

# 2022 Oregon Mechanical Specialty Code adoption

## Summary of amendments to the base code

Effective: Oct. 1, 2022

The 2022 Oregon Mechanical Specialty Code (OMSC) became effective Oct. 1, 2022, with a 3-month phase-in period ending Dec. 31, 2022. During the phase-in period, use of the 2019 OMSC or the 2022 OMSC is permitted.

The 2022 OMSC is based on the 2021 International Mechanical Code (IMC) and the 2021 International Fuel Gas Code (IFGC) with integrated new construction provisions of the 2021 International Fire Code (IFC) and Oregon-specific amendments. The following is a summary of adopted amendments to the 2021 IMC and 2021 IFGC. This summary is intended to help with the transition from the previous edition and does not include all changes adopted in the 2022 OMSC.



The changes are denoted as follows:

<u>Blue/underline:</u>	Added language to the 2021 IMC or the 2021 IFGC in Appendix C
<u>Orange/dotted underline:</u>	Added new construction provisions from the 2021 IFC
<del>Red/strikethrough:</del>	Deleted language from the 2021 IMC
<i>Pink/italics</i>	Clarifying notes

Notes for Chapter 1: The entire chapter is included in this summary. Only added language to the IBC is highlighted. The deleted language has not been included.

Notes for Appendix C: The adopted provisions of the IFGC are integrated as Appendix C. The entire appendix is included in this summary. Only the added language to the IFGC is highlighted. The deleted language has not been included.

The following amendments were made throughout the 2021 IMC and 2021 IFGC and are not included in this summary:

References to:	Changed to (unless otherwise indicated in this summary):
International Building Code.....	Applicable sections of the Oregon Structural Specialty Code
International Fuel Gas Code.....	Applicable sections of Appendix C
International Energy Conservation Code.....	Applicable sections of the Oregon Energy Efficiency Specialty Code
International Residential Code.....	Applicable sections of the Oregon Residential Specialty Code
International Plumbing Code.....	Applicable sections of the Oregon Plumbing Specialty Code
NFPA 70.....	Applicable sections of the Oregon Electrical Specialty Code
International Fire Code.....	Applicable sections of the Oregon Structural Specialty Code

For questions about the 2022 OMSC, visit the division website to [contact a building code specialist](#).

# CHAPTER 1

## SCOPE AND ADMINISTRATION

### PART 1—SCOPE AND APPLICATION

#### SECTION 101 SCOPE AND GENERAL REQUIREMENTS

**101.1 Title.** These regulations shall be known as the [Oregon Mechanical Specialty Code](#), hereinafter referred to as “this code.”

**101.2 Scope.** [The scope of this code is as provided in ORS 455.020\(1\) and as further noted in this section.](#)

[ORS 455.020 is not part of this code but is reprinted here for the reader’s convenience:](#)

[455.020 Purpose; scope of application; exceptions; scope of rules; fees by rule.](#)

[\(1\) This chapter is enacted to enable the Director of the Department of Consumer and Business Services to promulgate a state building code to govern the construction, reconstruction, alteration and repair of buildings and other structures and the installation of mechanical devices and equipment therein, and to require the correction of unsafe conditions caused by earthquakes in existing buildings. The state building code shall establish uniform performance standards providing reasonable safeguards for health, safety, welfare, comfort and security of the residents of this state who are occupants and users of buildings, and will provide for the use of modern methods, devices, materials, techniques and practicable maximum energy conservation.](#)

This code shall regulate the design, installation, alteration and inspection of mechanical systems that are permanently installed and utilized to provide control of environmental conditions and related processes within buildings. This code shall also regulate those mechanical systems, system components, equipment and appliances specifically addressed herein. The installation of fuel gas distribution piping and equipment, fuel gas-fired appliances and fuel gas-fired appliance venting systems shall [comply with Appendix C, “Fuel Gas,” of this code.](#)

Detached one- and two-family dwellings and townhouses not more than three stories above grade plane in height with a separate means of egress and their accessory structures not more than three stories above grade plane in height shall comply with this code or the *Residential Code*.

[This code, as adopted by the State of Oregon, Building Codes Division, includes portions of the International Mechanical Code, the International Fuel Gas Code, the International Fire Code and other nationally adopted codes pertaining to any construction, reconstruction, alteration, repair and installation of materials and equipment in or part of buildings and structures governed by the state building code.](#)

[101.2.1 Matters not available for local regulation under the statutory authority of this code.](#) While the following matters may be included in the published national model code, they may not be regulated by the local municipality under the statutory authority of this code. Any references to these matters retained in this code are for the convenience of the reader.

- [1. The construction, alteration, moving, demolition, repair, maintenance and work located primarily in a public way.](#)
- [2. Mechanical equipment not specifically regulated in this code.](#)
- [3. Hydraulic flood control structures including, but not limited to, dams and levees.](#)
- [4. Mechanical equipment in or part of structures that are not covered by the state building code. Buildings exempt from the Building Code by ORS 455.315 shall comply with this code, as applicable.](#)

**101.2.2 Appendices.** Provisions in the appendices shall not apply unless specifically adopted [as noted in Sections 101.2.2.1 and 101.2.2.2.](#)

[101.2.2.1 Appendices adopted.](#) Appendix C, “Fuel Gas,” is adopted by the State of Oregon, Building Codes Division, as part of the *state building code*.

[101.2.2.2 Appendices not adopted.](#)

The following appendices are informative only and not adopted by the State of Oregon, Building Codes Division, as part of this code:

- [1. Appendix A \(Chimney Connector Passthroughs\).](#)
- [2. Appendix B \(Recommended Permit Fee Schedule\).](#)

The following appendices are not adopted by the State of Oregon, Building Codes Division, as part of this code, but the referenced matters are preempted by the *state building code* and may not be adopted by a local municipality:

- [1. Appendix C \(Board of Appeals\) published in the 2021 International Mechanical Code.](#)

**101.3 Purpose.** The purpose of this code, [as provided in ORS 455.020\(1\) and noted in Section 101.2,](#) is to establish minimum requirements to provide a reasonable level of safety, health and general welfare by regulating and controlling the design, construction, installation and location of mechanical systems.

**101.4 Severability.** If a section, subsection, sentence, clause or phrase of this code is, for any reason, held to be [invalid](#), such decision shall not affect the validity of the remaining portions of this code.

## SECTION 102 APPLICABILITY

**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.

**102.1.1 Statutory references.** This code is adopted pursuant to Oregon Revised Statutes (ORS). Where this code and the statutes specify different requirements, the statute shall govern. Statutes related to this code include, but are not limited to, ORS 455.010 through 455.895 and ORS 447.210 through 447.310.

Statutes referenced may be obtained from the State of Oregon, Building Codes Division, 1535 Edgewater St. NW, Salem, OR 97304 or P.O. Box 14470, Salem, OR 97309 at a nominal cost or read online at: Oregon.gov/bcd.

**102.2 Referenced codes and standards.** The codes and standards referenced in this code shall be considered as part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections 102.2.1 and 102.2.2.

**Exception:** Where enforcement of a code provision would violate the conditions of the listing of the *equipment* or *appliance*, the conditions of the listing and the manufacturer's installation instructions shall apply.

**102.2.1 Conflicts.** Where conflicts occur between provisions of this code and the referenced standards, the provisions of this code shall apply.

**102.2.2 Provisions in referenced codes and standards.** 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.

**102.3 Other laws.** The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.

**102.4 Application of references.** Reference to chapter section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this code.

**102.5 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, a mechanical system lawfully in existence at the time of the adoption of this code.

### Occupied and existing structures under state law related to building inspection programs.

Note: This information is provided for *building official* use and is not intended to provide direction to any other form of government outside of a *building official* operating under the State of Oregon, Building Codes Division's laws and rules. Questions regarding this information should be addressed through local counsel.

Under ORS 476.030 and Chapter 455, *building officials* are prohibited from requiring corrections or any changes to an existing structure that is maintained in conformity with the state building code regulations in effect at the time of construction.

Under ORS Chapters 476 and 455, occupied structures that have no valid certificate of occupancy do not fall under the delegated authority from the State of Oregon, Building Codes Division. No state authority exists for *building officials* to access buildings or require corrections for structures unless a permit application is on file.

References within the *state building code* that provide access and investigative authority to *building officials* are rescinded and are not valid.

Under state authority, buildings occupied without a valid certificate of occupancy or permit are under the enforcement authority of the Office of State Fire Marshal.

Local programs should ensure that adequate local ordinances have been adopted allowing for enforcement action where a certificate of occupancy was not issued or where no permit has been applied for.

**102.6 Additions, alterations or repairs.** Additions, alterations, renovations or repairs to a mechanical system shall conform to that required for a new mechanical system without requiring the existing mechanical system to comply with all of the requirements of this code. Additions, alterations or repairs shall not cause an existing mechanical system to become unsafe, hazardous or overloaded.

Minor additions, alterations, renovations and repairs to existing mechanical systems 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*.

**102.7 Change in occupancy.** It shall be unlawful to make a change in the *occupancy* of any structure that will subject the structure to any special provision of this code applicable to the new *occupancy* without approval. The *building official* shall certify that such structure meets the intent of the provisions of the Building Code.

**102.8 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 *municipality* 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.

**102.9 Moved buildings.** Except as determined by Section [102.5](#), mechanical systems that are a part of buildings or structures moved into or within the *municipality* shall comply with the provisions of this code for new installations. [See ORS 455.410 for moved buildings.](#)

[ORS 455.410](#) is not part of this code but is reprinted here for the reader's convenience:

**[455.410 Relocated buildings, substantial compliance required; permits.](#)**

(1) Existing buildings or structures which are removed from their foundation and relocated to another site within this state shall be in substantial compliance as defined in subsections (2) and (3) of this section.

(2) "Substantial compliance" means compliance with local construction codes in effect as of the original permit date of the building or structure, or where there was no permitting required at the time of original construction, with basic health and safety standards, as described in the closest dated *Uniform Housing Code*, as published by the International Conference of Building Officials as of the date of construction. Only the insulation, overhead and underneath the structure, shall be upgraded to the current insulation requirements of the state building code, or to the maximum extent possible subject to the design of the structure. Nothing in this statute shall be construed to mean that all heating, plumbing and electrical systems shall be replaced with systems meeting current standards for new construction, except that any life-threatening deficiencies in those systems shall be repaired, notwithstanding that the cost of rehabilitation may exceed 50 percent of the value of the structure before rehabilitation.

(3) All foundation and basement construction on the structure and any remodeling at the new location shall be constructed subject to all applicable local current building and safety codes, or where none exist, with the applicable standards as described in the *Uniform Housing Code* described in subsection (2) of this section.

(4) All moved houses shall be provided with either battery-operated or hard-wired smoke detection devices located in accordance with the provisions of the state building code. Nothing in this section is intended to permit any person to move a structure unless the person first consults with the appropriate building inspection authority and obtains all required permits.

## PART 2—ADMINISTRATION AND ENFORCEMENT

### SECTION 103 CODE COMPLIANCE AGENCY

[This section is not adopted by the State of Oregon, Building Codes Division, as part of this code.](#)

## SECTION 104 DUTIES AND POWERS OF THE BUILDING OFFICIAL

[The requirements of Sections 104.1 and 104.3 shall apply unless specifically amended by a local municipality under the authority of ORS 455.020.](#)

**104.1 General.** The *building official* is hereby authorized and directed to enforce the provisions of this code. The *building official* shall have the authority to render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions. [The building official shall act on any question relative to the installation, alteration or repair of mechanical systems, except as otherwise specifically provided for by statutory requirements.](#)

[Consistent with discretionary decision-making powers granted to building officials, a building official may take any action including but not limited to waiving a requirement, modifying a requirement or accepting an alternate method to the requirements of this code. When waiving or accepting a modification, a building official shall not allow a provision that would create an unsafe or dangerous condition regarding fire and life safety, and may not enforce requirements that are in addition to this code except where additional code requirements are specified by the terms of an alternate method approval.](#)

**104.2 Applications and permits.** The *building official* shall receive applications, review *construction documents* and issue permits for the installation and alteration of mechanical systems, inspect the premises for which such permits have been issued and enforce compliance with the provisions of this code.

**104.3 Inspections.** The *building official* shall ensure that all inspections [required by this code, are conducted by properly certified](#) individuals. [All](#) reports of such inspections shall be in writing and be certified by a responsible officer of such *approved* agency or by the responsible individual.

**104.4 Right of entry.** [This section is not adopted by the State of Oregon, Building Codes Division, as part of this code.](#)

**104.5 Notices and orders.** The *building official* shall issue all necessary notices or orders to ensure compliance with this code.

**104.6 Department records.** The *building official* shall keep official records [according to the applicable retention requirements set forth in OAR 166-150-0020 for locations where the county has jurisdiction, in OAR 166-200-0250 for locations where a city has jurisdiction, and in OAR 166 Division 300, et al., for locations where the State of Oregon has jurisdiction.](#) The *building official* shall maintain a permanent record of all *permits* issued in *flood hazard areas*, including copies of inspection reports and certifications.

**104.7 Liability.** [See ORS 30.265 for regulations relating to liability.](#)



## SECTION 105 APPROVAL

**105.1 Modifications.** Where there are practical difficulties involved in carrying out the provisions of this code, the *building official* shall have the authority to grant modifications for individual cases upon application of the owner or owner's authorized agent, provided that the *building official* shall first find that special individual reason makes the strict letter of this code impractical and the modification is in compliance with the intent and purpose of this code and does not create an unsafe or dangerous condition regarding fire and life safety, and does not enforce requirements that are in addition to the state building code except where additional code requirements are specified by the terms of an alternate method approval. The details of action granting modifications shall be recorded and entered in the files of the mechanical inspection department.

**105.2 Alternative materials, methods, equipment and appliances.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *building official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

**105.2.1 Research reports.** Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from *approved* sources.

**105.3 Required testing.** Where there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the *building official* shall have the authority to require tests as evidence of compliance to be made at no expense to the *municipality*.

**105.3.1 Test methods.** Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the *building official* shall approve the testing procedures.

**105.3.2 Testing agency.** Tests shall be performed by an *approved* agency.

**105.3.3 Test reports.** Reports of tests shall be retained by the *building official* for the period required for retention of public records.

**105.4 Approved materials and equipment.** Materials, *equipment* and devices *approved* by the *building official* shall be constructed and installed in accordance with

such approval.

**105.5 Material, equipment and appliance reuse.** Materials, *equipment*, appliances and devices shall not be reused unless such elements have been reconditioned, tested and placed in good and proper working condition and *approved*.

**105.6 Request for approval.** ORS 455.060 provides for state rulings on acceptable materials, design and methods of construction. Where a ruling has been issued, ORS 455.060(4) applies.

ORS 455.060(4) is not part of this code but is reprinted here for the reader's convenience:

**455.060 Rulings on acceptability of material, design or method of construction; effect of approval; fees.**

(1) Any person who desires to use or furnish any material, design or method of construction or installation in the state, or any building official, may request the Director of the Department of Consumer and Business Services to issue a ruling with respect to the acceptability of any material, design or method of construction about which there is a question under any provision of the state building code. Requests shall be in writing and, if made by anyone other than a building official, shall be made and the ruling issued prior to the use or attempted use of such questioned material, design or method.

(2) In making rulings, the director shall obtain the approval of the appropriate advisory board as to technical and scientific facts and shall consider the standards and interpretations published by the body that promulgated any nationally recognized model code adopted as a specialty code of this state.

(3) A copy of the ruling issued by the director shall be certified to the person making the request. Additional copies shall be transmitted to all building officials in the state. The director shall keep a permanent record of all such rulings, and shall furnish copies thereof to any interested person upon payment of such fees as the director may prescribe.

(4) A building official or inspector shall approve the use of any material, design or method of construction approved by the director pursuant to this section if the requirements of all other local ordinances are satisfied.

## SECTION 106 PERMITS

**106.1 Where required.** An owner, owner's authorized agent or contractor who desires to erect, install, enlarge, alter, repair, remove, convert or replace a mechanical system, the installation of which is regulated by this code, or to cause such work to be performed, shall first make application to the *building official* and obtain the required permit for the work.

**Exception:** Where *equipment* and *appliance* replacements or repairs must be performed in an emergency situation, the permit application shall be submitted to the building official within the next 5 business days.

**106.2 Work exempt from permit.** Permits shall not be required for the following:

1. Portable heating appliances.
2. Portable ventilation appliances and *equipment*.
3. Portable cooling units.
4. Steam, hot water or chilled water piping within any heating or cooling *equipment* or appliances regulated by this code.
5. The replacement of any minor part that does not alter the approval of *equipment* or an *appliance* or make such *equipment* or *appliance* unsafe.
6. Portable evaporative coolers.
7. Self-contained refrigeration systems that contain 10 pounds (4.5 kg) or less of refrigerant, or that are actuated by motors of 1 horsepower (0.75 kW) or less.
8. Portable fuel cell appliances that are not connected to a fixed piping system and are not interconnected to a power grid.

[The requirements of Sections 106.3 through 106.4.6 shall apply unless specifically amended by a local municipality, under the authority of ORS 455.020.](#)

**106.3 Application for permit.** Each application for a permit, with the required fee, shall be filed with the *building official* on a form furnished for that purpose and shall contain a general description of the proposed work and its location. The application shall be signed by the owner or the owner's authorized agent. The permit application shall indicate the proposed *occupancy* of all parts of the building and of that portion of the site or lot, if any, not covered by the building or structure and shall contain such other information required by the *building official*.

[Where the local municipality has adopted a master permit or minor label program, see OAR Chapter 918, Division 100.](#)

**106.3.1 Preliminary inspection.** Before a permit is issued, the *building official* is authorized to inspect and evaluate the systems, *equipment*, buildings, devices, premises and spaces or areas to be used.

**106.3.2 Time limitation of application.** An application for a permit for any proposed work shall be deemed to have been abandoned 180 days after the date of filing, unless such application has been pursued in good faith or a permit has been issued; except that the *building official* shall have the authority to grant one or more extensions of time for additional periods not exceeding 90 days each. The extension shall be requested in writing and justifiable cause demonstrated.

**106.4 Action on permit.** The application, *construction documents* and other data filed by an applicant for a permit shall be reviewed by the *building official*. If the *building official* finds that the proposed work conforms to the requirements of this code and all laws and ordinances applicable thereto, and that the fees specified

in Section 109.1 have been paid, a permit shall be issued to the applicant. [Where the local municipality has adopted a master permit or minor label program, see OAR Chapter 918, Division 100.](#)

**106.4.1 Approved construction documents.** When the *building official* issues the permit where *construction documents* are required, the *construction documents* shall be endorsed in writing and stamped "APPROVED." Such *approved construction documents* shall not be changed, modified or altered without authorization from the *building official*. Work shall be done in accordance with the *approved construction documents*.

**106.4.2 Validity.** The *building official* shall have the authority to issue a permit for the construction of part of a mechanical system before the *construction documents* for the entire system have been submitted or *approved*, provided that adequate information and detailed statements have been filed complying with all pertinent requirements of this code. The holder of such permit shall proceed at his or her own risk without assurance that the permit for the entire mechanical system will be granted.

The issuance of a permit or approval of *construction documents* shall not be construed to be a permit for, or an approval of, any violation of any of the provisions of this code. A permit presuming to give authority to violate or cancel the provisions of this code shall be invalid.

The issuance of a permit based on *construction documents* and other data shall not prevent the *building official* from thereafter requiring the correction of errors in said *construction documents* and other data or from preventing building operations from being carried on thereunder where in violation of this code.

**106.4.3 Expiration.** Every permit issued by the *building official* under the provisions of this code shall expire by limitation and become null and void if the work authorized by such permit is not commenced within 180 days from the date of such permit, or if the work authorized by such permit is suspended or abandoned at any time after the work is commenced for a period of 180 days. Before such work recommences, a new permit shall be first obtained and the fee therefor shall be one-half the amount required for a new permit for such work, provided that changes have not been made and will not be made in the original *construction documents* for such work, and provided further that such suspension or abandonment has not exceeded one year.

**106.4.4 Extensions.** A permittee holding an unexpired permit shall have the right to apply for an extension of the time within which the permittee will commence work under that permit where work is unable to be commenced within the time required by this section for good and satisfactory reasons. The *building official*

shall extend the time for action by the permittee for a period not exceeding 180 days if there is reasonable cause.

**106.4.5 Suspension or revocation of permit.** The *building official* shall have the authority to suspend or revoke a permit issued under the provisions of this code wherever the permit is issued in error or on the basis of incorrect, inaccurate or incomplete information, or in violation of any ordinance or regulation or any of the provisions of this code.

**106.4.6 Previous approvals.** This code shall not require changes in the *construction documents*, construction or designated *occupancy* of a structure for which a lawful permit has been heretofore issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within 180 days after the effective date of this code and has not been abandoned.

**106.4.7 Posting of permit.** The permit or a copy shall be kept on the site of the work until the completion of the project.

## SECTION 107 CONSTRUCTION DOCUMENTS

**107.1 Construction documents.** *Construction documents*, engineering calculations, diagrams and other data shall be submitted in two or more sets, or in a digital format where allowed by the *building official*, with each application for a permit. The *building official* shall require *construction documents*, computations and specifications to be prepared and designed by a *registered design professional* where required by state law. *Construction documents* shall be drawn to scale and shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that the work conforms to the provisions of this code. *Construction documents* for buildings more than two stories in height shall indicate where penetrations will be made for mechanical systems.

**Exception:** The *building official* shall have the authority to waive the submission of *construction documents*, calculations or other data if the nature of the work applied for is such that reviewing of *construction documents* is not necessary to determine compliance with this code.

**107.2 Retention of construction documents.** One set of *approved construction documents* shall be retained by the *building official* for a period of not less than that dictated by OAR 166-150-0020 where a county has jurisdiction, OAR 166-200-0250 where a city has jurisdiction and OAR Division 166, Chapter 300 for the cities and counties where the State of Oregon has jurisdiction. One set of *approved construction documents* shall be returned to the applicant, and said set shall be kept on the site of the building or job at all times during which the work authorized thereby is in progress.

## SECTION 108 NOTICE OF APPROVAL

**108.1 Approval.** After the prescribed tests and inspections indicate that the work complies in all respects with this code, a notice of approval shall be issued by the *building official*.

**108.2 Revocation.** The *building official* is authorized to, in writing, suspend or revoke a notice of approval issued under the provisions of this code wherever the notice is issued in error, on the basis of incorrect information supplied, or where it is determined that the building or structure, premise or portion thereof is in violation of any ordinance or regulation or any of the provisions of this code.

## SECTION 109 FEES

**109.1 Payment of fees.** A permit shall not be valid until the fees prescribed by law have been paid. An amendment to a permit shall not be released until the additional fee, if any, has been paid.

**109.2 Schedule of permit fees.** Where work requires a permit, a fee for each permit shall be paid as required, in accordance with the schedule as established by the municipality, under authority of ORS 455.020 and 455.210, or as set forth in OAR Chapter 918, Division 440 where the State of Oregon has jurisdiction.

ORS 455.020(2) is not part of this code but is reprinted here for the reader's convenience:

455.020(2) Purpose; scope of application; exceptions; scope of rules; fees by rule.

(2) The rules adopted pursuant to this chapter shall include structural standards; standards for the installation and use of mechanical, heating and ventilating devices and equipment; and standards for prefabricated structures; and shall, subject to ORS 455.210, prescribe reasonable fees for the issuance of building permits and similar documents, inspections and plan review services by the Department of Consumer and Business Services. The department may also establish, by rule, the amount of any fee pertaining to the state building code or any specialty code that is authorized by statute, but for which an amount is not specified by statute.

ORS 455.210(3)(a) is not part of this code but is reprinted for the reader's convenience:

ORS 455.210 Fees; appeal of fees; surcharge; reduced fees; rules.

(3)(a) A municipality may adopt by ordinance or regulation such fees as may be necessary and reasonable to provide for the administration and enforcement of any specialty code or codes for which the municipality has assumed responsibility under ORS 455.148 or 455.150. A municipality shall give the director notice of the proposed adoption of a new or increased fee under this subsection. The municipality shall give the notice to the director at the time the municipality provides the opportunity for public comment under ORS 294.160 regarding the fee or, if the proposed fee is contained in an estimate of municipal budget resources, at the time notice of the last budget meeting is published under ORS 294.426.

**ORAR 918-050-0100** is not part of this code but is reprinted here for the reader's convenience.

### Uniform Fee Methodology

#### 918-050-0100 Statewide Fee Methodologies for Residential and Commercial Permits

(1) Residential construction permit fees shall be calculated using the following methodologies:

(a) A plumbing permit fee for new construction includes one kitchen and is based on the number of bathrooms, from one to three, on a graduated scale. An additional set fee shall be assessed for each additional bath or kitchen.

(A) No additional fee shall be charged for the first 100 feet of water and sewer lines, hose bibbs, icemakers, underfloor low-point drains, and rain drain packages that include the piping, gutters, downspouts, and perimeter system.

(B) The plumbing permit fee described in this section does not include:

- (i) Any storm water retention/detention facility;
- (ii) Irrigation and fire suppression systems; or
- (iii) Additional water, sewer and service piping or private storm drainage systems exceeding the first 100 feet.

(C) Permit fees for an addition, alteration, or repair shall be calculated based on the number of fixtures, appurtenances, and piping, with a set minimum fee.

(b) A mechanical permit fee shall be calculated per appliance and related equipment, with a set minimum fee.

(c) Effective January 1, 2009, a structural permit fee for new construction and additions shall be calculated using the ICC Building Valuation Data Table current as of April 1 of each year, multiplied by the square footage of the dwelling to determine the valuation. The valuation shall then be applied to the *municipality's* fee schedule to determine the permit fee. The plan review fee shall be based on a predetermined percentage of the permit fee set by the *municipality*.

(A) The square footage of a dwelling, addition, or garage shall be determined from outside exterior wall to outside exterior wall for each level.

(B) The square footage of a carport, covered porch, patio, or deck shall be calculated separately at fifty percent of the value of a private garage from the ICC Building Valuation Data Table current as of April 1.

(C) Permit fees for an alteration or repair shall be calculated based on the fair market value as determined by the building official, and then applying the valuation to the *municipality's* fee schedule.

(2) Commercial construction permit fees shall be calculated using the following methodologies:

(a) A plumbing permit fee shall be calculated based on the number of fixtures and footage of piping, with a set minimum fee.

(b) A mechanical permit fee shall be calculated based on the value of the mechanical equipment and installation costs and applied to the *municipality's* fee schedule with a set minimum fee.

(c) A structural permit fee shall be calculated by applying the valuation to the *municipality's* fee schedule with a minimum set fee. Valuation shall be the greater of either:

(A) The valuation based on the ICC Building Valuation Data Table current as of April 1 of each year, using the occupancy and construction type as determined by the building official, multiplied by the square footage of the structure; or (B) The value as stated by the applicant.

(C) When the construction or occupancy type does not fit the ICC Building Valuation Data Table, the valuation shall be determined by the building official with input from the applicant.

Stat. Auth.: ORS 455.048 & 455.055

Stats. Implemented: ORS 455.046 & 455.055

**109.2.1 Mechanical permits.** Fees shall be assessed in accordance with the provisions of this section and as set forth in the fee schedule of the *municipality* under the authority of ORS 455.210, or as set forth in ORAR 918-440-0050 where the State of Oregon has jurisdiction.

**109.2.2 Plan review fees.** Where a plan or other data is required to be submitted by Section 107, a plan review fee shall be paid at the time of submitting plans and specifications for review. The plan review fees for mechanical work shall be a percentage of the total permit fee as set forth in Section 109.2.

**109.2.2.1 Separate fees for plan review.** The plan review fees in this section are separate from the permit fees specified in Section 106.5 and are in addition to the permit fees. The state surcharge is not applied to plan review fees.

**109.2.2.2 Incomplete or changed plans.** When plans are incomplete or changed so as to require additional plan review, an additional plan review fee shall be charged according to the rate established by the *municipality*, or ORAR Chapter 918, Division 460 where the State of Oregon has jurisdiction.

**109.3 Work commencing before permit issuance.** Any person who commences work on a mechanical system before obtaining the necessary permits shall be subject to an investigative fee. The amount of the investigative fee shall be the average or actual additional cost of ensuring that the mechanical system is in conformance with this code and shall be in addition to the required permit fees. Fees shall be charged according to the rate established by the *municipality*, or as established by the state where the State of Oregon has jurisdiction.



[ORS 455.058](#) is not part of this code but is reprinted here for the reader's convenience:

[ORS 455.058 Investigation fee for work commenced without permit; rules.](#) Except as provided in subsection (2) of this section, the Department of Consumer and Business Services, or a *municipality* administering and enforcing a building inspection program, may assess an investigation fee against a person that is required to obtain a permit for work on the electrical, gas, mechanical, elevator, boiler, plumbing or other systems of a building or structure if the work is commenced before the permit required for the work is obtained. The amount of the investigation fee shall be the average or actual additional cost of ensuring that a building, structure or system is in conformance with state building code requirements that results from the person not obtaining a required permit before work for which the permit is required commences.

(2) This section does not apply to:

(a) An emergency repair required for health, safety, the prevention of property damage or the prevention of financial harm if the required building permit for the repair is obtained no later than five business days after commencement of the repair; or

(b) Any project for which construction, alteration, repair, maintenance or installation in a building or structure prior to obtaining a permit is expressly authorized by law.

(3) The department may adopt rules and establish policies and procedures for use by the department or municipalities in assessing an investigation fee under this section.

**109.4 Related fees.** The payment of the fee for the construction, alteration, removal or demolition for work done in connection to or concurrently with the work authorized by a permit shall not relieve the applicant or holder of the permit from the payment of other fees that are prescribed by law.

**109.5 Refunds.** The *building official* is authorized to establish a refund policy.

## SECTION 110 SERVICE UTILITIES

**110.1 Connection of service utilities.** A person shall not make connections from a utility, source of energy, fuel or power to any building or system that is regulated by this code for which a permit is required, until authorized by the *building official*.

