placed in the air inlet to a furnace in a manner that will reduce the required air to the furnace.

618.3 Prohibited sources. Outdoor or return air for forced-air heating and cooling systems shall not be taken from the following locations:

1. Closer than 10 feet (3048 mm) from an appliance vent outlet, a vent opening from a plumbing drainage system or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside air inlet.

2. Where there is the presence of objectionable odors, fumes or flammable vapors; or where located less than 10 feet (3048 mm) above the surface of any abutting public way or driveway; or where located at grade level by a sidewalk, street, alley or driveway.

3. A hazardous or insanitary location or a refrigeration machinery room as defined in the Mechanical Code of New York State.

4. A room or space, the volume of which is less than 25 percent of the entire volume served by such system. Where connected by a permanent opening having an area sized in accordance with this code, adjoining rooms or spaces shall be considered to be a single room or space for the purpose of determining the volume of such rooms or spaces.

   Exception: The minimum volume requirement shall not apply where the amount of return air taken from a room or space is less than or equal to the amount of supply air delivered to such room or space.
5. A room or space containing an appliance where such a room or space serves as the sole source of return air.

**Exception:** This shall not apply where:

1. The appliance is a direct-vent appliance or an appliance not requiring a vent in accordance with Section 501.8.

2. The room or space complies with the following requirements:

   2.1. The return air shall be taken from a room or space having a volume exceeding 1 cubic foot for each 10 Btu/h (9.6 L/W) of combined input rating of all fuel-burning appliances therein.

   2.2. The volume of supply air discharged back into the same space shall be approximately equal to the volume of return air taken from the space.

   2.3. Return-air inlets shall not be located within 10 feet (3048 mm) of a draft hood in the same room or space or the combustion chamber of any atmospheric burner appliance in the same room or space.

3. Rooms or spaces containing solid fuel-burning appliances, provided that return-air inlets are located not less than 10 feet (3048 mm) from the firebox of such appliances.

6. A closet, bathroom, toilet room, kitchen, garage, boiler room, furnace room or unconditioned attic.

**Exceptions:**

1. Where return air intakes are located not less than 10 feet (3048 mm) from cooking appliances and serve only the kitchen area, taking return air from a kitchen area shall not be prohibited.

2. Dedicated forced air systems serving only a garage shall not be prohibited from obtaining return air from the garage.

7. A crawl space by means of direct connection to the return side of a forced-air system. Transfer openings in the crawl space enclosure shall not be prohibited.

618.4 Screen. Required outdoor air inlets for residential portions of a building shall be covered with a screen having $\frac{1}{4}$-inch (6.4 mm) openings. Required outdoor air inlets serving a nonresidential portion of a building shall be covered with screen having openings larger than $\frac{1}{4}$-inch (6.4 mm) and not larger than 1 inch (25 mm).
618.5 Return-air limitation.
Return air from one dwelling unit shall not be discharged into another dwelling unit.

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

SECTION 619
CONVERSION BURNERS

619.1 Conversion burners.
The installation of conversion burners shall conform to ANSI Z21.8.

SECTION 620
UNIT HEATERS

620.1 General.
Unit heaters shall be tested in accordance with ANSI Z83.8/CSA 2.6 and shall be installed in accordance with the manufacturer’s instructions.

620.2 Support.
Suspended-type unit heaters shall be supported by elements that are designed and constructed to accommodate the weight and dynamic loads. Hangers and brackets shall be of noncombustible material.

620.3 Ductwork.
Ducts shall not be connected to a unit heater unless the heater is listed for such installation.

620.4 Clearance.
Suspended-type unit heaters shall be installed with clearances to combustible materials of not less than 18 inches (457 mm) at the sides, 12 inches (305 mm) at the bottom and 6 inches (152 mm) above the top where the unit heater has an internal draft hood or 1 inch (25 mm) above the top of the sloping side of the vertical draft hood.

Floor-mounted-type unit heaters shall be installed with clearances to combustible materials at the back and one side only of not less than 6 inches (152 mm). Where the flue gases are vented horizontally, the 6-inch (152 mm) clearance shall be measured from the draft hood or vent instead of the rear wall of the unit heater. Floor-mounted-type unit heaters shall not be installed on combustible floors unless listed for such installation.

Clearances for servicing all unit heaters shall be in accordance with the manufacturer’s installation instructions.

Exception: Unit heaters listed for reduced clearance shall be permitted to be installed with such clearances in accordance with their listing and the manufacturer’s instructions.
620.5 Installation in commercial garages and aircraft hangars.
Unit heaters installed in garages for more than three motor vehicles or in aircraft hangars shall be installed in accordance with Sections 305.9, 305.10 and 305.11.

SECTION 621
UNVENTED ROOM HEATERS

621.1 General.
Unvented room heaters shall be tested in accordance with ANSI Z21.11.2 and shall be installed in accordance with the conditions of the listing and the manufacturer’s instructions. Unvented room heaters utilizing fuels other than fuel gas shall be regulated by the Mechanical Code of New York State.

621.2 Prohibited use.
One or more unvented room heaters shall not be used as the sole source of comfort heating in a dwelling unit.

621.3 Input rating.
Unvented room heaters shall not have an input rating in excess of 40,000 Btu/h (11.7 kW).

621.4 Prohibited locations.
Unvented room heaters shall not be installed within occupancies in Groups A, E and I. The location of unvented room heaters shall comply with Section 303.3.

621.5 Room or space volume.
The aggregate input rating of all unvented appliances installed in a room or space shall not exceed 20 Btu/h per cubic foot (207 W/m$^3$) of volume of such room or space. Where the room or space in which the appliances are installed is directly connected to another room or space by a doorway, archway or other opening of comparable size that cannot be closed, the volume of such adjacent room or space shall be permitted to be included in the calculations.

621.6 Oxygen-depletion safety system.
Unvented room heaters shall be equipped with an oxygen-depletion-sensitive safety shutoff system. The system shall shut off the gas supply to the main and pilot burners when the oxygen in the surrounding atmosphere is depleted to the percent concentration specified by the manufacturer, but not lower than 18 percent. The system shall not incorporate field adjustment means capable of changing the set point at which the system acts to shut off the gas supply to the room heater.

621.7 Unvented decorative room heaters.
An unvented decorative room heater shall not be installed in a factory-built fireplace unless the fireplace system has been specifically tested, listed and labeled for such use in accordance with UL 127.

621.7.1 Ventless firebox enclosures.
Ventless firebox enclosures used with unvented decorative room heaters shall be listed as complying with ANSI Z21.91.
SECTION 622
VENTED ROOM HEATERS

622.1 General.
Vented room heaters shall be tested in accordance with ANSI Z21.86/CSA 2.32, shall be designed and equipped as specified in Section 602.2 and shall be installed in accordance with the manufacturer’s instructions.

SECTION 623
COOKING APPLIANCES

623.1 Cooking appliances.
Cooking appliances that are designed for permanent installation, including ranges, ovens, stoves, broilers, grills, fryers, griddles, hot plates and barbecues, shall be tested in accordance with ANSI Z21.1, ANSI Z21.58/CSA 1.6 or ANSI Z83.11/CSA 1.8 and shall be installed in accordance with the manufacturer’s instructions.

623.2 Prohibited location.
Cooking appliances designed, tested, listed and labeled for use in commercial occupancies shall not be installed within dwelling units or within any area where domestic cooking operations occur.

Exceptions:

1. Appliances that are also listed as domestic cooking appliances.

2. Where the installation is designed by a licensed Professional Engineer, in compliance with the manufacturer’s installation instructions.

623.3 Domestic appliances.
Cooking appliances installed within dwelling units and within areas where domestic cooking operations occur shall be listed and labeled as household-type appliances for domestic use.

623.4 Domestic range installation.
Domestic ranges installed on combustible floors shall be set on their own bases or legs and shall be installed with clearances of not less than that shown on the label.

623.5 Open-top broiler unit hoods.
A ventilating hood shall be provided above a domestic open-top broiler unit, unless otherwise listed for forced down draft ventilation.

623.5.1 Clearances.
A minimum clearance of 24 inches (610 mm) shall be maintained between the cooking top and combustible material above the hood. The hood shall be at least as wide as the open-top broiler unit and be centered over the unit.

623.6 Commercial cooking appliance venting.
Commercial cooking appliances, other than those exempted by Section 501.8, shall be vented by connecting the appliance to a vent or chimney in accordance with this code and the appliance manufacturer’s instructions or the appliance shall be vented in accordance with Section 505.1.1.
623.7 **Vertical clearance above cooking top.**

Household cooking appliances shall have a vertical clearance above the cooking top of not less than 30 inches (760 mm) to combustible material and metal cabinets. A minimum clearance of 24 inches (610 mm) is permitted where one of the following is installed:

1. The underside of the combustible material or metal cabinet above the cooking top is protected with not less than \( \frac{1}{4} \) -inch (6.4 mm) insulating millboard covered with sheet metal not less than 0.0122 inch (0.3 mm) thick.

2. A metal ventilating hood constructed of sheet metal not less than 0.0122 inch (0.3 mm) thick is installed above the cooking top with a clearance of not less than \( \frac{1}{4} \) inch (6.4 mm) between the hood and the underside of the combustible material or metal cabinet. The hood shall have a width not less than the width of the appliance and shall be centered over the appliance.

3. A listed cooking appliance or microwave oven is installed over a listed cooking appliance and in compliance with the terms of the manufacturer’s installation instructions for the upper appliance.

**SECTION 624
WATER HEATERS**

624.1 **General.**

Water heaters shall be tested in accordance with ANSI Z21.10.1/CSA 4.1 and ANSI Z21.10.3/CSA 4.3 and shall be installed in accordance with the manufacturer’s instructions. Water heaters utilizing fuels other than fuel gas shall be regulated by the Mechanical Code of New York State.

624.1.1 **Installation requirements.**

The requirements for water heaters relative to sizing, relief valves, drain pans and scald protection shall be in accordance with the Plumbing Code of New York State.

624.2 **Water heaters utilized for space heating.**

Water heaters utilized both to supply potable hot water and provide hot water for space-heating applications shall be listed and labeled for such applications by the manufacturer and shall be installed in accordance with the manufacturer’s instructions and the Plumbing Code of New York State.

**SECTION 625
REFRIGERATORS**

625.1 **General.**

Refrigerators shall be tested in accordance with ANSI Z21.19/CSA 1.4 and shall be installed in accordance with the manufacturer’s instructions.

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Refrigerators shall be provided with adequate clearances for ventilation at the top and back, and shall be installed in accordance with the manufacturer’s instructions. If such instructions are not available, not less than 2 inches (51 mm) shall be provided between the back of the refrigerator and the wall and not less than 12 inches (305 mm) above the top.

SECTION 626
GAS-FIRED TOILETS

626.1 General.
Gas-fired toilets shall be tested in accordance with ANSI Z21.61 and installed in accordance with the manufacturer’s instructions.

626.2 Clearance.
A gas-fired toilet shall be installed in accordance with its listing and the manufacturer’s instructions, provided that the clearance shall in any case be sufficient to afford ready access for use, cleanout and necessary servicing.

SECTION 627
AIR-CONDITIONING APPLIANCES

627.1 General.
Gas-fired air-conditioning appliances shall be tested in accordance with ANSI Z21.40.1/CGA 2.91 or ANSI Z21.40.2/CGA 2.92 and shall be installed in accordance with the manufacturer’s instructions.

627.2 Independent piping.
Gas piping serving heating appliances shall be permitted to also serve cooling appliances where such heating and cooling appliances cannot be operated simultaneously (see Section 402).

627.3 Connection of gas engine-powered air conditioners.
To protect against the effects of normal vibration in service, gas engines shall not be rigidly connected to the gas supply piping.

627.4 Clearances for indoor installation.
Air-conditioning appliances installed in rooms other than alcoves and closets shall be installed with clearances not less than those specified in Section 308.3 except that air-conditioning appliances listed for installation at lesser clearances than those specified in Section 308.3 shall be permitted to be installed in accordance with such listing and the manufacturer’s instructions and air-conditioning appliances listed for installation at greater clearances than those specified in Section 308.3 shall be installed in accordance with such listing and the manufacturer’s instructions.

Air-conditioning appliances installed in rooms other than alcoves and closets shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material is protected in accordance with Table 308.2.

627.5 Alcove and closet installation.
Air-conditioning appliances installed in spaces such as alcoves and closets shall be specifically listed for such installation and installed in accordance with the terms of such listing.
installation clearances for air-conditioning appliances in alcoves and closets shall not be reduced by the protection methods described in Table 308.2.

627.6 Installation.
Air-conditioning appliances shall be installed in accordance with the manufacturer’s instructions. Unless the appliance is listed for installation on a combustible surface such as a floor or roof, or unless the surface is protected in an approved manner, the appliance shall be installed on a surface of noncombustible construction with noncombustible material and surface finish, and combustible material shall not be against the underside thereof.

627.7 Plenums and air ducts.
A plenum supplied as a part of the air-conditioning appliance shall be installed in accordance with the appliance manufacturer’s instructions. Where a plenum is not supplied with the appliance, such plenum shall be installed in accordance with the fabrication and installation instructions provided by the plenum and appliance manufacturer. The method of connecting supply and return ducts shall facilitate proper circulation of air.

Where the air-conditioning appliance is installed within a space separated from the spaces served by the appliance, the air circulated by the appliance shall be conveyed by ducts that are sealed to the casing of the appliance and that separate the circulating air from the combustion and ventilation air.

627.8 Refrigeration coils.
A refrigeration coil shall not be installed in conjunction with a forced-air furnace where circulation of cooled air is provided by the furnace blower, unless the blower has sufficient capacity to overcome the external static resistance imposed by the duct system and cooling coil at the air throughput necessary for heating or cooling, whichever is greater. Furnaces shall not be located upstream from cooling units, unless the cooling unit is designed or equipped so as not to develop excessive temperature or pressure. Refrigeration coils shall be installed in parallel with or on the downstream side of central furnaces to avoid condensation in the heating element, unless the furnace has been specifically listed for downstream installation. With a parallel flow arrangement, the dampers or other means used to control flow of air shall be sufficiently tight to prevent any circulation of cooled air through the furnace.

Means shall be provided for disposal of condensate and to prevent dripping of condensate onto the heating element.

627.9 Cooling units used with heating boilers.
Boilers, where used in conjunction with refrigeration systems, shall be installed so that the chilled medium is piped in parallel with the heating boiler with appropriate valves to prevent the chilled medium from entering the heating boiler. Where hot water heating boilers are connected to heating coils located in air-handling units where they might be exposed to refrigerated air circulation, such boiler piping systems shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

627.10 Switches in electrical supply line.
Means for interrupting the electrical supply to the air-conditioning appliance and to its associated cooling tower (if supplied and installed in a location remote from the air conditioner) shall be provided within sight of and not over 50 feet (15 240 mm) from the air conditioner and cooling tower.
SECTION 628
ILLUMINATING APPLIANCES

628.1 General.
Illuminating appliances shall be tested in accordance with ANSI Z21.42 and shall be installed in accordance with the manufacturer’s instructions.

628.2 Mounting on buildings.
Illuminating appliances designed for wall or ceiling mounting shall be securely attached to substantial structures in such a manner that they are not dependent on the gas piping for support.

628.3 Mounting on posts.
Illuminating appliances designed for post mounting shall be securely and rigidly attached to a post. Posts shall be rigidly mounted. The strength and rigidity of posts greater than 3 feet (914 mm) in height shall be at least equivalent to that of a $2\frac{1}{2}$-inch-diameter (64 mm) post constructed of 0.064-inch-thick (1.6-mm) steel or a 1-inch (25.4 mm) Schedule 40 steel pipe. Posts 3 feet (914 mm) or less in height shall not be smaller than a $3\frac{3}{4}$-inch (19.1 mm) Schedule 40 steel pipe. Drain openings shall be provided near the base of posts where there is a possibility of water collecting inside them.