**110.2 Temporary connection.** The *building official* shall have the authority to authorize the temporary connection of the building or system to the utility, source of energy, fuel, power, water system or sewer system for the purpose of testing systems or for use under a temporary approval.

**110.3 Authority to disconnect service utilities.** The *building official* shall have the authority to authorize disconnection of utility service to the building, structure or system regulated by this code and the referenced codes and standards in case of emergency where necessary to eliminate an immediate hazard to life or property or where such utility connection has been made without the approval required by Section 110.1 or 110.2. The *building official* shall notify the serving utility, and wherever possible the owner or the owner's authorized agent and occupant of the building, structure or service system, of the decision to disconnect prior to taking such action. If not notified prior to disconnecting, the owner, the owner's authorized agent or occupant of the building, structure or service system shall be notified in writing as soon as practical thereafter.

## SECTION 111 TEMPORARY EQUIPMENT, SYSTEMS AND USES

**111.1 General.** The *building official* is authorized to issue a permit for temporary *equipment*, systems and uses. Such permits shall be limited as to time of service, but shall not be permitted for more than 180 days. The *building official* is authorized to grant extensions for demonstrated cause.

**111.2 Conformance.** Temporary *equipment*, systems and uses shall conform to the structural strength, fire safety, means of egress, accessibility, light, ventilation and sanitary requirements of this code as necessary to ensure the public health, safety and general welfare.

**111.3 Temporary utilities.** The *building official* is authorized to give permission to temporarily supply utilities before an installation has been fully completed and the final certificate of completion has been issued. The part covered by the temporary certificate shall comply with the requirements specified for temporary lighting, heat or power in the code.

**111.4 Termination of approval.** The *building official* is authorized to terminate such permit for temporary *equipment*, systems or uses and to order the temporary *equipment*, systems or uses to be discontinued.

## SECTION 112 INSPECTIONS AND TESTING

**112.1 General.** The *building official* is authorized to conduct such inspections as are deemed necessary to determine compliance with the provisions of this code. Construction or work for which a permit is required shall be subject to inspection by the *building official*, and such construction or work shall remain [accessible](#) and [exposed](#) for inspection purposes until *approved*. Approval as a result of an inspection shall not be construed to be an approval of a violation of the provisions of this code. Inspections presuming to give authority to violate or cancel the provisions of this code [shall](#) not be valid.

**112.2 Required inspections and testing.** The [building official](#), upon notification from the permit holder or the permit holder's agent, shall make the following inspections and other such inspections as necessary, and shall either release that portion of the construction or shall notify the permit holder or the permit holder's agent of violations that must be corrected. The holder of the permit shall be responsible for the scheduling of such inspections.

1. Underground inspection shall be made after trenches or ditches are excavated and bedded, piping installed, and before backfill is put in place. Where excavated soil contains rocks, broken concrete, frozen chunks and other rubble that would damage or break the piping or cause corrosive action, clean backfill shall be on the job site.
2. Rough-in inspection shall be made after the roof, framing, fireblocking and bracing are in place and all ducting and other components to be concealed are complete, and prior to the installation of wall or ceiling membranes.
3. Final inspection shall be made upon completion of the mechanical system.

**Exception:** Ground-source heat pump loop systems tested in accordance with Section 1210.10 shall be permitted to be backfilled prior to inspection.

The requirements of this section shall not be considered to prohibit the operation of any heating *equipment* or appliances installed to replace existing heating *equipment* or appliances serving an occupied portion of a structure provided that a request for inspection of such heating *equipment* or appliances has been filed with the department not more than 48 hours after such replacement work is completed, and before any portion of such *equipment* or appliances is concealed by any permanent portion of the structure.

**112.2.1 Other inspections.** In addition to the inspections specified in Section 112.2, the [building official](#) is authorized to make or require other inspections of any construction work to ascertain compliance with the provisions of this code that are enforced.

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

**112.2.3 Approval required.** Work shall not be done beyond the point indicated in each successive inspection without first obtaining the approval of the [building official](#). The [building official](#), upon notification, shall make the requested inspections and shall either indicate the portion of the construction that is satisfactory as completed, or notify the permit holder or his or her agent wherein the same fails to comply with this code. Any portions that do not

comply shall be corrected and such portion shall not be covered or concealed until authorized by the [building official](#).

**112.3 Testing.** Mechanical systems shall be tested as required in this code and in accordance with Sections 108.3.1 through 108.3.3. Tests shall be made by the permit holder and observed by the [building official](#).

**112.3.1 New, altered, extended or repaired systems.** New mechanical systems and parts of existing systems, which have been altered, extended, renovated or repaired, shall be tested as prescribed herein to disclose leaks and defects.

**112.3.2 Apparatus, material and labor for tests.** Apparatus, material and labor required for testing a mechanical system or part thereof shall be furnished by the permit holder.

**112.3.3 Reinspection and testing.** Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made so as to achieve compliance with this code. The work or installation shall then be resubmitted to the [building official](#) for inspection and testing. [Reinspection fees shall be in accordance with a rate established by the municipality, or as established by the state where the State of Oregon has jurisdiction.](#)

**112.4 Contractor responsibilities.** [It shall be the responsibility of every contractor who enters into contracts for the installation or repair of mechanical systems for which a permit is required, to comply with adopted state and local rules and regulations concerning licensing and permits.](#)

## SECTION 113 BOARD OF APPEALS

**113.1 General.** In order to hear and decide appeals of orders, decisions or determinations made by the [building official](#) relative to the application and interpretation of this code, [the local municipality shall establish an appeals procedure.](#)

**113.2 Limitations on authority.** An application for appeal shall be based on a claim that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an equivalent or better form of construction is proposed. The board [of appeals](#) shall not have the authority to waive requirements of this code.

**113.3 Qualifications.** The board of appeals shall consist of members who are qualified by experience and training [to pass on matters pertaining to professions or disciplines applicable to this code.](#)

**113.4 Alternative appeal process.** [ORS 455.475 provides an alternative appeal process to any established by a local municipality. See OAR 918-008-0120. An applicant for a building permit may choose to appeal a building official's decision to a local appeals board or](#)

directly to the appropriate specialty code program chief.

**Note:** Forms for filing an appeal under ORS 455.475 are available online at: [Oregon.gov/bcd](http://Oregon.gov/bcd).

**ORS 455.475** is not part of this code but is reprinted here for the reader's convenience:

**455.475. Appeal of decision of building official.**

(1) An applicant for a building permit may appeal a decision made by a building official under authority established pursuant to ORS 455.148, 455.150 or 455.467. The following apply to an appeal under this subsection:

(a) An appeal regarding the interpretation or application of a particular specialty code provision shall be made first to the appropriate specialty code chief inspector of the Department of Consumer and Business Services. The decision of the department chief inspector may be appealed to the appropriate advisory board. The decision of the advisory board may only be appealed to the Director of the Department of Consumer and Business Services if codes in addition to the applicable specialty code are at issue.

(b) If the appropriate advisory board determines that a decision by the department chief inspector is a major code interpretation, then the inspector shall distribute the decision in writing to all applicable specialty code public and private inspection authorities in the state. The decision shall be distributed within 60 days after the board's determination, and there shall be no charge for the distribution of the decision. As used in this paragraph, a "major code interpretation" means a code interpretation decision that affects or may affect more than one job site or more than one inspection jurisdiction.

(2) Except as provided in subsection (1) of this section, an applicant for a building permit may appeal the decision of a building official on any matter relating to the administration and enforcement of this chapter to the department. The appeal must be in writing. A decision by the department on an appeal filed under this subsection is subject to judicial review as provided in ORS 183.484.

(3) If an appeal is made under this section, an inspection authority shall extend the plan review deadline by the number

**ORS 455.690** is not part of this code but is reprinted here for the reader's convenience:

**455.690 Appeal to advisory boards.**

Any person aggrieved by the final decision of a municipal appeals board or a subordinate officer of the Department of Consumer and Business Services as to the application of any provision of a specialty code may, within 30 days after the date of the decision, appeal to the appropriate advisory board. The appellant shall submit a fee of \$20, payable to the department, with the request for appeal. The final decision of the involved municipality or state officer shall be subject to review and final determination by the appropriate advisory board as to technical and scientific determinations related to the application of the specialty code involved.

**SECTION 114  
RESERVED**

**SECTION 115  
VIOLATIONS**

**115.1 Prohibited acts.** Prohibited acts are described in ORS 455.450.

**ORS 455.450** is not part of this code but is reprinted here for the reader's convenience:

**455.450 Prohibited acts.** A person may not:

(1) Violate, or procure or assist in the violation of, any final order the Director of the Department of Consumer and Business Services, an advisory board, a state administrative officer or any local appeals board, building official or inspector, concerning the application of the state building code in a particular case or concerning a license, certificate, registration or other authorization.

(2) Engage in, or procure or assist any other person to engage in, any conduct or activity for which a permit, label, license, certificate, registration or other formal authorization is required by any specialty code, any provision of ORS 446.003 to 446.200, 446.225 to 446.285, 446.395 to 446.420, 446.566 to 446.646, 446.666 to 446.746, 479.510 to 479.945, 479.950 and 480.510 to 480.670, this chapter or ORS chapter 447, 460 or 693 or any rule adopted or order issued for the administration and enforcement of these provisions without first having obtained such permit, label, license, certificate, registration or other formal authorization.

(3) Violate, or procure or assist in the violation of, any standard, specification, requirement, prohibition or other technical provision set forth in the state building code or an applicable local building code or in any rule or order of the Department of Consumer and Business Services, an advisory board, a local governing body or local building official.

**115.2 Notice of violation.** The *building official* has the authority to serve a notice of violation or order to the person responsible for the erection, installation, alteration, extension, or repair of mechanical work in violation of the provisions of this code, or in violation of a detail statement or the *approved construction documents* thereunder, or in violation of a permit or certificate issued under the provisions of this code. Such order shall direct the discontinuance of the illegal action or condition and the abatement of the violation.

**115.3 Violation penalties.** Persons who violate a provision of this code or fail to comply with any of the requirements thereof or who erects, installs, alters or repairs mechanical work in violation of the *approved construction documents* or directive of the *building official*, or of a permit or certificate issued under the provisions of this code, may be subject to penalties as prescribed by law.

**115.3.1 Penalty amounts.** Penalty amounts, except those described in Section 109.3, are limited by ORS 455.895 or as adopted by the *municipality* having authority. Local authority to levy penalties is limited to violations of code application.

ORS 455.895 is not part of this code but is reprinted here for the reader's convenience:

**455.895 Civil penalties.**

(1)(a) The State Plumbing Board may impose a civil penalty against a person as provided under ORS 447.992 and 693.992. Amounts recovered under this paragraph are subject to ORS 693.165.

(b) The Electrical and Elevator Board may impose a civil penalty against a person as provided under ORS 479.995. Amounts recovered under this paragraph are subject to ORS 479.850.

(c) The Board of Boiler Rules may impose a civil penalty against a person as provided under ORS 480.670. Amounts recovered under this paragraph are subject to ORS 480.670.

(2) The Department of Consumer and Business Services, or an appropriate advisory board, if any, may at its discretion impose a civil penalty against any person who violates the state building code or ORS 446.003 to 446.200, 446.225 to 446.285, 446.395 to 446.420, 446.566 to 446.646, 446.666 to 446.746, 479.510 to 479.945, 479.950 or 480.510 to 480.670, or this chapter or ORS chapter 447, 460 or 693, or any rule adopted or order issued for the administration and enforcement of those statutes. Except as provided in subsections (3), (4) and (9) of this section or ORS 446.995, a civil penalty imposed under this section must be in an amount determined by the appropriate advisory board or the department of not more than \$5,000 for each offense or, in the case of a continuing offense, not more than \$1,000 for each day of the offense.

(3) Each violation of ORS 446.003 to 446.200 or 446.225 to 446.285, or any rule or order issued under ORS 446.003 to 446.200 or 446.225 to 446.285, constitutes a separate violation with respect to each manufactured structure or with respect to each failure or refusal to allow or perform an act required thereby, except that the maximum civil penalty may not exceed \$1 million for any related series of violations occurring within one year from the date of the first violation.

(4) The department may impose a civil penalty of not more than \$25,000 against a public body responsible for administering and enforcing a building inspection program. As used in this subsection, "public body" has the meaning given that term in ORS 174.109.

(5) The maximum penalty established by this section for a violation may be imposed only upon a finding that the person has engaged in a pattern of violations. The department, by rule, shall define what constitutes a pattern of violations. Except as provided in subsections (1) and (10) of this section, moneys received from any civil penalty under this section are appropriated continuously for and shall be used by the department for enforcement and administration of provisions and rules described in subsection (2) of this section.

(6) Civil penalties under this section shall be imposed as provided in ORS 183.745.

(7) A civil penalty imposed under this section may be remitted or reduced upon such terms and conditions as the department or the appropriate advisory board considers proper and consistent with the public health and safety. In any judicial review of a civil penalty imposed under this section, the court may, in its discretion, reduce the penalty.

(8) Any officer, director, shareholder or agent of a corporation, or member or agent of a partnership or association, who personally participates in or is an accessory to any violation by the partnership, association or corporation of a provision or rule described in subsection (2) of this section is subject to the penalties prescribed in this section.

(9) In addition to the civil penalty set forth in subsection (1) or (2) of this section, any person who violates a provision or rule described in subsection (2) of this section may be required by the department or the appropriate advisory board to forfeit and pay to the General Fund of the State Treasury a civil penalty in an amount determined by the department or advisory board that does not exceed five times the amount by which such person profited in any transaction that violates a provision or rule described in subsection (2) of this section.

(10) If a civil penalty is imposed for a violation of a provision of ORS 446.566 to 446.646 and the violation relates to a filing or failure to file with a county assessor functioning as agent of the department, the department, after deducting an amount equal to the department's procedural, collection and other related costs and expenses, shall forward one-half of the remaining civil penalty amount to the county in which the manufactured structure is located at the time of the violation.

## SECTION 116 STOP WORK ORDER

This section is not adopted by the State of Oregon, Building Codes Division, as part of this code. A municipality may have authority outside of this code to regulate these matters locally, where not preempted.



# CHAPTER 2 DEFINITIONS

## SECTION 201 GENERAL

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**IMC 201.4**      **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.

Words of common usage are given their plain, natural and ordinary meanings. Words that have well-defined legal meanings are given those meanings.

## SECTION 202 GENERAL DEFINITIONS

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### B

**~~BOILER.~~**

**BOILER.** (For Chapter 10) As defined in ORS 480.515(3).

ORS 480.515(3) is not part of this code but is reprinted here for the reader's convenience:

480.515 Definitions for ORS 480.510 to 480.670.

(3) "Boiler" or "boilers" means:

(a) A closed vessel or vessels intended for the heating or vaporizing of liquids to be used externally to such vessel or vessels by the application of heat from combustible fuels, electricity or nuclear energy;

(b) Related appurtenances including but not limited to pressure piping directly connected and related to the safe operation of a boiler; and

(c) Pressure piping consisting of boiler or nonboiler external piping connected to a boiler, but not potable water nonboiler external piping.

**BOILER CODE.** For the purposes of this code, *Boiler Code* shall mean the *Oregon Boiler and Pressure Vessel Specialty Code* as adopted by OAR 918-225-0430. The *Boiler Code* is expressly enforced by the Oregon Building Codes Division. Inspections and plan reviews are performed only by inspectors authorized by the state.

**BUILDING CODE.** For the purposes of this code, *Building Code* shall mean the *Oregon Structural Specialty Code* as adopted by OAR 918-460-0100.

**BUILDING OFFICIAL.** The officer charged with the administration and enforcement of this code, or a duly authorized representative.

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### C

**CODE OFFICIAL.**      *Not adopted/deleted*

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### D

**DESIGN FLOOD ELEVATION.** The elevation of the "design flood," ~~including wave height, relative to within~~ the ~~datum specified on the community's legally designated~~ flood hazard area ~~map designated by the flood plain administrator~~. 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 (mm), 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).

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D *continued*

**DOMESTIC WATER HEATER. (For Chapter 10)** As defined in ORS 480.525(1)(b).

ORS 480.525(1)(b) is not part of this code but is reprinted here for the reader's convenience:

**480.525 Exempt vessels.**

(1)(b) Domestic water heaters designed for heating potable water, equipped with an approved pressure-relieving device, containing only water and that do not exceed a:

(A) Capacity of 120 gallons;

(B) Water temperature of 210 degrees Fahrenheit;

(C) Pressure of 150 pounds per square inch gauge pressure; or

(D) Heat input of 200,000 BTU per hour.

E

**ELECTRICAL CODE.** For the purposes of this code, *Electrical Code* shall mean the *Oregon Electrical Specialty Code* as adopted by OAR 918-400-0455.

**ENERGY CODE.** For the purposes of this code, *Energy Code* shall mean the energy provisions as adopted by OAR 918-460-0500.

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

F

**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.

**FLOOD HAZARD AREA.** The area designated as a *flood hazard area* by the *flood plain administrator*.

**FLOOD PLAIN ADMINISTRATOR.**

Informational Note:

Each local community participating in the National Flood Insurance Program (NFIP) designates a local *flood plain administrator* who is responsible to make sure communities meet their insurance program obligations. Certain matters comprised within the NFIP program may conflict with or overlap with the *state building code*. Certain decisions such as sill plate height and other NFIP criteria fall under the authority and responsibility of the *flood plain administrator*. Once decisions under the NFIP program are made, then the appropriate requirements of this code for the construction of the building are applied.

Local communities may choose to designate their local *building official* as the *flood plain administrator* or may designate other staff. When a *building official* functioning in the capacity of *flood plain administrator* exercises authority under the NFIP, such decisions are not part of this code nor subject to the *building official* duties and responsibilities as adopted by the State of Oregon, Building Codes Division.

Per ORS 455.210(3)(c), local communities are prohibited from using building permit monies for any matter other than administration and enforcement of the state building code. Administration and implementation of a local NFIP program are not part of the *state building code*.

J

**JOINT, MECHANICAL.** A general form of gastight 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.

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<b>M</b>	<p><b><u>MECHANICAL CODE.</u></b> <u>For the purposes of this code, <i>Mechanical Code</i> shall mean the <i>Oregon Mechanical Specialty Code</i> as adopted by OAR 918-440-0010.</u></p> <p><b>MEDIUM-DUTY COOKING APPLIANCE.</b> Medium-duty cooking <i>appliances</i> include electric discrete element ranges (with or without oven), electric and gas hot-top ranges, electric and gas griddles, electric and gas double-sided griddles, electric and gas fryers (including open deep fat fryers, donut fryers, kettle fryers and pressure fryers), electric and gas <del>conveyor pizza ovens, electric and gas</del> tilting skillets (braising pans) and electric and gas rotisseries.</p>
<b>O</b>	<p><b><del>OUTLET.</del></b> <del><i>A threaded connection or bolted flange in a piping system to which a gas-burning fired appliance is attached</i></del> <u>The point at which a gas-burning fired appliance connects to the gas piping system.</u></p>
<b>P</b>	<p><b><u>PLUMBING CODE.</u></b> <u>For the purposes of this code, <i>Plumbing Code</i> shall mean the <i>Oregon Plumbing Specialty Code</i> as adopted by OAR 918-750-0110.</u></p> <p><b><u>POINT OF DELIVERY.</u></b> <u>For natural gas systems, the <i>point of delivery</i> 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 <i>point of delivery</i>. For undiluted liquefied petroleum gas systems, the point of delivery shall be considered to be the outlet of the first stage pressure regulator that provides utilization pressure, exclusive of line gas regulators, in the system.</u></p>
<b>R</b>	<p><b><u>RESIDENTIAL CODE.</u></b> <u>For the purposes of this code, <i>Residential Code</i> shall mean the <i>Oregon Residential Specialty Code</i> as adopted by OAR 918-480-0005.</u></p>
<b>S</b>	<p><b><u>STATE BUILDING CODE.</u></b> <u>The combined specialty codes adopted pursuant to ORS 455 and any code regulation or requirement in effect at the time of construction—regardless of when the building or structure was built.</u></p>
<b>T</b>	<p><b>THIRD-PARTY CERTIFICATION AGENCY.</b> <i>Not adopted/Deleted</i></p> <p><b>THIRD-PARTY CERTIFIED.</b> <i>Not adopted/Deleted</i></p> <p><b>THIRD-PARTY TESTED.</b> <i>Not adopted/Deleted</i></p>
<b>V</b>	<p><b>VENT.</b> A pipe or other conduit composed of factory-made components, containing a passageway for conveying <i>combustion</i> products and air to the atmosphere, <i>listed</i> and <i>labeled</i> for use with a specific type or class of <i>appliance</i>.</p> <p><b><u>Special gas vent.</u></b> <u>A vent <i>listed</i> and <i>labeled</i> for use with <i>listed</i> Category II, III and IV appliances.</u></p> <p><b><u>Type B vent.</u></b> <u>A vent <i>listed</i> and <i>labeled</i> for use with appliances with draft hoods and other Category I appliances that are <i>listed</i> for use with Type B vents.</u></p> <p><b><u>Type BW vent.</u></b> <u>A vent <i>listed</i> and <i>labeled</i> for use with wall furnaces.</u></p> <p><b><u>VESTIBULE.</u></b> <u>A passage, hall or chamber between the outer door and the interior of a <i>building</i>.</u></p>
<b>W</b>	<p><b>WATER HEATER.</b> <del><i>Any heating appliance or equipment</i></del> <u><i>Appliances</i> that <i>heats</i> heat potable water, <del>and supplies such water to the potable hot water distribution system</del> are equipped with <i>approved</i> safety devices, and operate at or below all of the following:</u></p> <ol style="list-style-type: none"> <li><u>1. Volume of 120 gallons (454 L);</u></li> <li><u>2. Water temperature of 210°F (98.9°C);</u></li> <li><u>3. 150 pounds (1034 kPa) per square inch operating pressure; and</u></li> <li><u>4. 200,000 Btu (58 620 W) input.</u></li> </ol>

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# CHAPTER 3

## GENERAL REGULATIONS

### SECTION 301 GENERAL

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IMC 301.3 – 301.18	301.3 Identification. 301.4 Plastic pipe, fittings and components. 301.5 Third-party testing and certification.	<i>Not adopted / Deleted</i> <i>Not adopted / Deleted</i> <i>Not adopted / Deleted</i>
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IMC 301.6 – 201.8 *Renumbered*

301.6 ~~301.9~~ Label information. *Renumbered*

Note: For reference only. Not adopted as part of this code.  
Solid-fuel-burning devices, as defined by the Oregon Department of Environmental Quality OAR 340-262-0450, shall bear a DEQ certification label.

IMC 301.10 – 301.15 *Renumbered*

301.13 ~~301.16~~ **Flood hazard.** For structures located in flood hazard areas, mechanical systems, equipment and appliances shall be located at or above the elevation ~~required~~ established by ~~Section 1612 of the International Building Code~~ flood plain administrator for utilities and attendant equipment.

**Exception:** Mechanical systems, equipment and appliances are permitted to be located below the elevation ~~required by Section 1612 of the of the International Building Code~~ established by the flood plain administrator 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 up to such elevation.

301.13.1 ~~301.16.1~~ **Coastal high-hazard areas and coastal A zones.** In coastal high-hazard areas and coastal A zones subject to high-velocity wave action as established by the flood plain administrator, mechanical systems and *equipment* shall not be mounted on or penetrate walls intended to break away under flood loads.

301.14 ~~301.17~~ **Rodentproofing.** *Renumbered*

301.15 ~~301.18~~ **Seismic resistance.** Where earthquake loads are applicable in accordance with the ~~International Building Code~~, mechanical system supports and anchorage ~~and bracing~~ shall be designed and installed for seismic forces in accordance with Chapter 16 of the ~~International Building Code~~.

### SECTION 303 EQUIPMENT AND APPLIANCE LOCATION

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IMC 303.3 **303.3 Prohibited locations.** Fuel-fired appliances shall not be located in, or obtain *combustion* air from, any of the following rooms or spaces:

*(Items 1 – 5 and Exceptions 1 – 2 remain unchanged)*

3. Appliances installed in a dedicated enclosure in which all *combustion* air is taken directly from the outdoors, in accordance with Chapter 7. *Access* to such enclosure shall be through a solid door, weather-stripped ~~in accordance with the exterior door air leakage requirements of the International Energy Conservation Code~~ and equipped with an *approved* self-closing device.

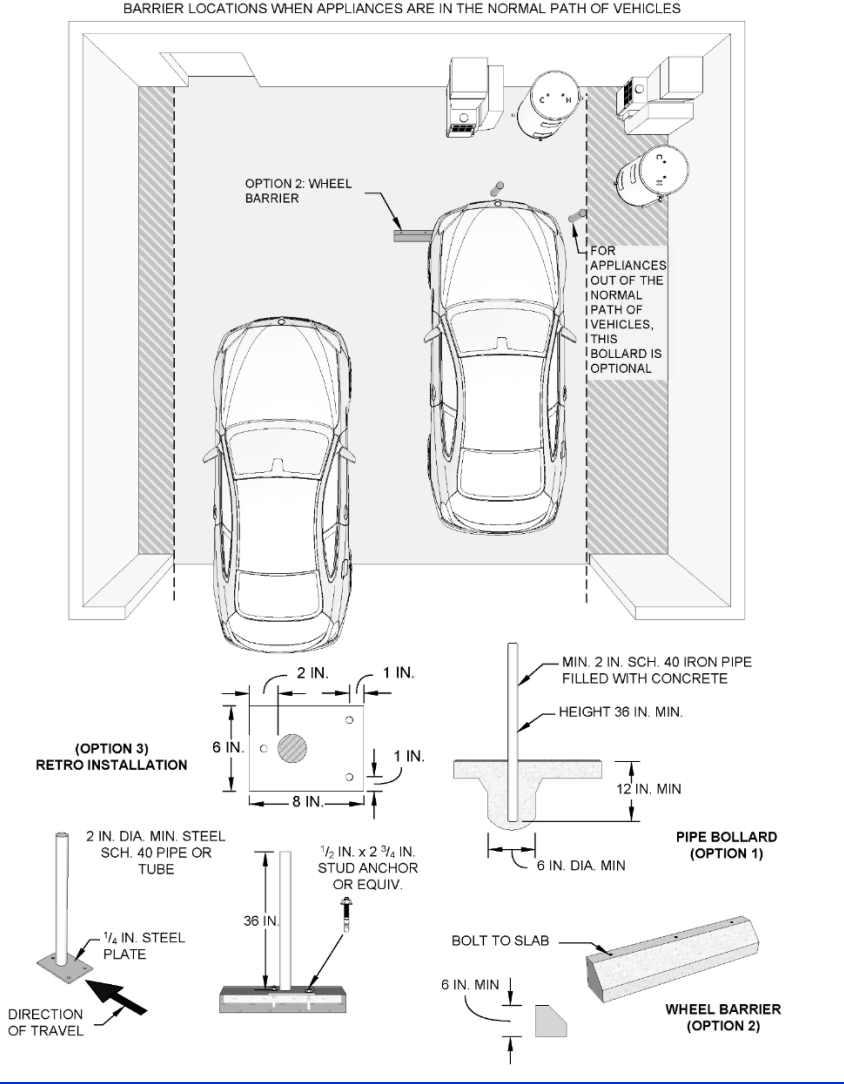


SECTION 304 INSTALLATION

IMC 304.6

304.6 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 304.3 and NFPA 30A Figure 304.6.



For SI: 1 inch = 25.4 mm. **FIGURE 304.6**  
**ILLUSTRATIONS OF NORMAL VEHICLE PATH AND RECOMMENDED TYPES OF PROTECTION**

IMC 304.7

304.7 Private garages. Appliances located in private garages and carports 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 304.3 and Figure 304.6.

**IMC 304.11** **304.11 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 and each end of the roof hatch parallel to the roof edge. 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 *International Building Code*.

**Exception:**

1. Guards are not required where fall arrest/restraint anchorage connector devices that comply with ANSI/ASSP Z359.1 are installed.
2. This section shall not apply to the replacement, repair or maintenance of an existing appliance or piece of equipment lawfully in existence at the time of the adoption of this code.

## SECTION 306 ACCESS AND SERVICE SPACE

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**IMC 306.5** **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 four units vertical in 12 units horizontal (33-percent slope). Such access shall not require the use of portable ladders. Where access involves climbing over parapet walls, the height shall be measured to the top of the parapet wall.

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

*(Items 1 through 9 remain unchanged)*

10. Access paths to ladders and ladder landings shall ~~be provided~~ remain unobstructed 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.

**Exceptions:**

1. This section shall not apply to the replacement, repair or maintenance of an existing appliance or piece of equipment lawfully in existence at the time of the adoption of this code.
2. This section shall not apply to Group R-3 occupancies.

**306.5.1 Sloped roofs.** *(Only the exception in this section has been changed)*

**Exception:** This section shall not apply to the replacement, repair or maintenance of an existing appliance or piece of equipment lawfully in existence at the time of the adoption of this code.

**SECTION 307 CONDENSATE DISPOSAL**

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**IMC 307.2.1**      **307.2.1 Condensate disposal.** Condensate from all cooling coils and evaporators shall be conveyed from the drain pan outlet to an *approved* place of disposal as listed in Items 1, 2 and 3 of this section. Such piping shall maintain a minimum horizontal slope in the direction of discharge of not less than one-eighth unit vertical in 12 units horizontal (1-percent slope). ~~Condensate shall not discharge into a street, alley or other areas so as to cause a nuisance.~~

- 1. Units larger than 6 tons (21.1 kW) nominal capacity shall discharge to a sanitary sewer drain, storm sewer drain or other approved location. Where discharging to a sanitary sewer, such drains shall be indirectly connected in accordance with the *Plumbing Code*.
- 2. Units 6 tons (21.1 kW) and smaller nominal capacity shall discharge in accordance with Item 1 or shall discharge to a gutter, roof drain or other approved location.
- 3. Condensate drains from rooftop units shall discharge in accordance with Item 1 or 2 or shall discharge onto rooftops where the condensate does not discharge into a street, alley or other areas so as to cause a nuisance.