628.4 Appliance pressure regulators.
Where an appliance pressure regulator is not supplied with an illuminating appliance and the service line is not equipped with a service pressure regulator, an appliance pressure regulator shall be installed in the line to the illuminating appliance. For multiple installations, one regulator of adequate capacity shall be permitted to serve more than one illuminating appliance.

SECTION 629
SMALL CERAMIC KILNS

629.1 General.
Kilns shall be installed in accordance with the manufacturer’s instructions and the provisions of this code. Kilns shall comply with Section 301.3.

SECTION 630
INFRARED RADIANT HEATERS

630.1 General.
Infrared radiant heaters shall be tested in accordance with ANSI Z83.19 or Z83.20 and shall be installed in accordance with the manufacturer’s instructions.

630.2 Support.
Infrared radiant heaters shall be fixed in a position independent of gas and electric supply lines. Hangers and brackets shall be of noncombustible material.

630.3 Combustion and ventilation air.
Where unvented infrared heaters are installed, natural or mechanical means shall provide outdoor

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ventilation air at a rate of not less than 4 cfm per 1,000 Btu/h (0.38 m³/min/kW) of the aggregate input rating of all such heaters installed in the space. Exhaust openings for removing flue products shall be above the level of the heaters.

630.4 Installation in commercial garages and aircraft hangars.
Overhead infrared heaters installed in garages for more than three motor vehicles or in aircraft hangars shall be installed in accordance with Sections 305.9, 305.10 and 305.11.

SECTION 631
BOILERS

631.1 Standards.
Boilers shall be listed in accordance with the requirements of ANSI Z21.13/CSA 4.9 or UL 795. If applicable, the boiler shall be designed and constructed in accordance with the requirements of ASME CSD-1 and as applicable, the ASME Boiler and Pressure Vessel Code, Sections I, II, IV, V and IX and NFPA 85.

[NY] 631.1.1 Other standards.
Low-pressure boilers are also regulated by the New York State Department of Labor, 12 NYCRR, Industrial Code Rule 4, and high-pressure boilers are also regulated by the New York State Department of Labor, 12 NYCRR, Industrial Code Rule 14.

631.2 Installation.
In addition to the requirements of this code, the installation of boilers shall be in accordance with the manufacturer’s instructions and the Mechanical Code of New York State. Operating instructions of a permanent type shall be attached to the boiler. Boilers shall have all controls set, adjusted and tested by the installer. A complete control diagram together with complete boiler operating instructions shall be furnished by the installer. The manufacturer’s rating data and the nameplate shall be attached to the boiler.

631.3 Clearance to combustible materials.
Clearances to combustible materials shall be in accordance with Section 308.4.

SECTION 632
EQUIPMENT INSTALLED IN EXISTING UNLISTED BOILERS

632.1 General.
Gas equipment installed in existing unlisted boilers shall comply with Section 631.1 and shall be installed in accordance with the manufacturer’s instructions and the Mechanical Code of New York State.

SECTION 633
STATIONARY FUEL-CELL POWER SYSTEMS

[F] 633.1 General.
Stationary fuel-cell power systems having a power output not exceeding 10 MW shall be tested in accordance with ANSI CSA America FC 1 and shall be installed in accordance with the
manufacturer’s instructions, NFPA 853, the Building Code of New York State and the Fire Code of New York State.

SECTION 634
CHIMNEY DAMPER OPENING AREA

634.1 Free opening area of chimney dampers.
Where an unlisted decorative appliance for installation in a vented fireplace is installed, the fireplace damper shall have a permanent free opening equal to or greater than specified in Table 634.1.

<table>
<thead>
<tr>
<th>CHIMNEY HEIGHT (feet)</th>
<th>MINIMUM PERMANENT FREE OPENING (square inches)³</th>
<th>Appliance input rating (Btu per hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>6</td>
<td>7,800</td>
<td>14,000</td>
</tr>
<tr>
<td>8</td>
<td>8,400</td>
<td>15,200</td>
</tr>
<tr>
<td>10</td>
<td>9,000</td>
<td>16,800</td>
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<tr>
<td>15</td>
<td>9,800</td>
<td>18,200</td>
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<tr>
<td>20</td>
<td>10,600</td>
<td>20,200</td>
</tr>
<tr>
<td>30</td>
<td>11,200</td>
<td>21,600</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 square inch = 645.16 m², 1 British thermal unit per hour = 0.2931 W.

a. The first six minimum permanent free openings (8 to 51 square inches) correspond approximately to the cross-sectional areas of chimneys having diameters of 3 through 8 inches, respectively. The 64-square-inch opening corresponds to the cross-sectional area of standard 8-inch by 8-inch chimney tile.

SECTION 635
GASEOUS HYDROGEN SYSTEMS

635.1 Installation.
The installation of gaseous hydrogen systems shall be in accordance with the applicable requirements of this code, the Fire Code of New York State and the Building Code of New York State.

SECTION 636
OUTDOOR DECORATIVE APPLIANCES

636.1 General.
Permanently fixed-in-place outdoor decorative appliances shall be tested in accordance with ANSI Z21.97 and shall be installed in accordance with the manufacturer’s instructions.
CHAPTER 7
GASEOUS HYDROGEN SYSTEMS

SECTION 701
GENERAL

701.1 Scope.
The installation of gaseous hydrogen systems shall comply with this chapter and Chapters 53 and 58 of the Fire Code of New York State. Compressed gases shall also comply with Chapter 50 of the Fire Code of New York State for general requirements.

701.2 Permits.
Permits shall be required as set forth in Section 105 and as required by the Fire Code of New York State.

SECTION 702
GENERAL DEFINITIONS

702.1 Definitions.
The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

[F] GASEOUS HYDROGEN SYSTEM. An assembly of piping, devices and apparatus designed to generate, store, contain, distribute or transport a nontoxic, gaseous hydrogen containing mixture having at least 95-percent hydrogen gas by volume and not more than 1-percent oxygen by volume. Gaseous hydrogen systems consist of items such as compressed gas containers, reactors and appurtenances, including pressure regulators, pressure relief devices, manifolds, pumps, compressors and interconnecting piping and tubing and controls.

[F] HYDROGEN FUEL-GAS ROOM. A room or space that is intended exclusively to house a gaseous hydrogen system.

HYDROGEN-GENERATING APPLIANCE. A self-contained package or factory-matched packages of integrated systems for generating gaseous hydrogen. Hydrogen-generating appliances utilize electrolysis, reformation, chemical or other processes to generate hydrogen.

SECTION 703
GENERAL REQUIREMENTS

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. Exhaust ventilation shall be required 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.

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[F] 703.2 Containers, cylinders and tanks.
Compressed gas containers, cylinders and tanks shall comply with Chapters 53 and 58 of the Fire Code of New York State.

[F] 703.2.1 Limitations for indoor storage and use.
Flammable gas cylinders in occupancies regulated by the Residential Code of New York State shall not exceed 250 cubic feet (7.1 m³) at normal temperature and pressure (NTP).

[F] 703.2.2 Design and construction.
Compressed gas containers, cylinders and tanks shall be designed, constructed and tested in accordance with Chapter 50 of the Fire Code of New York State, ASME Boiler and Pressure Vessel Code (Section VIII) or DOTn 49 CFR, Parts 100-180.

[F] 703.3 Pressure relief devices.
Pressure relief devices shall be provided in accordance with Sections 703.3.1 through 703.3.8. Pressure relief devices shall be sized and selected in accordance with CGA S-1.1, CGA S-1.2 and CGA S-1.3.

[F] 703.3.1 Valves between pressure relief devices and containers.
Valves including shutoffs, check valves and other mechanical restrictions shall not be installed between the pressure relief device and container being protected by the relief device.

Exception: A locked-open shutoff valve on containers equipped with multiple pressure relief device installations where the arrangement of the valves provides the full required flow through the minimum number of required relief devices at all times.

[F] 703.3.2 Installation.
Valves and other mechanical restrictions shall not be located between the pressure relief device and the point of release to the atmosphere.

[F] 703.3.3 Containers.
Containers shall be provided with pressure relief devices in accordance with the ASME Boiler and Pressure Vessel Code (Section VIII), DOTn 49 CFR, Parts 100-180 and Section 703.3.7.

[F] 703.3.4 Vessels other than containers.
Vessels other than containers shall be protected with pressure relief devices in accordance with the ASME Boiler and Pressure Vessel Code (Section VIII), or DOTn 49 CFR, Parts 100-180.

[F] 703.3.5 Sizing.
Pressure relief devices shall be sized in accordance with the specifications to which the container was fabricated. The relief device shall be sized to prevent the maximum design pressure of the container or system from being exceeded.

[F] 703.3.6 Protection.
Pressure relief devices and any associated vent piping shall be designed, installed and located so that their operation will not be affected by water or other debris accumulating inside the vent or obstructing the vent.
[F] 703.3.7 Access.
Pressure relief devices shall be located such that they are provided with ready access for inspection and repair.

[F] 703.3.8 Configuration.
Pressure relief devices shall be arranged to discharge unobstructed in accordance with Section 2309 of the Fire Code of New York State. Discharge shall be directed to the outdoors in such a manner as to prevent impingement of escaping gas on personnel, containers, equipment and adjacent structures and to prevent introduction of escaping gas into enclosed spaces. The discharge shall not terminate under eaves or canopies.

Exception: This section shall not apply to DOTn-specified containers with an internal volume of 2 cubic feet (0.057 m³) or less.

[F] 703.4 Venting.
Relief device vents shall be terminated in an approved location in accordance with Section 2309 of the Fire Code of New York State.

[F] 703.5 Security.
Compressed gas containers, cylinders, tanks and systems shall be secured against accidental dislodgement in accordance with Chapter 53 of the Fire Code of New York State.

[F] 703.6 Electrical wiring and equipment.
Electrical wiring and equipment shall comply with NFPA 70.

SECTION 704
PIPING, USE AND HANDLING

704.1 Applicability.
Use and handling of containers, cylinders, tanks and hydrogen gas systems shall comply with this section. Gaseous hydrogen systems, equipment and machinery shall be listed or approved.

704.1.1 Controls.
Compressed gas system controls shall be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate or path. Automatic controls shall be designed to be fail safe in accordance with accepted engineering practice.

704.1.2 Piping systems.
Piping, tubing, valves and fittings conveying gaseous hydrogen shall be designed and installed in accordance with Sections 704.1.2.1 through 704.1.2.5.1, Chapter 50 of the Fire Code of New York State, and ASME B31.12. Cast-iron pipe, valves and fittings shall not be used.

704.1.2.1 Sizing.
Gaseous hydrogen piping shall be sized in accordance with approved engineering methods.

704.1.2.2 Identification of hydrogen piping systems.
Hydrogen piping systems shall be marked in accordance with ANSI A13.1. Markings used
for piping systems shall consist of the name of the contents and shall include a direction-of-flow arrow. Markings shall be provided at all of the following locations:

1. At each valve.
2. At wall, floor and ceiling penetrations.
3. At each change of direction.
4. At intervals not exceeding 20 feet (6096 mm).

**704.1.2.3 Piping design and construction.**
Piping and tubing materials shall be 300 series stainless steel or materials listed or approved for hydrogen service and the use intended through the full range of operating conditions to which they will be subjected. Piping systems shall be designed and constructed to provide allowance for expansion, contraction, vibration, settlement and fire exposure.

**704.1.2.3.1 Prohibited locations.**
Piping shall not be installed in or through a circulating air duct; clothes chute; chimney or gas vent; ventilating duct; dumbwaiter; or elevator shaft. Piping shall not be concealed or covered by the surface of any wall, floor or ceiling.

**704.1.2.3.2 Interior piping.**
Except for through penetrations, piping located inside of buildings shall be installed in exposed locations and provided with ready access for visual inspection.

**704.1.2.3.3 Underground piping.**
Underground piping, including joints and fittings, shall be protected from corrosion and installed in accordance with approved engineered methods.

**704.1.2.3.4 Piping through foundation wall.**
Underground piping shall not penetrate the outer foundation or basement wall of a building.

**704.1.2.3.5 Protection against physical damage.**
Where piping other than stainless steel piping, stainless steel tubing or black steel is installed through holes or notches in wood studs, joists, rafters or similar members less than 1 \( \frac{1}{2} \) inches (38 mm) from the nearest edge of the member, the pipe shall be protected by shield plates. Shield plates shall be a minimum of \( \frac{1}{16} \) -inch-thick (1.6 mm) steel, shall cover the area of the pipe where the member is notched or bored and shall extend a minimum of 4 inches (102 mm) above sole plates, below top plates and to each side of a stud, joist or rafter.

**704.1.2.3.6 Piping outdoors.**
Piping installed above ground, outdoors, shall be securely supported and located where it will be protected from physical damage. Piping passing through an exterior wall of a building shall be encased in a protective pipe sleeve. The annular space

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between the piping and the sleeve shall be sealed from the inside such that the sleeve is ventilated to the outdoors. Where passing through an exterior wall of a building, the piping shall be protected against corrosion by coating or wrapping with an inert material. Below-ground piping shall be protected against corrosion.

**704.1.2.3.7 Settlement.**
Piping passing through concrete or masonry walls shall be protected against differential settlement.

**704.1.2.4 Joints.**
Joints in piping and tubing in hydrogen service shall be listed as complying with ASME B31.3 to include the use of welded, brazed, flared, socket, slip and compression fittings. Gaskets and sealants used in hydrogen service shall be listed as complying with ASME B31.12. Threaded and flanged connections shall not be used in areas other than hydrogen cutoff rooms and outdoors.

**704.1.2.4.1 Brazed joints.**
Brazing alloys shall have a melting point greater than 1,000°F (538°C).

**704.1.2.4.2 Electrical continuity.**
Mechanical joints shall maintain electrical continuity through the joint or a bonding jumper shall be installed around the joint.

**704.1.2.5 Valves and piping components.**
Valves, regulators and piping components shall be listed or approved for hydrogen service, shall be provided with access and shall be designed and constructed to withstand the maximum pressure to which such components will be subjected.

**704.1.2.5.1 Shutoff valves on storage containers and tanks.**
Shutoff valves shall be provided on all storage container and tank connections except for pressure relief devices. Shutoff valves shall be provided with ready access.

**704.2 Upright use.**
Compressed gas containers, cylinders and tanks, except those with a water volume less than 1.3 gallons (5 L) and those designed for use in a horizontal position, shall be used in an upright position with the valve end up. An upright position shall include conditions where the container, cylinder or tank axis is inclined as much as 45 degrees (0.79 rad) from the vertical.

**704.3 Material-specific regulations.**
In addition to the requirements of this section, indoor and outdoor use of hydrogen compressed gas shall comply with the material-specific provisions of Chapters 53 and 58 of the Fire Code of New York State.

**704.4 Handling.**
The handling of compressed gas containers, cylinders and tanks shall comply with Chapter 50 of the Fire Code of New York State.

### SECTION 705
**TESTING OF HYDROGEN PIPING SYSTEMS**

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

705.2 Inspections.
Inspections shall consist of a visual examination of the entire piping system installation and a pressure test. Hydrogen piping systems shall be inspected in accordance with this code. Inspection methods such as outlined in ASME B31.12 shall be permitted where specified by the design engineer and approved by the building official. Inspections shall be conducted or verified by the building official prior to system operation.

705.3 Pressure tests.
A hydrostatic or pneumatic leak test shall be performed. Testing of hydrogen piping systems shall utilize testing procedures identified in ASME B31.12 or other approved methods, provided that the testing is performed in accordance with the minimum provisions specified in Sections 705.3.1 through 705.4.1.

705.3.1 Hydrostatic leak tests.
The hydrostatic test pressure shall be not less than one-and-one-half times the maximum working pressure, and not less than 100 psig (689.5 kPa gauge).

705.3.2 Pneumatic leak tests.
The pneumatic test pressure shall be not less than one-and-one-half times the maximum working pressure for systems less than 125 psig (862 kPa gauge) and not less than 5 psig (34.5 kPa gauge), whichever is greater. For working pressures at or above 125 psig (862 kPa gauge), the pneumatic test pressure shall be not less than 110 percent of the maximum working pressure.

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

705.3.4 Test medium.
Deionized water shall be utilized to perform hydrostatic pressure testing and shall be obtained from a potable source. The medium utilized to perform pneumatic pressure testing shall be air, nitrogen, carbon dioxide or an inert gas; oxygen shall not be used.

705.3.5 Test duration.
The minimum test duration shall be \( \frac{1}{2} \) hour. The test duration shall be not less than \( \frac{1}{2} \) hour for each 500 cubic feet (14.2 m\(^3\)) of pipe volume or fraction thereof. For piping systems having a volume of more than 24,000 cubic feet (680 m\(^3\)), the duration of the test shall not be required to exceed 24 hours. The test pressure required in Sections 705.3.1 and 705.3.2 shall be maintained for the entire duration of the test.

705.3.6 Test gauges.
Gauges used for testing shall be as follows:
1. Tests requiring a pressure of 10 psig (68.95 kPa gauge) or less shall utilize a testing gauge having increments of 0.10 psi (0.6895 kPa) or less.

2. Tests requiring a pressure greater than 10 psig (68.98 kPa gauge) but less than or equal to 100 psig (689.5 kPa gauge) shall utilize a testing gauge having increments of 1 psi (6.895 kPa) or less.

3. Tests requiring a pressure greater than 100 psig (689.5 kPa gauge) shall utilize a testing gauge having increments of 2 psi (13.79 kPa) or less.

**Exception:** Measuring devices having an equivalent level of accuracy and resolution shall be permitted where specified by the design engineer and approved by the building official.

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

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

#### 705.3.7.2 Equipment disconnection.
Where the piping system is connected to appliances, equipment or components designed for operating pressures of less than the test pressure, such appliances, equipment and components shall be isolated from the piping system by disconnecting them and capping the outlet(s).

#### 705.3.7.3 Equipment isolation.
Where the piping system is connected to appliances, equipment or components designed for operating pressures equal to or greater than the test pressure, such appliances, equipment and components shall be isolated from the piping system by closing the individual appliance, equipment or component shutoff valve(s).

### 705.4 Detection of leaks and defects.
The piping system shall withstand the test pressure specified for the test duration specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall indicate a leak within the system. Piping systems shall not be approved except where this reduction in pressure is attributed to some other cause.

#### 705.4.1 Corrections.
Where leakage or other defects are identified, the affected portions of the piping system shall be repaired and retested.

### 705.5 Purging of gaseous hydrogen piping systems.
Purging shall comply with Sections 705.5.1 through 705.5.4.

#### 705.5.1 Removal from service.
Where piping is to be opened for servicing, addition or modification, the section to be worked on shall be isolated from the supply at the nearest convenient point and the line pressure
vented to the outdoors. The remaining gas in this section of pipe shall be displaced with an inert gas.

**705.5.2 Placing in operation.**
Prior to placing the system into operation, the air in the piping system shall be displaced with inert gas. The inert gas flow shall be continued without interruption until the vented gas is free of air. The inert gas shall then be displaced with hydrogen until the vented gas is free of inert gas. The point of discharge shall not be left unattended during purging. After purging, the vent opening shall be closed.

**705.5.3 Discharge of purged gases.**
The open end of piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition except where precautions are taken to perform this operation in a safe manner by ventilation of the space, control of purging rate and elimination of all hazardous conditions.

**705.5.3.1 Vent pipe outlets for purging.**
Vent pipe outlets for purging shall be located such that the inert gas and fuel gas is released outdoors and not less than 8 feet (2438 mm) above the adjacent ground level. Gases shall be discharged upward or horizontally away from adjacent walls to assist in dispersion. Vent outlets shall be located such that the gas will not be trapped by eaves or other obstructions and shall be at least 5 feet (1524 mm) from building openings and lot lines of properties that can be built on.

**705.5.4 Placing equipment in operation.**
After the piping has been placed in operation, all equipment shall be purged in accordance with Section 707.2 and then placed in operation, as necessary.

**SECTION 706**
LOCATION OF GASEOUS HYDROGEN SYSTEMS

[F] **706.1 General.**
The location and installation of gaseous hydrogen systems shall be in accordance with Sections 706.2 and 706.3.

**Exception:** Stationary fuel-cell power plants in accordance with Section 633.

[F] **706.2 Indoor gaseous hydrogen systems.**
Gaseous hydrogen systems shall be located in indoor rooms or areas constructed in accordance with this code, the Building Code of New York State, the Mechanical Code of New York State or NFPA 2.

[F] **706.3 Outdoor gaseous hydrogen systems.**
Gaseous hydrogen systems shall be located outdoors in accordance with Section 2309.3.1.1 of the Fire Code of New York State.

**SECTION 707**
OPERATION AND MAINTENANCE OF GASEOUS HYDROGEN SYSTEMS
[F] 707.1 Maintenance.
Gaseous hydrogen systems and detection devices shall be maintained in accordance with the Fire Code of New York State and the manufacturer’s installation instructions.

[F] 707.2 Purging.
Purging of gaseous hydrogen systems, other than piping systems purged in accordance with Section 705.5, shall be in accordance with Sections 2309.6 and 2309.6.1 of the Fire Code of New York State or in accordance with the system manufacturer’s instructions.

SECTION 708
DESIGN OF LIQUEFIED HYDROGEN SYSTEMS ASSOCIATED WITH HYDROGEN VAPORIZATION OPERATIONS

[F] 708.1 General.
The design of liquefied hydrogen systems shall comply with Chapter 55 of the Fire Code of New York State.
CHAPTER 8
REFERENCED STANDARDS

User note:

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 102.4.

*Denotes standards that are incorporated by reference into 19 NYCRR Part 1224

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ANSI

ANSI A13.1—2015: Scheme for the Identification of Piping Systems
704.1.2.2

ANSI FC 1—2012: Stationery Fuel Cell Power Systems
633.1

ANSI NGV 5.1—2015: Residential Fueling Appliances
413.4.1

403.5.5

403.10.1, 403.10.2, 403.10.3

Z21.1—2010: Household Cooking Gas Appliances
623.1

Z21.5.1/CSA 7.1—2014: Gas Clothes Dryers—Volume I—Type 1 Clothes Dryers
613.1

Z21.5.2/CSA 7.2—2014: Gas Clothes Dryers—Volume II—Type 2 Clothes Dryers
613.1, 614.3

*Z21.8—94 (R2002): Installation of Domestic Gas Conversion Burners
619.1

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Z21.10.1/CSA 4.1—2012: Gas Water Heaters—Volume I—Storage, Water Heaters with Input Ratings of 75,000 Btu per Hour or Less
624.1

Z21.10.3/CSA 4.3—2011: Gas Water Heaters—Volume III—Storage, Water Heaters with Input Ratings above 75,000 Btu per Hour, Circulating and Instantaneous
624.1

Z21.11.2—2011: Gas-fired Room Heaters—Volume II—Unvented Room Heaters
621.1

Z21.13/CSA 4.9—2011: Gas-fired Low-pressure Steam and Hot Water Boilers
631.1

Z21.15/CSA 9.1—2009: Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves
Table 409.1.1

625.1

Z21.24/CSA 6.10—2006: Connectors for Gas Appliances
411.1, 411.3

627.1

627.1

628.1

Z21.47/CSA 2.3—2012: Gas-fired Central Furnaces
618.1

Z21.50/CSA 2.22—2016: Vented Gas Fireplaces
604.1

Z21.54—2009: Gas Hose Connectors for Portable Outdoor Gas-fired Appliances
411.1

617.1

Z21.58/CSA 1.6—2013: Outdoor Cooking Gas Appliances
623.1
Z21.60/CSA 2.26—2012: Decorative Gas Appliances for Installation in Solid-fuel Burning Fireplaces
602.1

626.1

Z21.69/CSA 6.16—2009: Connectors for Movable Gas Appliances
411.1.1, 411.1.4

Z21.75/CSA 6.27—2007: Connectors for Outdoor Gas Appliances and Manufactured Homes
411.1, 411.2

410.1

602.1, 602.2

608.1, 609.1, 622.1

605.1

621.7.1

Z21.93/CSA 6.30—2013: Excess Flow Valves for Natural and LP Gas with Pressures up to 5 psig
410.4

Z21.97—2012: Outdoor Decorative Appliances
636.1

Z83.4/CSA 3.7—2012: Nonrecirculating Direct-gas-fired Industrial Air Heaters
611.1

Z83.8/CSA 2.6—2009: Gas Unit Heater, Gas Packaged Heater, Gas Utility Heaters and Gas-fired Duct Furnaces
610.1, 620.1

Z83.11/CSA 1.8—2013: Gas Food Service Equipment
623.1

Z83.18—2012: Recirculating Direct Gas-fired Industrial Air Heaters
612.1

630.1
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631.1, 703.2.2, 703.3.3, 703.3.4

CSD-1—2016: Controls and Safety Devices for Automatically Fired Boilers

631.1

ASTM

A53/A53M—12: Specification for Pipe, Steel, Black and Hot Dipped Zinc-coated Welded and Seamless
403.4.2

A106/A106M—14: Specification for Seamless Carbon Steel Pipe for High-temperature Service
403.4.2

A254—12: Specification for Copper Brazed Steel Tubing
403.5.1

A268—10: Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
403.5.2

A269—15: Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
403.5.2

A312—15: Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes
403.4.2

B88—14: Specification for Seamless Copper Water Tube
403.5.3

B210—12: Specification for Aluminum and Aluminum-alloy Drawn Seamless Tubes
403.5.4

B241/B241M—12e1: Specification for Aluminum and Aluminum-alloy, Seamless Pipe and Seamless Extruded Tube
403.4.4, 403.5.4

403.5.3

501.12
D2513—14e1: Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings
403.6, 403.6.1, 403.11, 404.17.2

E136—16: Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
202

404.17.2

F2945—15: Standard Specification for Polyamide 11 Gas Pressure Pipe, Tubing and Fittings
403.6

CGA

S-1.1—(2017): Pressure Relief Device Standards—Part 1—Cylinders for Compressed Gases
703.3

S-1.2—(2009): Pressure Relief Device Standards—Part 2—Cargo and Portable Tanks for Compressed Gases
703.3

S-1.3—(2016): Pressure Relief Device Standards—Part 3—Stationary Storage Containers for Compressed Gases
703.3

CSA

ANSI/CSA FC 1—2014: Fuel Cell Technologies—Part 3-100; Stationary fuel cell power systems—Safety
633.1

CSA 8—93: Requirements for Gas-fired Log Lighters for Wood Burning Fireplaces
603.1

ANSI/CSA NGV 5.1—2015: Residential Fueling Appliances
413.4.1
DOTn

49 CFR, Parts 192.281(e) & 192.283 (b)—(2009): Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
403.6.1

703.2.2, 703.3.3, 703.3.4

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*BCNYS—20: Building Code of New York State®
201.3, 301.10, 301.11, 301.12, 301.14, 302.1, 302.2, 305.6, 306.5.1, 306.6, 401.1.1, 412.6, 413.3, 413.3.1, 501.1, 501.3, 501.12, 501.15.4, 501.15.4.1, 609.3, 614.10, 633.1, 635.1, 706.2

*ECCCNYS—20: Energy Conservation Construction Code of New York State®
301.2

*FCNYS—20: Fire Code of New York State®
201.3, 401.2, 412.1, 412.6, 412.7, 412.7.3, 412.8, 413.1, 413.3, 413.3.1, 413.5, 413.9.2.5, 633.1, 701.1, 701.2, 703.2, 703.2.2, 703.3.8, 703.4, 703.5, 704.1.2, 704.3, 704.4, 706.2, 706.3, 707.1, 707.2, 708.1

*MCNYS—20: Mechanical Code of New York State®
201.3, 301.1.1, 301.13, 304.11, 307.1, 307.5, 501.1, 614.2, 614.10, 618.3, 621.1, 624.1, 631.2, 632.1, 703.1.2

*PCNYS—20: Plumbing Code of New York State®
201.3, 301.6, 307.3, 624.1.1, 624.2

*RCNYS—20: Residential Code of New York State®
703.2.1

MSS

Manufacturers Standardization Society of the Valve and Fittings Industry 127 Park

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### ANSI SP 58—2009: Pipe Hangers and Supports—Materials, Design and Manufacture

407.2

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### NFPA

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<td>2—16</td>
<td><em>Hydrogen Technologies Code</em></td>
<td>703.1, 706.2</td>
</tr>
<tr>
<td>30A—18</td>
<td><em>Code for Motor Fuel Dispensing Facilities and Repair Garages</em></td>
<td>305.4, 305.10</td>
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<td><em>Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines</em></td>
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<td><em>Design and Installation of Oxygen-fuel Gas Systems for Welding, Cutting and Allied Processes</em></td>
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<td>58—17</td>
<td><em>Liquefied Petroleum Gas Code</em></td>
<td>401.2, 402.7, 403.6.2, 403.11</td>
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103—2010: Factory-built Chimneys, Residential Type and Building Heating Appliances—with Revisions through July 2012
   506.1

   621.7

378—2006: Draft Equipment
   503.3.3

441—2010: Gas Vents—with Revisions through June 2014
   502.1

641—2010: Type L Low-temperature Venting Systems—with Revisions through June 2013
   502.1

651—2011: Schedule 40 and 80 Rigid PVC Conduit and Fittings—with Revisions through May 2014
   403.6.3

795—2011: Commercial-industrial Gas Heating Equipment—with Revisions through November 2013
   610.1, 618.1, 631.1

   506.3

1618—09: Wall Protectors, Floor Protectors and Hearth Extensions—with Revisions through October 2015
   308.2

   502.1, 503.4.1

1777—2007: Chimney Liners—with Revisions through October 2015
   501.12, 501.15.4

   616.1
APPENDIX A
SIZING AND CAPACITIES OF GAS PIPING

This appendix is informative and is not part of the code.

A.1 General piping considerations.

The first goal of determining the pipe sizing for a fuel gas piping system is to make sure that there is sufficient gas pressure at the inlet to each appliance. The majority of systems are residential and the appliances will all have the same, or nearly the same, requirement for minimum gas pressure at the appliance inlet. This pressure will be about 5-inch water column (w.c.) (1.25 kPa), which is enough for proper operation of the appliance regulator to deliver about 3.5-inches water column (w.c.) (875 kPa) to the burner itself. The pressure drop in the piping is subtracted from the source delivery pressure to verify that the minimum is available at the appliance.

There are other systems, however, where the required inlet pressure to the different appliances may be quite varied. In such cases, the greatest inlet pressure required must be satisfied, as well as the farthest appliance, which is almost always the critical appliance in small systems.

There is an additional requirement to be observed besides the capacity of the system at 100-percent flow. That requirement is that at minimum flow, the pressure at the inlet to any appliance does not exceed the pressure rating of the appliance regulator. This would seldom be of concern in small systems if the source pressure is $\frac{1}{2}$ psi (14-inch w.c.) (3.5 kPa) or less but it should be verified for systems with greater gas pressure at the point of supply.

To determine the size of piping used in a gas piping system, the following factors must be considered:

1. Allowable loss in pressure from point of delivery to appliance.
3. Length of piping and number of fittings.
4. Specific gravity of the gas.
5. Diversity factor.