**IMC 307.2.2**      **307.2.2 Drainpipe materials and sizes.** Components of the condensate disposal system shall be ABS, cast iron, copper and copper alloy, CPVC, cross-linked polyethylene, galvanized steel, PE-RT, polyethylene, polypropylene, PVC or PVDF 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 *International Plumbing Code* relative to the material type.~~ Condensate waste and drain line size shall be not less than 3/4-inch pipe size and shall not decrease in size from the drain pan connection to the place of condensate disposal. Where the drainpipes from more than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with Table 307.2.2.

**SECTION 310 EXPLOSION CONTROL**

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**IMC 310**            **310.1 Required.**                                    *Not adopted / Entire section deleted*

**SECTION 311 SMOKE AND HEAT VENTS**

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**IMC 311**            **311.1 Required.**                                    *Not adopted / Entire section deleted*

**SECTION ~~312~~ 310 HEATING AND COOLING LOAD CALCULATIONS**

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**IMC 312**            *Entire section renumbered to 310*

**310.1 ~~312.1~~ Load calculations.** Heating and cooling system design loads for the purpose of sizing systems, appliances and *equipment* shall be determined in accordance with the procedures described in the ASHRAE/ACCA Standard 183. ~~Alternatively, design loads shall be determined by an approved equivalent computation procedure, using the design parameters specified in Chapter 3 [CE] of the *International Energy Conservation Code*.~~

# CHAPTER 4 VENTILATION

## SECTION 401 GENERAL

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**IMC 401.2** **401.2 Ventilation required.** Every occupied space shall be ventilated by natural means in accordance with ~~Section 402 or Chapter 12 of the Building Code~~ or by mechanical means in accordance with Section 403. ~~Where the air infiltration rate in a dwelling unit is less than 5 air changes per hour when tested with a blower door at a pressure of 0.2 inch water column (50 Pa) in accordance with Section R402.4.1.2 of the International Energy Conservation Code, the dwelling unit shall be ventilated by mechanical means in accordance with Section 403. Dwelling units complying with the air leakage requirements of the International Energy Conservation Code or ASHRAE 90.1 shall be ventilated by mechanical means in accordance with Section 403.~~ Ambulatory care facilities and Group I-2 occupancies shall be ventilated by mechanical means in accordance with Section 407.

**Exception:** Rooms within a private dwelling that contain a bathtub, shower or spa facility shall be provided with mechanical ventilation in accordance with the provisions of Table 403.3.1.1.

Note: Heating and air-conditioning controls shall conform to the Energy Code.

**IMC 401.4** **401.4 Intake opening location.** Air intake openings shall comply with all of the following:

1. Intake openings shall be located not less than 10 feet (3048 mm) from lot lines or buildings on the same lot.
2. Mechanical and gravity outdoor air intake openings shall be located not less than 10 feet (3048 mm) horizontally from any hazardous or noxious contaminant source, such as gas meters, vents, streets, alleys, parking lots and loading docks, except as specified in Item 3 or Section 501.3.1. Outdoor air intake openings shall be permitted to be located less than 10 feet (3048 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such locations. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.
3. Intake openings shall be located not less than 3 feet (914 mm) below contaminant sources where such sources are located within 10 feet (3048 mm) of the opening. Separation is not required between intake air openings and living space *exhaust air* openings of an individual *dwelling unit* or *sleeping unit* where ~~an approved~~ factory-built intake/exhaust combination termination fitting is used to separate the air streams in accordance with the manufacturer's instructions.
4. Intake openings on structures in flood hazard areas shall be at or above the elevation ~~required established~~ by ~~Section 1612 of the International Building Code~~ the flood plain administrator for utilities and attendant equipment.

## SECTION 402 NATURAL VENTILATION

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Note: Section 402 is not part of this code but is printed here for the reader's convenience. Natural ventilation is regulated under the Building Code.



**SECTION 403 MECHANICAL VENTILATION**

**IMC 403.2.2**

**403.2.2 Transfer air.** ~~Except where recirculation from such spaces is prohibited by Table 403.3.1.1,~~ Air transferred from occupiable spaces is not prohibited from serving as *makeup air* for required exhaust systems in such spaces as kitchens, baths, toilet rooms, elevators and smoking lounges. The amount of transfer air and *exhaust air* shall be sufficient to provide the flow rates as specified in Section 403.3.1.1. The required outdoor airflow rates specified in Table 403.3.1.1 shall be introduced directly into such spaces or into the occupied spaces from which air is transferred or a combination of both.

**Exceptions:**

1. [Where recirculation from such spaces is prohibited by Table 403.3.1.1.](#)
2. [Air transferred from spaces served by other fan systems shall not be used if those systems are required to meet either Section 401.6 of this code or the \*Energy Code\*.](#)
3. [Where the ventilation schedule of the HVAC system supplying transfer air is not similar to the exhaust system operating schedule.](#)

**IMC 403.3.1.1**

**403.3.1.1 Outdoor airflow rate.** Ventilation systems shall be designed to have the capacity to supply the minimum outdoor airflow rate, determined in accordance with this section. ~~In each occupiable space, the ventilation system shall be designed to deliver the required rate of outdoor airflow to the breathing zone.~~ The occupant load utilized for design of the ventilation system shall be not less than the number determined from the estimated maximum occupant load rate indicated in Table 403.3.1.1. [The ventilation occupancy load and occupancy ventilation design methods shall be documented on plans and specifications.](#) Ventilation rates for occupancies not represented in Table 403.3.1.1 shall be those for a listed *occupancy* classification that is most similar in terms of occupant density, activities and building construction; or shall be determined by an *approved* engineering analysis. The ventilation system shall be designed to supply the required rate of *ventilation air* continuously during the period the building is occupied, except as otherwise stated in other provisions of the code.

With the exception of smoking lounges, the ventilation rates in Table 403.3.1.1 are based on the absence of smoking in occupiable spaces. Where smoking is anticipated in a space other than a smoking lounge, the ventilation system serving the space shall be designed to provide ventilation over and above that required by Table 403.3.1.1 in accordance with accepted engineering practice.

**Exception:** The occupant load is not required to be determined based on the estimated maximum occupant load rate indicated in Table 403.3.1.1 where *approved* statistical data document the accuracy of an alternate anticipated occupant density. [The occupant load shall be not less than one-half the number determined from Table 403.3.1.1.](#)

**IMC Table 403.3.1.1**

**TABLE 403.3.1.1  
MINIMUM VENTILATION RATES**

*(Portions of the Table not shown remain unchanged)*

OCCUPANCY CLASSIFICATION	OCCUPANT DENSITY #/1000 FT <sup>2</sup> <sup>a</sup>	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, <i>R<sub>p</sub></i> CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, <i>R<sub>a</sub></i> CFM/FT <sup>2</sup> <sup>a</sup>	EXHAUST AIRFLOW RATE CFM/FT <sup>2</sup> <sup>a</sup>
<b>Private dwellings, single and multiple</b>				
Garages, common for multiple units <sup>b</sup>	—	—	—	0.75
Kitchens <sup>b</sup>	—	—	—	50/ <del>100</del> 150 <sup>f</sup>
Living areas <sup>c</sup>	Based on number of bedrooms. First bedroom, 2; each additional bedroom, 1	0.35 ACH but not less than 15 cfm/person	—	—
Toilet rooms and bathrooms <sup>g, i, j</sup>	—	—	—	25/ <del>50</del> 80 <sup>f</sup>

g. Mechanical exhaust is required and recirculation from such spaces is prohibited. For ~~environmental air exhaust occupancies other than science laboratories~~, where there is a wheel type energy recovery ventilation (ERV) unit in the exhaust system design, the volume of air leaked from the exhaust airstream into the outdoor airstream within the ERV shall be less than 10 percent of the outdoor air volume. Recirculation of air that is contained completely within such spaces shall not be prohibited (see Section 403.2.1, Items 2 and 4).

- i. All rooms containing bathing or residential spa facilities shall be provided with a mechanical ventilation system controlled by a dehumidistat, timer or similar means of automatic control.
- j. Rooms containing bathing or residential spa facilities: Continuous ventilation fans shall be rated for sound at a maximum of 1.0 sone. Intermittent fans shall be rated for sound at a maximum of 3 sone unless their maximum rated airflow exceeds 400 cfm. Remotely installed fans located at least 4 feet away from the inlet grill are exempt from the sone rating requirements.

**IMC Table  
403.3.2.3**

**TABLE 403.3.2.3  
MINIMUM REQUIRED LOCAL EXHAUST RATES FOR GROUP R-2, R-3, AND R-4 OCCUPANCIES**

AREA TO BE EXHAUSTED	EXHAUST RATE CAPACITY
Kitchens	<del>150</del> <del>100</del> cfm intermittent or 25 cfm continuous
Bathrooms and toilet rooms	<del>80</del> <del>50</del> cfm intermittent or 20 cfm continuous

For SI: 1 cubic foot per minute = 0.0004719 m<sup>3</sup>/s.

**SECTION 404 ENCLOSED PARKING GARAGES**

**IMC 404.1**      **404.1 Enclosed parking garages.** Mechanical ventilation systems for enclosed parking garages shall be permitted to operate ~~or continuously~~ intermittently in accordance with the Energy Code.

The system shall be automatically operated by means of carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors. Such detectors shall be listed in accordance with UL 2075 and installed in accordance with their listing and the manufacturers’ instructions. *(The rest of this section remains unchanged)*

**SECTION 405 SYSTEMS CONTROL**

**OMSC 405.1.1**      **405.1.1 Ventilation controls for high occupancy areas.** Ventilation controls for high occupancy areas shall comply with the Energy Code.

**SECTION 407 AMBULATORY CARE FACILITIES AND GROUP I-2 OCCUPANCIES**

**IMC 407.1**      **407.1 General.** Mechanical ventilation for ambulatory care facilities and Group I-2 occupancies subject to licensure by the Oregon Health Authority (OHA) shall be designed and installed in accordance with OHA requirements (see OAR Chapter 333, Division 76 and 535 for ambulatory care facilities and OAR Chapter 333, Division 87 for Group I-2 occupancies). Mechanical ventilation for all other ambulatory care facilities and Group I-2 occupancies shall be designed and installed in accordance with this code, ASHRAE 170 and NFPA 99.

# CHAPTER 5

## EXHAUST SYSTEMS

### SECTION 501 GENERAL

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- IMC 501.3.1**      **501.3.1 Location of exhaust outlets.** The termination point of exhaust outlets and ducts discharging to the outdoors shall be located with the following minimum distances:  
*(Items 1, 2 and 5 remain unchanged)*
3. For all *environmental air* exhaust: 3 feet (914 mm) from property lines; 3 feet (914 mm) from operable openings into buildings for all occupancies other than Group U; and 10 feet (3048 mm) from mechanical air intakes. Such exhaust shall not be considered hazardous or noxious. Separation is not required between intake air openings and living space *exhaust air* openings of an individual *dwelling unit* or *sleeping unit* where ~~an approved~~ factory-built intake/exhaust combination termination fitting is used to separate the air streams in accordance with the manufacturer's instructions.
  4. Exhaust outlets serving structures in flood hazard areas shall be installed at or above the elevation ~~required established~~ by ~~Section 1612 of the~~ *International Building Code* [flood plain administrator](#) for utilities and attendant equipment.

### SECTION 502 REQUIRED SYSTEMS

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- IMC 502.4**      **502.4 Stationary storage battery systems.** Stationary storage battery systems shall be [provided with ventilation in accordance with Section 502.4.1 or 502.4.2](#) ~~regulated and ventilated in accordance with Section 1206.2.11.3 of the~~ *International Fire Code*.

[502.4.1 Large stationary storage battery systems.](#) [Large stationary storage battery systems shall be provided with ventilation in accordance with the Building Code.](#)

[502.4.2 Small stationary storage battery systems.](#) [Flooded lead-acid, flooded nickel-cadmium and valve-regulated lead-acid \(VRLA\) battery storage systems exceeding 7 batteries or 600 amp-hour total capacity shall be provided with continuous ventilation at a rate of not less than 1 cubic foot per minute per square foot \(cfm/ft<sup>2</sup>\) \[0.00508 m<sup>3</sup>/\(s • m<sup>2</sup>\)\] of floor area of the room and not less than 150 cfm \(4.25 m<sup>3</sup>/min\). Stationary storage battery systems shall not be located in a space with an open combustion source.](#)

[The exhaust system shall be designed to provide air movement across all parts of the floor for gases having a vapor density greater than air and across all parts of the vault ceiling for gases having a vapor density less than air.](#)

- IMC 502.5**      **502.5 Ventilation of battery systems in cabinets.** [Flooded lead-acid, flooded nickel-cadmium and VRLA battery storage systems exceeding seven batteries or 600 amp-hour total capacity shall be provided with ventilation in accordance with the Building Code.](#)

~~Stationary storage battery systems installed in cabinets shall be provided with ventilation in accordance with Section 502.4.~~

- IMC 502.6**      **502.6 Dry cleaning plants.** Ventilation in dry cleaning plants shall be adequate to protect employees and the public in accordance with this section ~~and DOL 29 CFR Part 1910.1000~~, where applicable.

<b>IMC 502.7.1</b>	<p><b>502.7.1 During construction.</b> <i>Not adopted/Deleted</i></p> <p><u>502.7.1</u> <del>502.7.2</del> Limited spraying spaces. <i>Renumbered</i></p> <p><u>502.7.2</u> <del>502.7.3</del> Flammable vapor areas. <i>Renumbered</i></p> <p><u>502.7.2.1</u> <del>502.7.3.1</del> Operation. <i>Renumbered</i></p> <p><u>502.7.2.2</u> <del>502.7.3.2</del> Recirculation. <i>Renumbered</i></p> <p><u>502.7.2.3</u> <del>502.7.3.3</del> Air velocity. <i>Renumbered</i></p> <p><u>502.7.2.3.1</u> <del>502.7.3.3.1</del> Open face or open front spray booth. <i>Renumbered</i></p> <p><u>502.7.2.3.2</u> <del>502.7.3.3.2</del> Enclosed spray booth or spray room ... <i>Renumbered</i></p> <p><u>502.7.2.4</u> <del>502.7.3.4</del> Ventilation obstruction. <i>Renumbered</i></p> <p><u>502.7.2.5</u> <del>502.7.3.5</del> Independent ducts. <i>Renumbered</i></p> <p><u>502.7.2.6</u> <del>502.7.3.6</del> Fan motors and belts. <i>Renumbered</i></p> <p><u>502.7.3</u> <del>502.7.4</del> Dipping operations. <i>Renumbered</i></p> <p><u>502.7.4</u> <del>502.7.5</del> Electrostatic apparatus. <i>Renumbered</i></p> <p><u>502.7.5</u> <del>502.7.6</del> Powder coating. <i>Renumbered</i></p> <p><b>502.7.7 Floor resurfacing operations.</b> <i>Not adopted/Deleted</i></p>
<b>IMC 502.9.5</b>	<p><b>502.9.5 Flammable and combustible liquids.</b> Exhaust ventilation systems shall be provided as required by Sections 502.9.5.1 through 502.9.5.5 for the storage, use, dispensing, mixing and handling of flammable and combustible liquids. Unless otherwise specified, this section shall apply to any quantity of flammable and combustible liquids.</p> <p><b>Exceptions:</b></p> <p><del>1.</del> This section shall not apply to flammable and combustible liquids that are exempt from the <del>International Fire Code</del> <i>the Building Code</i>.</p> <p><del>2.</del> The storage of beer, distilled spirits and wine in barrels and casks conforming to the requirements of the <del>International Fire Code</del></p>
<b>IMC 502.19</b>	<p><b>502.19 Indoor firing ranges.</b> Ventilation shall be provided in an <i>approved</i> manner in areas utilized as indoor firing ranges. <del>Ventilation shall be designed to protect employees and the public in accordance with DOL 29 CFR 1910.1025 where applicable.</del></p>

## SECTION 504 CLOTHES DRYER EXHAUST

<b>IMC 504.9.2</b>	<p><b>504.9.2 Duct installation.</b> 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. <del>Ducts shall not be joined with screws or similar fasteners that protrude more than <math>\frac{1}{8}</math> inch (3.2 mm) into the inside of the duct.</del></p> <p>Where dryer exhaust ducts are enclosed in wall or ceiling cavities, such cavities shall allow the installation of the duct without deformation.</p>
<b>IMC 504.9.3</b>	<p><b>504.9.3 Transition ducts.</b> Transition ducts used to connect the dryer to the exhaust duct system shall be a single length <del>that is listed and labeled in accordance with UL 2158A</del>. Transition ducts shall be not greater than 8 feet (2438 mm) in length and shall not be concealed within construction.</p>



## SECTION 505 DOMESTIC COOKING EXHAUST EQUIPMENT

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**IMC 505.2**      **505.2 Domestic cooking exhaust.** Where domestic cooking exhaust equipment is provided, it shall comply with the following as applicable:

*(Items 1 through 4 remain unchanged)*

5. Cooktops and ranges installed in Group I-1, I-2 Condition 2, and R-2 college dormitories operated by a college or university for student housing shall comply with Section 904.13 of the Building Code.

**IMC 505.3**      **505.3 Exhaust ducts.** Domestic cooking exhaust equipment shall discharge to the outdoors through sheet metal ducts constructed of galvanized steel, stainless steel, aluminum or copper. Such ducts shall have smooth inner walls, shall be airtight and shall be equipped with a backdraft damper. Installations in Group I-1 and I-2 occupancies shall be in accordance with the ~~International Building Code and Section 904.13 of the International Fire Code.~~

**Exceptions:**

1. In other than Groups I-1 and I-2, where installed in accordance with the manufacturer's instructions and where mechanical ~~or natural~~ ventilation is otherwise provided in accordance with Chapter 4, listed and labeled ductless range hoods shall not be required to discharge to the outdoors. *(Exception 2 remains unchanged)*

**IMC 505.6**      **505.6 Other than Group R.**      *Not adopted / Deleted*

## SECTION 506 COMMERCIAL KITCHEN HOOD VENTILATION SYSTEM DUCTS AND EXHAUST EQUIPMENT

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**IMC 506.3.2.5**      **506.3.2.5 Grease duct test.** Prior to the use or concealment of any portion of a grease duct system, a leakage test shall be performed. Ducts shall be considered to be concealed where installed in shafts or covered by coatings or wraps that prevent the ductwork from being visually inspected on all sides. The permit holder shall be responsible to provide the necessary *equipment* and perform the grease duct leakage test. A light test or approved equivalent pressure test shall be performed to determine that all welded and brazed joints are liquid tight.

A light test shall be performed by passing a lamp having a power rating of not less than 100 watts through the entire section of ductwork to be tested. The lamp shall be open so as to emit light equally in all directions perpendicular to the duct walls. A test shall be performed for the entire duct system, including the hood-to-duct connection. The duct work shall be permitted to be tested in sections, provided that every joint is tested. For *listed* factory-built grease ducts, this test shall be limited to duct joints assembled in the field and shall exclude factory welds.

## SECTION 507 COMMERCIAL KITCHEN HOODS

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**IMC 507.1.2**      **507.1.2 Domestic cooking appliances used for commercial purposes.** Domestic cooking appliances utilized for commercial purposes shall be provided with Type I or Type II hoods as required for the type of appliances and processes in accordance with Sections 507.2 and 507.3. Domestic cooking appliances utilized for domestic cooking shall comply with Section 505.

**Exception:** A single domestic cooking appliance installed where domestic cooking operations occur, such as in a church, day care center, fire station, employee lunchroom or similar types of commercial occupancies, shall meet the requirements of Section 505.1.

**IMC 507.2.6**      **507.2.6 Clearances for Type I hood.** A Type I hood shall be installed with a *clearance* to combustibles of not less than 18 inches (457 mm). This clearance may be reduced to 3 inches (76 mm), provided that the combustible material is protected with materials as specified for 1-hour fire-resistive construction on the hood side. Hoods less than 12 inches (305 mm) from the ceiling or wall shall be flashed solidly with materials of the thickness specified in Section 507.2.3 or materials conforming to 1-hour fire-resistive construction. *(The exceptions remain unchanged)*

**IMC 507.3**

**507.3 Type II hoods.** Type II hoods shall be installed above dishwashers and appliances that produce heat or moisture and do not produce grease or smoke as a result of the cooking process, ~~except where the heat and moisture loads from such appliances are incorporated into the HVAC system design or into the design of a separate removal system. Type II hoods shall be installed above all appliances that produce products of combustion and do not produce grease or smoke as a result of the cooking process. Spaces containing cooking appliances that do not require Type II hoods shall be provided with exhaust at a rate of 0.70 cfm per square foot (0.00356 m<sup>3</sup>/(s • m<sup>2</sup>)). For the purpose of determining the floor area required to be exhausted, each individual appliance that is not required to be installed under a Type II hood shall be considered as occupying not less than 100 square feet (9.3 m<sup>2</sup>). Such additional square footage shall be provided with exhaust at a rate of 0.70 cfm per square foot [0.00356 m<sup>3</sup>/(s • m<sup>2</sup>)]~~.

**Exception:** Type II hoods shall not be required where all of the following are met:

1. The appliance does not produce products of combustion.
2. The heat and moisture load from such appliances are incorporated into the HVAC system design or into the design of a separate removal system.
3. The general space exhaust required by Section 403.3 is increased by 70 cfm per appliance without a Type II hood.

## SECTION 511 DUST, STOCK AND REFUSE CONVEYING SYSTEMS

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**IMC 511.1.1**

**511.1.1 Collectors and separators.** Collectors and separators involving such systems as centrifugal separators, bag filter systems and similar devices, and associated supports shall be constructed of noncombustible materials and shall be located on the exterior of the building or structure. A collector or separator shall not be located nearer than 10 feet (3048 mm) to combustible construction or to an unprotected wall or floor opening, unless the collector is provided with a metal vent pipe that extends above the highest part of any roof with a distance of 30 feet (9144 mm).

**Exceptions:**

1. Collectors such as “Point of Use” collectors, close extraction weld fume collectors, spray finishing booths, stationary grinding tables, sanding booths, and integrated or machine-mounted collectors shall be permitted to be installed indoors provided that the installation is in accordance with the ~~International Fire Code and NFPA 70~~ Building Code and the Electrical Code and is approved by the building official.
2. Collectors in independent exhaust systems handling combustible dusts in a facility shall be permitted to be installed indoors provided that all of the following conditions are met:
  - 2.1. There are not more than three independent collectors.
  - 2.2. Each collector does not service more than five dust-producing appliances.
  - 2.3. Such collectors are installed in compliance with the ~~International Fire Code Building Code and NFPA 70~~ the Electrical Code and are approved by the building official.

# CHAPTER 6 DUCT SYSTEMS

## SECTION 602 PLENUMS

**IMC 602.4**      **602.4 Flood hazard.** For structures located in flood hazard areas, plenum spaces shall be located above the elevation ~~required established~~ by ~~Section 1612 of the International Building Code~~ the flood plain administrator for utilities and attendant equipment or shall be designed and constructed to prevent water from entering or accumulating within the plenum spaces during floods up to such elevation. If the plenum spaces are located below the elevation ~~required established~~ by ~~Section 1612 of the International Building Code~~ the flood plain administrator for utilities and attendant equipment, they shall be capable of resisting hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding up to such elevation.

## SECTION 603 DUCT CONSTRUCTION AND INSTALLATION

**IMC 603.2**      **603.2 Duct sizing.** Ducts installed within a single dwelling unit shall be sized in accordance with ACCA Manual D, ~~the appliance manufacturer's installation instructions~~ or other approved methods. Ducts installed within all other buildings shall be sized in accordance with the ASHRAE *Handbook of Fundamentals* or other equivalent computation procedure.

### IMC Table 603.4

**TABLE 603.4**  
**DUCT CONSTRUCTION MINIMUM SHEET METAL THICKNESS FOR SINGLE DWELLING UNITS<sup>a</sup>**  
*(Replace table with the following)*

<u>DUCT SIZE</u>	<u>GALVANIZED</u>		<u>ALUMINUM MINIMUM THICKNESS (in.)</u>
	<u>Minimum thickness (in.)</u>	<u>Equivalent galvanized gage no.</u>	
<u>Round ducts and enclosed rectangular ducts</u>			
<u>14 inches or less</u>	<u>0.0157</u>	<u>28</u>	<u>0.0175</u>
<u>16 and 18 inches</u>	<u>0.0187</u>	<u>26</u>	<u>0.018</u>
<u>20 inches and over</u>	<u>0.0236</u>	<u>24</u>	<u>0.023</u>
<u>Exposed rectangular ducts</u>			
<u>14 inches or less</u>	<u>0.0157</u>	<u>28</u>	<u>0.0175</u>
<u>Over 14 inches<sup>a</sup></u>	<u>0.0187</u>	<u>26</u>	<u>0.018</u>

For SI: 1 inch = 25.4 mm, 1-inch water gauge = 249 Pa.

a. For duct gages and reinforcement requirements at static pressures of 1/2-inch, 1-inch and 2-inch w.g., SMACNA HVAC Duct Construction Standards, Tables 2-1, 2-2 and 2-3 shall apply.

**IMC 603.9**      **603.9 Joints, seams and connections.** *(Only the exception has been changed)*

**Exceptions:**

1. For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams and locking-type joints and seams. This exception shall not apply to snap-lock and button-lock type joints and seams located outside of conditioned spaces.
2. Adjustable metal elbow gore, longitudinal pipe joints, integral seams within a boot fitting, or similar fitting and integral seams within a "Y" fitting.

**603.9.1 Fastening.** Duct connections to flanges of air distribution system equipment or sheet metal fittings shall be mechanically fastened. Crimp joints for round ducts shall have a contact lap of at least 1 1/2 inches (38 mm). Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened in accordance with the manufacturer's installation instructions. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked 181B-C.

**IMC 603.13**      **603.13 Flood hazard areas.** For structures in flood hazard areas, ducts shall be located above the elevation ~~required~~ established by ~~Section 1612 of the International Building Code~~ the flood plain administrator for utilities and attendant equipment or shall be designed and constructed to prevent water from entering or accumulating within the ducts during floods up to such elevation. If the ducts are located below the elevation ~~required~~ established by ~~Section 1612 of the International Building Code~~ the flood plain administrator for utilities and attendant equipment, the ducts shall be capable of resisting hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding up to such elevation.

**SECTION 604 INSULATION**

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<b>IMC 604.11</b>	<b>604.11 Vapor retarders.</b>	<i>Not adopted/deleted</i>
	<u>604.11</u> <del>604.12</del> Weatherproof barriers.	<i>Renumbered</i>
	<u>604.12</u> <del>604.13</del> Internal insulation.	<i>Renumbered</i>



# CHAPTER 9

## SPECIFIC APPLIANCES, FIREPLACES AND SOLID FUEL-BURNING EQUIPMENT

### SECTION 901 GENERAL

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**IMC 901.1**      **901.1 Scope.** This chapter shall govern the approval, design, installation, construction, ~~maintenance, alteration~~ and repair of the appliances and *equipment* specifically identified herein and factory-built fireplaces. The approval, design, installation, construction, ~~maintenance, alteration~~ and repair of gas-fired appliances shall be regulated by ~~the International Fuel Gas Code Appendix C.~~

### SECTION 923 SMALL CERAMIC KILNS

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**IMC 923.1**      **923.1 General.** Kilns shall be listed and labeled unless otherwise approved in accordance with Section 105.2. ~~Electric kilns shall comply with UL 499.~~ The approval of unlisted appliances in accordance with Section 105.2 shall be based on approved engineering evaluation. The provisions of this section shall apply to listed and unlisted kilns that are used for ceramics, have a maximum interior volume of 20 cubic feet (0.566 m<sup>3</sup>) and are used for hobby and noncommercial purposes.

**923.1.1 Installation.** Kilns shall be installed in accordance with the manufacturer's instructions and the provisions of this code. Electric kilns shall comply with UL 499.

**OMSC 923.2**      **923.2 Unlisted outdoor kiln installation.** Unlisted kilns shall be installed only outdoors in accordance with the manufacturer's installation instructions and Sections 923.2.1 through 923.2.1.5.1.

**923.2.1 Installations under structures.** Kilns shall be installed with minimum clearances as specified in Section 923.2.1.1. Kilns located under a roof and enclosed by two or more vertical wall surfaces shall have a hood and gravity ventilation duct installed to comply with Sections 923.2.1.3 and 923.2.1.4.

**923.2.1.1 Clearances for interior installation.** The sides and tops of kilns shall be located a minimum of 18 inches (457 mm) from any noncombustible surface and 3 feet (914 mm) from any combustible wall surface. Kilns shall be installed on *noncombustible* flooring, consisting of at least 2 inches (51 mm) of solid masonry or concrete extending at least 12 inches (305 mm) beyond the base or supporting members of the kiln.

**Exception:** These clearances may be reduced, provided that independent testing is provided to and approved by the building official.

**923.2.1.2 Control side clearance.** The clearance on the control side of a kiln shall not be reduced to less than 30 inches (762 mm).

**923.2.1.3 Hoods.** Where required, a canopy type hood shall be installed directly above each kiln. The face opening area of the hood shall be equal to or greater than the top horizontal surface area of the kiln. The hood shall be constructed of not less than 0.030-inch (0.76 mm) (No. 22 U.S. gage) galvanized steel or equivalent and be supported at a height of between 12 inches and 30 inches (305 mm and 762 mm) above the kiln by *noncombustible* supports.

**Exception:** Electric kilns installed with *listed* exhaust blowers may be used when marked as being suitable for the kiln and installed in accordance with the manufacturer's instructions.