For any gas piping system, or special appliance, or for conditions other than those covered by the tables provided in this code, such as longer runs, greater gas demands or greater pressure drops, the size of each gas piping system should be determined by standard engineering practices acceptable to the building official.

A.2 Description of tables.
A.2.1 General.
The quantity of gas to be provided at each outlet should be determined, whenever possible, directly from the manufacturer’s gas input Btu/h rating of the appliance that will be installed. In case the ratings of the appliances to be installed are not known, Table 402.2 shows the approximate consumption (in Btu per hour) of certain types of typical household appliances.

To obtain the cubic feet per hour of gas required, divide the total Btu/h input of all appliances by the average Btu heating value per cubic feet of the gas. The average Btu per cubic feet of the gas in the area of the installation can be obtained from the serving gas supplier.

A.2.2 Low pressure natural gas tables.
Capacities for gas at low pressure [less than 2.0 psig (13.8 kPa gauge)] in cubic feet per hour of 0.60 specific gravity gas for different sizes and lengths are shown in Tables 402.4(1) through 402.4(4) for iron pipe or equivalent rigid pipe; in Tables 402.4(8) through 402.4(11) for smooth wall semirigid tubing; in Tables 402.4(20) through 402.4(24) for polyethylene pipe and tubing; and in Tables 402.4(15) through 402.4(17) for corrugated stainless steel tubing. Tables 402.4(1), 402.4(8) and 402.4(20) are based upon a pressure drop of 0.3-inch w.c. (75 Pa), whereas Tables 402.4(2), 402.4(9), 402.4(15) and 402.4(21) are based upon a pressure drop of 0.5-inch w.c. (125 Pa). Tables 402.4(3), 402.4(4), 402.4(10), 402.4(11), 402.4(16) and 402.4(17) are special low-pressure applications based upon pressure drops greater than 0.5-inch w.c. (125 Pa). In using these tables, an allowance (in equivalent length of pipe) should be considered for any piping run with four or more fittings (see Table A.2.2).

<table>
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<tr>
<th>Nominal pipe size, inches</th>
<th>SCREWED FITTINGS</th>
<th>90° WELDING ELBOWS AND SMOOTH BENDS</th>
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<tr>
<td></td>
<td>0.622</td>
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<tr>
<td>5/8</td>
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TABLE A.2.2
EQUIVALENT LENGTHS OF PIPE FITTINGS AND VALVES

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### TABLE A.2.2—continued

#### EQUIVALENT LENGTHS OF PIPE FITTINGS AND VALVES

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<td>0.622</td>
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For SI: 1 foot = 305 mm, 1 degree = 0.01745 rad.

**Note:** Values for welded fittings are for conditions where bore is not obstructed by weld spatter or backing rings. If appreciably obstructed, use values for “Screwed Fittings.”

1. Flanged fittings have three-fourths the resistance of screwed elbows and tees.
2. Tabular figures give the extra resistance due to curvature alone to which should be added the full length of travel.
3. Small size socket-welding fittings are equivalent to miter elbows and miter tees.
4. Equivalent resistance in number of diameters of straight pipe computed for a value of \( t \cdot 0.0075 \) from the relation \( n - k/4f \).
5. For condition of minimum resistance where the centerline length of each miter is between \( d \) and \( 2d/2 \).
6. For pipe having other inside diameters, the equivalent resistance can be computed from the above \( n \) values.


### A.2.3 Undiluted liquefied petroleum tables

Capacities in thousands of Btu per hour of undiluted liquefied petroleum gases based on a pressure drop of 0.5-inch w.c. (125 Pa) for different sizes and lengths are shown in Table 402.4(28) for iron pipe or equivalent rigid pipe, in Table 402.4(30) for smooth wall semi-rigid tubing, in Table 402.4(32) for corrugated stainless steel tubing, and in Tables 402.4(35) and 402.4(37) for polyethylene plastic pipe and tubing. Tables 402.4(33) and 402.4(34) for corrugated stainless steel tubing and Table 402.4(36) for polyethylene plastic pipe are based on operating pressures greater than \( 1\frac{1}{2} \) pounds per square inch (psi) (3.5 kPa) and pressure drops greater than 0.5-inch w.c. (125 Pa). In using these tables, an allowance (in equivalent length of pipe) should be considered for any piping run with four or more fittings (see Table A.2.2).

### A.2.4 Natural gas specific gravity

Gas piping systems that are to be supplied with gas of a specific gravity of 0.70 or less can be
sized directly from the tables provided in this code, unless the building official specifies that a gravity factor be applied. Where the specific gravity of the gas is greater than 0.70, the gravity factor should be applied.

Application of the gravity factor converts the figures given in the tables provided in this code to capacities for another gas of different specific gravity. Such application is accomplished by multiplying the capacities given in the tables by the multipliers shown in Table A.2.4. In case the exact specific gravity does not appear in the table, choose the next higher value specific gravity shown.

### TABLE A.2.4

MULTIPLIERS TO BE USED WITH TABLES 402.4(1) THROUGH 402.4(22) WHERE THE SPECIFIC GRAVITY OF THE GAS IS OTHER THAN 0.60

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<th>MULTIPLIER</th>
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<td>1.16</td>
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<td>0.96</td>
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<td>0.61</td>
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<tr>
<td>0.70</td>
<td>0.93</td>
<td>1.70</td>
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<tr>
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<td>0.82</td>
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<td>0.54</td>
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### A.2.5 Higher pressure natural gas tables.

Capacities for gas at pressures 2.0 psig (13.8 kPa) or greater in cubic feet per hour of 0.60 specific gravity gas for different sizes and lengths are shown in Tables 402.4(5) through 402.4(7) for iron pipe or equivalent rigid pipe; Tables 402.4(12) to 402.4(14) for semirigid tubing; Tables 402.4(18) and 402.4(19) for corrugated stainless steel tubing; and Table 402.4(22) for polyethylene plastic pipe.

### A.3 Use of capacity tables.

#### A.3.1 Longest length method.

This sizing method is conservative in its approach by applying the maximum operating conditions in the system as the norm for the system and by setting the length of pipe used to size any given part of the piping system to the maximum value.

To determine the size of each section of gas piping in a system within the range of the capacity tables, proceed as follows (also see sample calculations included in this Appendix):

1. Divide the piping system into appropriate segments consistent with the presence of tees, branch lines and main runs. For each segment, determine the gas load (assuming all appliances operate simultaneously) and its overall length. An allowance

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(in equivalent length of pipe) as determined from Table A.2.2 shall be considered for piping segments that include four or more fittings.

(2) Determine the gas demand of each appliance to be attached to the piping system. Where Tables 402.4(1) through 402.4(24) are to be used to select the piping size, calculate the gas demand in terms of cubic feet per hour for each piping system outlet. Where Tables 402.4(25) through 402.4(37) are to be used to select the piping size, calculate the gas demand in terms of thousands of Btu per hour for each piping system outlet.

(3) Where the piping system is for use with other than undiluted liquefied petroleum gases, determine the design system pressure, the allowable loss in pressure (pressure drop), and specific gravity of the gas to be used in the piping system.

(4) Determine the length of piping from the point of delivery to the most remote outlet in the building/piping system.

(5) In the appropriate capacity table, select the row showing the measured length or the next longer length if the table does not give the exact length. This is the only length used in determining the size of any section of gas piping. If the gravity factor is to be applied, the values in the selected row of the table are multiplied by the appropriate multiplier from Table A.2.4.

(6) Use this horizontal row to locate ALL gas demand figures for this particular system of piping.

(7) Starting at the most remote outlet, find the gas demand for that outlet in the horizontal row just selected. If the exact figure of demand is not shown, choose the next larger figure left in the row.

(8) Opposite this demand figure, in the first row at the top, the correct size of gas piping will be found.

(9) Proceed in a similar manner for each outlet and each section of gas piping. For each section of piping, determine the total gas demand supplied by that section.

Where a large number of piping components (such as elbows, tees and valves) are installed in a pipe run, additional pressure loss can be accounted for by the use of equivalent lengths. Pressure loss across any piping component can be equated to the pressure drop through a length of pipe. The equivalent length of a combination of only four elbows/tees can result in a jump to the next larger length row, resulting in a significant reduction in capacity. The equivalent lengths in feet shown in Table A.2.2 have been computed on a basis that the inside diameter corresponds to that of Schedule 40 (standard-weight) steel pipe, which is close enough for most purposes involving other schedules of pipe. Where a more specific solution for equivalent length is desired, this can be made by multiplying the actual inside diameter of the pipe in inches by \( \frac{n}{12} \), or the actual inside diameter in feet by \( n \) (\( n \) can be read from the table heading). The equivalent length values can be used with reasonable accuracy for copper or copper alloy fittings and bends although the resistance per foot of copper or copper alloy pipe is less than that of steel. For copper
or copper alloy valves, however, the equivalent length of pipe should be taken as 45 percent longer than the values in the table, which are for steel pipe.

### A.3.2 Branch length method.
This sizing method reduces the amount of conservatism built into the traditional Longest Length Method. The longest length as measured from the meter to the furthest remote appliance is only used to size the initial parts of the overall piping system. The Branch Length Method is applied in the following manner:

1. Determine the gas load for each of the connected appliances.
2. Starting from the meter, divide the piping system into a number of connected segments, and determine the length and amount of gas that each segment would carry assuming that all appliances were operated simultaneously. An allowance (in equivalent length of pipe) as determined from Table A.2.2 should be considered for piping segments that include four or more fittings.
3. Determine the distance from the outlet of the gas meter to the appliance furthest removed from the meter.
4. Using the longest distance (found in Step 3), size each piping segment from the meter to the most remote appliance outlet.
5. For each of these piping segments, use the longest length and the calculated gas load for all of the connected appliances for the segment and begin the sizing process in Steps 6 through 8.
6. Referring to the appropriate sizing table (based on operating conditions and piping material), find the longest length distance in the first column or the next larger distance if the exact distance is not listed. The use of alternative operating pressures or pressure drops will require the use of a different sizing table, but will not alter the sizing methodology. In many cases, the use of alternative operating pressures or pressure drops will require the approval of both the building official and the local gas serving utility.
7. Trace across this row until the gas load is found or the closest larger capacity if the exact capacity is not listed.
8. Read up the table column and select the appropriate pipe size in the top row. Repeat Steps 6, 7 and 8 for each pipe segment in the longest run.
9. Size each remaining section of branch piping not previously sized by measuring the distance from the gas meter location to the most remote outlet in that branch, using the gas load of attached appliances and following the procedures of Steps 2 through 8.

### A.3.3 Hybrid pressure method.
The sizing of a 2 psi (13.8 kPa) gas piping system is performed using the traditional Longest Length Method but with modifications. The 2 psi (13.8 kPa) system consists of two independent pressure zones, and each zone is sized separately. The Hybrid Pressure Method is applied as follows:

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The sizing of the 2 psi (13.8 kPa) section (from the meter to the line regulator) is as follows:

1. Calculate the gas load (by adding up the name plate ratings) from all connected appliances. (In certain circumstances the installed gas load can be increased up to 50 percent to accommodate future addition of appliances.) Ensure that the line regulator capacity is adequate for the calculated gas load and that the required pressure drop (across the regulator) for that capacity does not exceed $\frac{3}{4}$ psi (5.2 kPa) for a 2 psi (13.8 kPa) system. If the pressure drop across the regulator is too high (for the connected gas load), select a larger regulator.

2. Measure the distance from the meter to the line regulator located inside the building.

3. If there are multiple line regulators, measure the distance from the meter to the regulator furthest removed from the meter.

4. The maximum allowable pressure drop for the 2 psi (13.8 kPa) section is 1 psi (6.9 kPa).

5. Referring to the appropriate sizing table (based on piping material) for 2 psi (13.8 kPa) systems with a 1 psi (6.9 kPa) pressure drop, find this distance in the first column, or the closest larger distance if the exact distance is not listed.

6. Trace across this row until the gas load is found or the closest larger capacity if the exact capacity is not listed.

7. Read up the table column to the top row and select the appropriate pipe size.

8. If there are multiple regulators in this portion of the piping system, each line segment must be sized for its actual gas load, but using the longest length previously determined above.

The low pressure section (all piping downstream of the line regulator) is sized as follows:

1. Determine the gas load for each of the connected appliances.

2. Starting from the line regulator, divide the piping system into a number of connected segments or independent parallel piping segments, and determine the amount of gas that each segment would carry assuming that all appliances were operated simultaneously. An allowance (in equivalent length of pipe) as determined from Table A.2.2 should be considered for piping segments that include four or more fittings.

3. For each piping segment, use the actual length or longest length (if there are sub-branchlines) and the calculated gas load for that segment and begin the sizing process as follows:

   a. Referring to the appropriate sizing table (based on operating pressure and piping material), find the longest length distance in the first column or the closest larger distance if the exact distance is not listed. The use of alternative operating...
pressures and/or pressure drops will require the use of a different sizing table, but will not alter the sizing methodology. In many cases, the use of alternative operating pressures and/or pressure drops can require the approval of the building official.

(b) Trace across this row until the appliance gas load is found or the closest larger capacity if the exact capacity is not listed.

(c) Read up the table column to the top row and select the appropriate pipe size.

(d) Repeat this process for each segment of the piping system.

A.3.4 Pressure drop per 100 feet method.
This sizing method is less conservative than the others, but it allows the designer to immediately see where the largest pressure drop occurs in the system. With this information, modifications can be made to bring the total drop to the critical appliance within the limitations that are presented to the designer.

Follow the procedures described in the Longest Length Method for Steps (1) through (4) and (9).

For each piping segment, calculate the pressure drop based on pipe size, length as a percentage of 100 feet (30 480 mm) and gas flow. Table A.3.4 shows pressure drop per 100 feet (30 480 mm) for pipe sizes from \( \frac{1}{2} \) inch (12.7 mm) through 2 inches (51 mm). The sum of pressure drops to the critical appliance is subtracted from the supply pressure to verify that sufficient pressure will be available. If not, the layout can be examined to find the high drop section(s) and sizing selections modified.

Note: Other values can be obtained by using the following equation:

\[
\text{Desired Value} = \frac{MBH \times \sqrt{\text{Desired Drop}}}{\text{Table Drop}}
\]

For example, if it is desired to get flow through \( \frac{3}{4} \) -inch (19.1 mm) pipe at 2 inches/100 feet, multiply the capacity of \( \frac{3}{4} \) -inch pipe at 1 inch/100 feet by the square root of the pressure ratio:

\[
147 MBH \times \frac{\sqrt{\frac{2\pi}{\text{w.c.}}}}{\sqrt{\frac{1\pi}{\text{w.c.}}}} = 147 \times 1.414 = 208 MBH
\]

(MBH = 1000 Btu/h)

**TABLE A.3.4**

**THOUSANDS OF BTU/H (MBH) OF NATURAL GAS PER 100 FEET OF PIPE AT VARIOUS PRESSURE DROPS AND PIPE DIAMETERS**
A.4 Use of sizing equations.