**923.2.1.4 Gravity ventilation ducts.** Each kiln hood shall be connected to a gravity ventilation duct extending in a vertical direction to outside the building. This duct shall be of the same construction as the hood and shall have a cross-sectional area of not less than one-fifteenth of the face opening of the hood. The duct shall terminate a minimum of 12 inches (305 mm) above any portion of a building within 4 feet (1219 mm) and terminate not less than 4 feet (1219 mm)

from any openable windows or other opening into the building or adjacent property line. The duct to the outside shall be shielded, without reduction of duct area, to prevent entrance of rain into the duct. The duct shall be supported at each section by *noncombustible* supports.

**923.2.1.5 Hood and duct clearances.** Every hood and duct serving a fuel-burning kiln shall have a *clearance* from combustible construction of at least 18 inches (457 mm). This clearance may be reduced in accordance with Table 308.4.2.

**923.2.1.5.1 Makeup air.** Provisions shall be made for *makeup air* to enter the enclosure in which a kiln is installed at a rate at least equal to the air being removed through the kiln hood.

## SECTION 926 GASEOUS HYDROGEN SYSTEMS

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**IMC 926.1**      **926.1 Installation.** The installation of gaseous hydrogen systems shall be in accordance with the applicable requirements of this code, ~~the *International Fire Code*, the *International Fuel Gas Code* and the *International*~~ and the *Building Code*.

## SECTION 927 RADIANT HEATING SYSTEMS

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**IMC 927**              Radiant heating systems.      *Not adopted / Reserved*

## SECTION 929 SOLID FUEL-BURNING DEVICES

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**OMSC 929**      **929.1 Used solid fuel-burning stoves.**

**Note:** For reference only-Not adopted as part of the *state building code*.

Solid fuel-burning devices, as defined by the Oregon Department of Environmental Quality, OAR 340-262-0500, are required by DEQ to bear a certification label.

**929.2 Labeling for identification.**

**Note:** For reference only: Not adopted as part of the *state building code*.

The Oregon Department of Environmental Quality regulates the sale and use of residential and commercial solid fuel-burning devices. See Oregon Administrative Rule (OAR) Chapter 340, Division 262. DEQ prohibits the installation of “used solid fuel-burning devices.”

**Exceptions:**

1. Solid fuel-burning devices certified as new on or after July 1, 1986, under rules adopted pursuant to OAR 340-262-0500.
2. Antique wood stoves pursuant to OAR 340-262-0700.
3. Pellet stoves under rules adopted pursuant to OAR 340-262-0450.

## SECTION ~~930-929~~ UNVENTED ALCOHOL FUEL-BURNING DECORATIVE APPLIANCES

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**IMC 929.1**      **930.1** ~~929.1~~ General.      *Renumbered*

## SECTION ~~931-930~~ LARGE-DIAMETER CEILING FANS

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**IMC 930.1**      **931.1** ~~930.1~~ General.      *Renumbered*

# CHAPTER 10

## BOILERS, WATER HEATERS AND PRESSURE VESSELS

### SECTION 1001 GENERAL

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**IMC 1001.1**      **1001.1 Scope.** ~~This chapter shall govern~~ The purpose of this chapter is to establish and provide minimum standards for the protection of the public welfare, health, safety and property by regulating and controlling the installation, alteration and repair of steam and hot water boilers, water heaters and, pressure vessels and their related piping that are not regulated by the *Boiler Code* or the *Plumbing Code*. (The Exceptions are deleted)

### SECTION 1002 WATER HEATERS

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**IMC 1002.1**      **1002.1 General.** Potable water heaters and hot water storage tanks shall be listed and labeled and installed in accordance with the manufacturer's instructions, the ~~*International Plumbing Code*~~ and, where applicable, this code. Water heaters shall be capable of being removed without first removing a permanent portion of the building structure. The potable water connections and relief valves for all water heaters shall conform to the requirements of the ~~*International Plumbing Code*~~. ~~Domestic electric water heaters shall comply with UL 174 or UL 1453. Commercial electric water heaters shall comply with UL 1453. Oil fired water heaters shall comply with UL 732. Solid fuel fired water heaters shall comply with UL 2523. Solar thermal water heating systems shall comply with Chapter 14 and ICC 900/SRCC 300.~~

### SECTION 1003 – 1016

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IMC 1003 through 1011 are not adopted.

#### **SECTION 1003** **BOILERS AND PRESSURE VESSELS**

**1003.1 General.** The requirements of this section shall apply to the boiler rooms, combustion air, chimneys, vents and fuel piping related to the construction, installation, repair and alteration of rooms for the installation of boilers and pressure vessels.

**1003.2 Standards.** Boilers and pressure vessels that are not regulated by the *Boiler Code* shall be designed and constructed in accordance with the requirements of their listing and labeling or the applicable standards for their use.

**1003.3 Installation.** In addition to the requirements of this code, the installation of boilers and pressure vessels that are not regulated by the *Boiler Code* shall conform to the manufacturer's instructions. Operating instructions of a permanent type shall be attached to the boiler. Boilers shall have all controls set, adjusted and tested by the installer. The manufacturer's rating data and the nameplate shall be attached to the boiler.

**1003.4 Workmanship.** All equipment, appurtenances, devices and piping shall be installed in a workmanlike manner conforming to the provisions and intent of this chapter.

#### **SECTION 1004** **PERMITS REQUIRED**

**1004.1 Permits.** It shall be unlawful to install any boiler or pressure vessel regulated by this code or the *Boiler Code* without first obtaining a permit from the local municipality and an installation permit from the State of Oregon, Oregon Building Codes Division, Boiler and Pressure Vessel Program. Permits obtained from the local municipality shall apply to the boiler rooms, combustion air, chimneys, vents, and fuel and hydronic piping related to the construction, repair and alteration of rooms for the installation of boilers and pressure vessels and the installation of any boiler or pressure vessel regulated by this code.

#### **SECTION 1005** **DETAILED REQUIREMENTS**

**1005.1 Safety requirements.** The installation of all boilers and pressure vessels not regulated by the *Boiler Code* shall conform to the minimum requirements for safety established by this code.

**1005.1.1 Safety relief valves for hot water boilers.** Hot water boilers shall be protected with a safety relief valve.

**1005.1.2 Pressure relief for pressure vessels.** All pressure vessels shall be protected with a pressure relief valve or pressure-limiting device as required by the manufacturer's installation instructions for the pressure vessel.

**1005.2 Stack dampers.** Stack dampers on boilers fired with oil or solid fuel that are not regulated by the *Boiler Code* shall not close more than 80 percent of the stack area when closed, except on automatic boilers with prepurge, automatic draft control and interlock. Operative dampers shall not be placed within any stack, flue or vent of a gas-fired boiler, except on an automatic boiler with prepurge, automatic draft control and interlock.

### **SECTION 1006 EXPANSION TANKS**

**1006.1 Expansion tanks.** Expansion tanks shall be securely fastened to the structure; supports shall be adequate to carry twice the weight of the tank filled with water without placing any strain on connecting piping.

All water heating systems incorporating hot water tanks or fluid relief columns shall be installed to prevent freezing under normal operating conditions.

An expansion tank shall be installed in every hot water system. For multiple boiler installations, not less than one expansion tank is required. Expansion tanks shall be of the closed or open type. Tanks shall be rated for the pressure of the hot water system.

### **SECTION 1007 SAFETY OR RELIEF VALVE DISCHARGE**

**1007.1 General.** The discharge from relief valves for water heaters and boilers not regulated by the *Boiler Code* shall be piped to within 18 inches (457 mm) of the floor or to an open receptacle, and when the operating temperature is in excess of 212°F (100°C), shall be equipped with a splash shield or centrifugal separator. Where the discharge from safety valves would result in a hazardous discharge of steam inside the boiler room, such discharge shall be extended outside the boiler room. Valves are prohibited between the safety valve and the atmosphere.

### **SECTION 1008 GAS PRESSURE REGULATORS**

**1008.1 General.** An approved gas pressure regulator shall be installed on gas-fired boilers not regulated by the *Boiler Code* where the gas supply pressure is higher than that at which the main burner is designed to operate. A separate approved gas pressure regulator shall be installed to regulate the gas pressure to the pilot or pilots. A separate regulator shall not be required for the pilot or pilots on manufacturer-assembled boiler-burner units that have been approved by the building official and on gas-fired boilers in Group R occupancies of less than six units and in Group U occupancies.

### **SECTION 1009 CLEARANCE FOR ACCESS**

**1009.1 Access.** Where boilers not regulated by the *Boiler Code* are installed or replaced, clearance shall be provided to allow access for inspection, maintenance and repair, and passageways shall have an unobstructed width of not less than 18 inches (457 mm). Clearance for repair and cleaning may be provided through a door or access panel into another area, provided that the opening is of sufficient size. Package boilers, miniature boilers, low-pressure boilers and hot water supply boilers with no manhole on top of shell shall have a minimum clearance of 2 feet (610 mm) from the ceiling.

### **SECTION 1010 BOILER ROOM ENCLOSURES**

**1010.1 Boiler rooms.** Boiler rooms and enclosures and access thereto shall comply with Chapter 3 and the *Building Code*.

### **SECTION 1011 FLOORS**

**1011.1 General.** Boilers shall be mounted on floors of noncombustible construction unless listed for mounting on combustible floors. The floor and related structural supports shall be designed as required in the *Building Code* to carry the loads imposed by the boiler and appurtenances.

### **SECTION 1012 CHIMNEYS OR VENTS**

**1012.1 General.** Where required, boilers shall be connected to a chimney or vent in accordance with Chapter 8 for oil or wood and Appendix C for fuel gas installations.

### **SECTION 1013 DRAINAGE**

**1013.1 Drains.** The boiler room shall have an approved floor drain or equivalent means for disposing of accumulation of liquid wastes incidental to cleaning or recharging.

### **SECTION 1014 FUEL SUPPLY PIPING**

**1014.1 Piping.** Fuel supply piping shall conform to Chapter 13, Appendix C or the standards cited in Chapter 15.

### **SECTION 1015 AIR FOR COMBUSTION AND VENTILATION**

**1015.1 General.** Air for combustion and ventilation shall be installed in accordance with Chapter 7 or Appendix C.

**SECTION 1016**  
**STEAM AND HOT WATER PIPING**

Note: Boilers and pressure vessels and related piping are regulated by the *Boiler Code*. See ORS 480.510 to 480.670.

**1016.1 General.** Steam piping is regulated by the *Oregon Boiler and Pressure Vessel Law*, related *Oregon Administrative Rules*, and *Boiler Code*. The *Boiler Code* is administered and enforced by the State of Oregon, Building Codes Division, Boiler and Pressure Vessel Program.

**1016.1.1 Hot water piping systems.** Water piping used for hot water heating systems and hydronics shall be installed in accordance with Chapter 12.



# CHAPTER 11

## REFRIGERATION

### SECTION 1101 GENERAL

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#### IMC 1101

Note: Brazing certifications required. A person qualified for inspection of brazing or welding of refrigeration piping shall have a valid certification meeting the requirements in OAR 918-0981020. A person engaged in the brazing or welding of refrigeration piping shall have a valid certification meeting the requirements in OAR 918-440-0015. For refrigeration piping regulated by the State of Oregon, Building Codes Division, Boiler and Pressure Vessel Program, see requirements listed in OAR 918-225-0310.

1101.6 Maintenance.	<i>Not adopted / Deleted</i>
1101.7 Change in refrigerant type.	<i>Not adopted / Deleted</i>
1101.8 Refrigerant discharge.	<i>Not adopted / Deleted</i>
<u>1101.6</u> <del>1101.9</del> Locking access port caps.	<i>Renumbered</i>

### SECTION 1102 SYSTEM REQUIREMENTS

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IMC 1102.3	1102.3 Access port protection.	<i>Not adopted / Deleted</i>
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### SECTION 1105 MACHINERY ROOM, GENERAL REQUIREMENTS

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**IMC 1105.1** 1105.1 Design and construction. Machinery rooms shall be designed and constructed in accordance with the ~~International Building Code and this section~~ Building Code and this section. A machinery room shall be dimensioned so as to provide clearances required by Chapter 3. Passageways shall maintain a clear head room of not less than 87 inches (2210 mm) below equipment and appliances located over passageways.

Access to machinery rooms shall be restricted to authorized personnel. A sign shall be posted on the machinery room door prohibiting access by others.

1105.1.1 Emergency signs. Refrigeration units or systems having a refrigerant circuit containing more than 220 pounds (100 kg) of Group A1 or 30 pounds (14 kg) of any other group refrigerant shall be provided with approved emergency signs, charts and labels in accordance with NFPA 704. Hazard signs shall be in accordance with the classification of refrigerants listed therein.

**IMC 1105.2** 1105.2 Openings. Ducts and air handlers in the *machinery room* that operate at a lower pressure than the room shall be sealed to prevent any refrigerant leakage from entering the airstream. Openings that permit passage of escaping refrigerant to other parts of the building are prohibited.

Exceptions:

1. Egress doors serving the machinery room.
2. Access doors and panels in air ducts and air-handling units, provided that such openings are gasketed and tight fitting.

**IMC 1105.3** 1105.3 Refrigerant detector. ~~Refrigerant detectors in machinery rooms shall be provided as required by Sections 605.8 and 605.17 of the International Fire Code.~~ Machinery rooms shall contain a refrigerant detector with audible and visual alarms. The detector, or a sampling tube that draws air to the detector, shall be located in an area where refrigerant from a leak will concentrate. The alarm shall be actuated at a value not greater than the corresponding TLV-TWA values shown in Table 1103.1. Detectors and alarms shall be placed in approved locations.

**Exception:** Detectors are not required for ammonia systems complying with Section 1105.3.1.

**1105.3.1 Refrigerants other than ammonia.** A detector, or a sampling tube that draws air to a detector, shall be provided at an *approved* location where refrigerant from a leak is expected to accumulate. The system shall be designed to initiate audible and visible alarms inside and outside each entrance to the refrigerating machinery room and transmit a signal to an *approved* location where the concentration of refrigerant detected exceeds the lesser of the following:

1. The corresponding TLV-TWA values provided in Table 1103.1.
2. Twenty-five percent of the lower flammable limit (LFL).

Detection of a refrigerant concentration exceeding the upper detection limit or 25 percent of the LFL, whichever is lower, shall stop refrigerant equipment in the machinery room in accordance with Section 1106.

**OMSC 1105.6.1.2 1105.6.1.2 Mechanical ventilation exhaust.** Exhaust from mechanical ventilation systems serving refrigeration machinery rooms containing flammable, toxic or highly toxic refrigerants, other than ammonia, capable of exceeding 25 percent of the LFL or 50 percent of the IDLH shall be equipped with approved treatment systems to reduce the discharge concentrations to those values or lower.

**Exception:** Refrigeration systems containing Group A2L complying with Section 1106.

**IMC 1105.8 1105.8 Emergency pressure control system.** ~~Emergency pressure control systems shall be provided in accordance with Section 605.10 of the *International Fire Code*.~~

~~Permanently installed refrigeration systems containing more than 6.6 pounds (3 kg) of flammable, toxic or highly toxic refrigerant or ammonia shall be provided with an emergency pressure control system in accordance with Sections 1105.8.1 through 1105.8.2.2.~~

## SECTION 1106 MACHINERY ROOM, SPECIAL REQUIREMENTS

**IMC 1106.4.1 1106.4.1 Ventilation system activation.** Ventilation shall be activated by the refrigerant detection system in the *machinery room*. ~~refrigerant~~ detection systems shall be in accordance with ~~Section 605.8 of the *International Fire Code* and~~ all of the following:

1. The detectors shall activate at or below a *refrigerant* concentration of 25 percent of the *LFL*.
2. Upon activation, the detection system shall activate the emergency ventilation system required by Section 1106.4.2.
3. The detection, signaling and control circuits shall be supervised.

**IMC 1106.5.1 1106.5.1 Refrigeration system emergency shutoff.** A clearly identified switch of the break-glass type or with an approved tamper-resistant cover shall provide off-only control of refrigerant compressors, refrigerant pumps, and normally closed, automatic refrigerant valves located ~~in~~ *at an approved location immediately outside* the machinery room *and adjacent to its primary entrance*. Additionally, this equipment shall be automatically shut off whenever the refrigerant vapor concentration in the machinery room exceeds the vapor detector's upper detection limit or 25 percent of the LEL, whichever is lower.

## SECTION 1111 PERIODIC TESTING

**IMC 1111 Periodic Testing.** *Not adopted/Entire section is deleted*

# CHAPTER 12

## HYDRONIC PIPING

### SECTION 1205 VALVES

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**IMC 1205.1.1**      **1205.1.1 Heat exchangers.** Shutoff valves shall be installed on the supply and return side of a heat exchanger.

**Exception:** Shutoff valves shall not be required where heat exchangers are integral with a boiler; or are a component of a manufacturer's boiler and heat exchanger packaged unit and are capable of being isolated from the hydronic system ~~by the supply and return valves required by Section 1005.1.~~

### SECTION 1206 PIPING INSTALLATION

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**IMC 1206.9.1**      **1206.9.1 Flood hazard. Piping** located in a flood hazard area shall be capable of resisting hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the *design flood elevation* as established by the flood plain administrator.

### SECTION 1209 EMBEDDED PIPING

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**IMC 1209.1**      **1209.1 Materials.** Piping for heating panels shall be standard-weight steel pipe, Type L copper tubing, polybutylene or other *approved* plastic pipe or tubing, cross-linked polyethylene (PEX) tubing, cross-linked polyethylene/aluminum/ cross-linked polyethylene (PEX-AL-PEX) pressure pipe or polybutylene rated at 100 psi (689 kPa) at 180°F (82°C).

**IMC 1209.5.2**      **1209.5.2 Insulation material marking.**      *Not adopted / Section deleted*

### SECTION 1210 PLASTIC PIPE GROUND-SOURCE HEAT PUMP LOOP SYSTEMS

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**IMC 1210.7.1**      **1210.7.1 Heat exchangers.** Shutoff valves shall be installed on the supply and return side of a heat exchanger.

**Exception:** Shutoff valves shall not be required where heat exchangers are integral with a boiler or are a component of a manufacturer's boiler and heat exchanger packaged unit and are capable of being isolated from the hydronic system ~~by the supply and return valves required by Section 1005.1.~~

# CHAPTER 13

## FUEL OIL PIPING AND STORAGE

### SECTION 1301 GENERAL

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- IMC 1301.1**      **1301.1 Scope.** This chapter shall govern the design, installation, construction and repair of fuel-oil storage and piping systems. ~~The storage of fuel oil and flammable and combustible liquids shall be in accordance with Chapters 6 and 57 of the *International Fire Code*.~~
- IMC 1301.2**      **1301.2 Storage and piping systems.** Fuel-oil storage systems shall comply with ~~Section 603.3 of the *International Fire Code*~~ *Building Code*. Fuel-oil piping systems shall comply with the requirements of this code and the *Oregon Department of Environmental Quality*.
- IMC 1301.5**      **1301.5 Tanks abandoned or removed.**      *Not adopted / Section deleted*

### SECTION 1305 FUEL OIL SYSTEM INSTALLATION

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- IMC 1305.2.1**      **1305.2.1 Flood hazard.** Fuel oil pipe, equipment and appliances located in flood hazard areas shall be located above the elevation ~~required by Section 1612 of the *International Building Code*~~ established by the *flood plain administrator* for utilities and attendant equipment or shall be capable of resisting hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding up to such elevation.

# CHAPTER 14

## SOLAR THERMAL SYSTEMS

### SECTION 1401 GENERAL

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**IMC 1401.1**      **1401.1 Scope.** This chapter shall govern the design, construction, installation, *alteration* and repair of solar thermal systems, *equipment* and appliances intended to utilize solar energy for nonpotable space heating or cooling, ~~domestic hot water heating~~, swimming pool heating or process heating.

### SECTION 1402 DESIGN AND INSTALLATION

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**IMC 1402.3.1**      **1402.3.1 Relief device.** Each section of the system in which excessive pressures are capable of developing shall have a relief device located so that a section cannot be valved off or otherwise isolated from a relief device. Listed and labeled relief valves shall ~~comply~~ have a minimum rated capacity for the equipment or appliances served and discharged in accordance with the requirements of Section ~~1006.6~~1007. For indirect solar systems, pressure relief valves in solar loops shall also comply with ICC 900/SRCC 300.

### SECTION 1403 HEAT TRANSFER FLUIDS

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**IMC 1403.4**      **1403.4 Toxicity.** The use of toxic fluids shall comply with Title 15 of the Federal Hazardous Substances Act ~~and Chapter 60 of the International Fire Code~~.



# CHAPTER 15

## REFERENCED STANDARDS

<b>ASHRAE</b>	<del>90.1—2016: Energy Standard for Buildings Except Low-rise Residential Buildings</del> <del>180—2018: Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems</del>
<b>ASME</b>	<del>A112.4.1—2009 (R2019): Water Heater Relief Valve Drain Tubes</del> <del>BPVC—2019: ASME Boiler &amp; Pressure Vessel Code</del> <del>CSD-1—2021: Controls and Safety Devices for Automatically Fired Boilers</del>
<b>CPSC</b>	<del>CPSC August 2011: Title 15 of the Federal Hazardous Substance Act</del>
<b>DOL</b>	<del>29 CFR Part 1910.1000 (2015): Air Contaminants</del> <del>29 CFR Part 1910.1025 (2015): Toxic and Hazardous Substances</del>
<b>ICC</b>	<del>IBC—21: International Building Code®</del> <del>IECC—21: International Energy Conservation Code®</del> <del>IFC—21: International Fire Code®</del> <del>IFGC—21: International Fuel Gas Code®</del> <del>IPC—21: International Plumbing Code®</del> <del>IRC—21: International Residential Code®</del>
<b>IIAR</b>	<del>ANSI/IIAR 3—2017: Ammonia Refrigeration Valves</del> <del>ANSI/IIAR 4—2020: Installation of Closed-circuit Ammonia Mechanical Refrigeration Systems</del> <del>ANSI/IIAR 5—2019: Startup of Closed-circuit Ammonia Refrigeration Systems</del>
<b>NBBI</b>	<del>NBIC—2017: National Board Inspection Code, Part 3</del>
<b>NFPA</b>	<del>30A—21: Code for Motor Fuel-dispensing Facilities and Repair Garages</del> <del>70—20: National Electrical Code</del> <del>85—19: Boiler and Combustion Systems Hazards Code</del>
<b>NSF</b>	<del>14—2017: Plastic Piping System Components and Related Materials</del>
<b>UL</b>	<del>174—04: Household Electric Storage Tank Water Heaters—with revisions through December 2016</del> <del>732—2018: Oil-fired Storage Tank Water Heaters</del> <del>834—04: Heating, Water Supply and Power Boilers Electric—with revisions through September 2018</del> <del>1453—2016: Electric Booster and Commercial Storage Tank Water Heaters—with revisions through May 2018</del> <del>2158A—2013: Outline of Investigation for Clothes Dryer Transition Duct—with revisions through April 2017</del> <del>2523—2009: Solid Fuel-fired Hydronic Heating Appliances, Water Heaters, and Boilers—with revisions through March 2018</del>

# APPENDIX C

## FUEL GAS

### SECTION C101

#### SCOPE AND GENERAL REQUIREMENTS

**C101.1 Title.** These regulations shall be known as [Appendix C](#), hereinafter referred to as “this [appendix](#).”

**C101.2 Scope.** This [appendix](#) shall apply to the installation of fuel-gas *pipng* systems, fuel gas appliances, gaseous hydrogen systems and related accessories in accordance with Sections [C101.2.1](#) through [C101.2.4](#).

**Exception:** Detached one- and two-family dwellings and townhouses not more than three stories above grade plane in height with separate means of egress and their accessory structures not more than three stories above grade plane in height, shall comply with the *Residential Code*.

**C101.2.1 Gaseous hydrogen systems.** Gaseous hydrogen systems shall be regulated by [Section C701](#).

**C101.2.2 Piping systems.** These regulations cover *pipng* 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 C402.7. Coverage shall extend from the *point of delivery* to the outlet of the *appliance* shutoff valves. *Pipng* system requirements shall include design, materials, components, fabrication, assembly, installation, testing, inspection, operation and maintenance.

**C101.2.3 Gas appliances.** Requirements for gas appliances and related accessories shall include installation, combustion and ventilation air and venting and connections to *pipng* systems.

**C101.2.4 Systems, appliances and equipment outside the scope.** This [appendix](#) shall not apply to the following:

1. Portable [fuel](#) gas appliances and *equipment* of all types that is not connected to a fixed fuel *pipng* system.
2. Raw material (feedstock) applications except for *pipng* to special atmosphere generators.
3. Oxygen-fuel gas cutting and welding systems.
4. Industrial gas applications using gases such as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen.
5. Petroleum refineries, pipeline compressor or pumping stations, loading terminals, compounding plants, refinery tank farms and natural gas processing plants.

6. Integrated chemical plants or portions of such plants where flammable or combustible liquids or gases are produced by, or used in, chemical reactions.

7. LP-gas installations at utility gas plants.

8. Liquefied natural gas (LNG) installations.

9. Proprietary items of *equipment*, apparatus or instruments such as gas-generating sets, compressors and calorimeters.

10. LP-gas *equipment* for vaporization, gas mixing and gas manufacturing.

11. Temporary [fuel](#) gas *pipng* for buildings under construction or renovation that is not to become part of the permanent *pipng* system.

12. Installation of LP-gas systems for railroad switch heating.

13. Installation of hydrogen gas, LP-gas and compressed natural gas (CNG) systems on vehicles.

14. Except as provided in Section C401.1.1, gas *pipng*, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in the distribution of gas, other than undiluted LP-gas.

15. Building design and construction, except as specified herein.

16. *Pipng* systems for mixtures of gas and air within the flammable range with an operating pressure greater than 10 psig (69 kPa gauge).

17. Portable fuel cell appliances that are neither connected to a fixed *pipng* system nor interconnected to a power grid.

**C101.3 Purpose.** The purpose of this [appendix](#) is to establish minimum requirements to provide a reasonable level of safety, health, property protection and general welfare by regulating and controlling the design, construction, installation, quality of materials and location of fuel gas *equipment* or systems.

**C101.4 Severability.** If a section, subsection, sentence, clause or phrase of this [appendix](#) is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this [appendix](#).

### SECTION C102

#### NOTICE OF APPROVAL

**C102.1 Approval.** After the prescribed tests and inspections indicate that the work complies in all respects with this [appendix](#), a notice of approval shall be issued by the [building official](#).

**C102.2 Revocation.** The *building official* is authorized to, in writing, suspend or revoke a notice of approval issued under the provisions of this [appendix](#) wherever the notice is issued in error, or on the basis of incorrect information supplied or where it is determined that the building or structure, premise, or portion thereof is in violation of any ordinance or regulation or any of the provisions of [this appendix](#).

### SECTION **C103** SERVICE UTILITIES

**C103.1 Connection of service utilities.** A person shall not make connections from a utility, source of energy, fuel or power to any building or system that is regulated by this [appendix](#) for which a permit is required until authorized by the *building official*.

**C103.2 Temporary connection.** The *building official* shall have the authority to authorize the temporary connection of the building or system to the utility, source of energy, fuel, power, water system or sewer system for the purpose of testing the installation or for use under a temporary approval.

### SECTION **C104** TEMPORARY EQUIPMENT, SYSTEMS AND USES

**C104.1 General.** The *building official* is authorized to issue a permit for temporary *equipment*, systems and uses. Such permits shall be limited as to time of service, but shall not be permitted for more than 180 days. The *building official* is authorized to grant extensions for demonstrated cause.

**C104.2 Conformance.** Temporary *equipment*, systems and uses shall conform to the structural strength, fire safety, means of egress, accessibility, light, ventilation and sanitary requirements of this [appendix](#) as necessary to ensure the public health, safety and general welfare.

**C104.3 Temporary utilities.** The *building official* is authorized to give permission to temporarily supply utilities before an installation has been fully completed and the final certificate of completion has been issued. The part covered by the temporary certificate shall comply with the requirements specified for temporary lighting, heat or power in [this appendix](#).

**C104.4 Termination of approval.** The *building official* is authorized to terminate such permit for a temporary structure or use and to order the temporary structure or use to be discontinued.

### SECTION **C105** INSPECTIONS AND TESTING

**C105.1 General.** The *building official* is authorized to conduct such inspections as are deemed necessary to determine compliance with the provisions of this [appendix](#). Construction or work for which a permit is

required shall be subject to inspection by the *building official*, and such construction or work shall remain visible and able to be accessed for inspection purposes until *approved*. Approval as a result of an inspection shall not be construed to be an approval of a violation of the provisions of this [appendix](#). Inspections presuming to give authority to violate or cancel the provisions of this [appendix](#) shall not be valid.

**C105.2 Required inspections and testing.** The *building official*, on notification from the permit holder or the permit holder's agent, shall make the following inspections and other such inspections as necessary, and shall either release that portion of the construction or notify the permit holder or the permit holder's agent of violations that are required to be corrected. The holder of the permit shall be responsible for scheduling such inspections.

1. Underground inspection shall be made after trenches or ditches are excavated and bedded, *pipng* is installed and before backfill is put in place. Where excavated soil contains rocks, broken concrete, frozen chunks and other rubble that would damage or break the *pipng* or cause corrosive action, clean backfill shall be on the job site.
2. Rough-in inspection shall be made after the roof, framing, fireblocking and bracing are in place and components to be concealed are complete, and prior to the installation of wall or ceiling membranes.
3. Final inspection shall be made upon completion of the installation.

The requirements of this section shall not be considered to prohibit the operation of any heating *appliance* installed to replace an existing heating *appliance* serving an occupied portion of a structure in the event a request for inspection of such heating *appliance* has been filed with the department not more than 48 hours after replacement work is completed, and before any portion of such *appliance* is concealed by any permanent portion of the structure.