Capacities of smooth wall pipe or tubing can also be determined by using the following formulae:

(1) High Pressure [1.5 psi (10.3 kPa) and above]:

\[
Q = 181.6 \sqrt[5]{\frac{D^5 \times (P_1^2 - P_2^2) \times Y}{C_r \times \text{fba} \times L}}
\]

\[
= 2237 D^{2.623} \left[ \frac{(P_1^2 - P_2^2) \times Y}{C_r \times L} \right]^{0.541}
\]

(2) Low Pressure [Less than 1.5 psi (10.3 kPa)]:

\[
Q = 187.3 \sqrt[5]{\frac{D^5 \times \Delta H}{C_r \times \text{fba} \times L}}
\]

\[
= 2313 D^{2.623} \left( \frac{\Delta H}{C_r \times L} \right)^{0.541}
\]

where:

- \( Q \) = Rate, cubic feet per hour at 60°F and 30-inch mercury column
- \( D \) = Inside diameter of pipe, in.
- \( P_1 \) = Upstream pressure, psia
- \( P_2 \) = Downstream pressure, psia
- \( Y \) = Superexpansibility factor = 1/supercompressibility factor
- \( C_r \) = Factor for viscosity, density and temperature*

\[
= 0.00354 \left( \frac{Z}{S} \right)^{0.152}
\]

*Note: See Table 402.4 for \( Y \) and \( C_r \) for natural gas and propane.
Specific gravity of gas at 60°F and 30-inch mercury column (0.60 for natural gas, 1.50 for propane), or $S = 1488\mu$

Absolute temperature, °F or $T = t + 460$

Temperature, °F $t$

Viscosity of gas, centipoise (0.012 for natural gas, 0.008 for propane), or $Z = 1488\mu$

Base friction factor for air at 60°F (CF = 1) $fba$

Length of pipe, ft $L$

Pressure drop, in. w.c. ($27.7$ in. H$_2$O = 1 psi) $DH$

(For SI, see Section 402.4)

A.5 Pipe and tube diameters.

Where the internal diameter is determined by the formulas in Section 402.4, Tables A.5.1 and A.5.2 can be used to select the nominal or standard pipe size based on the calculated internal diameter.

**TABLE A.5.1**

**SCHEDULE 40 STEEL PIPE STANDARD SIZES**

<table>
<thead>
<tr>
<th>NOMINAL SIZE (inch)</th>
<th>INTERNAL DIAMETER (inch)</th>
<th>NOMINAL SIZE (inch)</th>
<th>INTERNAL DIAMETER (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{1}{4}$</td>
<td>0.364</td>
<td>$\frac{1}{2}$</td>
<td>1.610</td>
</tr>
<tr>
<td>$\frac{3}{8}$</td>
<td>0.493</td>
<td>2</td>
<td>2.067</td>
</tr>
<tr>
<td>$\frac{1}{2}$</td>
<td>0.622</td>
<td>$\frac{1}{2}$</td>
<td>2.469</td>
</tr>
<tr>
<td>$\frac{3}{4}$</td>
<td>0.824</td>
<td>3</td>
<td>3.068</td>
</tr>
<tr>
<td>1</td>
<td>1.049</td>
<td>$\frac{3}{2}$</td>
<td>3.548</td>
</tr>
<tr>
<td>$\frac{1}{4}$</td>
<td>1.380</td>
<td>4</td>
<td>4.026</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

**TABLE A.5.2**

**COPPER TUBE STANDARD SIZES**

<table>
<thead>
<tr>
<th>TUBE TYPE</th>
<th>NOMINAL OR STANDARD SIZE (inches)</th>
<th>INTERNAL DIAMETER (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>$\frac{1}{4}$</td>
<td>0.305</td>
</tr>
<tr>
<td>L</td>
<td>$\frac{1}{4}$</td>
<td>0.315</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Material</th>
<th>Fraction</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACR (D)</td>
<td>3/8</td>
<td>0.315</td>
</tr>
<tr>
<td>ACR (A)</td>
<td>3/8</td>
<td>0.311</td>
</tr>
<tr>
<td>K</td>
<td>3/8</td>
<td>0.402</td>
</tr>
<tr>
<td>L</td>
<td>3/8</td>
<td>0.430</td>
</tr>
<tr>
<td>ACR (D)</td>
<td>1/2</td>
<td>0.430</td>
</tr>
<tr>
<td>ACR (A)</td>
<td>1/2</td>
<td>0.436</td>
</tr>
<tr>
<td>K</td>
<td>1/2</td>
<td>0.527</td>
</tr>
<tr>
<td>L</td>
<td>1/2</td>
<td>0.545</td>
</tr>
<tr>
<td>ACR (D)</td>
<td>5/8</td>
<td>0.545</td>
</tr>
<tr>
<td>ACR (A)</td>
<td>5/8</td>
<td>0.555</td>
</tr>
<tr>
<td>K</td>
<td>5/8</td>
<td>0.652</td>
</tr>
<tr>
<td>L</td>
<td>5/8</td>
<td>0.666</td>
</tr>
<tr>
<td>ACR (D)</td>
<td>3/4</td>
<td>0.666</td>
</tr>
<tr>
<td>ACR (A)</td>
<td>3/4</td>
<td>0.680</td>
</tr>
<tr>
<td>K</td>
<td>3/4</td>
<td>0.745</td>
</tr>
<tr>
<td>L</td>
<td>3/4</td>
<td>0.785</td>
</tr>
<tr>
<td>ACR</td>
<td>7/8</td>
<td>0.785</td>
</tr>
<tr>
<td>K</td>
<td>1</td>
<td>0.995</td>
</tr>
<tr>
<td>L</td>
<td>1</td>
<td>1.025</td>
</tr>
<tr>
<td>ACR</td>
<td>1 1/8</td>
<td>1.025</td>
</tr>
<tr>
<td>K</td>
<td>1 1/4</td>
<td>1.245</td>
</tr>
<tr>
<td>L</td>
<td>1 1/4</td>
<td>1.265</td>
</tr>
<tr>
<td>ACR</td>
<td>1 1/8</td>
<td>1.265</td>
</tr>
<tr>
<td>K</td>
<td>1 1/2</td>
<td>1.481</td>
</tr>
<tr>
<td>L</td>
<td>1 1/2</td>
<td>1.505</td>
</tr>
</tbody>
</table>
A.6 Examples of piping system design and sizing.

A.6.1 Example 1: Longest length method.
Determine the required pipe size of each section and outlet of the piping system shown in Figure A.6.1, with a designated pressure drop of 0.5-inch w.c. (125 Pa) using the Longest Length Method. The gas to be used has 0.60 specific gravity and a heating value of 1,000 Btu/ft³ (37.5 MJ/m³).

Solution:

(1) Maximum gas demand for Outlet A:

\[
\text{Consumption (rating plate input)} = \frac{35,000 \text{ Btu per hour rating}}{1,000 \text{ Btu per cubic foot}} = 35 \text{ cubic feet per hour} = 35 \text{ cfm}
\]

Maximum gas demand for Outlet B:

\[
\text{Consumption} = \frac{75,000}{1,000} = 75 \text{ cfm}
\]

Maximum gas demand for Outlet C:

\[
\text{Consumption} = \frac{35,000}{1,000} = 35 \text{ cfm}
\]
Maximum gas demand for Outlet D:

\[
\text{Consumption} \quad \frac{\text{Btu of gas}}{1,000} = 100 \text{ cfm}
\]

(2) The length of pipe from the point of delivery to the most remote outlet (A) is 60 feet (18 288 mm). This is the only distance used.

(3) Using the row marked 60 feet (18 288 mm) in Table 402.4(2):

(a) Outlet A, supplying 35 cfh (0.99 m³/hr), requires \(\frac{1}{2}\)-inch pipe.

(b) Outlet B, supplying 75 cfh (2.12 m³/hr), requires \(\frac{3}{4}\)-inch pipe.

(c) Section 1, supplying Outlets A and B, or 110 cfh (3.11 m³/hr), requires \(\frac{3}{4}\)-inch pipe.

(d) Section 2, supplying Outlets C and D, or 135 cfh (3.82 m³/hr), requires \(\frac{3}{4}\)-inch pipe.

(e) Section 3, supplying Outlets A, B, C and D, or 245 cfh (6.94 m³/hr), requires 1-inch pipe.

(4) If a different gravity factor is applied to this example, the values in the row marked 60 feet (18 288 mm) of Table 402.4(2) would be multiplied by the appropriate multiplier from Table A.2.4 and the resulting cubic feet per hour values would be used to size the piping.
A.6.2 Example 2: Hybrid or dual pressure systems.
Determine the required CSST size of each section of the piping system shown in Figure A.6.2, with a designated pressure drop of 1 psi (6.9 kPa) for the 2 psi (13.8 kPa) section and 3-inch w.c. (0.75 kPa) pressure drop for the 13-inch w.c. (2.49 kPa) section. The gas to be used has 0.60 specific gravity and a heating value of 1,000 Btu/ft³ (37.5 MJ/m³).

Solution:

1. Size 2 psi (13.8 kPa) line using Table 402.4(18).
2. Size 10-inch w.c. (2.5 kPa) lines using Table 402.4(16).
3. Using the following, determine if sizing tables can be used.
   a. Total gas load shown in Figure A.6.2 equals 110 cfh (3.11 m³/hr).
   b. Determine pressure drop across regulator [see notes in Table 402.4(18)].
   c. If pressure drop across regulator exceeds $\frac{3}{4}$ psi (5.2 kPa), Table 402.4(18) cannot be used. Note: If pressure drop exceeds $\frac{3}{4}$ psi (5.2 kPa), then a larger regulator must be selected or an alternative sizing method must be used.
(d) Pressure drop across the line regulator [for 110 cfh (3.11 m³/hr)] is 4-inch w.c. (0.99 kPa) based on manufacturer’s performance data.

(e) Assume the CSST manufacturer has tubing sizes or EHDs of 13, 18, 23 and 30.

(4) Section A [2 psi (13.8 kPa) zone]
   (a) Distance from meter to regulator = 100 feet (30 480 mm).
   (b) Total load supplied by A = 110 cfh (3.11 m³/hr) (furnace + water heater + dryer).
   (c) Table 402.4(18) shows that EHD size 18 should be used.
      Note: It is not unusual to oversize the supply line by 25 to 50 percent of the as-installed load. EHD size 18 has a capacity of 189 cfh (5.35 m³/hr).

(5) Section B (low pressure zone)
   (a) Distance from regulator to furnace is 15 feet (4572 mm).
   (b) Load is 60 cfh (1.70 m³/hr).
   (c) Table 402.4(16) shows that EHD size 13 should be used.

(6) Section C (low pressure zone)
   (a) Distance from regulator to water heater is 10 feet (3048 mm).
   (b) Load is 30 cfh (0.85 m³/hr).
   (c) Table 402.4(16) shows that EHD size 13 should be used.

(7) Section D (low pressure zone)
   (a) Distance from regulator to dryer is 25 feet (7620 mm).
   (b) Load is 20 cfh (0.57 m³/hr).
   (c) Table 402.4(16) shows that EHD size 13 should be used.
A.6.3 Example 3: Branch length method.

Determine the required semirigid copper tubing size of each section of the piping system shown in Figure A.6.3, with a designated pressure drop of 1-inch w.c. (250 Pa) (using the Branch Length Method). The gas to be used has 0.60 specific gravity and a heating value of 1,000 Btu/ft³ (37.5 MJ/m³).

Solution:

(1) Section A

(a) The length of tubing from the point of delivery to the most remote appliance is 50 feet (15 240 mm), A + C.

(b) Use this longest length to size Sections A and C.

(c) Using the row marked 50 feet (15 240 mm) in Table 402.4(10), Section A, supplying 220 cfm (6.2 m³/hr) for four appliances requires 1-inch tubing.

(2) Section B

(a) The length of tubing from the point of delivery to the range/oven at the end of Section B is 30 feet (9144 mm), A + B.

(b) Use this branch length to size Section B only.
(c) Using the row marked 30 feet (9144 mm) in Table 402.4(10), Section B, supplying 75 cfh (2.12 m³/hr) for the range/oven requires \( \frac{1}{2} \)-inch tubing.

(3) Section C

(a) The length of tubing from the point of delivery to the dryer at the end of Section C is 50 feet (15 240 mm), A + C.

(b) Use this branch length (which is also the longest length) to size Section C.

(c) Using the row marked 50 feet (15 240 mm) in Table 402.4(10), Section C, supplying 30 cfh (0.85 m³/hr) for the dryer requires \( \frac{3}{8} \)-inch tubing.

(4) Section D

(a) The length of tubing from the point of delivery to the water heater at the end of Section D is 30 feet (9144 mm), A + D.

(b) Use this branch length to size Section D only.

(c) Using the row marked 30 feet (9144 mm) in Table 402.4(10), Section D, supplying 35 cfh (0.99 m³/hr) for the water heater requires \( \frac{3}{8} \)-inch tubing.

(5) Section E

(a) The length of tubing from the point of delivery to the furnace at the end of Section E is 30 feet (9144 mm), A + E.

(b) Use this branch length to size Section E only.

(c) Using the row marked 30 feet (9144 mm) in Table 402.4(10), Section E, supplying 80 cfh (2.26 m³/hr) for the furnace requires \( \frac{1}{2} \)-inch tubing.
A.6.4 Example 4: Modification to existing piping system.
Determine the required CSST size for Section G (retrofit application) of the piping system shown in Figure A.6.4, with a designated pressure drop of 0.5-inch w.c. (125 Pa) using the branch length method. The gas to be used has 0.60 specific gravity and a heating value of 1,000 Btu/ft$^3$ (37.5 MJ/m$^3$).

**Solution:**

1. The length of pipe and CSST from the point of delivery to the retrofit appliance (barbecue) at the end of Section G is 40 feet (12 192 mm), A + B + G.
2. Use this branch length to size Section G.
3. Assume the CSST manufacturer has tubing sizes or EHDs of 13, 18, 23 and 30.
4. Using the row marked 40 feet (12 192 mm) in Table 402.4(15), Section G, supplying 40 cfh (1.13 m$^3$/hr) for the barbecue requires EHD 18 CSST.
5. The sizing of Sections A, B, F and E must be checked to ensure adequate gas carrying capacity since an appliance has been added to the piping system (see A.6.1 for details).
A.6.5 Example 5: Calculating pressure drops due to temperature changes.
A test piping system is installed on a warm autumn afternoon when the temperature is 70°F (21°C). In accordance with local custom, the new piping system is subjected to an air pressure test at 20 psig (138 kPa). Overnight, the temperature drops and when the inspector shows up first thing in the morning the temperature is 40°F (4°C).

If the volume of the piping system is unchanged, then the formula based on Boyle’s and Charles’ law for determining the new pressure at a reduced temperature is as follows:

\[
\frac{T_1}{T_2} = \frac{P_1}{P_2}
\]

where:

\[T_1 = \text{Initial temperature, absolute } (T_1 + 459)\]
\[T_2 = \text{Final temperature, absolute } (T_2 + 459)\]
\[P_1 = \text{Initial pressure, psia } (P_1 + 14.7)\]
\[P_2 = \text{Final pressure, psia } (P_2 + 14.7)\]

\[
\frac{(70 + 459)}{(40 + 459)} = \frac{(20 + 14.7)}{(P_2 + 14.7)}
\]

\[
\frac{529}{499} = \frac{34.7}{(P_2 + 14.7)}
\]
\[(P_2 + 14.7) \times \frac{529}{499} = 34.7\]

\[(P_2 + 14.7) \times \frac{34.7}{1.060} = \]

\[
P_2 = 32.7 - 14.7\]

\[
P_2 = 18 \text{ psig}\]

Therefore, the gauge could be expected to register 18 psig (124 kPa) when the ambient temperature is 40°F (4°C).