**C105.3 Testing.** Installations shall be tested as required in this [appendix](#) and in accordance with Sections [C105.3.1](#) through [C105.3.3](#). Tests shall be made by the permit holder and observed by the *building official*.

**C105.3.1 New, altered, extended or repaired installations.** New installations and parts of existing installations, which have been altered, extended, renovated or repaired, shall be tested as prescribed herein to disclose leaks and defects.

**C105.3.2 Apparatus, instruments, material and labor for tests.** Apparatus, instruments, material and labor required for testing an installation or part thereof shall be furnished by the permit holder.

**C105.3.3 Reinspection and testing.** Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made so as to achieve compliance with this [appendix](#). The work or installation shall then be resubmitted to the [building official](#) for inspection and testing.

## **SECTION C201 FUEL GAS DEFINITIONS**

**C201.1 Scope.** Unless otherwise expressly stated, the following words and terms shall, for the purposes of this [appendix](#) and standard, have the meanings indicated in [Section C202](#).

**C201.2 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.

**C201.3 Terms defined in other codes.** Where terms are not defined in this [appendix](#) and are defined in [Chapter 2 of this code](#), the *Building Code*, *Electrical Code* or *Plumbing Code*, such terms shall have meanings ascribed to them as in those codes.

**C201.4 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. [Words of common usage are given their plain, natural and ordinary meanings. Words that have well-defined legal meanings are given those meanings.](#)

## **SECTION C202 GENERAL DEFINITIONS**

**C202.1 General.** [Definitions included in this section are in addition to the definitions found in Chapter 2 of this code.](#)

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

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

**ANODELESS RISER.** A transition assembly in which plastic *pipng* is installed and terminated above ground outside of a building.

**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, 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.

**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.

### **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).

**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.

**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.

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

**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).

**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.

**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.

**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*.

**CONCEALED PIPING.** *Piping* that is located in a *concealed location* (see "*Concealed location*").

**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 *pipng* system.

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

**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.

**CUBIC FOOT.** The amount of gas that occupies 1 cubic foot (0.02832 m<sup>3</sup>) 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).

**DECORATIVE APPLIANCE, VENTED.** A vented *appliance* 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).

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

**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.

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

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

**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.

**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.



**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, ENCLOSED.** 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 *pipng*. 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.

**GASEOUS HYDROGEN SYSTEM.** See Section [C702.1](#).

**HOUSE PIPING.** See “*Piping system.*”

**HYDROGEN FUEL-GAS ROOM.** See Section [C702.1](#).

**HYDROGEN-GENERATING APPLIANCE.** See Section [C702.1](#).

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

**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 NON-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 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.

**LEAK CHECK.** An operation performed on a gas *pipng* 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.

**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.

**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.

**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.

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

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

**PRESS-CONNECT JOINT.** A permanent mechanical joint incorporating an elastomeric seal or an elastomeric seal and corrosion-resistant grip or bite ring. The joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer.

**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 gastight integrity of gas *pipng* following its installation or modification.

**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.

**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*”).

**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 *pipng* 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 *pipng* 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.

**RISER, GAS.** A vertical pipe supplying fuel gas.

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

**SAFETY SHUTOFF DEVICE.** See “Flame safeguard.”

**SERVICE METER ASSEMBLY.** The meter, valve, regulator, piping, fittings and equipment installed by the service gas supplier before the point of delivery.

**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.

**SYSTEM SHUTOFF.** A valve installed after the point of delivery to shut off the entire piping system.

**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.

**Integral gas valve type.** An automatic device, actuated by temperature changes, designed to control the gas supply to the burner(s) in order to maintain temperatures between predetermined limits, and in which the thermal actuating element is an integral part of the device.

1. Graduating thermostat. A thermostat in which the motion of the valve is approximately in direct proportion to the effective motion of the thermal element induced by the temperature change.
2. Snap-acting thermostat. A thermostat in which the thermostatic valve travels instantly from the closed to the open position, and vice versa.

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

**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.

**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.

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

**Appliance shutoff.** A valve located in the *pipng* 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 *pipng* 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 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 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.

## SECTION C301 GENERAL REGULATIONS

**C301.1 Scope.** This [section and Sections C301.1.1 through C310.1](#) shall govern the approval and installation of all *equipment* and appliances that comprise parts of the installations regulated by this [appendix](#) in accordance with Section [C101.2](#).

**C301.1.1 Other fuels.** The requirements for combustion and dilution air for gas-fired appliances shall be governed by Section [C304](#). The requirements for combustion and dilution air for appliances operating with fuels other than fuel gas shall be regulated by [Chapter 7 of this code](#).

**C301.2 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 Code*.

**C301.3 Listed and labeled.** Appliances regulated by this [appendix](#) shall be *listed* and *labeled* for the application in which they are used unless otherwise *approved* in accordance with Section 105 [of this code](#). The approval of unlisted appliances in accordance with Section 105 [of this code](#) shall be based on *approved* engineering evaluation.

**C301.4 Fuel types.** Appliances shall be designed for use with the type of fuel gas that will be supplied to them.

**C301.4.1 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.

**C301.5 Flood hazard.** For structures located in flood hazard areas, the appliance, equipment and system installations regulated by this [appendix](#) shall be located at or above the elevation [established by the flood plain administrator](#) for utilities and attendant equipment.

**Exception:** The appliance, equipment and system installations regulated by this [appendix](#) are permitted to be located below the elevation [established by the flood plain administrator](#) 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.

## SECTION [C302](#) STRUCTURAL SAFETY

[C302.1 Structural safety.](#) See Section 302 of this code.

## SECTION [C303](#) APPLIANCE LOCATION

**C303.1 General.** Appliances shall be located as required by this section, specific requirements elsewhere in this [appendix](#) and the conditions of the *equipment* and *appliance* listing.

**C303.2 Hazardous locations.** Appliances shall not be located in a *hazardous location* unless *listed* and *approved* for the specific installation.

**C303.3 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 [C304.5](#).
3. A single wall-mounted unvented room heater is installed in a bathroom and such unvented room heater is equipped as specified in Section [C621.6](#) 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 [C304.5](#).
4. A single wall-mounted unvented room heater is installed in a bedroom and such unvented room heater is equipped as specified in Section [C621.6](#) 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 [C304.5](#).
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 [C304.6](#).
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 m<sup>2</sup>) that communicates with a space outside of a sleeping room, bathroom, toilet room or storage closet.

**C303.3.1 Fireplaces and decorative appliances in Group I-2 occupancies.** In Group I-2, Condition 2 occupancies, Gas fireplace appliances and decorative gas appliances shall be prohibited 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. In Group I-2, Condition 1 occupancies, gas *fireplace* appliances and decorative gas appliances shall be prohibited in patient sleeping rooms. In Group I-2 occupancies, The appliance controls shall be located where they can be accessed only by facility staff. Such fireplaces shall comply with Sections [C501.2](#) and [C604.1](#) and Section 915 of the [Building Code](#).

**C303.4 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 ([see Figure 304.6 of this code](#)).



**C303.5 Indoor locations.** Furnaces and boilers installed in closets and alcoves shall be *listed* for such installation.

**C303.6 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.

**C303.7 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 C304  
COMBUSTION, VENTILATION AND DILUTION  
AIR**

**C304.1 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 C304.5 through C304.9. Where the requirements of Section C304.5 are not met, outdoor air shall be introduced in accordance with one of the methods prescribed in Sections C304.6 through C304.9. *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 C504.

**C304.2 Appliance location.** Appliances shall be located so as not to interfere with proper circulation of combustion, ventilation and dilution air.

**C304.3 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.

**C304.4 Makeup air provisions.** Where exhaust fans, clothes dryers and kitchen ventilation systems interfere with the operation of appliances, makeup air shall be provided.

**C304.4.1 Special conditions.** In buildings containing combustion appliances, equipment or fireplaces not equipped with forced or induced draft or separated from the habitable area where an individual exhaust appliance exceeds 350 cfm (165.2 L/s), makeup air of sufficient quantity to equal that being exhausted shall be supplied to the area being ventilated. In such cases, the minimum size makeup air duct shall be 6 inches (152 mm) in diameter or equivalent in area.

**C304.5 Indoor combustion air.** The required volume of indoor air shall be determined in accordance with Section C304.5.1 or C304.5.2, except that where the air infiltration rate is known to be less than 0.40 air changes per hour (ACH), Section C304.5.2 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 C304.5.3, are considered to be part of the required volume.

**C304.5.1 Standard method.** The minimum required volume shall be 50 cubic feet per 1,000 Btu/h (4.8 m<sup>3</sup>/kW) of the *appliance* input rating.

**C304.5.2 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 C3-1.

$$Required\ Volume_{other} \geq \frac{21\ ft^3}{ACH} \left( \frac{I_{other}}{1,000\ Btu/h} \right)$$

**(Equation C3-1)**

For fan-assisted appliances, calculate volume using Equation C3-2.

$$Required\ Volume_{fan} \geq \frac{15\ ft^3}{ACH} \left( \frac{I_{fan}}{1,000\ Btu/h} \right)$$

**(Equation C3-2)**

where:

*I<sub>other</sub>* = All appliances other than fan assisted (input in Btu/h).

*I<sub>fan</sub>* = 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 0.60 *ACH* shall not be used in Equations C3-1 and C3-2.

**C304.5.3 Indoor opening size and location.** Openings used to connect indoor spaces shall be sized and located in accordance with Sections C304.5.3.1 and C304.5.3.2 (see Figure C304.5.3).



**C304.5.3.1 Combining spaces on the same story.**

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

**C304.5.3.2 Combining spaces in different stories.** The volumes of spaces in different stories shall be considered to be communicating spaces where such spaces are connected by one or more permanent openings in doors or floors having a total minimum free area of 2 square inches per 1,000 Btu/h (4402 mm<sup>2</sup>/kW) of total input rating of all appliances.

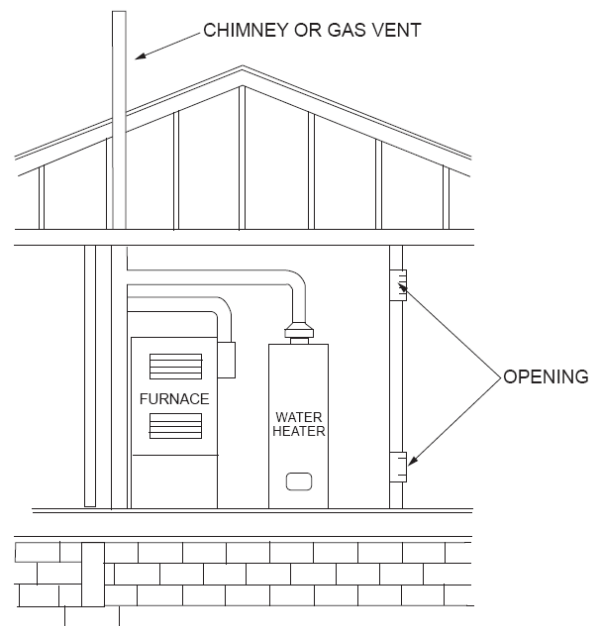
**C304.6 Outdoor combustion air.** Outdoor *combustion air* shall be provided through opening(s) to the outdoors in accordance with Section C304.6.1 or C304.6.2. The minimum dimension of air openings shall be not less than 3 inches (76 mm).

**C304.6.1 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<sup>2</sup>/kW) of total input rating of all appliances in the enclosure [see Figures C304.6.1(1) and C304.6.1(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<sup>2</sup>/ kW) of total input rating of all appliances in the enclosure [see Figure C304.6.1(3)].

**C304.6.2 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 C304.6.2) and shall have a minimum free area of 1 square inch per 3,000 Btu/h (734 mm<sup>2</sup>/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.

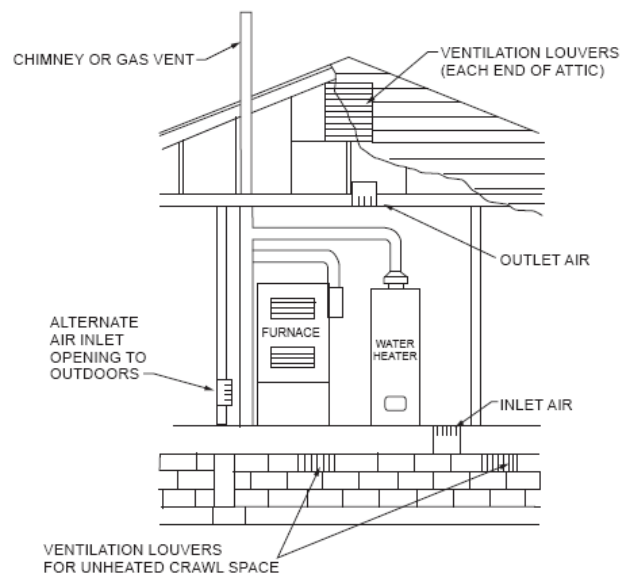


**FIGURE C304.5.3**  
**ALL AIR FROM INSIDE THE BUILDING**  
 (see Section C304.5.3)

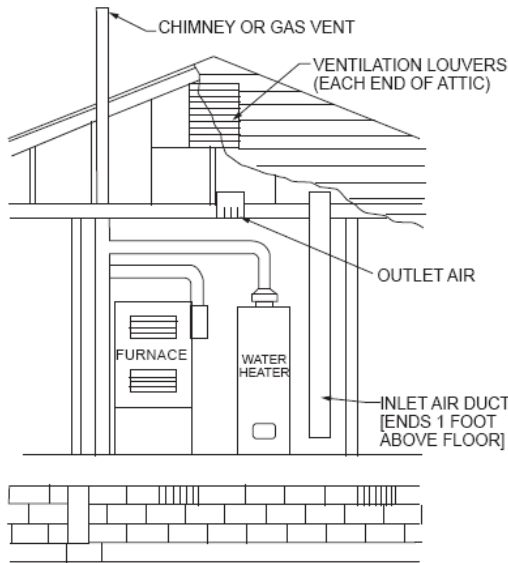
**C304.7 Combination indoor and outdoor combustion air.** The use of a combination of indoor and outdoor *combustion air* shall be in accordance with Sections C304.7.1 through C304.7.3.

**C304.7.1 Indoor openings.** Where used, openings connecting the interior spaces shall comply with Section C304.5.3.

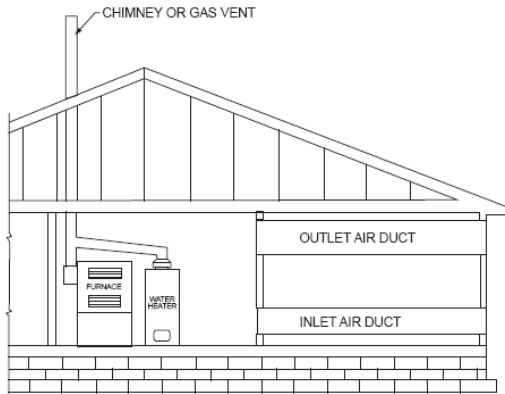
**C304.7.2 Outdoor opening location.** Outdoor opening(s) shall be located in accordance with Section C304.6.



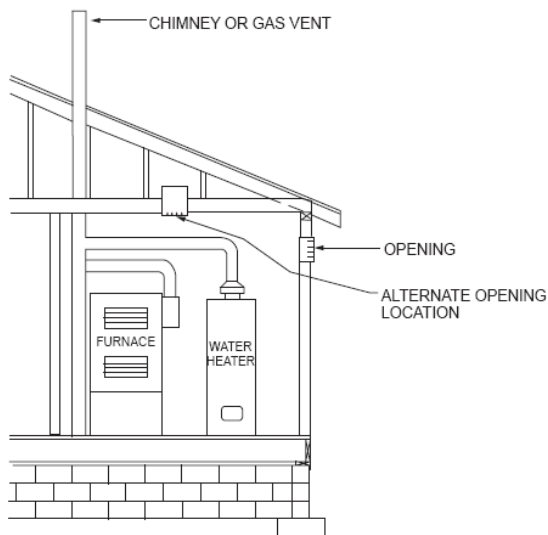
**FIGURE C304.6.1(1)**  
**ALL AIR FROM OUTDOORS—INLET AIR FROM VENTILATED CRAWL SPACE AND OUTLET AIR TO VENTILATED ATTIC**  
 (see Section C304.6.1)



**FIGURE C304.6.1(2)**  
**ALL AIR FROM OUTDOORS THROUGH VENTILATED**  
**ATTIC (see Section C304.6.1)**



**FIGURE C304.6.1(3)**  
**ALL AIR FROM OUTDOORS (see Section C304.6.1)**



**FIGURE C304.6.2**  
**SINGLE COMBUSTION AIR OPENING, ALL AIR FROM**  
**THE OUTDOORS (see Section C304.6.2)**

**C304.7.3 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 C304.6, multiplied by the reduction factor. The minimum dimension of air openings shall be not less than 3 inches (76 mm).

**C304.8 Engineered installations.** Engineered *combustion air* installations shall provide an adequate supply of combustion, ventilation and dilution air determined using engineering methods.

**C304.9 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 m<sup>3</sup>/min per kW) of total input rating of all appliances located within the space.

**C304.9.1 Makeup air.** Where exhaust fans are installed, makeup air shall be provided to replace the exhausted air.

**C304.9.2 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.

**C304.9.3 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.

**C304.10 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 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.

**C304.11 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 this code](#) 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.

**C304.12 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 C305 INSTALLATION

**C305.1 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 [appendix](#). Manufacturers' installation instructions shall be available on the job site at the time of inspection. Where [an appendix](#) 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 C301.3 shall be limited to uses recommended by the manufacturer and shall be installed in accordance with the manufacturer's instructions, the provisions of this [appendix](#) and the requirements determined by the [building official](#).

**C305.2 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.

**C305.3 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.

**C305.3.1 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.

**C305.3.2 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 C305.3.

**Exception:** This section shall not apply to *appliance* installations complying with Section C305.4.

**C305.4 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 C305.3 and NFPA 30A.

**C305.5 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 C305.3 (see Figure 304.6 of this code).

**C305.6 Construction and protection.** Boiler rooms and furnace rooms shall be protected as required by the *Building Code*.

**C305.7 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.

**C305.8 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 C308. 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.

**C305.9 Parking structures.** Appliances installed in enclosed, basement and underground parking structures shall be installed in accordance with NFPA 88A.

**C305.10 Repair garages.** Appliances installed in repair garages shall be installed in accordance with NFPA 30A.

**C305.11 Installation in aircraft hangars.** Heaters in aircraft hangars shall be installed in accordance with NFPA 409.

**C305.12 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 C306 ACCESS AND SERVICE SPACE

**C306.1 Access for maintenance and replacement.** 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*.

**C306.2 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.

**C306.3 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.



**C306.3.1 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 [the Electrical Code](#).

**C306.4 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.

**C306.4.1 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 [the Electrical Code](#).

**C306.5 Equipment and appliances on roofs or elevated structures.** [Installed in accordance with Section 306.5 of this code.](#)

**Exception:** [This section shall not apply to the replacement, repair or maintenance of an existing appliance or piece of equipment lawfully in existence at the time of the adoption of this appendix and code.](#)

**C306.6 Guards.** [Guards shall be installed in accordance with Section 306.6 of this code.](#)

**Exception:** [This section shall not apply to the replacement, repair or maintenance of an existing appliance or piece of equipment lawfully in existence at the time of the adoption of this appendix and code.](#)

**SECTION C307  
CONDENSATE DISPOSAL**

**Note:** [For additional information on condensate disposal, see Section 307 of this code.](#)

**C307.1 Evaporators and cooling coils.** Condensate drainage systems shall be provided for *equipment* and appliances containing evaporators and cooling coils in accordance with [this section and Section 307 of this code](#).

**C307.2 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 *pipng* shall be of *approved* corrosion-resistant material and shall be not smaller than the drain connection on the *appliance*. Such *pipng* 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). The termination of concealed condensate [secondary drain pipng](#) shall be [clearly](#) marked [with an embossed or engraved tag or in an approved manner](#).

**C307.3 Drain pipe materials and sizes.** Components of the condensate disposal system shall be ABS, cast iron, copper and copper alloy, CPVC, cross-linked polyethylene, galvanized steel, PE-RT, polyethylene, polypropylene, PVC or PVDF pipe or tubing. Components shall be selected for the pressure and temperature rating of the installation. Condensate waste and drain line size shall be not less than  $\frac{3}{4}$ -inch (19 mm) pipe size 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.

**C307.4 Traps.** Condensate drains shall be trapped as required by the *equipment* or *appliance* manufacturer.

**C307.5 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 this code](#).

**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.

**C307.6 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 C308 (IFGS)  
CLEARANCE REDUCTION**

**C308.1 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 gas-fired air-conditioning equipment and gas-fired central heating boilers and furnaces shall comply with Sections C308.3 and C308.4.

**C308.2 Reduction table.** The allowable *clearance* reduction shall be based on one of the methods specified in Table C308.2 or shall utilize a reduced *clearance* protective assembly *listed* and *labeled* in accordance with UL 1618. Where required clearances are not listed in Table C308.2, 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 C308.2(1) through C308.2(3)].

**C308.3 Clearances for indoor air-conditioning appliances.** *Clearance* requirements for indoor air-conditioning appliances shall comply with Sections C308.3.1 through C308.3.4.

**C308.3.1 Appliance clearances.** Air-conditioning appliances shall be installed with clearances in accordance with the manufacturer’s instructions.

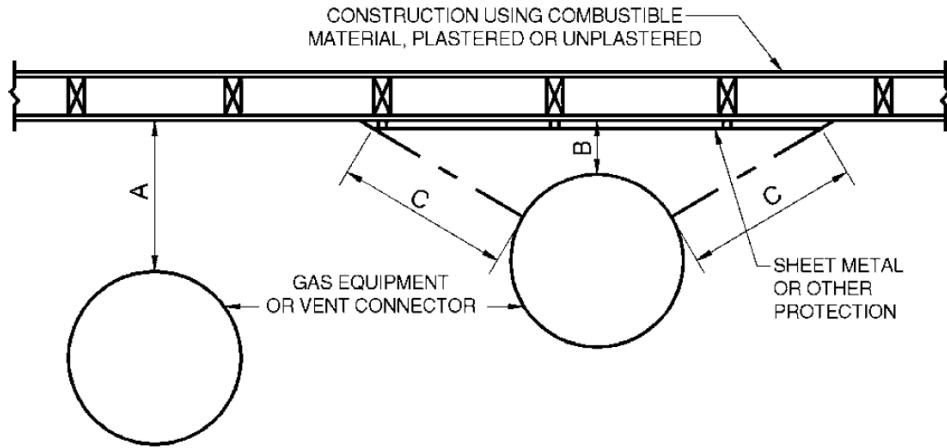
**TABLE C308.2**  
**REDUCTION OF CLEARANCES WITH SPECIFIED FORMS OF PROTECTION<sup>a</sup> through k**

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 C308.2(1), C308.2(2) and C308.2(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.									
	Above Col. 1	Sides and rear Col. 2	Above Col. 1	Sides and rear Col. 2	Above Col. 1	Sides and rear Col. 2	Above Col. 1	Sides and rear Col. 2	Above Col. 1	Sides and rear Col. 2
1. 3½-inch-thick masonry wall without ventilated airspace	—	24	—	12	—	9	—	6	—	5
2. ½-inch insulation board over 1-inch glass fiber or mineral wool batts	24	18	12	9	9	6	6	5	4	3
3. 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	18	12	9	6	6	4	5	3	3	3
4. 3½-inch-thick masonry wall with ventilated airspace	—	12	—	6	—	6	—	6	—	6
5. 0.024-inch (nominal 24 gage) sheet metal with ventilated airspace	18	12	9	6	6	4	5	3	3	2
6. ½-inch-thick insulation board with ventilated airspace	18	12	9	6	6	4	5	3	3	3
7. 0.024-inch (nominal 24 gage) sheet metal with ventilated airspace over 0.024-inch (nominal 24 gage) sheet metal with ventilated airspace	18	12	9	6	6	4	5	3	3	3
8. 1-inch glass fiber or mineral wool batts sandwiched between two sheets 0.024-inch (nominal 24 gage) sheet metal with ventilated airspace	18	12	9	6	6	4	5	3	3	3

For SI: 1 inch = 25.4 mm, °C = [(°F) 32]/1.8, 1 pound per cubic foot = 16.02 kg/m<sup>3</sup>, 1 Btu per inch per square foot per hour per °F = 0.144 W/m<sup>2</sup> × K.

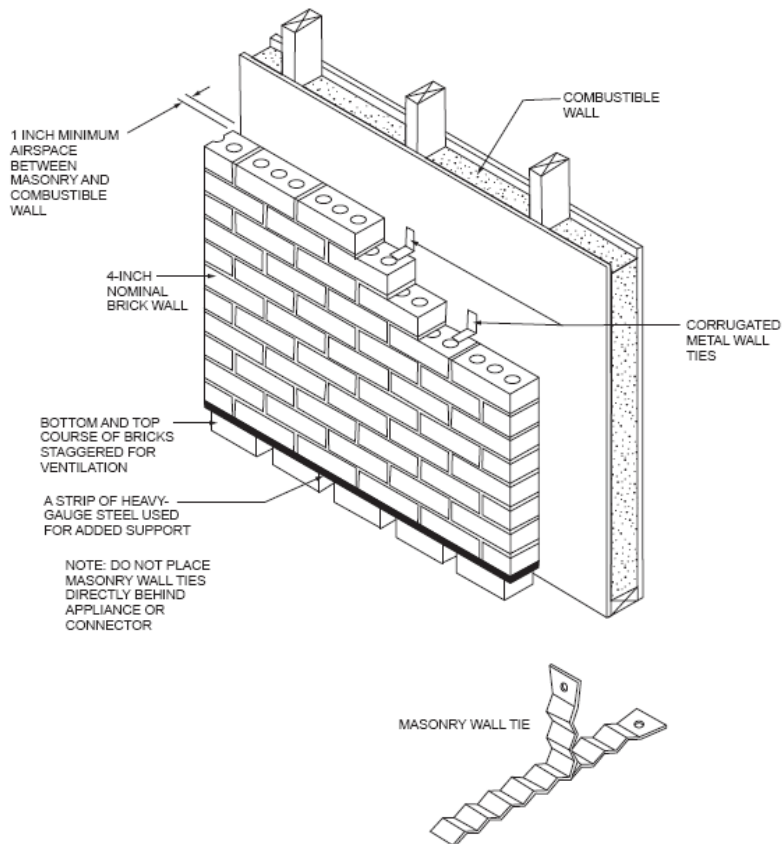
- a. Reduction of clearances from combustible materials shall not interfere with combustion air, draft hood clearance and relief, and accessibility of servicing.
- b. Clearances shall be measured from the outer surface of the combustible material to the nearest point on the surface of the appliance, 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 C308.2(2) and C308.2(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 1,500°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 C308.2. The protection applied to the construction using *combustible material* shall extend far enough in each direction to make “C” equal to “A.”

**FIGURE C308.2(1)**  
**EXTENT OF PROTECTION NECESSARY TO REDUCE CLEARANCES FROM APPLIANCE OR VENT CONNECTIONS**



For SI: 1 inch = 25.4 mm.

**FIGURE C308.2(3)**  
**MASONRY CLEARANCE REDUCTION SYSTEM**

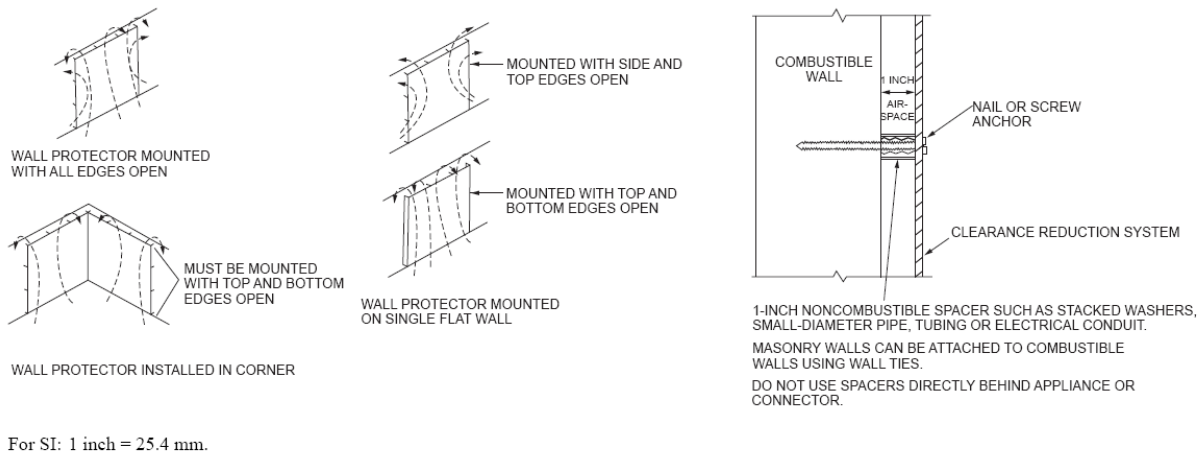


FIGURE C308.2(2)  
WALL PROTECTOR CLEARANCE REDUCTION SYSTEM

**C308.3.2 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 C308.2 and such reduction is allowed by the manufacturer's instructions.

**C308.3.3 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.

**C308.3.4 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.

**C308.4 Central-heating boilers and furnaces.** *Clearance* requirements for central-heating boilers and furnaces shall comply with Sections C308.4.1 through C308.4.5. The *clearance* to these appliances shall not interfere with *combustion air*; draft hood *clearance* and relief; and accessibility for servicing.

**C308.4.1 Appliance clearances.** Central-heating furnaces and low-pressure boilers shall be installed with clearances in accordance with the manufacturer's instructions.

**C308.4.2 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 C308.2 and such reduction is allowed by the manufacturer's instructions.

**C308.4.3 Clearance for servicing appliances.** Front *clearance* shall be sufficient for servicing the burner and the furnace or boiler.