**A.6.6 Example 6: Pressure drop per 100 feet of pipe method.**

Using the layout shown in Figure A.6.1 and \(DH = \text{pressure drop, in w.c.} \) (27.7 in. H \(\text{O} = 1 \text{ psi})

proceed as follows:

1. Length to A = 20 feet, with 35,000 Btu/hr.
   
   For \(\frac{1}{2}\)-inch pipe, \(\Delta H = \frac{20 \text{ feet}}{100 \text{ feet}} \times 0.3 \text{ inch w.c.} = 0.06 \text{ in w.c.}\)

2. Length to B = 15 feet, with 75,000 Btu/hr.
   
   For \(\frac{3}{4}\)-inch pipe, \(\Delta H = \frac{15 \text{ feet}}{100 \text{ feet}} \times 0.3 \text{ inch w.c.} = 0.045 \text{ in w.c.}\)

3. Section 1 = 10 feet, with 110,000 Btu/hr. Here there is a choice:
   
   For 1 inch pipe: \(\Delta H = \frac{10 \text{ feet}}{100 \text{ feet}} \times 0.2 \text{ inch w.c.} = 0.02 \text{ in w.c.}\)
   
   For \(\frac{3}{4}\)-inch pipe: \(\Delta H = \frac{10 \text{ feet}}{100 \text{ feet}} \times [0.5 \text{ inch w.c.} + \frac{(110,000 \text{ Btu/hr} - 104,000 \text{ Btu/hr})}{(147,000 \text{ Btu/hr} - 104,000 \text{ Btu/hr})} \times (1.0 \text{ inches w.c.} - 0.5 \text{ inch w.c.})] = 0.1 \times 0.57 \text{ inch w.c.} \approx 0.06 \text{ inch w.c.}\)

   *Note that the pressure drop between 104,000 Btu/hr and 147,000 Btu/hr has been interpolated as 110,000 Btu/hr.*

4. Section 2 = 20 feet, with 135,000 Btu/hr. Here there is a choice:
   
   For 1-inch pipe: \(\Delta H = \frac{20 \text{ feet}}{100 \text{ feet}} \times [0.2 \text{ inch w.c.} + \frac{(14,000 \text{ Btu/hr})}{(27,000 \text{ Btu/hr})} \times 0.1 \text{ inch w.c.}] = 0.05 \text{ inch w.c.}\)

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Note that the pressure drop between 121,000 Btu/hr and 148,000 Btu/hr has been interpolated as 135,000 Btu/hr, but interpolation for the \( \frac{3}{4} \)-inch pipe (trivial for 104,000 Btu/hr to 147,000 Btu/hr) was not used.

(5) Section 3 = 30 feet, with 245,000 Btu/hr. Here there is a choice:

For 1-inch pipe: \( \Delta H = \frac{30 \text{ feet}}{100 \text{ feet}} \times 1.0 \text{ inches w.c.} = 0.3 \text{ inch w.c.} \)

For \( \frac{1}{4} \)-inch pipe: \( \Delta H = \frac{30 \text{ feet}}{100 \text{ feet}} \times 0.2 \text{ inch w.c.} = 0.06 \text{ inch w.c.} \)

Note that interpolation for these options is ignored since the table values are close to the 245,000 Btu/hr carried by that section.

(6) The total pressure drop is the sum of the section approaching A, Sections 1 and 3, or either of the following, depending on whether an absolute minimum is needed or the larger drop can be accommodated.

Minimum pressure drop to farthest appliance:

\( \Delta H = 0.06 \text{ inch w.c.} + 0.02 \text{ inch w.c.} + 0.06 \text{ inch w.c.} = 0.14 \text{ inch w.c.} \)

Larger pressure drop to the farthest appliance:

\( \Delta H = 0.06 \text{ inch w.c.} + 0.06 \text{ inch w.c.} + 0.3 \text{ inch w.c.} = 0.42 \text{ inch w.c.} \)

Notice that Section 2 and the run to B do not enter into this calculation, provided that the appliances have similar input pressure requirements.

For SI units: 1 Btu/hr = 0.293 W, 1 cubic foot = 0.028 \( m^3 \), 1 foot = 0.305 m, 1 inch w.c. = 249 Pa.
APPENDIX B
SIZING OF VENTING SYSTEMS SERVING APPLIANCES EQUIPPED WITH DRAFT HOODS, CATEGORY I APPLIANCES AND APPLIANCES LISTED FOR USE WITH TYPE B VENTS

This appendix is informative and is not part of the code.

EXAMPLES USING SINGLE APPLIANCE VENTING TABLES

Example 1: Single draft-hood-equipped appliance.

An installer has a 120,000 British thermal unit (Btu) per hour input appliance with a 5-inch-diameter draft hood outlet that needs to be vented into a 10-foot-high Type B vent system. What size vent should be used assuming (a) a 5-foot lateral single-wall metal vent connector is used with two 90-degree elbows, or (b) a 5-foot lateral single-wall metal vent connector is used with three 90-degree elbows in the vent system?

Solution:

Table 504.2(2) should be used to solve this problem, because single-wall metal vent connectors are being used with a Type B vent.

(a) Read down the first column in Table 504.2(2) until the row associated with a 10-foot height and 5-foot lateral is found. Read across this row until a vent capacity greater than 120,000 Btu per hour is located in the shaded columns labeled “NAT Max” for draft-hood-equipped appliances. In this case, a 5-inch-diameter vent has a capacity of 122,000 Btu per hour and can be used for this application.

(b) If three 90-degree elbows are used in the vent system, then the maximum vent capacity listed in the tables must be reduced by 10 percent (see Section 504.2.3 for single appliance vents). This implies that the 5-inch-diameter vent has an adjusted capacity of only 110,000 Btu per hour. In this case, the vent system must be increased to 6 inches in diameter (see calculations below).

\[
122,000 \times 0.90 = 110,000 \text{ for 5-inch vent}
\]

From Table 504.2(2), Select 6-inch vent

\[
186,000 \times 0.90 = 167,000; \text{ This is greater than the required 120,000. Therefore, use a 6-inch vent and connector where three elbows are used.}
\]

Example 2: Single fan-assisted appliance.

An installer has an 80,000 Btu per hour input fan-assisted appliance that must be installed using 10 feet of lateral connector attached to a 30-foot-high Type B vent. Two 90-degree elbows are needed for the installation. Can a single-wall metal vent connector be used for this application?

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Solution:

Table 504.2(2) refers to the use of single-wall metal vent connectors with Type B vent. In the first column find the row associated with a 30-foot height and a 10-foot lateral. Read across this row, looking at the FAN Min and FAN Max columns, to find that a 3-inch-diameter single-wall metal vent connector is not recommended. Moving to the next larger size single wall connector (4 inches), note that a 4-inch-diameter single-wall metal connector has a recommended minimum vent capacity of 91,000 Btu per hour and a recommended maximum vent capacity of 144,000 Btu per hour. The 80,000 Btu per hour fan-assisted appliance is outside this range, so the conclusion is that a single-wall metal vent connector cannot be used to vent this appliance using 10 feet of lateral for the connector.

However, if the 80,000 Btu per hour input appliance could be moved to within 5 feet of the vertical vent, then a 4-inch single-wall metal connector could be used to vent the appliance. Table 504.2(2) shows the acceptable range of vent capacities for a 4-inch vent with 5 feet of lateral to be between 72,000 Btu per hour and 157,000 Btu per hour.

If the appliance cannot be moved closer to the vertical vent, then Type B vent could be used as the connector material. In this case, Table 504.2(1) shows that for a 30-foot high vent with 10 feet of lateral, the acceptable range of vent capacities for a 4-inch-diameter vent attached to a fan-assisted appliance is between 37,000 Btu per hour and 150,000 Btu per hour.

Example 3: Interpolating between table values.

An installer has an 80,000 Btu per hour input appliance with a 4-inch-diameter draft hood outlet that needs to be vented into a 12-foot-high Type B vent. The vent connector has a 5-foot lateral length and is also Type B. Can this appliance be vented using a 4-inch-diameter vent?

Solution:

Table 504.2(1) is used in the case of an all Type B vent system. However, since there is no entry in Table 504.2(1) for a height of 12 feet, interpolation must be used. Read down the 4-inch diameter NAT Max column to the row associated with 10-foot height and 5-foot lateral to find the capacity value of 77,000 Btu per hour. Read further down to the 15-foot height, 5-foot lateral row to find the capacity value of 87,000 Btu per hour. The difference between the 15-foot height capacity value and the 10-foot height capacity value is 10,000 Btu per hour. The capacity for a vent system with a 12-foot height is equal to the capacity for a 10-foot height plus \( \frac{2}{5} \) of the difference between the 10-foot and 15-foot height values, or 77,000 + \( \frac{2}{5} \) (10,000) = 81,000 Btu per hour. Therefore, a 4-inch-diameter vent can be used in the installation.

EXAMPLES USING COMMON VENTING TABLES

Example 4: Common venting two draft-hood-equipped appliances.

A 35,000 Btu per hour water heater is to be common vented with a 150,000 Btu per hour furnace using a common vent with a total height of 30 feet. The connector rise is 2 feet for the water heater.
with a horizontal length of 4 feet. The connector rise for the furnace is 3 feet with a horizontal length of 8 feet. Assume single-wall metal connectors will be used with Type B vent. What size connectors and combined vent should be used in this installation?

Solution:

Table 504.3(2) should be used to size single-wall metal vent connectors attached to Type B vertical vents. In the vent connector capacity portion of Table 504.3(2), find the row associated with a 30-foot vent height. For a 2-foot rise on the vent connector for the water heater, read the shaded columns for draft-hood-equipped appliances to find that a 3-inch-diameter vent connector has a capacity of 37,000 Btu per hour. Therefore, a 3-inch single-wall metal vent connector can be used with the water heater. For a draft-hood-equipped furnace with a 3-foot rise, read across the appropriate row to find that a 5-inch-diameter vent connector has a maximum capacity of 120,000 Btu per hour (which is too small for the furnace) and a 6-inch-diameter vent connector has a maximum vent capacity of 172,000 Btu per hour. Therefore, a 6-inch-diameter vent connector should be used with the 150,000 Btu per hour furnace. Since both vent connector horizontal lengths are less than the maximum lengths listed in Section 504.3.2, the table values can be used without adjustments.

In the common vent capacity portion of Table 504.3(2), find the row associated with a 30-foot vent height and read over to the NAT + NAT portion of the 6-inch-diameter column to find a maximum combined capacity of 257,000 Btu per hour. Since the two appliances total only 185,000 Btu per hour, a 6-inch common vent can be used.

Example 5a: Common venting a draft-hood-equipped water heater with a fan-assisted furnace into a Type B vent.

In this case, a 35,000 Btu per hour input draft-hood-equipped water heater with a 4-inch-diameter draft hood outlet, 2 feet of connector rise, and 4 feet of horizontal length is to be common vented with a 100,000 Btu per hour fan-assisted furnace with a 4-inch-diameter flue collar, 3 feet of connector rise, and 6 feet of horizontal length. The common vent consists of a 30-foot height of Type B vent. What are the recommended vent diameters for each connector and the common vent? The installer would like to use a single-wall metal vent connector.

Solution: [Table 504.3(2)].

Water Heater Vent Connector Diameter. Since the water heater vent connector horizontal length of 4 feet is less than the maximum value listed in Section 504.3.2, the venting table values can be used without adjustments. Using the Vent Connector Capacity portion of Table 504.3(2), read down the Total Vent Height (H) column to 30 feet and read across the 2-foot Connector Rise (R) row to the first Btu per hour rating in the NAT Max column that is equal to or greater than the water heater input rating. The table shows that a 3-inch vent connector has a maximum input rating of 37,000 Btu per hour. Although this is greater than the water heater input rating, a 3-inch vent connector is prohibited by Section 504.3.21. A 4-inch vent connector has a maximum input rating of 67,000 Btu per hour and is equal to the draft hood outlet diameter. A 4-inch vent connector is selected. Since the water heater is equipped with a draft hood, there are no minimum input rating restrictions.
Furnace Vent Connector Diameter. Using the Vent Connector Capacity portion of Table 504.3(2), read down the Total Vent Height \((H)\) column to 30 feet and across the 3-foot Connector Rise \((R)\) row. Since the furnace has a fan-assisted combustion system, find the first FAN Max column with a Btu per hour rating greater than the furnace input rating. The 4-inch vent connector has a maximum input rating of 119,000 Btu per hour and a minimum input rating of 85,000 Btu per hour. The 100,000 Btu per hour furnace in this example falls within this range, so a 4-inch connector is adequate. Since the furnace vent connector horizontal length of 6 feet does not exceed the maximum value listed in Section 504.3.2, the venting table values can be used without adjustment. If the furnace had an input rating of 80,000 Btu per hour, then a Type B vent connector [see Table 504.3(1)] would be needed in order to meet the minimum capacity limit.

Common Vent Diameter. The total input to the common vent is 135,000 Btu per hour. Using the Common Vent Capacity portion of Table 504.3(2), read down the Total Vent Height \((H)\) column to 30 feet and across this row to find the smallest vent diameter in the FAN + NAT column that has a Btu per hour rating equal to or greater than 135,000 Btu per hour. The 4-inch common vent has a capacity of 132,000 Btu per hour and the 5-inch common vent has a capacity of 202,000 Btu per hour. Therefore, the 5-inch common vent should be used in this example.

Summary. In this example, the installer can use a 4-inch diameter, single-wall metal vent connector for the water heater and a 4-inch-diameter, single-wall metal vent connector for the furnace. The common vent should be a 5-inch-diameter Type B vent.

Example 5b: Common venting into a masonry chimney.

In this case, the water heater and fan-assisted furnace of Example 5a are to be common vented into a clay tile-lined masonry chimney with a 30-foot height. The chimney is not exposed to the outdoors below the roof line. The internal dimensions of the clay tile liner are nominally 8 inches by 12 inches. Assuming the same vent connector heights, laterals, and materials found in Example 5a, what are the recommended vent connector diameters, and is this an acceptable installation?

Solution:

Table 504.3(4) is used to size common venting installations involving single-wall connectors into masonry chimneys.

Water Heater Vent Connector Diameter. Using Table 504.3(4), Vent Connector Capacity, read down the Total Vent Height \((H)\) column to 30 feet, and read across the 2-foot Connector Rise \((R)\) row to the first Btu per hour rating in the NAT Max column that is equal to or greater than the water heater input rating. The table shows that a 3-inch vent connector has a maximum input of only 31,000 Btu per hour while a 4-inch vent connector has a maximum input of 57,000 Btu per hour. A 4-inch vent connector must therefore be used.

Furnace Vent Connector Diameter. Using the Vent Connector Capacity portion of Table 504.3(4), read down the Total Vent Height \((H)\) column to 30 feet and across the 3-foot Connector Rise \((R)\) row. Since the furnace has a fan-assisted combustion system, find the first FAN Max column with a Btu per hour rating greater than the furnace input rating. The 4-inch vent connector has a maximum input rating of 127,000 Btu per hour and a minimum input rating of 95,000 Btu per hour.
per hour. The 100,000 Btu per hour furnace in this example falls within this range, so a 4-inch connector is adequate.

Masonry Chimney. From Table B-1, the equivalent area for a nominal liner size of 8 inches by 12 inches is 63.6 square inches. Using Table 504.3(4), Common Vent Capacity, read down the FAN + NAT column under the Minimum Internal Area of Chimney value of 63 to the row for 30-foot height to find a capacity value of 739,000 Btu per hour. The combined input rating of the furnace and water heater, 135,000 Btu per hour, is less than the table value, so this is an acceptable installation.

Section 504.3.17 requires the common vent area to be not greater than seven times the smallest listed appliance categorized vent area, flue collar area, or draft hood outlet area. Both appliances in this installation have 4-inch-diameter outlets. From Table B-1, the equivalent area for an inside diameter of 4 inches is 12.2 square inches. Seven times 12.2 equals 85.4, which is greater than 63.6, so this configuration is acceptable.

Example 5c: Common venting into an exterior masonry chimney.

In this case, the water heater and fan-assisted furnace of Examples 5a and 5b are to be common vented into an exterior masonry chimney. The chimney height, clay tile liner dimensions, and vent connector heights and laterals are the same as in Example 5b. This system is being installed in Charlotte, North Carolina. Does this exterior masonry chimney need to be relined? If so, what corrugated metallic liner size is recommended? What vent connector diameters are recommended?