**C308.4.4 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.

**C308.4.5 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 C309 (IFGC) ELECTRICAL

**C309.1 Grounding.** *Gas piping* shall not be used as a grounding electrode.

**C309.2 Connections.** Electrical connections between appliances and the building wiring, including the grounding of the appliances, shall conform to [the Electrical Code](#).

## SECTION C310 (IFGS) ELECTRICAL BONDING

**C310.1 Pipe and tubing.** Each aboveground portion of a *gas piping* system that is likely to become energized shall be electrically continuous and bonded to an effective ground fault current path. *Gas piping* 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*.

**C310.1.1 Corrugated stainless steel tubing (CSST).** CSST shall be bonded in accordance with the Electrical Code and the manufacturer's instructions.

## **SECTION C401 GAS PIPING INSTALLATIONS**

**C401.1 Scope.** Sections C401.1.1 through C417.3.6 and this section shall govern the design, installation and modification of *piping* systems. The applicability of this appendix 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 and inspection of such *piping* systems.

**C401.1.1 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*.

Notice of installation. A "Notice of Installation" is required by the State Fire Marshal for all LP-gas tank installations. Installation requirements of LP-gas tanks and tubing or piping up to the first stage regulator are under the authority of the State Fire Marshal.

**C401.2 Liquefied petroleum gas storage.** The storage system for liquefied petroleum gas shall be designed and installed in accordance with the *Building Code* and NFPA 58.

**C401.3 Modifications to existing systems.** In modifying or adding to existing *piping* systems, sizes shall be maintained in accordance with this appendix.

**C401.4 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.

**C401.5 Identification.** For other than steel pipe and CSST, 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 *piping* located in the same room as the *appliance* served. CSST shall be identified as required by ANSI LC 1/CSA 6.26.

**C401.6 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.

**C401.7 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.

**C401.8 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 C402.

**C401.9 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.

**C401.10 Piping materials standards.** Piping, tubing and fittings shall be manufactured to the applicable referenced standards, specifications and performance criteria listed in Section C403 and shall be identified in accordance with Section C401.9.

## **SECTION C402 PIPE SIZING**

**C402.1 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*.

**C402.2 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.

**C402.3 Sizing.** Gas *piping* shall be sized in accordance with one of the following:

1. Pipe sizing tables or sizing equations in accordance with Section C402.4 or C402.5 as applicable.
2. The sizing tables included in a *listed piping* system's manufacturer's installation instructions.
3. Engineering methods.

**C402.4 Sizing tables and equations.** This section applies to piping materials other than noncorrugated stainless steel tubing. Where Tables C402.4(1) through C402.4(37) are used to size *piping* or tubing, the pipe length shall be determined in accordance with Section C402.4.1, C402.4.2 or C402.4.3.

Where Equations C4-1 and C4-2 are used to size *pip*ing or tubing, the pipe or tubing shall have smooth inside walls and the pipe length shall be determined in accordance with Section C402.4.1, C402.4.2 or C402.4.3.

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

$$D = \frac{Q^{0.381}}{19.17 \left( \frac{\Delta H}{C_r \times L} \right)^{0.206}} \quad \text{(Equation C4-1)}$$

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

$$D = \frac{Q^{0.381}}{18.93 \left[ \frac{(P_1^2 - P_2^2) \times Y}{C_r \times L} \right]^{0.206}} \quad \text{(Equation C4-2)}$$

Where:

- $C_r$  = Value determined by Table C402.4.
- $D$  = 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.
- $Y$  = Value determined by Table C402.4.
- $\Delta H$  = Pressure drop, inch water column (27.7-inch water column = 1 psi).

**TABLE C402.4**  
**Cr AND Y VALUES FOR NATURAL GAS AND UNDILUTED PROPANE AT STANDARD CONDITIONS**

GAS	EQUATION FACTORS	
	$C_r$	$Y$
Natural gas	0.6094	0.9992
Undiluted propane	1.2462	0.9910

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.

**C402.4.1 Longest length method.** The pipe size of each section of gas *pip*ing shall be determined using the longest length of *pip*ing from the *point of delivery* to the most remote *outlet* and the load of the section.

**C402.4.2 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 *pip*ing and the load of the section.

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

**C402.4.3 Hybrid pressure.** The pipe size for each section of higher pressure gas *pip*ing shall be determined using the longest length of *pip*ing 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 *pip*ing from the regulator to the most remote outlet served by the regulator.

**C402.5 Noncorrugated stainless steel tubing.** Noncorrugated stainless steel tubing shall be sized in accordance with Equations C4-1 and C4-2 of Section C402.4 in conjunction with Section C402.4.1, C402.4.2 or C402.4.3.

**C402.6 Allowable pressure drop.** The design pressure loss in a *pip*ing system, from the *point of delivery* to the inlet connection of all appliances served, shall be such that the supply pressure at each *appliance* inlet is greater than or equal to the minimum pressure required by the *appliance*.

**C402.7 Maximum operating pressure.** The maximum pressure for *pip*ing 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 *pip*ing joints are welded or brazed.
2. The *pip*ing is joined by fittings *listed* to ANSI LC4/CSA6.32 and installed in accordance with the manufacturer’s instructions.
3. The *pip*ing joints are flanged and pipe-to-flange connections are made by welding or brazing.
4. The *pip*ing is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
5. The *pip*ing is located inside buildings or separate areas of buildings used exclusively for any of the following:
  - 5.1. Industrial processing or heating.
  - 5.2. Research.
  - 5.3. Warehousing.
  - 5.4. Boiler or mechanical rooms.
6. The *pip*ing is a temporary installation for buildings under construction.
7. The *pip*ing serves appliances or *equipment* used for agricultural purposes.
8. The *pip*ing system is an LP-gas *pip*ing system with an operating pressure greater than 20 psi (137.9 kPa) and complies with NFPA 58.

**C402.7.1 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 C403 PIPING MATERIALS

**C403.1 General.** Materials used for *pipng* systems shall comply with the requirements of [Sections C403.2 through C417.3.6 and this section](#) or shall be *approved*.

**C403.2 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.

**C403.3 Metallic pipe.** Metallic pipe shall comply with Sections C403.3.1 through C403.3.4.

**C403.3.1 Cast iron.** Cast-iron pipe shall not be used.

**C403.3.2 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.

**C403.3.3 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.

**C403.3.4 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.

**C403.4 Metallic tubing.** Tubing shall not be used with gases corrosive to the tubing material.

**C403.4.1 Steel tubing.** Steel tubing shall comply with ASTM A254.

**C403.4.2 Stainless steel.** Stainless steel tubing shall comply with ASTM A268 or ASTM A269.

**C403.4.3 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).

**C403.4.4 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.

**C403.4.5 Corrugated stainless steel tubing.** Corrugated stainless steel tubing shall be *listed* in accordance with ANSI LC 1/CSA 6.26.

**C403.5 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.

**C403.5.1 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).



**C403.5.2 LP-gas systems.** The use of plastic pipe, tubing and fittings in undiluted liquefied petroleum gas *pipng* systems shall be in accordance with NFPA 58.

**C403.5.3 Regulator vent piping.** Plastic pipe and fittings used to connect regulator vents to remote vent terminations shall be PVC conforming to UL 651. PVC vent *pipng* shall not be installed indoors.

**C403.6 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.

**C403.7 Protective coating.** Where in contact with material or atmosphere exerting a corrosive action, metallic *pipng* and fittings coated with a corrosion-resistant material shall be used. External or internal coatings or linings used on *pipng* or components shall not be considered as adding strength.

**C403.8 Metallic pipe threads.** Metallic pipe and fitting threads shall be taper pipe threads and shall comply with ASME B1.20.1.

**C403.8.1 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.

**C403.8.2 Number of threads.** Field threading of metallic pipe shall be in accordance with Table C403.8.2.

**TABLE C403.8.2  
SPECIFICATIONS FOR THREADING METALLIC PIPE**

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

For SI: 1 inch = 25.4 mm.

**C403.8.3 Threaded joint sealing.** Threaded joints shall be made using a Thread joint sealing material. Thread joint sealing materials shall be nonhardening and shall be resistant to the chemical constituents of the gases to be conducted through the *pipng*. Thread joint sealing materials shall be compatible with the pipe and fitting materials on which the sealing materials are used.

**C403.9 Metallic piping joints and fittings.** The type of *pipng* 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.

**C403.9.1 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 L-C4/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.

**C403.9.2 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.

**C403.9.3 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.

**C403.9.4 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.

**C403.9.5 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.

**C403.10 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 *pipng* 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. Polyethylene Heat fusion fittings shall be marked "ASTM D2513." Polyamide heat fusion fittings shall be marked "ASTM F2945."

3. Where compression-type mechanical joints are used, the gasket material in the fitting shall be compatible with the plastic *pipng* 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 *pipng* joints and fittings for use in liquefied petroleum gas *pipng* systems shall be in accordance with NFPA 58.

**C403.11 Flanges.** Flanges and flange gaskets shall comply with Sections C403.11.1 through C403.11.7.

**C403.11.1 Cast iron.** Cast-iron flanges shall be in accordance with ASME B16.1.

**C403.11.2 Steel.** Steel flanges shall be in accordance with ASME B16.5 or ASME B16.47.

**C403.11.3 Nonferrous.** Nonferrous flanges shall be in accordance with ASME B16.24.

**C403.11.4 Ductile iron.** Ductile-iron flanges shall be in accordance with ASME B16.42.

**C403.11.5 Raised face.** Raised face flanges shall not be joined to flat faced cast-iron, ductile-iron or nonferrous material flanges.

**C403.11.6 Flange facings.** Standard facings shall be permitted for use under this [appendix](#). 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.

**C403.11.7 Lapped flanges.** Lapped flanges shall be used only above ground or in exposed locations accessible for inspection.

**C403.12 Flange gaskets.** Material for gaskets shall be capable of withstanding the design temperature and pressure of the *pipng* 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.

**C403.12.1 Metallic gaskets.** Metallic flange gaskets shall be in accordance with ASME B16.20.

**C403.12.2 Nonmetallic gaskets.** Nonmetallic flange gaskets shall be in accordance with ASME B16.21.

## SECTION C404 PIPING SYSTEM INSTALLATION

**C404.1 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 [appendix](#), the provisions of this [appendix](#) shall apply.

**C404.2 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 [appendix](#).

**C404.3 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*.

**C404.4 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.

**C404.5 Fittings in concealed locations.** Fittings installed in concealed locations shall be limited to the following types:

1. Threaded elbows, tees, couplings, plugs and caps.
2. Brazed fittings.
3. Welded fittings.
4. Fittings listed to ANSI LC-1/CSA 6.26 or ANSI LC4/CSA 6.32.

**C404.6 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.

**C404.7 Protection against physical damage.** Where piping will be concealed within light-frame construction assemblies, the piping shall be protected against penetration by fasteners in accordance with Sections C404.7.1 through C404.7.3.

**Exception:** [Schedule 40 or greater](#) black steel piping and galvanized steel piping shall not be required to be protected.

**C404.7.1 Piping through holes or notches.** Where piping is installed through holes or notches in framing members and the piping is located less than 1½ inches (38 mm) from the framing member face to which wall, ceiling or floor membranes will be attached, the pipe shall be protected by shield plates that cover the width of the pipe and the framing member and that extend not less than 4 inches (102 mm) to each side of the framing member. Where the framing member that the

piping passes through is a bottom plate, bottom track, top plate or top track, the shield plates shall cover the framing member and extend not less than 4 inches (102 mm) above the bottom framing member and not less than 4 inches (102 mm) below the top framing member.

**C404.7.2 Piping installed in other locations.** Where the piping is located within a framing member and is less than 1½ inches (38 mm) from the framing member face to which wall, ceiling or floor membranes will be attached, the piping shall be protected by shield plates that cover the width and length of the piping. Where the piping is located outside of a framing member and is located less than 1½ inches (38 mm) from the nearest edge of the face of the framing member to which the membrane will be attached, the piping shall be protected by shield plates that cover the width and length of the piping.

**C404.7.3 Shield plates.** Shield plates shall be of steel material having a thickness of not less than 0.0575 inch (1.463 mm) (No. 16 gage).

**C404.8 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 C404.8.1 or C404.8.2.

**C404.8.1 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.

**C404.8.2 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.

**C404.9 Above-ground outdoor piping.** *Piping* installed outdoors shall be elevated not less than 3½ inches (89 mm) above ground and where installed across roof surfaces, shall be elevated not less than 3½ 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.

**C404.10 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.

**C404.11 Protection against corrosion.** Steel pipe or tubing exposed to corrosive action, such as soil conditions or moisture, shall be protected in accordance Sections C404.11.1 through C404.11.4.

**C404.11.1 Galvanizing.** Zinc coating shall not be deemed adequate protection for underground gas piping.

**C404.11.2 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.

**C404.11.3 Dissimilar metals.** Where dissimilar metals are joined underground, an insulating coupling or fitting shall be used.

**C404.11.4 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.

**C404.12 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 C404.12.1.

**C404.12.1 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.

**C404.13 Trenches.** The trench shall be graded so that the pipe has a firm, substantially continuous bearing on the bottom of the trench.

**C404.14 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 C404.11 and shall be installed in accordance with Section C404.14.1 or C404.14.2.

**C404.14.1 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.

**C404.14.2 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.

**C404.15 Outlet closures.** Gas *outlets* that do not connect to *appliances* shall be capped gastight.

**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.

**C404.16 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.

**C404.17 Plastic pipe.** The installation of plastic pipe shall comply with Sections C404.17.1 through C404.17.3.

**C404.17.1 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 *pipng* 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 C404.12.

**C404.17.2 Connections.** Connections made outdoors and underground between metallic and plastic *pipng* shall be made only with transition fittings conforming to ASTM D2513 Category I or ASTM F1973.

**C404.17.3 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 *pipng*. *Access* shall be provided to the tracer wire or the tracer wire shall terminate above ground at each end of the nonmetallic *pipng*. The tracer wire size shall be not less than 18 AWG and the insulation type shall be suitable for direct burial.

**C404.18 Pipe debris removal.** The interior of piping shall be clear of debris. The use of a flammable or combustible gas to clean or remove debris from a piping system shall be prohibited.

**C404.19 Prohibited devices.** A device shall not be placed inside the *pipng* 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.

**C404.20 Testing of piping.** Before any system of *pipng* is put in service or concealed, it shall be tested to ensure that it is gastight. Testing, inspection and purging of *pipng* systems shall comply with Section C406.

## SECTION C405

### PIPING BENDS AND CHANGES IN DIRECTION

**C405.1 General.** Changes in direction of pipe shall be permitted to be made by the use of fittings, factory bends or field bends.

**C405.2 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.

**C405.3 Plastic pipe.** Plastic pipe bends shall comply with the following:

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

**C405.4 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 C406

### INSPECTION, TESTING AND PURGING

**C406.1 General.** Prior to acceptance and initial operation, all *pipng* installations shall be visually inspected and pressure tested to determine that the materials, design, fabrication and installation practices comply with the requirements of this [appendix](#).

**C406.1.1 Inspections.** Inspection shall consist of visual examination during or after manufacture, fabrication, assembly or pressure tests.

**C406.1.1.1 Rough piping inspection.** [This inspection shall be made after piping authorized by the permit has been installed and before such piping has been covered or concealed or a fixture or appliance has been attached thereto. This inspection shall include a determination that the gas piping size, material and installation meet the requirements of this appendix.](#)



**C406.1.1.2 Final piping inspection.** This inspection shall be made after piping authorized by the permit has been installed and after all portions thereof which are to be covered or concealed are so concealed and after fixtures, appliances or shutoff valves have been attached thereto.

**C406.1.2 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.

**C406.1.3 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.

**C406.1.4 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.

**C406.1.5 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.

**C406.1.6 Pipe clearing.** Prior to testing, the interior of the pipe shall be cleared of all foreign material.

**C406.2 Test medium.** The test medium shall be air, nitrogen, carbon dioxide or an inert gas. Oxygen shall not be used as a test medium.

**C406.3 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 [appendix](#).

**C406.3.1 Expansion joints.** Expansion joints shall be provided with temporary restraints, if required, for the additional thrust load under test.

**C406.3.2 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.

**C406.3.3 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).

**C406.3.4 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).

**C406.3.5 Testing precautions.** Testing of piping systems shall be performed in a manner that protects the safety of employees and the public during the test.

**C406.4 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 [use a 15-psi gauge or 30-psi gauge for testing 14 inches w.c. systems and a 100-psi gauge for testing systems exceeding 14 inches w.c. operating pressure. The gauges shall not exceed the manufacturer's listing and labeling.](#)

**C406.4.1 Test pressure.** [Gas piping systems under 14 inches w.c. pressure shall be tested at a pressure of not less than 10 pounds per square inch \(69 kPa\) gauge. Test pressures shall be held for not less than 15 minutes with no perceptible drop in pressure. For welded piping and piping carrying gas at pressures exceeding 14 inches w.c. pressure, the test pressure shall be at least 60 pounds per square inch \(0.0422 kg/mm<sup>2</sup>\) for not less than 30 minutes.](#)

**Exception:** [Testing, inspection and purging of LP-gas piping systems performed by using NFPA 54 shall be permitted.](#)

## SECTION C407 PIPING SUPPORT

**C407.1 General.** Piping shall be provided with support in accordance with Section [C407.2](#).

**C407.2 Design and installation.** Piping shall be supported with pipe hooks, pipe straps, bands, brackets, 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 [C415](#).

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*.

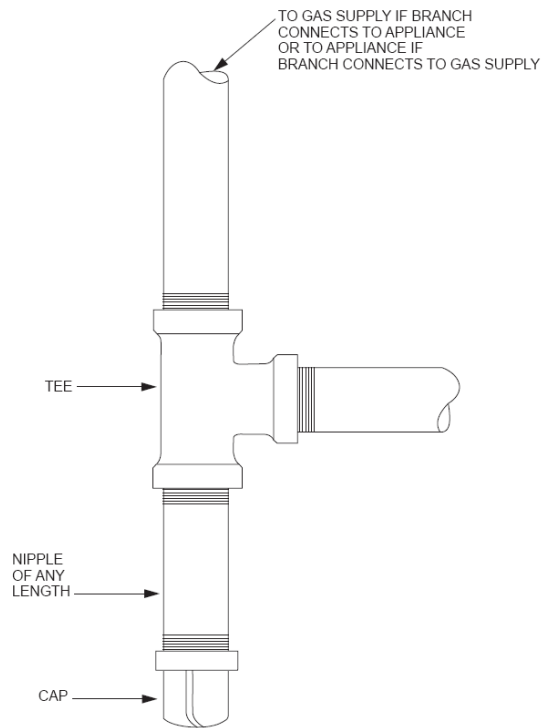
**SECTION C408  
DRIPS AND SLOPED PIPING**

**C408.1 Slopes.** *Piping* for other than dry gas conditions shall be sloped not less than 1/4 inch in 15 feet (6.3 mm in 4572 mm) to prevent traps.

**C408.2 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.

**C408.3 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.

**C408.4 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 C408.4 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 C408.4  
METHOD O**

**SECTION C409  
SHUTOFF VALVES**

**C409.1 General.** *Piping* systems shall be provided with shutoff valves in accordance with this section.

**C409.1.1 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 C409.1.1.

**C409.1.2 Prohibited locations.** Shutoff valves shall be prohibited in concealed locations and *furnace plenums*.

**TABLE C409.1.1  
MANUAL GAS VALVE STANDARDS**

VALVE STANDARDS	APPLIANCE SHUTOFF VALVE APPLICATION UP TO 1/2 psig PRESSURE	OTHER VALVE APPLICATIONS			
		UP TO 1/2 psig PRESSURE	UP TO 2 psig PRESSURE	UP TO 5 psig PRESSURE	UP TO 125 psig PRESSURE
ANSI Z21.15/CGA 9.1	X	—	—	—	—
ASME B16.44	X	X	X <sub>a</sub>	X <sub>b</sub>	—
ASME B16.33	X	X	X	X	X

For SI: 1 pound per square inch gauge = 6.895 kPa.  
 a. If labeled 2G.  
 b. If labeled 5G.



**C409.1.3 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.

**C409.2 Meter valve.** Every meter shall be equipped with a shutoff valve located on the supply side of the meter.

**C409.3 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.

**C409.3.1 Multiple -tenant buildings.** In multiple -tenant buildings, where a common *pipng* 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.

**C409.3.2 Individual buildings.** In a common system serving more than one building, shutoff valves shall be installed outdoors at each building.

**C409.3.3 Identification of shutoff valves.** Each house line shutoff valve shall be plainly marked with an identification tag attached by the installer so that the *pipng* systems supplied by such valves are readily identified.

**C409.4 MP regulator valves.** A *listed* shutoff valve shall be installed immediately ahead of each MP regulator.

**C409.5 Appliance shutoff valve.** Each *appliance* shall be provided with a shutoff valve in accordance with Section C409.5.1, C409.5.2 or C409.5.3.

**C409.5.1 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.

**C409.5.2 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 *pipng* from the shutoff valve to within 6 feet (1829 mm) of the *appliance* shall be designed, sized and installed in accordance with Sections C401 through C408.

**C409.5.3 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 *pipng* from the manifold to within 6 feet (1829 mm) of the *appliance* shall be designed, sized and installed in accordance with Sections C401 through C408.

**C409.6 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.”

**C409.7 Shutoff valves in tubing systems.** Shutoff valves installed in tubing systems shall be rigidly and securely supported independently of the tubing.

## SECTION C410 FLOW CONTROLS

**C410.1 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.

**C410.2 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 C410.4.
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.

**C410.3 Liquefied petroleum (LP) gas regulators.** LP-gas second stage and 2 psi regulators, as defined by NFPA 58, shall be installed in accordance with the following:

1. Regulators installed outdoors shall be protected from motor vehicle impact. For examples of approved types of protection (see Figure 304.6 of this code).
2. Regulator vent discharge shall be located not less than 3 feet (915 mm) horizontally from openings below the point of discharge and not less than 5 feet (1525 mm) in any direction from exterior sources of ignition, openings into direct-vent appliances or mechanical ventilation air intakes.
3. Venting of regulators shall comply with Sections C410.4 and C410.4.1.

**C410.4 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.

**C410.4.1 Vent piping.** Vent *piping* for relief vents and breather vents shall be constructed of materials allowed for gas *piping* in accordance with Section C403. 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.

**C410.5 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.

**C410.6 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 C411 APPLIANCE AND MANUFACTURED HOME CONNECTIONS

**C411.1 Connecting appliances.** Except as required by Section C411.1.1, 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 in compliance with ANSI Z21.41/CGA 6.9 used in conjunction with listed and labeled appliance connectors.
6. Listed and labeled convenience outlets in compliance with ANSI Z21.90/CGA 6.24 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 C411.3.

**C411.1.1 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.

**C411.1.2 Protection against damage.** Connectors and tubing shall be installed so as to be protected against physical damage.

**C411.1.3 Connector installation.** *Appliance* fuel connectors shall be installed in accordance with the manufacturer's instructions and Sections C411.1.3.1 through C411.1.3.4.

**C411.1.3.1 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 C402 and the location of the *appliance* shutoff valve complies with Section C409.5.

**C411.1.3.2 Minimum size.** Connectors shall have the capacity for the total demand of the connected *appliance*.

**C411.1.3.3 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 C403 shall be permitted to pass through walls, floors, partitions and ceilings where installed in accordance with Section C409.5.2 or C409.5.3.
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.

**C411.1.3.4 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 C409.5.

**C411.1.4 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 C411.1. Such flexible connectors shall be installed and protected against physical damage in accordance with the manufacturer's instructions.

**C411.1.5 Connection of gas engine-powered air conditioners.** Internal combustion engines shall not be rigidly connected to the gas supply *piping*.

**C411.1.6 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*.

**C411.2 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.

**C411.3 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 C412 LIQUEFIED PETROLEUM GAS MOTOR VEHICLE FUEL-DISPENSING FACILITIES

**C412.1 General.** Motor fuel-dispensing facilities for LP-gas fuel shall be in accordance with [the Building Code](#).

## SECTION C413 COMPRESSED NATURAL GAS MOTOR VEHICLE FUEL-DISPENSING FACILITIES

**C413.1 General.** Motor fuel-dispensing facilities for CNG fuel shall be in accordance with [the Building Code](#).

**C414.1 Special supplementary gas.** Where air, oxygen or other special supplementary gas is introduced into the gas piping system, an approved backflow preventer shall be installed. The backflow preventer shall be on the gas line to the equipment or appliance supplied by the special gas and located between the source of the gas and the gas meter.

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

**C414.2 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.

**SECTION C415  
PIPING SUPPORT INTERVALS**

**C415.1 Interval of support.** Piping shall be supported at intervals not exceeding the spacing specified in Table C415.1. Spacing of supports for CSST shall be in accordance with the CSST manufacturer’s instructions.

**TABLE C415.1  
SUPPORT OF PIPING**

STEEL PIPE, NOMINAL SIZE OF PIPE (inches)	SPACING OF SUPPORTS (feet)	NOMINAL SIZE OF TUBING (SMOOTH-WALL) (inch O.D.)	SPACING OF SUPPORTS (feet)
1/2	6	1/2	4
3/4 or 1	8	5/8 or 3/4	6
1 1/4 or larger (horizontal)	10	7/8 or 1 (horizontal)	8
1 1/4 or larger (vertical)	Every floor level	1 or larger (vertical)	Every floor level

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

**SECTION C416  
FUEL GAS EQUIPMENT AND INSTALLATIONS IN MANUFACTURED STRUCTURE (MOBILE HOME OR RECREATIONAL VEHICLE) PARKS**

**C416.1 Required gas supply.** The minimum hourly volume of gas required at each manufactured structure (mobile home or recreational vehicle) lot outlet or any section of the manufactured structure park gas piping system shall be calculated as shown in Table C415.1.

Required gas supply for buildings or other fuel gas-consuming appliances connected to the manufactured structure park gas piping system shall be calculated as provided in this appendix.

**TABLE C416.1  
MINIMUM DEMAND FACTORS FOR CALCULATING GAS PIPING SYSTEMS IN MANUFACTURED STRUCTURE PARKS**

NUMBER OF MANUFACTURED STRUCTURE LOTS	DEMAND FACTOR BTU/H MANUFACTURED STRUCTURE LOT x 0.2931 FOR W
1	250,000
2	234,000
3	208,000
4	198,000
5	184,000
6	174,000
7	166,000
8	162,000
9	158,000
10	154,000
11-20	132,000
21-30	124,000
31-40	118,000
41-60	112,000
Over 60	102,000

For SI: 1 Btu/h = 0.2931 W.

**C416.2 Mechanical protection.** Customer-owned gas outlet risers, regulators, meters, valves or other exposed equipment shall be protected from mechanical damage. Such protection may consist of posts, fencing or other permanent barriers. Atmospherically controlled regulators shall be installed in such a manner that moisture cannot enter the regulator vent and accumulate above the diaphragm. Where the regulator vent may be obstructed by snow or ice, shields, hoods or other suitable devices shall be provided to guard against obstruction of the vent opening.

**C416.3 Gas meters.** Customer-owned meters shall be installed in ventilated and accessible locations, not closer than 3 feet (914 mm) to sources of ignition. Where meters are installed, they shall not depend on the gas outlet riser for support, but shall be adequately supported by a post or bracket placed on a firm footing or other approved means providing equivalent support.

**C416.4 Gas piping size.** The size of each section of natural gas or LP-gas piping systems shall be determined as specified in this appendix.

**SECTION C417  
OVERPRESSURE PROTECTION DEVICES**

**C417.1 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.



**C417.2 Pressure limitation requirements.** The requirements for pressure limitation shall be in accordance with Sections [C417.2.2 through C417.2.5](#).

**C417.2.1 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 [C417.1](#), 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.

**C417.2.2 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 [C417.1](#), 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.

**C417.2.3 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 [C417.2.1](#), independently of any other pressure control equipment in the piping system.

**C417.2.4 Failure detection.** Each gas piping system for which an overpressure protection device is required by Section [C417](#) shall be designed and installed so that a failure of the primary pressure control device(s) is detectable.

**C417.2.5 Relief valve.** Where a pressure relief valve is used to meet the requirements of Section [C417](#), it shall have a flow capacity such that the pressure in the protected system is maintained at or below the limits specified in Section [C417.2.1](#) 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 over-pressure protection is not less than the regulator's normal operating inlet pressure.

**C417.3 Overpressure protection devices.** Overpressure protection devices shall be one of the following:

1. Pressure relief valve.
2. Monitoring regulator.
3. Series regulator installed upstream from the line regulator and set to continuously limit the pressure on the inlet of the line regulator to the maximum values specified by Section [C417.2.1](#).

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 [C417.2.1](#). 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 [C417.3.1 through C417.3.6](#).

**C417.3.1 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.

**C417.3.2 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.

**C417.3.3 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 [C417.2.4 and C417.2.2](#).

**C417.3.4 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.
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.

**C417.3.5 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.

**C417.3.6 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.



## **SECTION C501 CHIMNEYS AND VENTS**

**C501.1 Scope.** This [section and Sections C501.2 through C506.3](#) shall govern the installation, 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, repair and approval of factory-built chimneys, chimney liners, vents and connectors serving appliances burning fuels other than fuel gas shall be regulated by [Chapter 8 of this code](#). The construction, repair, maintenance and approval of masonry chimneys shall be regulated by the *Building Code*.

**C501.2 General.** Every *appliance* shall discharge the products of combustion to the outdoors, except for appliances exempted by Section [C501.8](#).

**C501.3 Masonry chimneys.** Masonry chimneys shall be constructed in accordance with Section [C503.5.3](#) and the *Building Code*.

**C501.4 Minimum size of chimney or vent.** Chimneys and vents shall be sized in accordance with Sections [C503](#) and [C504](#).

**C501.5 Abandoned inlet openings.** Abandoned inlet openings in chimneys and vents shall be closed by an *approved* method.

**C501.6 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.

**C501.7 Connection to fireplace.** Connection of appliances to chimney flues serving fireplaces shall be in accordance with Sections [C501.7.1](#) through [C501.7.3](#).

**C501.7.1 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.

**C501.7.2 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.

**C501.7.3 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.

**C501.8 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 [504 of this code](#)).
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.
9. Direct-fired makeup air heaters.
10. Other appliances *listed* for unvented use and not provided with flue collars.
11. Specialized appliances of limited input such as laboratory burners 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<sup>3</sup>) 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<sup>3</sup>). 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.

**C501.9 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.

**C501.10 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.

**C501.11 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 C503.

**C501.12 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*.
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).

**C501.13 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 C501.12.
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.

**C501.14 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.

**C501.15 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 C501.15.1 through C501.15.4.

**C501.15.1 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 C502.

**C501.15.2 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.

**C501.15.3 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.

**C501.15.4 Clearances.** Chimneys and vents shall have airspace *clearance* to combustibles in accordance with the *Building Code* 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.

**C501.15.4.1 Fireblocking.** Noncombustible fireblocking shall be provided in accordance with the *Building Code*.

## SECTION C502 VENTS

**C502.1 General.** Vents, except as provided in Section C503.7, 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.

**C502.2 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 C503.

**C502.3 Vent application.** The application of vents shall be in accordance with Table C503.4.

**C502.4 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 provided as part of a *listed* vent system shall be installed in accordance with the manufacturer's instructions.

**C502.5 Installation.** Vent systems shall be sized, installed and terminated in accordance with the vent and *appliance* manufacturer's installation instructions and Section [C503](#).

**C502.6 Support of vents.** All portions of vents shall be adequately supported for the design and weight of the materials employed.

**C502.7 Protection against physical damage.** In concealed locations, where a vent is installed through holes or notches in studs, joists, rafters or similar members less than 1½ inches (38 mm) from the nearest edge of the member, the vent shall be protected by shield plates [in accordance with Section 305.5 of this code](#).

**C502.7.1 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 [C503](#) VENTING OF APPLIANCES

**C503.1 General.** The venting of appliances shall be in accordance with Sections [C503.2](#) through [C503.16](#).

**C503.2 Venting systems required.** Except as permitted in Sections [C501.8](#) and [C503.2.1](#) through [C503.2.4](#), all appliances shall be connected to venting systems.

**C503.2.1 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.

**C503.2.2 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.

**C503.2.3 Direct-vent appliances.** *Listed direct-vent appliances* shall be installed in accordance with the manufacturer's instructions. Through-the-wall vent terminations for *listed direct-vent appliances* shall be in accordance with Section [C503.8, Item 3](#).

**C503.2.4 Appliances with integral vents.** Appliances incorporating integral venting means shall be installed in accordance with Section [C503.8, Items 1 and 2](#).

**C503.2.5 Incinerators.** Incinerators shall be vented in accordance with NFPA 82.

**C503.3 Design and construction.** Venting systems shall be designed and constructed so as to convey all flue and vent gases to the outdoors.

**C503.3.1 Appliance draft requirements.** A venting system shall satisfy the draft requirements of the *appliance* in accordance with the manufacturer's instructions.

**C503.3.2 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 [C503.4](#) through [C503.16](#).

**C503.3.3 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.

**C503.3.4 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.

**C503.3.5 Air ducts and furnace plenums.** Venting systems shall not extend into or pass through any fabricated air duct or *furnace plenum*.

**C503.3.6 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.

**C503.4 Type of venting system to be used.** The type of venting system to be used shall be in accordance with Table C503.4.

**C503.4.1 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.

**C503.4.1.1 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.

**C503.4.2 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.

**C503.5 Masonry, metal and factory-built chimneys.** Masonry, metal and factory-built chimneys shall comply with Sections C503.5.1 through C503.5.11.

**C503.5.1 Factory-built chimneys.** Factory-built chimneys shall be *listed* in accordance with UL 103. Factory-built chimneys used to vent *appliances* that operate at a positive vent pressure shall be *listed* for such application.

**C503.5.2 Metal chimneys.** Metal chimneys shall be built and installed in accordance with NFPA 211.

**C503.5.3 Masonry chimneys.** Masonry chimneys shall be built and installed in accordance with [the Building Code](#) 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 C503.6.4.

**TABLE C503.4  
TYPE OF VENTING SYSTEM TO BE USED**

APPLIANCES	TYPE OF VENTING SYSTEM
Listed Category I appliances Listed appliances equipped with draft hood Appliances listed for use with Type B gas vent	Type B gas vent (Section C503.6) Chimney (Section C503.5) Single-wall metal pipe (Section C503.7) Listed chimney lining system for gas venting (Section C503.5.3) Special gas vent listed for these appliances (Section C503.4.2)
Listed vented wall furnaces	Type B-W gas vent (Sections C503.6, C608)
Category II, Category III and Category IV appliances	As specified or furnished by manufacturers of listed appliances (Sections C503.4.1, C503.4.2)
Incinerators	In accordance with NFPA 82
Appliances that can be converted for use with solid fuel	Chimney (Section C503.5)
Unlisted combination gas and oil-burning appliances	Chimney (Section C503.5)
Listed combination gas and oil-burning appliances	Type L vent (Section C503.6) or chimney (Section C503.5)
Combination gas and solid fuel-burning appliances	Chimney (Section C503.5)
Appliances listed for use with chimneys only	Chimney (Section C503.5)
Unlisted appliances	Chimney (Section C503.5)
Decorative appliances in vented fireplaces	Chimney
Gas-fired toilets	Single-wall metal pipe (Section C626)
Direct-vent appliances	See Section C503.2.3
Appliances with integral vent	See Section C503.2.4



**C503.5.4 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.

**C503.5.5 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 C504.
2. The effective areas of the vent connector and chimney flue of a venting system serving a single *appliance* with a draft hood shall be not less than the area of the *appliance* flue collar or draft hood outlet, nor greater than seven times the draft hood outlet area.
3. The effective area of the chimney flue or a venting system serving two appliances with draft hoods shall be not less than the area of the larger draft hood outlet plus 50 percent of the area of the smaller draft hood outlet, nor greater than seven times the smallest draft hood outlet area.
4. Chimney venting systems using mechanical draft shall be sized in accordance with engineering methods.
5. Other engineering methods.

**C503.5.6 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.

**C503.5.6.1 Chimney lining.** Chimneys shall be lined in accordance with [the Building Code](#).

**C503.5.6.2 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 [the Building Code](#) or [this appendix](#) and it shall be suitable for the appliances to be vented.

**C503.5.7 Chimneys serving appliances burning other fuels.** Chimneys serving *appliance*s burning other fuels shall comply with Sections C503.5.7.1 through C503.5.7.4.

**C503.5.7.1 Solid fuel-burning appliances.** An *appliance* shall not be connected to a chimney flue serving a separate *appliance* designed to burn solid fuel.

**C503.5.7.2 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.

**C503.5.7.3 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*.

**C503.5.7.4 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.

**C503.5.8 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.

**C503.5.9 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.

**C503.5.10 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 [appendix](#) 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.

**C503.5.11 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.

**C503.6 Gas vents.** Gas vents shall comply with Sections C503.6.1 through C503.6.14 (see Section C202, General Definitions).

**C503.6.1 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.

**C503.6.2 Installation, general.** Gas vents shall be installed in accordance with the manufacturer’s instructions.

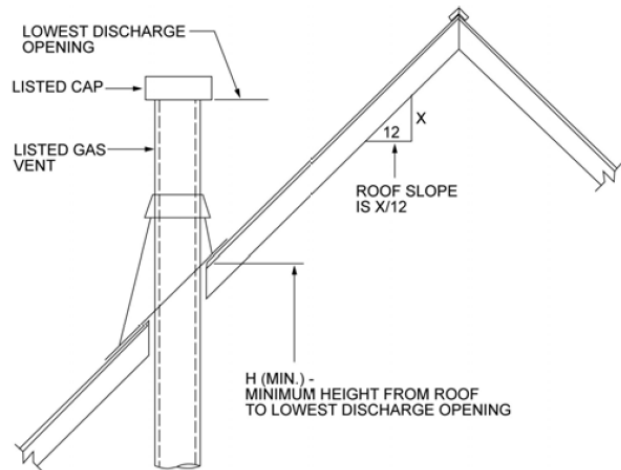
**C503.6.3 Type B-W vent capacity.** A Type B-W gas vent shall have a *listed* capacity not less than that of the *listed* vented wall furnace to which it is connected.

**C503.6.4 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.”

**C503.6.5 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 C503.6.5.
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 C503.2.2.
4. As provided for direct-vent systems in Section C503.2.3.
5. As provided for appliances with integral vents in Section C503.2.4.
6. As provided for mechanical draft systems in Section C503.3.3.
7. As provided for ventilating hoods and exhaust systems in Section C503.3.4.



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

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

**FIGURE C503.6.5**  
**TERMINATION LOCATIONS FOR GAS VENTS WITH LISTED CAPS 12 INCHES OR LESS IN SIZE NOT LESS THAN 8 FEET FROM A VERTICAL WALL**

**C503.6.5.1 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.

**C503.6.6 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.

**C503.6.7 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.

**C503.6.8 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).

**C503.6.9 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 C503.2.3 and C503.3.3.

**C503.6.10 Size of gas vents.** Venting systems shall be sized and constructed in accordance with Sections C503.6.10.1 through C503.6.10.4 and the *appliance* manufacturer's installation instructions.

**C503.6.10.1 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 C504.
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. Engineering methods.

**C503.6.10.2 Vent offsets.** Type B and L vents sized in accordance with Item 2 or 3 of Section C503.6.10.1 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.

**C503.6.10.3 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.

**C503.6.10.4 Mechanical draft.** Chimney venting systems using mechanical draft shall be sized in accordance with engineering methods.

**C503.6.11 Gas vents serving appliances on more than one floor.** Where a common vent is installed in a multistory installation to vent Category I appliances located on more than one floor level, the venting system shall be designed and installed in accordance with *approved* engineering methods. For the purpose of this section, crawl spaces, basements and attics shall be considered to be floor levels.

**C503.6.11.1 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.

**C503.6.11.2 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 C504.3(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.

**C503.6.12 Support of gas vents.** Gas vents shall be supported and spaced in accordance with the manufacturer's installation instructions.

**C503.6.13 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:

“This gas vent is for appliances that burn gas. Do not connect to solid or liquid fuel-burning appliances or incinerators.”

**C503.6.14 Fastener penetrations.** Screws, rivets and other fasteners shall not penetrate the inner wall of doublewall 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.

**C503.7 Single-wall metal pipe.** Single-wall metal pipe vents shall comply with Sections C503.7.1 through C503.7.13.

**C503.7.1 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.

**C503.7.2 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).

**C503.7.3 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.

**C503.7.4 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.

**C503.7.5 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 C503.7.7.

**C503.7.6 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 C503.7.7.

**C503.7.7 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.

**C503.7.8 Clearances.** Minimum clearances from singlewall metal pipe to *combustible material* shall be in accordance with Table C503.10.2.5. The *clearance* from singlewall metal pipe to *combustible material* shall be permitted to be reduced where the *combustible material* is protected as specified for vent connectors in Table C308.2.

**C503.7.9 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 C504.
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. Engineering methods.

**C503.7.10 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).

**C503.7.11 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.

**C503.7.12 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.

**C503.7.13 Marking.** Single-wall metal pipe shall comply with the marking provisions of Section C503.6.13.

**C503.8 Venting system terminal clearances.** The clearances for through-the-wall direct-vent and nondirect-vent terminals shall be in accordance with Table C503.8 and Figure C503.8.

**Exception:** The clearances in Table C503.8 shall not apply to the combustion air intake of a direct-vent appliance.

**C503.9 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. Drains for condensate shall be installed in accordance with the *appliance* and vent manufacturer's instructions.

**C503.10 Vent connectors for Category I appliances.** Vent connectors for Category I *appliances* shall comply with Sections C503.10.1 through C503.10.14.

**C503.10.1 Where required.** A vent connector shall be used to connect an *appliance* to a gas vent, chimney or single-wall metal pipe, except where the gas vent, chimney or single-wall metal pipe is directly connected to the *appliance*.

**C503.10.2 Materials.** Vent connectors shall be constructed in accordance with Sections C503.10.2.1 through C503.10.2.5.

**C503.10.2.1 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.

**C503.10.2.2 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.

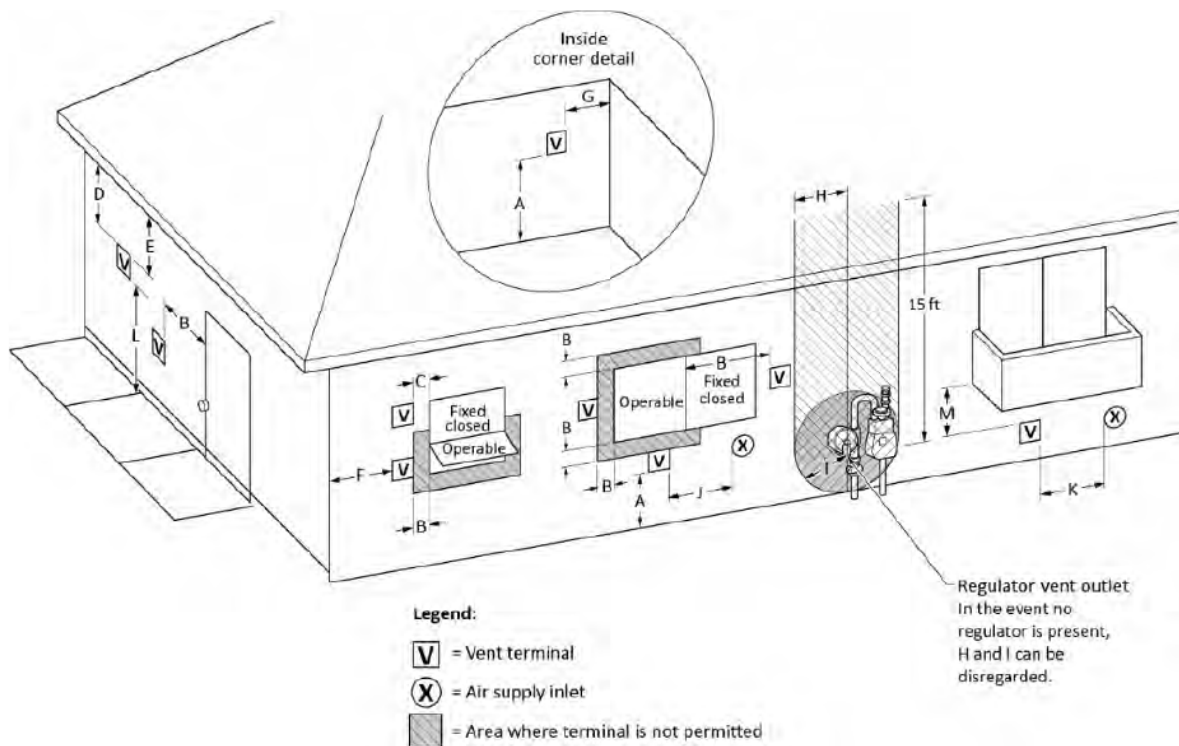
**Exception:** Single-wall metal pipe located within the exterior walls of the building in areas having a local 99-percent winter design temperature of 5°F (-15°C) or higher shall be permitted to be used in unconditioned spaces other than attics, garages and crawl spaces.

**TABLE C503.8  
THROUGH-THE-WALL VENT TERMINAL CLEARANCE**

FIGURE CLEARANCE	CLEARANCE LOCATION	MINIMUM CLEARANCE FOR DIRECT-VENT TERMINALS	MINIMUM CLEARANCE FOR NONDIRECT-VENT TERMINALS
A	Clearance above finished grade level, veranda, porch, deck, or balcony	12 inches	
B	Clearance to window or door that is openable	6 inches: Appliances ≤ 10,000 Btu/hr 9 inches: Appliances > 10,000 Btu/hr ≤ 50,000 Btu/hr 12 inches: Appliances > 50,000 Btu/hr ≤ 150,000 Btu/hr Appliances > 150,000 Btu/hr, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for nondirect-vent terminals in Row B	4 feet below or to side of opening or 1 foot above opening
C	Clearance to nonopenable window	None unless otherwise specified by the appliance manufacturer	
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet from the center line of the terminal	None unless otherwise specified by the appliance manufacturer	
E	Clearance to unventilated soffit	None unless otherwise specified by the appliance manufacturer	
F	Clearance to outside corner of building	None unless otherwise specified by the appliance manufacturer	
G	Clearance to inside corner of building	None unless otherwise specified by the appliance manufacturer	
H	Clearance to each side of center line extended above regulator vent outlet	3 feet up to a height of 15 feet above the regulator vent outlet	
I	Clearance to service regulator vent outlet in all directions	3 feet for gas pressures up to 2 psi; 10 feet for gas pressures above 2 psi	
J	Clearance to nonmechanical air supply inlet to building and the combustion air inlet to any other appliance	Same clearance as specified for Row B	
K	Clearance to a mechanical air supply inlet	10 feet horizontally from inlet or 3 feet above inlet	
L	Clearance above paved sidewalk or paved driveway located on public property	7 feet and shall not be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard	
M	Clearance to underside of veranda, porch, deck, or balcony	12 inches where the area beneath the veranda, porch, deck or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open.	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 Btu/hr = 0.293 W.





**FIGURE C503.8 THROUGH-THE-WALL VENT TERMINAL CLEARANCE**

**C503.10.2.3 Residential-type appliance connectors.** Where vent connectors for residential-type appliances are not installed in attics or other unconditioned spaces, connectors for *listed* appliances having draft hoods, appliances having draft hoods and equipped with *listed* conversion burners and Category I appliances shall be one of the following:

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

Vent connectors shall not be covered with insulation.

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

**C503.10.2.4 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 C503.10.2.4. Factory-built chimney sections shall be joined together in accordance with the chimney manufacturer’s instructions.

**TABLE C503.10.2.4 MINIMUM THICKNESS FOR GALVANIZED STEEL VENT CONNECTORS FOR LOW-HEAT APPLIANCES**

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

For SI: 1 inch = 25.4 mm.

**C503.10.2.5 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 C503.10.2.5 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<sup>1</sup>/<sub>2</sub> 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<sup>1</sup>/<sub>2</sub> inches (114 mm) thick laid on the 4<sup>1</sup>/<sub>2</sub>-inch (114 mm) bed for a vent connector having a diameter or greatest cross-sectional dimension greater than 18 inches (457 mm).
4. Where Factory-built chimney sections are installed, they shall be joined together in accordance with the chimney manufacturer's instructions.

**TABLE C503.10.2.5  
MINIMUM THICKNESS FOR STEEL VENT CONNECTORS  
FOR MEDIUM-HEAT APPLIANCES**

VENT CONNECTOR SIZE		MINIMUM THICKNESS (inch)
Diameter (inches)	Area (square inches)	
Up to 14	Up to 154	0.053
Over 14 to 16	154 to 201	0.067
Over 16 to 18	201 to 254	0.093
Over 18	Larger than 254	0.123

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm<sup>2</sup>.

**C503.10.3 Size of vent connector.** Vent connectors shall be sized in accordance with Sections C503.10.3.1 through C503.10.3.5.

**C503.10.3.1 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 C504 or engineering methods.

**C503.10.3.2 Multiple draft hood.** Where a single *appliance* having more than one draft hood outlet or flue collar is installed, the manifold shall be constructed according to the instructions of the *appliance* manufacturer. Where there are no instructions, the manifold shall be designed and constructed in accordance with engineering methods. As an alternate method, the effective area of the manifold shall equal the combined area of the flue collars or draft hood outlets and the vent connectors shall have a rise of not less than 12 inches (305 mm).

**C503.10.3.3 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 C504 or 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.

#### **C503.10.3.4 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 C504 or 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.

**C503.10.3.5 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.

**C503.10.4 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.

**C503.10.4.1 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.

**C503.10.5 Clearance.** Minimum clearances from vent connectors to *combustible material* shall be in accordance with Table C503.10.5.

**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 C308.2.

**C503.10.6 Joints.** Joints between sections of connector *pipng* 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.

TABLE C503.10.5  
CLEARANCES FOR CONNECTORS<sup>a</sup>

APPLIANCE	MINIMUM DISTANCE FROM COMBUSTIBLE MATERIAL			
	Listed Type B gas vent material	Listed Type L vent material	Single-wall metal pipe	Factory-built chimney sections
Listed appliances with draft hoods and appliances listed for use with Type B gas vents	As listed	As listed	6 inches	As listed
Residential boilers and furnaces with listed gas conversion burner and with draft hood	6 inches	6 inches	9 inches	As listed
Residential appliances listed for use with Type L vents	Not permitted	As listed	9 inches	As listed
Listed gas-fired toilets	Not permitted	As listed	As listed	As listed
Unlisted residential appliances with draft hood	Not permitted	6 inches	9 inches	As listed
Residential and low-heat appliances other than above	Not permitted	9 inches	18 inches	As listed
Medium-heat appliances	Not permitted	Not permitted	36 inches	As listed

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.

**C503.10.7 Connector junctions.** Where vent connectors are joined together, the connection shall be made with a tee or wye fitting.

**C503.10.8 Slope.** A vent connector shall be installed without dips or sags and shall slope upward toward the vent or chimney not less than 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.

**C503.10.9 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.

**C503.10.10 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.

**C503.10.11 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 C501.9).

**C503.10.12 Inspection.** The entire length of a vent connector shall be provided with ready access for inspection, cleaning and replacement.

**C503.10.13 Fireplaces.** A vent connector shall not be connected to a chimney flue serving a *fireplace* unless the *fireplace* flue opening is permanently sealed.

**C503.10.14 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 C503.7.4.

**C503.10.15 Medium-heat connectors.** Vent connectors for medium-heat appliances shall not pass through walls or partitions constructed of *combustible material*.

**C503.11 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 C503.4.

**C503.12 Draft hoods and draft controls.** The installation of draft hoods and draft controls shall comply with Sections C503.12.1 through 503.12.7.

**C503.12.1 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.

**C503.12.2 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.

**C503.12.2.1 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.

**C503.12.3 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.

**C503.12.4 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.

**C503.12.5 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.

**C503.12.6 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.

**C503.12.7 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.

**C503.13 Manually operated dampers.** A manually operated damper shall not be placed in the vent connector for any *appliance*. Fixed baffles and balancing baffles shall not be classified as manually operated dampers.

**C503.13.1 Balancing baffles.** Balancing baffles shall be *listed* in accordance with UL 378 and shall be mechanically locked in the desired position before placing the *appliance* in operation.

**C503.14 Automatically operated vent dampers.** An automatically operated vent damper shall be *listed*.

**C503.15 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 *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 C503.3 and C503.3.1 is obtained.
5. Vent dampers serving *listed* appliances installed in accordance with Sections C504.2.1 and C504.3.1 or *engineering methods*.

**C503.16 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 C504 SIZING OF CATEGORY I APPLIANCE VENTING SYSTEMS

**C504.1 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 + FAN.** The maximum combined *appliance* input rating of two or more Category I fan-assisted appliances attached to the common vent.

**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.

**FAN Max.** The maximum input rating of a Category I fan-assisted appliance attached to a vent or connector.

**FAN Min.** The minimum input rating of a Category I fan-assisted appliance attached to a vent or connector.

**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.

**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 + NAT.** The maximum combined *appliance* input rating of two or more Category I draft-hood-equipped appliances attached to the common vent.

**NAT Max.** The maximum input rating of a Category I draft-hood-equipped *appliance* attached to a vent or connector.

**C504.2 Application of single-appliance vent Tables C504.2(1) through C504.2(6).** The application of Tables C504.2(1) through C504.2(6) shall be subject to the requirements of Sections C504.2.1 through C504.2.17.

**C504.2.1 Vent obstructions.** These venting tables shall not be used where obstructions, as described in Section C503.15, 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.

**C504.2.2 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 ( $0.90 \times$  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.

**C504.2.3 Vent offsets.** Single-appliance venting configurations with zero (0) lateral lengths in Tables C504.2(1), C504.2(2) and C504.2(5) shall not have elbows in the venting system. Single-appliance venting configurations with lateral lengths include two 90-degree (1.57 rad) elbows. For each additional elbow up to and including 45 degrees (0.79 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 rad) up to and including 90 degrees (1.57 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 C504.2(1) through C504.2(5).

**C504.2.4 Zero lateral.** Zero (0) lateral (*L*) shall apply only to a straight vertical vent attached to a top outlet draft hood or flue collar.

**C504.2.5 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.

**C504.2.6 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.

**C504.2.7 Liner system sizing and connections.** *Listed* corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Table C504.2(1) or C504.2(2) for Type B vents with the maximum capacity reduced by 20 percent ( $0.80 \times$  maximum capacity) and the minimum capacity as shown in Table C504.2(1) or C504.2(2). Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with Section C504.2.3. 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.



**C504.2.8 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.

**C504.2.9 Chimney and vent locations.** Tables C504.2(1), C504.2(2), C504.2(3), C504.2(4) and C504.2(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 C503.6.5, and where vents terminate in accordance with Section C503.6.5, 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 C504.2(3) in combination with Table C504.2(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.
2. Vent connector length is limited to 1½ 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 C504.2(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 C504.2(6).

**C504.2.10 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.

**C504.2.11 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.

**C504.2.12 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.

**C504.2.13 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.

**C504.2.14 Table interpolation.** Interpolation shall be permitted in calculating capacities for vent dimensions that fall between the table entries.

**C504.2.15 Extrapolation prohibited.** Extrapolation beyond the table entries shall not be permitted.

**C504.2.16 Engineering calculations.** Where a vent height is less than 6 feet (1829 mm) or greater than shown in the tables, an engineering method shall be used to calculate the vent capacity.

**C504.2.17 Height entries.** Where the actual height of a vent falls between entries in the height column of the applicable table in Tables C504.2(1) through C504.2(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.

**C504.3 Application of multiple appliance vent Tables C504.3(1) through C504.3(7).** The application of Tables C504.3(1) through C504.3(7b) shall be subject to the requirements of Sections C504.3.1 through C504.3.28.

**C504.3.1 Vent obstructions.** These venting tables shall not be used where obstructions, as described in Section C503.15, 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 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.

**C504.3.2 Connector length limit.** The vent connector shall be routed to the vent utilizing the shortest possible route. Except as provided in Section C504.3.3, the maximum vent connector horizontal length shall be 1½ feet for each inch (18 mm per mm) of connector diameter as shown in Table C504.3.2.

**C504.3.3 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 C504.3.2. For example, the maximum length listed in Table C504.3.2 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 ( $0.90 \times$  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 ( $0.80 \times$  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 C504.2(1) shall be used. For single-wall connectors, Table C504.2(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.

**C504.3.4 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 ( $0.90 \times$  maximum common vent capacity) to the common vent capacity part of the common vent tables. The length of the common vent connector manifold ( $L_m$ ) shall not exceed 1½ feet for each inch (18 mm per mm) of common vent connector manifold diameter ( $D$ ).

**C504.3.5 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 C504.3.6. The horizontal length of the common vent *offset* ( $L_o$ ) shall not exceed 1½ 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 1½ feet for each inch (18 mm per mm) of common vent diameter ( $D$ ).

**TABLE 504.3.2  
MAXIMUM VENT CONNECTOR LENGTH**

CONNECTOR DIAMETER (inches)	CONNECTOR MAXIMUM HORIZONTAL LENGTH (feet)
3	4½
4	6
5	7½
6	9
7	10½
8	12
9	13½
10	15
12	18
14	21
16	24
18	27
20	30
22	33
24	36

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

**C504.3.6 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.

**C504.3.7 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.

**C504.3.8 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.

**C504.3.9 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.

**C504.3.9.1 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.

**C504.3.10 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.

**C504.3.11 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.

**C504.3.12 Vent height measurement.** The available total height (H) For multiple appliances on the same floor shall be measured from the highest draft hood outlet or flue collar up to the level of the outlet of the common vent.

**C504.3.13 Multistory height measurement.** Where *appliances* are located on more than one floor, the 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.

**C504.3.14 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 C504.2(1) or C504.2(2) for available total height (H) up to the lowest interconnection.

**C504.3.15 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.

**C504.3.16 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 1½ 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 ( $0.80 \times$  maximum common vent capacity).

4. A multistory common vent shall not be reduced in size above the *offset*.

**C504.3.17 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.

**C504.3.18 Multiple input rate appliances.** The minimum vent connector capacity (FAN Min) for appliances with more than one input rate shall be determined from the tables and shall be less than the lowest appliance input rating. the maximum vent connector capacity (FAN Max or NAT Max) for appliances with more than one input rate shall be determined from the tables and shall be greater than the highest appliance input rating.

**C504.3.19 Liner system sizing and connections.** Listed, corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Table C504.3(1) or C504.3(2) for Type B vents, with the maximum capacity reduced by 20 percent ( $0.80 \times$  maximum capacity) and the minimum capacity as shown in Table C504.3(1) or C504.3(2). Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with Sections C504.3.5 and C504.3.6. 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.

**C504.3.20 Chimney and vent location.** Tables C504.3(1), C504.3(2), C504.3(3), C504.3(4) and C504.3(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 C503.6.5 and where vents terminate in accordance with Section C503.6.5, 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 [C504.3\(6a\)](#), [C504.3\(6b\)](#), [C504.3\(7a\)](#) and [C504.3\(7b\)](#) 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 [C504.3\(6a\)](#) for NAT+NAT or Table [C504.3\(7a\)](#) for FAN+NAT.
4. The input rating of each space-heating appliance is greater than the minimum input rating given by Table [C504.3\(6b\)](#) for NAT+NAT or Table [C504.3\(7b\)](#) for FAN+NAT.
5. The vent connector sizing is in accordance with Table [C504.3\(3\)](#).

**[C504.3.21 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 [for example, 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.