Solution:

In accordance with Section 504.3.20, Type B vent connectors are required to be used with exterior masonry chimneys. Use Tables 504.3(7a), (7b) to size FAN+NAT common venting installations involving Type-B double wall connectors into exterior masonry chimneys.

The local 99-percent winter design temperature needed to use Table 504.3(7b) can be found in the ASHRAE Handbook of Fundamentals. For Charlotte, North Carolina, this design temperature is 19°F.

Chimney Liner Requirement. As in Example 5b, use the 63 square inch Internal Area columns for this size clay tile liner. Read down the 63 square inch column of Table 504.3(7a) to the 30-foot height row to find that the combined appliance maximum input is 747,000 Btu per hour. The combined input rating of the appliances in this installation, 135,000 Btu per hour, is less than the maximum value, so this criterion is satisfied. Table 504.3(7b), at a 19°F design temperature, and at the same vent height and internal area used above, shows that the minimum allowable input rating of a space-heating appliance is 470,000 Btu per hour. The furnace input rating of 100,000 Btu per hour is less than this minimum value. So this criterion is not satisfied, and an alternative venting design needs to be used, such as a Type B vent shown in Example 5a or a listed chimney liner system shown in the remainder of the example.

In accordance with Section 504.3.19, Table 504.3(1) or 504.3(2) is used for sizing corrugated metallic liners in masonry chimneys, with the maximum common vent capacities reduced by 20 percent. This example will be continued assuming Type B vent connectors.
Water Heater Vent Connector Diameter. Using Table 504.3(1), Vent Connector Capacity, read down the Total Vent Height \((H)\) column to 30 feet, and read across the 2-foot Connector Rise \((R)\) row to the first Btu/h rating in the NAT Max column that is equal to or greater than the water heater input rating. The table shows that a 3-inch vent connector has a maximum capacity of 39,000 Btu/h. Although this rating is greater than the water heater input rating, a 3-inch vent connector is prohibited by Section 504.3.21. A 4-inch vent connector has a maximum input rating of 70,000 Btu/h and is equal to the draft hood outlet diameter. A 4-inch vent connector is selected.

Furnace Vent Connector Diameter. Using Table 504.3(1), Vent Connector Capacity, read down the Vent Height \((H)\) column to 30 feet, and read across the 3-foot Connector Rise \((R)\) row to the first Btu per hour rating in the FAN Max column that is equal to or greater than the furnace input rating. The 100,000 Btu per hour furnace in this example falls within this range, so a 4-inch connector is adequate.

Chimney Liner Diameter. The total input to the common vent is 135,000 Btu per hour. Using the Common Vent Capacity Portion of Table 504.3(1), read down the Vent Height \((H)\) column to 30 feet and across this row to find the smallest vent diameter in the FAN+NAT column that has a Btu per hour rating greater than 135,000 Btu per hour. The 4-inch common vent has a capacity of 138,000 Btu per hour. Reducing the maximum capacity by 20 percent (Section 504.3.19) results in a maximum capacity for a 4-inch corrugated liner of 110,000 Btu per hour, less than the total input of 135,000 Btu per hour. So a larger liner is needed. The 5-inch common vent capacity listed in Table 504.3(1) is 210,000 Btu per hour, and after reducing by 20 percent is 168,000 Btu per hour. Therefore, a 5-inch corrugated metal liner should be used in this example.

Single-Wall Connectors. Once it has been established that relining the chimney is necessary, Type B double-wall vent connectors are not specifically required. This example could be redone using Table 504.3(2) for single-wall vent connectors. For this case, the vent connector and liner diameters would be the same as found above with Type B double-wall connectors.
Table 504.2(1) is used when sizing Type B double-wall gas vent connected directly to the appliance. 
**Note:** The appliance can be either Category I draft hood equipped or fan-assisted type.

**FIGURE B-1**

**TYPE B DOUBLE-WALL VENT SYSTEM SERVING A SINGLE APPLIANCE WITH A TYPE B DOUBLE-WALL VENT**

For SI: 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

Table 504.2(2) is used when sizing a single-wall metal vent connector attached to a Type B double-wall gas vent. 
**Note:** The appliance can be either Category I draft hood equipped or fan-assisted type.

**FIGURE B-2**

**TYPE B DOUBLE-WALL VENT SYSTEM SERVING A SINGLE APPLIANCE WITH A SINGLE-WALL METAL VENT CONNECTOR**
Table 504.2(3) is used when sizing a Type B double-wall gas vent connector attached to a tile-lined masonry chimney.

Note: "A" is the equivalent cross-sectional area of the tile liner.
Note: The appliance can be either Category I draft hood equipped or fan-assisted type.

**FIGURE B-3**  
VENT SYSTEM SERVING A SINGLE APPLIANCE  
WITH A MASONRY CHIMNEY OF TYPE B  
DOUBLE-WALL VENT CONNECTOR
Table 504.2(4) is used when sizing a single-wall vent connector attached to a tile-lined masonry chimney.

**Note:** “A” is the equivalent cross-sectional area of the tile liner.

**Note:** The appliance can be either Category I draft hood equipped or fan-assisted type.

### FIGURE B-4
VENT SYSTEM SERVING A SINGLE APPLIANCE USING A MASONRY CHIMNEY AND A SINGLE-WALL METAL VENT CONNECTOR

Asbestos cement Type B or single-wall metal vent serving a single draft-hood-equipped appliance [see Table 504.2(5)].

### FIGURE B-5
ASBESTOS CEMENT TYPE B OR SINGLE-WALL METAL VENT SYSTEM SERVING A SINGLE DRAFT-HOOD-EQUIPPED APPLIANCE
Table 504.3(1) is used when sizing Type B double-wall vent connectors attached to a Type B double-wall common vent.  

**Note:** Each appliance can be either Category I draft hood equipped or fan-assisted type.

**FIGURE B-6**

VENT SYSTEM SERVING TWO OR MORE APPLIANCES WITH TYPE B DOUBLE-WALL VENT AND TYPE B DOUBLE-WALL VENT CONNECTOR
Table 504.3(2) is used when sizing single-wall vent connectors attached to a Type B double-wall common vent. **Note:** Each appliance can be either Category I draft hood equipped or fan-assisted type.

**FIGURE B-7**
VENT SYSTEM SERVING TWO OR MORE APPLIANCES WITH TYPE B DOUBLE-WALL VENT AND SINGLE-WALL METAL VENT CONNECTORS

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Table 504.3(3) is used when sizing Type B double-wall vent connectors attached to a tile-lined masonry chimney.  
**Note:** "A" is the equivalent cross-sectional area of the tile liner.  
**Note:** Each appliance can be either Category I draft hood equipped or fan-assisted type.

**FIGURE B-8**  
MASONRY CHIMNEY SERVING TWO OR MORE APPLIANCES  
WITH TYPE B DOUBLE-WALL VENT CONNECTOR

Table 504.3(4) is used when sizing single-wall metal vent connectors attached to a tile-lined masonry chimney.  
**Note:** "A" is the equivalent cross-sectional area of the tile liner.  
**Note:** Each appliance can be either Category I draft hood equipped or fan-assisted type.

**FIGURE B-9**  
MASONRY CHIMNEY SERVING TWO OR MORE APPLIANCES  
WITH SINGLE-WALL METAL VENT CONNECTORS
Asbestos cement Type B or single-wall metal pipe vent serving two or more draft-hood-equipped appliances [see Table 504.3(5)].

**FIGURE B-10**

ASBESTOS CEMENT TYPE B OR SINGLE-WALL METAL VENT SYSTEM SERVING TWO OR MORE DRAFT-HOOD-EQUIPPED APPLIANCES
Example: Manifolded Common Vent Connector LM shall be not greater than 18 times the common vent connector manifold inside diameter; i.e., a 4-inch (102 mm) inside diameter common vent connector manifold shall not exceed 72 inches (1829 mm) in length (see Section 504.3.4).

**Note:** This is an illustration of a typical manifolded vent connector. Different appliance, vent connector, or common vent types are possible. Consult Section 502.3.

**FIGURE B-11**
**USE OF MANIFOLD COMMON VENT CONNECTOR**

![Diagram of a manifolded common vent connector]

Example: Offset Common Vent

**Note:** This is an illustration of a typical offset vent. Different appliance, vent connector, or vent types are possible. Consult Sections 504.2 and 504.3.

**FIGURE B-12**
**USE OF OFFSET COMMON VENT**

![Diagram of an offset common vent]
Vent connector size depends on:
- Input
- Rise
- Available total height “H”
- Table 504.3(1) connectors

Common vent size depends on:
- Combined inputs
- Available total height “H”
- Table 504.3(1) common vent

FIGURE B-13
MULTISTORY GAS VENT DESIGN PROCEDURE
FOR EACH SEGMENT OF SYSTEM
Principles of design of multistory vents using vent connector and common vent design tables (see Sections 504.3.11 through 504.3.17).

FIGURE B-14
MULTISTORY VENT SYSTEMS

For SI: 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

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FIGURE B-15 (EXAMPLE 1)
SINGLE DRAFT-HOOD-EQUIPPED APPLIANCE

For SI: 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

FIGURE B-16 (EXAMPLE 2)
SINGLE FAN-ASSISTED APPLIANCE
FIGURE B-17 (EXAMPLE 4)
COMMON VENTING TWO DRAFTHOOD-EQUIPPED APPLIANCES
FIGURE B-18 (EXAMPLE 5A)
COMMON VENTING A DRAFT HOOD WITH A FAN-ASSISTED FURNACE INTO A TYPE B DOUBLE-WALL COMMON VENT

FIGURE B-19

NFGC:
99% Winter Design Temperatures for the Contiguous United States
This map is a necessarily generalized guide to temperatures in the contiguous United States. Temperatures shown for areas such as mountainous regions and large urban centers are not necessarily accurate. The climate data used to develop this map are from the ASHRAE Handbook—Fundamentals (Climate Conditions for the United States). For 99% winter design temperature in Alaska, consult the ASHRAE Handbook—Fundamentals. 99% winter design temperatures for Hawaii are greater than 37°F.

TABLE B-1
MASONRY CHIMNEY LINER DIMENSIONS WITH CIRCULAR EQUIVALENTS 

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<th>EQUIVALENT AREA (square inches)</th>
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<td>36</td>
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</table>

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 m².

a. Where liner sizes differ dimensionally from those shown in Table B-1, equivalent diameters can be determined from published tables for square and rectangular ducts of equivalent carrying capacity or by other engineering methods.
APPENDIX C
EXIT TERMINALS OF MECHANICAL DRAFT AND DIRECT-VENT VENTING SYSTEMS

This appendix is informative and is not part of the code.

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W
APPENDIX D  
RECOMMENDED PROCEDURE FOR SAFETY INSPECTION OF AN EXISTING APPLIANCE INSTALLATION  
This appendix is informative and is not part of this code.

D.1 General.  
The following procedure is intended as a guide to aid in determining that an appliance is properly installed and is in a safe condition for continued use. Where a gas supplier performs an inspection, their written procedures should be followed.

D.1.1 Application.  
This procedure is intended for existing residential installations of a furnace, boiler, room heater, water heater, cooking appliance, fireplace appliance and clothes dryer. This procedure should be performed prior to any attempt to modify the appliance installation or building envelope.

D.1.2 Weatherization programs.  
Before a building envelope is to be modified as part of a weatherization program, the existing appliance installation should be inspected in accordance with these procedures. After all unsafe conditions are repaired, and immediately after the weatherization is complete, the appliance inspections in D.5.2 are to be repeated.

D.1.3 Inspection procedure.  
The safety of the building occupant and inspector are to be determined as the first step as described in D.2. Only after the ambient environment is found to be safe should inspections of gas piping and appliances be undertaken. It is recommended that all inspections described in D.3, D.4, and D.6, where the appliance is in the off mode, be completed and any unsafe conditions repaired or corrected before continuing with inspections of an operating appliance described in D.5 and D.6.

D.1.4 Manufacturer instructions.  
Where available, the manufacturer’s installation and operating instructions for the installed appliances should be used as part of these inspection procedures to determine if it is installed correctly and is operating properly.

D.1.5 Instruments.  
The inspection procedures include measuring for fuel gas and carbon monoxide (CO) and will require the use of a combustible gas detector (CGD) and a CO detector. It is recommended that both types of detectors be listed. Prior to any inspection, the detectors should be calibrated or tested in accordance with the manufacturer’s instructions. In addition, it is recommended that the detectors have the following minimum specifications.

(1) Gas Detector. The CGD should be capable of indicating the presence of the type of fuel gas for which it is to be used (e.g. natural gas or propane). The combustible gas detector should be capable of the following:
(2) **CO Detector.** The CO detector should be capable of the following functions and have a numeric display scale as follows:

a. **PPM:** For measuring ambient room and appliance emissions a display scale in parts per million (ppm) from 0 to 1,000 ppm in 1 ppm increments.

b. **Alarm:** A sound alarm function where hazardous levels of ambient CO is found (see D.2 for alarm levels)

c. **Air Free:** Capable of converting CO measurements to an air free level in ppm. Where a CO detector is used without an air free conversion function, the CO air free can be calculated in accordance with footnote 3 in Table D.6.

### D.2 Occupant and inspector safety.

Prior to entering a building, the inspector should have both a combustible gas detector (CGD) and CO detector turned on, calibrated, and operating. Immediately upon entering the building, a sample of the ambient atmosphere should be taken. Based on CGD and CO detector readings, the inspector should take the following actions:

1. The CO detector indicates a carbon monoxide level of 70 ppm or greater. The inspector should immediately notify the occupant of the need for themselves and any building occupant to evacuate; the inspector shall immediately evacuate and call 911.

2. Where the CO detector indicates a reading between 30 ppm and 70 ppm. The inspector should advise the occupant that high CO levels have been found and recommend that all possible sources of CO should be turned off immediately and windows and doors opened. Where it appears that the source of CO is a permanently installed appliance, advise the occupant to keep the appliance off and have the appliance serviced by a qualified servicing agent.

3. Where CO detector indicates CO below 30 ppm the inspection can continue.

4. The CGD indicates a combustible gas level of 20% LEL or greater. The inspector should immediately notify the occupant of the need for themselves and any building occupant to evacuate; the inspector shall immediately evacuate and call 911.

5. The CGD indicates a combustible gas level below 20% LEL, the inspection can continue.
If during the inspection process it is determined a condition exists that could result in unsafe appliance operation, shut off the appliance and advise the owner of the unsafe condition. Where a gas leak is found that could result in an unsafe condition, advise the owner of the unsafe condition and call the gas supplier to turn off the gas supply. The inspector should not continue a safety inspection on an operating appliance, venting system, and piping system until repairs have been made.

D.3 Gas piping and connection inspections.

(1) **Leak Checks.** Conduct a test for gas leakage using either a non-corrosive leak detection solution or a CGD confirmed with a leak detection solution.

   The preferred method for leak checking is by use of gas leak detection solution applied to all joints. This method provides a reliable visual indication of significant leaks.

   The use of a CGD in its audio sensing mode can quickly locate suspect leaks but can be overly sensitive indicating insignificant and false leaks. All suspect leaks found through the use of a CGD should be confirmed using a leak detection solution.

   Where gas leakage is confirmed, the owner should be notified that repairs must be made. The inspection should include the following components:

   a. All gas piping fittings located within the appliance space.

   b. Appliance connector fittings.

   c. Appliance gas valve/regulator housing and connections.

(2) **Appliance Connector.** Verify that the appliance connection type is compliant with Section 411 of the *International Fuel Gas Code*. Inspect flexible appliance connections to determine if they are free of cracks, corrosion and signs of damage. Verify that there are no uncoated brass connectors. Where connectors are determined to be unsafe or where an uncoated brass connector is found, the appliance shutoff valve should be placed in the off position and the owner notified that the connector must be replaced.

(3) **Piping Support.** Inspect piping to determine that it is adequately supported, that there is no undue stress on the piping, and if there are any improperly capped pipe openings.

(4) **Bonding.** Verify that the electrical bonding of gas piping is compliant with Section 310 of the *International Fuel Gas Code*.

D.4 Inspections to be performed with the appliance not operating.
The following safety inspection procedures are performed on appliances that are not operating. These inspections are applicable to all appliance installations.

---

1. **Preparing for Inspection.** Shut off all gas and electrical power to the appliances located in the same room being inspected. For gas supply, use the shutoff valve in the supply line or at the manifold serving each appliance. For electrical power, place the circuit breaker in the off position or remove the fuse that serves each appliance. A lock type device or tag should be installed on each gas shutoff valve and at the electrical panel to indicate that the service has been shut off for inspection purposes.

2. **Vent System Size and Installation.** Verify that the existing venting system size and installation are compliant with Chapter 5 of the *International Fuel Gas Code*. The size and installation of venting systems for other than natural draft and Category I appliances should be in compliance with the manufacturer’s installation instructions. Inspect the venting system to determine that it is free of blockage, restriction, leakage, corrosion, and other deficiencies that could cause an unsafe condition. Inspect masonry chimneys to determine if they are lined. Inspect plastic venting systems to determine that it is free of sagging and it is sloped in an upward direction to the outdoor vent termination.

3. **Combustion Air Supply.** Inspect provisions for combustion air as follows:
   
   a. **No Direct-vent Appliances.** Determine that non-direct vent appliance installations are compliant with the combustion air requirements in Section 304 of the *International Fuel Gas Code*. Inspect any interior and exterior combustion air openings and any connected combustion air ducts to determine that there is no blockage, restriction, corrosion or damage. Inspect to determine that the upper horizontal combustion air duct is not sloped in a downward direction toward the air supply source.
   
   b. **Direct Vent Appliances.** Verify that the combustion air supply ducts and pipes are securely fastened to direct vent appliance and determine that there are no separations, blockage, restriction, corrosion or other damage. Determine that the combustion air source is located in the outdoors or to areas that freely communicate to the outdoors.
   
   c. **Unvented Appliances.** Verify that the total input of all unvented room heaters and gas-fired refrigerators installed in the same room or rooms that freely communicate with each other does not exceed $20 \text{ Btu/hr/ft}^3$.

4. **Flooded Appliances.** Inspect the appliance for signs that the appliance may have been damaged by flooding. Signs of flooding include a visible water submerge line on the appliance housing, excessive surface or component rust, deposited debris on internal components, and mildew-like odor. Inform the owner that any part of the appliance control system and any appliance gas control that has been under water must be replaced. All flood-damaged plumbing, heating, cooling and electrical appliances should be replaced.

5. **Flammable Vapors.** Inspect the room/space where the appliance is installed to determine if the area is free of the storage of gasoline or any flammable products such as oil-based solvents, varnishes or adhesives. Where the appliance is installed where flammable products will be stored or used, such as a garage, verify that the appliance
burner(s) is a minimum of 18" above the floor unless the appliance is listed as flammable vapor ignition resistant.

(6) **Clearances to Combustibles.** Inspect the immediate location where the appliance is installed to determine if the area is free of rags, paper or other combustibles. Verify that the appliance and venting system are compliant with clearances to combustible building components in accordance with Sections 305.8, 501.15.4, 502.5, 503.6.2, 503.10.5 and other applicable sections of Section 503.

(7) **Appliance Components.** Inspect internal components by removing access panels or other components for the following:

a. Inspect burners and crossovers for blockage and corrosion. The presence of soot, debris, and signs of excessive heating are potential indicators of incomplete combustion caused by blockage or improper burner adjustments.

b. Metallic and non-metallic hoses for signs of cracks, splitting, corrosion, and loose connections.

c. Signs of improper or incomplete repairs

d. Modifications that override controls and safety systems

e. Electrical wiring for loose connections; cracks, missing or worn electrical insulation; and indications of excessive heat or electrical shorting. Appliances requiring an external electrical supply should be inspected for proper electrical connection in accordance with the National Electric Code.

(8) **Placing Appliances Back in Operation.** Return all inspected appliances and systems to their preexisting state by reinstalling any removed access panels and components. Turn on the gas supply and electricity to each appliance found in safe condition. Proceed to the operating inspections in D.5 through D.6.

D.5 Inspections to be performed with the Appliance Operating.
The following safety inspection procedures are to be performed on appliances that are operating where there are no unsafe conditions or where corrective repairs have been completed.

D.5.1 General Appliance Operation.

(1) **Initial Startup.** Adjust the thermostat or other control device to start the appliance. Verify that the appliance starts up normally and is operating properly.

Determine that the pilot(s), where provided, is burning properly and that the main burner ignition is satisfactory, by interrupting and re-establishing the electrical supply to the appliance in any convenient manner. If the appliance is equipped with a continuous pilot(s), test all pilot safety devices to determine whether they are operating properly by extinguishing the pilot(s) when the main burner(s) is off and determining, after 3 minutes, that the main burner gas does not flow upon a call for heat. If the appliance is not provided with a pilot(s), test for proper
operation of the ignition system in accordance with the appliance manufacturer’s lighting and operating instructions.

(2) **Flame Appearance.** Visually inspect the flame appearance for proper color and appearance. Visually determine that the main burner gas is burning properly (i.e., without floating, lifting, or flashback). Adjust the primary air shutter as required. If the appliance is equipped with high and low flame controlling or flame modulation, check for proper main burner operation at low flame.

(3) **Appliance Shutdown.** Adjust the thermostat or other control device to shut down the appliance. Verify that the appliance shuts off properly.

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

(1) **Preparing for Inspection.** Close all exterior building doors and windows and all interior doors between the space in which the appliance is located and other spaces of the building that can be closed. Turn on any clothes dryer. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers and any fireplace doors.

(2) **Placing the Appliance in Operation.** Place the appliance being inspected in operation. Adjust the thermostat or control so the appliance will operate continuously.

(3) **Spillage Test.** Verify that all appliances located within the same room are in their standby mode and ready for operation. Follow lighting instructions for each appliance as necessary. Test for spillage at the draft hood relief opening as follows:

 a. After 5 minutes of main burner operation, check for spillage using smoke.

 b. Immediately after the first check, turn on all other fuel gas burning appliances within the same room so they will operate at their full inputs and repeat the spillage test.

 c. Shut down all appliances to their standby mode and wait for 15 minutes.

 d. Repeat the spillage test steps a through c on each appliance being inspected.

(4) **Additional Spillage Tests.** Determine if the appliance venting is impacted by other door and air handler settings by performing the following tests.

 a. Set initial test condition in accordance with D.5.2 (1).

 b. Place the appliance(s) being inspected in operation. Adjust the thermostat or control so the appliance(s) will operate continuously.
c. Open the door between the space in which the appliance(s) is located and the rest of the building. After 5 minutes of main burner operation, check for spillage at each appliance using smoke.

d. Turn on any other central heating or cooling air handler fan that is located outside of the area where the appliances are being inspected. After 5 minutes of main burner operation, check for spillage at each appliance using smoke. The test should be conducted with the door between the space in which the appliance(s) is located and the rest of the building in the open and in the closed position.

(5) Return doors, windows, exhaust fans, fireplace dampers, and any other fuel gas burning appliance to their previous conditions of use.

(6) If, after completing the spillage test it is believed sufficient combustion air is not available, the owner should be notified that an alternative combustion air source is needed in accordance with Section 304 of the International Fuel Gas Code. Where it is believed that the venting system does not provide adequate natural draft, the owner should be notified that alternative vent sizing, design or configuration is needed in accordance with Chapter 5 of the International Fuel Gas Code. If spillage occurs, the owner should be notified as to its cause, be instructed as to which position of the door (open or closed) would lessen its impact, and that corrective action by a HVAC professional should be taken.

D.6 Appliance-Specific Inspections.
The following appliance-specific inspections are to be performed as part of a complete inspection. These inspections are performed either with the appliance in the off or standby mode (indicated by “OFF”) or on an appliance that is operating (indicated by “ON”). The CO measurements are to be undertaken only after the appliance is determined to be properly venting. The CO detector should be capable of calculating CO emissions in ppm air free.

(1) Forced Air Furnaces:

a. OFF. Verify that an air filter is installed and that it is not excessively blocked with dust.

b. OFF. Inspect visible portions of the furnace combustion chamber for cracks, ruptures, holes, and corrosion. A heat exchanger leakage test should be conducted.

c. ON. Verify both the limit control and the fan control are operating properly. Limit control operation can be checked by blocking the circulating air inlet or temporarily disconnecting the electrical supply to the blower motor and determining that the limit control acts to shut off the main burner gas.

d. ON. Verify that the blower compartment door is properly installed and can be properly re-secured if opened. Verify that the blower compartment door safety switch operates properly.

e. ON. Check for flame disturbance before and after blower comes on which can indicate heat exchanger leaks.
f. **ON.** Measure the CO in the vent after 5 minutes of main burner operation. The CO should not exceed threshold in Table D.6.

(2) Boilers:

a. **OFF and ON.** Inspect for evidence of water leaks around boiler and connected piping.

b. **ON.** Verify that the water pumps are in operating condition. Test low water cutoffs, automatic feed controls, pressure and temperature limit controls, and relief valves in accordance with the manufacturer's recommendations to determine that they are in operating condition.

c. **ON.** Measure the CO in the vent after 5 minutes of main burner operation. The CO should not exceed threshold in Table D.6.

(3) Water Heaters:

a. **OFF.** Verify that the pressure-temperature relief valve is in operating condition. Water in the heater should be at operating temperature.

b. **OFF.** Verify that inspection covers, glass, and gaskets are intact and in place on a flammable vapor ignition resistant (FVIR) type water heater.

c. **ON.** Verify that the thermostat is set in accordance with the manufacturer's operating instructions and measure the water temperature at the closest tub or sink to verify that it is no greater than 120ºF.

d. **OFF.** Where required by the local building code in earthquake prone locations, inspect that the water heater is secured to the wall studs in two locations (high and low) using appropriate metal strapping and bolts.

e. **ON.** Measure the CO in the vent after 5 minutes of main burner operation. The CO should not exceed threshold in Table D.6.

(4) Cooking Appliances:

a. **OFF.** Inspect oven cavity and range-top exhaust vent for blockage with aluminum foil or other materials.

b. **OFF.** Inspect cook top to verify that it is free from a build-up of grease.

c. **ON.** Measure the CO above each burner and at the oven exhaust vents after 5 minutes of burner operation. The CO should not exceed threshold in Table D.6.

(5) Vented Room Heaters:

a. **OFF.** For built-in room heaters and wall furnaces, inspect that the burner compartment is free of lint and debris.
b. OFF. Inspect that furnishings and combustible building components are not blocking the heater.

c. ON. Measure the CO in the vent after 5 minutes of main burner operation. The CO should not exceed threshold in Table D.6.

(6) Vent-free (Unvented) Heaters:

a. OFF. Verify that the heater input is not more than 40,000 Btu input, but not more than 10,000 Btu where installed in a bedroom, and 6,000 Btu where installed in a bathroom.

b. OFF. Inspect the ceramic logs provided with gas log type vent free heaters that they are properly located and aligned.

c. OFF. Inspect the heater that it is free of excess lint build-up and debris.

d. OFF. Verify that the oxygen depletion safety shutoff system has not been altered or bypassed.

e. ON. Verify that the main burner shuts down within 3 minutes by extinguishing the pilot light. The test is meant to simulate the operation of the oxygen depletion system (ODS).

f. ON. Measure the CO after 5 minutes of main burner operation. The CO should not exceed threshold in Table D.6.

(7) Gas Log Sets and Gas Fireplaces:

a. OFF. For gas logs installed in wood burning fireplaces equipped with a damper, verify that the fireplace damper is in a fixed open position.

b. ON. Measure the CO in the firebox (log sets installed in wood burning fireplaces or in the vent (gas fireplace) after 5 minutes of main burner operation. The CO should not exceed threshold in Table D.6.

(8) Gas Clothes Dryer:

a. OFF. Where installed in a closet, verify that a source of make-up air is provided and inspect that any make-up air openings, louvers, and ducts are free of blockage.

b. OFF. Inspect for excess amounts of lint around the dryer and on dryer components. Inspect that there is a lint trap properly installed and it does not have holes or tears. Verify that it is in a clean condition.

c. OFF. Inspect visible portions of the exhaust duct and connections for loose fittings and connections, blockage, and signs of corrosion. Verify that the duct termination is not blocked and that it terminates in an outdoor location. Verify that only approved metal vent ducting material is installed (plastic and vinyl materials are not approved for gas dryers).
d. ON. Verify mechanical components including drum and blower are operating properly.

e. ON. Operate the clothes dryer and verify that exhaust system is intact and exhaust is exiting the termination.

f. ON. Measure the CO at the exhaust duct or termination after 5 minutes of main burner operation. The CO should not exceed threshold in Table D.6.

### TABLE D.6
**CO THRESHOLDS**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>CO Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boilers (all categories)</td>
<td>400 ppm air free</td>
</tr>
<tr>
<td>Central Furnace (all categories)</td>
<td>400 ppm air free</td>
</tr>
<tr>
<td>Floor Furnace</td>
<td>400 ppm air free</td>
</tr>
<tr>
<td>Gravity Furnace</td>
<td>400 ppm air free</td>
</tr>
<tr>
<td>Wall Furnace</td>
<td>200 ppm air free</td>
</tr>
<tr>
<td>Wall Furnace (Direct Vent)</td>
<td>400 ppm air free</td>
</tr>
<tr>
<td>Vented Room Heater</td>
<td>200 ppm air free</td>
</tr>
<tr>
<td>Vent-Free Room Heater</td>
<td>200 ppm air free</td>
</tr>
<tr>
<td>Water Heater</td>
<td>200 ppm air free</td>
</tr>
<tr>
<td>Oven/Broiler</td>
<td>225 ppm as measured</td>
</tr>
<tr>
<td>Top Burner</td>
<td>25 ppm as measured (per burner)</td>
</tr>
<tr>
<td>Clothes Dryer</td>
<td>400 ppm air free</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>25 ppm as measured</td>
</tr>
<tr>
<td>Gas Log (gas fireplace)</td>
<td>25 ppm as measured in vent</td>
</tr>
<tr>
<td>Gas Log (installed in wood burning fireplace)</td>
<td>400 ppm air free in firebox</td>
</tr>
</tbody>
</table>

1. Parts per million
2. Air free emission levels are based on a mathematical equation (involving carbon monoxide and oxygen or carbon dioxide readings) to convert an actual diluted flue gas carbon monoxide testing sample to an undiluted air free flue gas carbon monoxide level utilized in the appliance certification standards. For natural gas or propane, using as-measured CO ppm and $O_2$ percentage:

$$CO_{AFppm} = \left( \frac{20.9}{209 - O_2} \right) \times CO_{ppm}$$

where:
- $CO_{AFppm}$ = Carbon monoxide, air-free ppm.
- $CO_{ppm}$ = As-measured combustion gas carbon monoxide ppm.
- $O_2$ = Percentage of oxygen in combustion gas, as a percentage.

3. An alternate method of calculating the CO air free when access to an oxygen meter is not available:

$$CO_{AFppm} = \left( \frac{UCO_2}{CO_2} \right) \times CO$$

where:

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\[ \text{UCO}_2 = \text{Ultimate concentration of carbon dioxide for the fuel being burned in percent for natural gas (12.2 percent) and propane (14.0 percent)} \]
\[ \text{CO}_2 = \text{Measured concentration of carbon dioxide in combustion products in percent} \]
\[ \text{CO}_2 = \text{Measured concentration of carbon monoxide in combustion products in percent} \]
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