**[C504.3.22 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 [C504.3\(2\)](#) or [C504.3\(4\)](#), as appropriate.

**[C504.3.23 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.

**[C504.3.24 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.

**[C504.3.25 Table interpolation.](#)** Interpolation shall be permitted in calculating capacities for vent dimensions that fall between table entries.

**[C504.3.26 Extrapolation prohibited.](#)** Extrapolation beyond the table entries shall not be permitted.

**[C504.3.27 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.

**[C504.3.28 Height entries.](#)** Where the actual height of a vent falls between entries in the height column of the applicable table in Tables [C504.3\(1\)](#) through [C504.3\(7b\)](#), 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 [C505](#) DIRECT-VENT, INTEGRAL VENT, MECHANICAL VENT AND VENTILATION/EXHAUST HOOD VENTING

**[C505.1 General.](#)** The installation of direct-vent and integral vent appliances shall be in accordance with Section [C503](#). Mechanical venting systems and exhaust hood venting systems shall be designed and installed in accordance with Section [C503](#). [Exhaust hood venting used in conjunction with commercial cooking operations shall be designed and installed in accordance with Section 507 of this code.](#)

## SECTION [C506](#) FACTORY-BUILT CHIMNEYS

**[C506.1 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.

**[C506.2 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.

**C506.3 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.

### SECTION C601 SPECIFIC APPLIANCES

**C601.1 Scope.** This [section and Sections C602 through C635.1](#) shall govern the approval, design, installation, construction, *alteration* and repair of the appliances and *equipment* specifically identified herein.

### SECTION C602 DECORATIVE APPLIANCES FOR INSTALLATION IN FIREPLACES

**C602.1 General.** Decorative appliances for installation in *approved* solid fuel-burning fireplaces shall be *listed* 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 *listed* in accordance with ANSI Z21.84.

**C602.2 Flame safeguard device.** Decorative appliances for installation in *approved* solid fuel-burning fireplaces, with the exception of those *listed* 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.

**C602.3 Prohibited installations.** Decorative appliances for installation in fireplaces shall not be installed where prohibited by Section [C303.3](#).

### SECTION C603 LOG LIGHTERS

**C603.1 General.** Log lighters shall be *listed* in accordance with CSA 8 and installed in accordance with the manufacturer's instructions.

### SECTION C604 VENTED GAS FIREPLACES (DECORATIVE APPLIANCES)

**C604.1 General.** Vented gas fireplaces shall be *listed* 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 [C602.2](#).

**C604.2 Access.** Panels, grilles and *access* doors that are required to be removed for normal servicing operations shall not be attached to the building.

### SECTION C605 VENTED GAS FIREPLACE HEATERS

**C605.1 General.** Vented gas fireplace heaters shall be installed in accordance with the manufacturer's instructions, shall be *listed* in accordance with ANSI Z21.88/CSA 2.33 and shall be designed and equipped as specified in Section [C602.2](#).

### SECTION C606 INCINERATORS AND CREMATORIES

**C606.1 General.** Incinerators and crematories shall be installed in accordance with the manufacturer's instructions.

### SECTION C607 COMMERCIAL-INDUSTRIAL INCINERATORS

**C607.1 Incinerators, commercial-industrial.** Commercial industrial-type incinerators shall be constructed and installed in accordance with NFPA 82.

### SECTION C608 VENTED WALL FURNACES

**C608.1 General.** Vented wall furnaces shall be *listed* in accordance with ANSI Z21.86/CSA 2.32 and shall be installed in accordance with the manufacturer's instructions.

**C608.2 Venting.** Vented wall furnaces shall be vented in accordance with Section [C503](#).

**C608.3 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.

**C608.4 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*.

**C608.5 Ducts prohibited.** Ducts shall not be attached to wall furnaces. Casing extension boots shall not be installed unless *listed* as part of the *appliance*.

**C608.6 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 C609 FLOOR FURNACES

**C609.1 General.** Floor furnaces shall be *listed* in accordance with ANSI Z21.86/CSA 2.32 and shall be installed in accordance with the manufacturer's instructions.

**C609.2 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.

**C609.3 Bracing.** The floor around the furnace shall be braced and headed with a support framework designed in accordance with the *Building Code*.

**C609.4 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*.

**C609.5 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 C609.6 and shall project into a nonhabitable space.

**C609.6 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 C304.

## SECTION C610 DUCT FURNACES

**C610.1 General.** Duct furnaces shall be *listed* in accordance with ANSI Z83.8/CSA 2.6 or UL 795 and shall be installed in accordance with the manufacturer's instructions.

**C610.2 Access panels.** Ducts connected to duct furnaces shall have removable *access* panels on both the upstream and downstream sides of the furnace.

**C610.3 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.

**C610.4 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 C611 NONRECIRCULATING DIRECT-FIRED INDUSTRIAL AIR HEATERS

**C611.1 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.

**C611.2 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 permitted to provide ventilation air.

**C611.3 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.



**C611.4 Supply air.** All air handled by a *nonrecirculating direct-fired industrial air heater*, including *combustion air*, shall be ducted directly from the outdoors.

**C611.5 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.

**C611.6 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.

**C611.7 Relief opening.** The design of the installation shall include provisions to permit *nonrecirculating direct-fired industrial air heaters* to operate at rated capacity without over-pressurizing 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.

**C611.8 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.

**C611.9 Purging.** Inlet ducting, where used, shall be purged by not less than four air changes prior to an ignition attempt.

## SECTION C612 RECIRCULATING DIRECT-FIRED INDUSTRIAL AIR HEATERS

**C612.1 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.

**C612.2 Location.** *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.

**C612.3 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.

**C612.4 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.

**C612.5 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<sup>3</sup> 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.

**C612.6 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.

**C612.7 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 C613 CLOTHES DRYERS

**C613.1 General.** Clothes dryers shall be *listed* 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 [and Chapter 5 of this code](#).

## SECTION C614 CLOTHES DRYER EXHAUST

**C614.1 Installation.** See [Chapter 5 of this code for exhaust system requirements.](#)

## SECTION C615 SAUNA HEATERS

**C615.1 General.** Sauna heaters shall be installed in accordance with the manufacturer's instructions [and Chapter 9 of this code.](#)

**C615.2 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.

**C615.3 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 [C304](#).

## SECTION C616 ENGINE AND GAS TURBINE-POWERED EQUIPMENT

**C616.1 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.

**C616.2 Gas supply connection.** *Equipment* powered by internal combustion engines and turbines shall not be rigidly connected to the gas supply *pipng*.

## SECTION C617 POOL AND SPA HEATERS

**C617.1 General.** Pool and spa heaters shall be *listed* in accordance with ANSI Z21.56/CSA 4.7 and shall be installed in accordance with the manufacturer's instructions.

## SECTION C618 FORCED-AIR WARM-AIR FURNACES

**C618.1 General.** Forced-air warm-air furnaces shall be *listed* in accordance with ANSI Z21.47/CSA 2.3 or UL 795 and shall be installed in accordance with the manufacturer's instructions.

**C618.2 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.

**C618.3 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.

**Exception:** [Listed outdoor appliances that provide both circulating air and vent discharge.](#)

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 [Chapter 2 of this code.](#)
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 [appendix](#), 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 [C501.8](#).

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.

**C618.4 Screen.** Required outdoor air inlets for residential portions of a building shall be covered with a screen having 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 1/4 inch (6.4 mm) and not larger than 1 inch (25 mm).

**C618.5 Return-air limitation.** Return air from one *dwelling unit* shall not be discharged into another *dwelling unit*.

**C618.6 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. Return air shall not be taken from the mechanical room containing the furnace.

## SECTION C619 CONVERSION BURNERS

**C619.1 Conversion burners.** The installation of conversion burners shall conform to ANSI Z21.8.

## SECTION C620 UNIT HEATERS

**C620.1 General.** Unit heaters shall be *listed* in accordance with ANSI Z83.8/CSA 2.6 and shall be installed in accordance with the manufacturer's instructions.

**C620.2 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*.

**C620.3 Ductwork.** Ducts shall not be connected to a unit heater unless the heater is *listed* for such installation.

**C620.4 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.

**C620.5 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 C305.9, C305.10 and C305.11.

## SECTION C621 UNVENTED ROOM HEATERS

**C621.1 General.** Unvented room heaters shall be *listed* 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 [Chapter 9 of this code](#).

**C621.2 Prohibited use.** One or more unvented room heaters shall not be used as the sole source of comfort heating in a *dwelling unit*.

**C621.3 Input rating.** Unvented room heaters shall not have an input rating in excess of 40,000 Btu/h (11.7 kW).

**C621.4 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 C303.3.

**C621.5 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<sup>3</sup>) 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.

**C621.6 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.

**C621.7 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.

**C621.7.1 Ventless firebox enclosures.** Ventless firebox enclosures used with unvented decorative room heaters shall be *listed* as complying with ANSI Z21.91.

## SECTION C622 VENTED ROOM HEATERS

**C622.1 General.** Vented room heaters shall be *listed* in accordance with ANSI Z21.86/CSA 2.32, shall be designed and equipped as specified in Section C602.2 and shall be installed in accordance with the manufacturer's instructions.

## SECTION C623 COOKING APPLIANCES

**C623.1 Cooking appliances.** Cooking appliances that are designed for permanent installation, including ranges, ovens, stoves, broilers, grills, fryers, griddles, hot plates and barbecues, shall be *listed* 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.

**C623.2 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.

**Exception:** Appliances that are also listed as domestic cooking appliances.

**C623.3 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.

**C623.4 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.

**C623.5 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.

**C623.5.1 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.

**C623.6 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 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 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 cooking *appliance* or microwave oven is installed over a cooking *appliance* and in compliance with the terms of the manufacturer's installation instructions for the upper *appliance*.



## SECTION C624 WATER HEATERS

**C624.1 General.** Water heaters shall be *listed* in accordance with ANSI Z21.10.1/CSA 4.1 or 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 [Chapter 10 of this code](#).

**C624.1.1 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*.

**C624.2 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*.

## SECTION C625 REFRIGERATORS

**C625.1 General.** Refrigerators shall be *listed* in accordance with ANSI Z21.19/CSA 1.4 and shall be installed in accordance with the manufacturer's instructions.

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 C626 GAS-FIRED TOILETS

**C626.1 General.** Gas-fired toilets shall be tested in accordance with ANSI Z21.61 and installed in accordance with the manufacturer's instructions.

**C626.2 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 C627 AIR-CONDITIONING APPLIANCES

**C627.1 General.** Gas-fired air-conditioning appliances shall be *listed* 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.

**C627.2 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 [C402](#)).

**C627.3 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*.

**C627.4 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 [C308.3](#) except that air-conditioning appliances *listed* for installation at lesser clearances than those specified in Section [C308.3](#) 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 [C308.3](#) 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 [C308.2](#).

**C627.5 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. The installation clearances for air-conditioning appliances in alcoves and closets shall not be reduced by the protection methods described in Table [C308.2](#).

**C627.6 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.

**C627.7 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.



**C627.8 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.

**C627.9 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 *pipng* systems shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

**C627.10 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 **C628** ILLUMINATING APPLIANCES

**C628.1 General.** Illuminating appliances shall be *listed* in accordance with ANSI Z21.42 and shall be installed in accordance with the manufacturer's instructions.

**C628.2 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 pipng* for support.

**C628.3 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<sup>1</sup>/<sub>2</sub>-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 <sup>3</sup>/<sub>4</sub>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.

**C628.4 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 **C629** SMALL CERAMIC KILNS

**C629.1 General.** Kilns shall be installed in accordance with the manufacturer's instructions and the provisions of this [appendix](#). Kilns shall comply with Section [C301.3](#).

**C629.2 Unlisted fuel-gas kiln installation.** See [Chapter 9](#).

## SECTION **C630** INFRARED RADIANT HEATERS

**C630.1 General.** Infrared radiant heaters shall be *listed* in accordance with ANSI Z83.19 or Z83.20 and shall be installed in accordance with the manufacturer's instructions.

**C630.2 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*.

**C630.3 Combustion and ventilation air.** Where unvented infrared heaters are installed, natural or mechanical means shall provide outdoor ventilation air at a rate of not less than 4 cfm per 1,000 Btu/h (0.38 m<sup>3</sup>/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.

**C630.4 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 [C305.9](#), [C305.10](#) and [C305.11](#).

## SECTION **C631** BOILERS

**C631.1 Standards.** Boilers shall be *listed* in accordance with [Chapter 10](#)

**C631.2 Clearance to combustible materials.** Clearances to *combustible materials* shall be in accordance with Section [C308.4](#).

## SECTION **C632** RESERVED

## SECTION **C633** STATIONARY FUEL-CELL POWER SYSTEMS

**C633.1 General.** Stationary fuel-cell power systems having a power output not exceeding 10 MW shall be tested in accordance with ANSI/CSA FC 1 and shall be installed in accordance with the manufacturer's instructions, NFPA 853 and the [Building Code](#).

## SECTION **C634** GASEOUS HYDROGEN SYSTEMS

**C634.1 Installation.** The installation of gaseous hydrogen systems shall be in accordance with the applicable requirements of this [appendix](#) and the [Building Code](#).

## SECTION **C636** OUTDOOR DECORATIVE APPLIANCES

**C636.1 General.** Permanently fixed-in-place outdoor decorative appliances shall be *listed* in accordance with ANSI Z21.97 and shall be installed in accordance with the manufacturer's instructions.

## SECTION **C701** GASEOUS HYDROGEN SYSTEMS, GENERAL

**C701.1 Scope.** The installation of gaseous hydrogen systems shall comply with this [section](#) and [Sections C702.1 through C708.1](#) and [the Building Code](#). Compressed gases shall also comply with [the Building Code](#) for general requirements.

## SECTION **C702** GENERAL DEFINITIONS

**C702.1 Definitions.** The following words and terms shall, for the purposes of [Sections C703.1 through C708.1](#) and as used elsewhere in this [appendix](#), have the meanings shown herein.

**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.

**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 **C703** GENERAL REQUIREMENTS

**C703.1 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.

**C703.2 Containers, cylinders and tanks.** Compressed gas containers, cylinders and tanks shall comply with [the Building Code](#).

**C703.2.1 Limitations for indoor storage and use.** Flammable gas cylinders in occupancies regulated by the *Residential Code* shall not exceed 250 cubic feet (7.1 m<sup>3</sup>) at normal temperature and pressure (NTP).

**C703.2.2 Design and construction.** Compressed gas containers, cylinders and tanks shall be designed, constructed and tested in accordance with [the Building Code](#), [the Boiler Code](#) or DOTn 49 CFR, Parts 100-180.

**C703.3 Pressure relief devices.** Pressure relief devices shall be provided in accordance with Sections [C703.3.1](#) through [C703.3.8](#). Pressure relief devices shall be sized and selected in accordance with CGA S-1.1, CGA S-1.2 and CGA S-1.3.

**C703.3.1 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.

**C703.3.2 Installation.** Valves and other mechanical restrictions shall not be located between the pressure relief device and the point of release to the atmosphere.

**C703.3.3 Containers.** Containers shall be provided with pressure relief devices in accordance with the [Boiler Code](#) DOTn 49 CFR, Parts 100-180 and Section C703.3.7.

**C703.3.4 Vessels other than containers.** Vessels other than containers shall be protected with pressure relief devices in accordance with the [Boiler Code](#).

**C703.3.5 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.

**C703.3.6 Protection.** Pressure relief devices and any associated vent *pipng* 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.

**C703.3.7 Access.** Pressure relief devices shall be located such that they are provided with ready *access* for inspection and repair.

**C703.3.8 Configuration.** Pressure relief devices shall be arranged to discharge unobstructed in accordance with the [Building Code](#). 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 m<sup>3</sup>) or less.

**C703.4 Venting.** Relief device vents shall be terminated in an *approved* location in accordance with Section 2309 of the [Building Code](#).

**C703.5 Security.** Compressed gas containers, cylinders, tanks and systems shall be secured against accidental dislodgement in accordance with the [Building Code](#).

**C703.6 Electrical wiring and equipment.** Electrical wiring and *equipment* shall comply with the [Electrical Code](#).

## SECTION C704 PIPING, USE AND HANDLING

**C704.1 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*.

**C704.1.1 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.

**C704.1.2 Piping systems.** *Piping*, tubing, valves and fittings conveying gaseous hydrogen shall be designed and installed in accordance with Sections C704.1.2.1 through C704.1.2.5.1, the [Building Code](#), and ASME B31.12. Cast-iron pipe, valves and fittings shall not be used.

**C704.1.2.1 Sizing.** Gaseous hydrogen *pipng* shall be sized in accordance with *approved* engineering methods.

**C704.1.2.2 Identification of hydrogen piping systems.** Hydrogen *pipng* systems shall be marked in accordance with ANSI A13.1. Markings used for *pipng* 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).

**C704.1.2.3 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.

**C704.1.2.3.1 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.

**C704.1.2.3.2 Interior piping.** Except for through penetrations, *pipng* located inside of buildings shall be installed in exposed locations and provided with ready *access* for visual inspection.

**C704.1.2.3.3 Underground piping.** Underground *piping*, including joints and fittings, shall be protected from corrosion and installed in accordance with *approved* engineered methods.

**C704.1.2.3.4 Piping through foundation wall.** Underground *piping* shall not penetrate the outer foundation or basement wall of a building.

**C704.1.2.3.5 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 1½ 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 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.

**C704.1.2.3.6 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 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.

**C704.1.2.3.7 Settlement.** *Piping* passing through concrete or masonry walls shall be protected against differential settlement.

**C704.1.2.4 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.

**C704.1.2.4.1 Brazed joints.** Brazing alloys shall have a melting point greater than 1,000°F (538°C).

**C704.1.2.4.2 Electrical continuity.** Mechanical joints shall maintain electrical continuity through the joint or a bonding jumper shall be installed around the joint.

**C704.1.2.5 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.

**C704.1.2.5.1 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*.

**C704.2 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.

**C704.3 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 [the Building Code](#).

**C704.4 Handling.** The handling of compressed gas containers, cylinders and tanks shall comply with [the Building Code](#).

## SECTION C705 TESTING OF HYDROGEN PIPING SYSTEMS

**C705.1 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 [appendix](#).

**C705.2 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 [appendix](#). 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.

**C705.3 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 C705.3.1 through C705.4.1.

**C705.3.1 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).



**C705.3.2 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.

**C705.3.3 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 *pipng* greater than 50 percent of the specified minimum yield strength of the pipe.

**C705.3.4 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.

**C705.3.5 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<sup>3</sup>) of pipe volume or fraction thereof. For *pipng* systems having a volume of more than 24,000 cubic feet (680 m<sup>3</sup>), the duration of the test shall not be required to exceed 24 hours. The test pressure required in Sections C705.3.1 and C705.3.2 shall be maintained for the entire duration of the test.

**C705.3.6 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*.

**C705.3.7 Test preparation.** Pipe joints, including welds, shall be left exposed for examination during the test.

**C705.3.7.1 Expansion joints.** Expansion joints shall be provided with temporary restraints, if required, for the additional thrust load under test.

**C705.3.7.2 Equipment disconnection.** Where the *pipng* 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 *pipng* system by disconnecting them and capping the *outlet(s)*.

**C705.3.7.3 Equipment isolation.** Where the *pipng* 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 *pipng* system by closing the individual *appliance*, *equipment* or component shutoff valve(s).

**C705.4 Detection of leaks and defects.** The *pipng* 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. *Pipng* systems shall not be *approved* except where this reduction in pressure is attributed to some other cause.

**C705.4.1 Corrections.** Where leakage or other defects are identified, the affected portions of the *pipng* system shall be repaired and retested.

**C705.5 Purging of gaseous hydrogen piping systems.** Purging shall comply with Sections C705.5.1 through C705.5.4.

**C705.5.1 Removal from service.** Where *pipng* 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.

**C705.5.2 Placing in operation.** Prior to placing the system into operation, the air in the *pipng* 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.

**C705.5.3 Discharge of purged gases.** The open end of *pipng* 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.



**C705.5.3.1 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.

**C705.5.4 Placing equipment in operation.** After the *pipng* has been placed in operation, all *equipment* shall be purged in accordance with Section C707.1 and then placed in operation, as necessary.

### SECTION C706 LOCATION OF GASEOUS HYDROGEN SYSTEMS

**C706.1 General.** The location and installation of gaseous hydrogen systems shall be in accordance with Sections C706.2 and C706.3.

**Exception:** Stationary fuel-cell power plants in accordance with Section C633.

**C706.2 Indoor gaseous hydrogen systems.** Gaseous hydrogen systems shall be located in indoor rooms or areas constructed in accordance with this [appendix](#), [this code](#), the *Building Code* or NFPA 2.

**C706.3 Outdoor gaseous hydrogen systems.** Gaseous hydrogen systems shall be located outdoors in accordance with [the Building Code](#).

### SECTION C707 OPERATION OF GASEOUS HYDROGEN SYSTEMS

**C707.1 Purging.** Purging of gaseous hydrogen systems, other than *pipng* systems purged in accordance with Section C705.5, shall be in accordance with [the Building Code](#) or in accordance with the system manufacturer's instructions.

### SECTION C708 DESIGN OF LIQUEFIED HYDROGEN SYSTEMS ASSOCIATED WITH HYDROGEN VAPORIZATION OPERATIONS

**C708.1 General.** The design of liquefied hydrogen systems shall comply with [the Building Code](#).

**SECTION C801**  
**REFERENCED STANDARDS**

## ANSI

American National Standards Institute  
25 West 43rd Street 4th Floor  
New York, NY 10036

**ANSI A13.1—2020: Scheme for the Identification of Piping Systems**

[C704.1.2.2](#)

**ANSI FC1—2014: Fuel cell technologies - Part 3-100: Stationary Fuel Power Systems—Safety**

[C633.1](#)

**ANSI LC-4/CSA 6.32—2012: Press-connect Metallic Fittings for Use in Fuel Gas Distribution Systems**

[C403.9.1](#), [C403.9.2](#), [C403.9.3](#)

**ANSI Z21.90/CSA 6.24—2015: Gas Convenience Outlets and Optional Enclosures**

[C411.1](#)

**LC1/CSA 6.26—2016: Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST)**

[C403.4.5](#)

**Z21.1—2016: Household Cooking Gas Appliances**

[C623.1](#)

**Z21.5.1/CSA 7.1—2017: Gas Clothes Dryers—Volume I—Type 1 Clothes Dryers**

[C613.1](#)

**Z21.5.2/CSA 7.2—2016: Gas Clothes Dryers—Volume II—Type 2 Clothes Dryers**

[C613.1](#)

**Z21.8—94 (R2012): Installation of Domestic Gas Conversion Burners**

[C619.1](#)

**Z21.10.1/CSA 4.1—2017: Gas Water Heaters—Volume I—Storage, Water Heaters with Input Ratings of 75,000 Btu per Hour or Less**

[C624.1](#)

**Z21.10.3/CSA 4.3—2017: Gas Water Heaters—Volume III—Storage, Water Heaters with Input Ratings above 75,000 Btu per Hour, Circulating and Instantaneous**

[C624.1](#)

**Z21.11.2—2016: Gas-fired Room Heaters—Volume II—Unvented Room Heaters**

[C621.1](#)

**Z21.15/CSA 9.1—2009(2014): Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves**

Table [C409.1.1](#)

**Z21.19/CSA 1.4—2014: Refrigerators Using Gas Fuel**

[C625.1](#)

**Z21.24/CSA 6.10—2015: Connectors for Gas Appliances**

[C411.1](#), [C411.2](#)

**Z21.40.1/CGA 2.91—1996 (R2017): Gas-fired Heat Activated Air Conditioning and Heat Pump Appliances**

[C627.1](#)

**Z21.40.2/CGA 2.92—1996 (R2017): Gas-fired Work Activated Air Conditioning and Heat Pump Appliances (Internal Combustion)**

[C627.1](#)

**Z21.41/CSA 6.9—2014: Quick Disconnect Devices for use with Gas Fuel Appliances**

[C411.1](#)

**Z21.42—2013: Gas-fired Illuminating Appliances**

- [C628.1](#)
- Z21.47/CSA 2.3—2016: Gas-fired Central Furnaces**
- [C618.1](#)
- Z21.50/CSA 2.22—2016: Vented Decorative Gas Fireplaces**
- [C604.1](#)
- Z21.54—2014: Gas Hose Connectors for Portable Outdoor Gas-fired Appliances**
- [C411.1](#)
- Z21.56/CSA 4.7—2017: Gas-fired Pool Heaters**
- [C617.1](#)
- Z21.58/CSA 1.6—2015: Outdoor Cooking Gas Appliances**
- [C623.1](#)
- Z21.60/CSA 2.26—2017: Decorative Gas Appliances for Installation in Solid-fuel Burning Fireplaces**
- [C602.1](#)
- Z21.61—1983 (R2013): Gas-fired Toilets**
- [C626.1](#)
- Z21.69/CSA 6.16—2015: Connectors for Movable Gas Appliances**
- [C411.1.1](#), [C411.1.4](#)
- Z21.75/CSA 6.27—2016: Connectors for Outdoor Gas Appliances and Manufactured Homes**
- [C411.1](#)
- Z21.80/CSA 6.22—2016: Line Pressure Regulators**
- [C410.1](#)
- Z21.84—2017: Manually Lighted, Natural Gas Decorative Gas Appliances for Installation in Solid-Fuel Burning Appliances**
- [C602.1](#), [C602.2](#)
- Z21.86/CSA 2.32—2016: Vented Gas-fired Space Heating Appliances**
- [C608.1](#), [C609.1](#), [C622.1](#)
- Z21.88/CSA 2.33—2016: Vented Gas Fireplace Heaters**
- [C605.1](#)
- Z21.91—2017: Ventless Firebox Enclosures for Gas-fired Unvented Decorative Room Heaters**
- [C621.7.1](#)
- Z21.93/CSA 6.30—2017: Excess Flow Valves for Natural Gas and Propane Gas with Pressures up to 5 psig**
- [C410.4](#)
- Z21.97—2014: Outdoor Decorative Appliances**
- [C635.1](#)
- Z83.4/CSA 3.7—2017: Nonrecirculating Direct-gas-fired Heating and Forced Ventilation Appliances for Commercial and Industrial Application**
- [C611.1](#)
- Z83.8/CSA 2.6—2016: Gas Unit Heater, Gas Packaged Heater, Gas Utility Heaters and Gas-fired Duct Furnaces**
- [C610.1](#), [620.1](#)
- Z83.11/CSA 1.8—2016: Gas Food Service Equipment**
- [C623.1](#)
- Z83.18—2017: Recirculating Direct Gas-fired Heating and Forced Ventilation Appliances for Commercial and Industrial Applications**
- [C612.1](#)
- Z83.19—09(R2014): Gas-fired High-intensity Infrared Heaters**
- [C630.1](#)
- Z83.20—2016: Gas-fired Tubular and Low-intensity Infrared Heaters**

[C630.1](#)

## ASME

American Society of Mechanical Engineers  
Two Park Avenue  
New York, NY 10016-5990

**B1.20.1—2019: Pipe Threads, General Purpose (inch)**

[C403.8](#)

**B16.1—2020: Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125 and 250**

[C403.11.1](#)

**B16.5—2019: Pipe Flanges and Flanged Fittings: NPS 1/2 through NFPS 24 Metric/Inch Standard**

[C403.11.2](#)

**B16.20—2017: Metallic Gaskets For Pipe Flanges: Ring-Joint, Spiral-Wound and Jacketed**

[C403.12.1](#)

**B16.21—2016: Nonmetallic Flat Gaskets for Pipe Flanges**

[C403.12.2](#)

**B16.24—2021: Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500 and 2500**

[C403.11.3](#)

**B16.33—2012(2017): Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 125 psig (Sizes 1/2 through 2)**

Table [C409.1.1](#)

**B16.42—2021: Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300**

[C403.11.4](#)

**B16.44—2017: Manually Operated Metallic Gas Valves for Use in Aboveground Piping Systems up to 5 psi**

Table [C409.1.1](#)

**B16.47—2020: Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric/Inch Standard**

[C403.11.2](#)

**B31.3—2020: Process Piping**

[C704.1.2.4](#)

**B31.12—2019: Hydrogen Piping and Pipelines**

[C704.1.2](#), [C704.1.2.4](#), [C705.2](#), [C705.3](#)

**B36.10M—2018: Welded and Seamless Wrought-steel Pipe**

[C403.3.2](#)

## ASTM

ASTM International  
100 Barr Harbor Drive, P.O. Box C700  
West Conshohocken, PA 19428-2959

**A53/A53M—2018: Specification for Pipe, Steel, Black and Hot Dipped Zinc-coated Welded and Seamless**

[C403.3.2](#)

**A106/A106M—2018: Specification for Seamless Carbon Steel Pipe for High-temperature Service**

[C403.3.2](#)

**A254—2010(2018): Specification for Copper Brazed Steel Tubing**

[C403.4.1](#)

**A268/A268—2010(16): Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service**

[C403.4.2](#)

**A269/A269M—2015A: Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service**

[C403.4.2](#)

**A312/A312M—2018: Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes**

[C403.3.2](#)

**B88—2016: Specification for Seamless Copper Water Tube**

[C403.4.3](#)

**B210—12: Specification for Aluminum and Aluminum-alloy Drawn Seamless Tubes**

[C403.4.4](#)

**B241/B241M—2016: Specification for Aluminum and Aluminum-alloy, Seamless Pipe and Seamless Extruded Tube**

[C403.3.4](#), [C403.4.4](#)

**B280—2018: Standard Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service**

[C403.4.3](#)

**C64 - 72(1977): Standard Specification for Refractories for Incinerators and Boilers**

[C503.10.2.5](#)

**C315—2007(2016): Specification for Clay Flue Liners and Chimney Pots**

[C501.12](#)

**D2513—2018A: Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings**

[C403.5](#), [C403.5.1](#), [C403.10](#), [C404.17.2](#)

**E136—2019: Standard Test Method for Assessing Combustibility of Using a Vertical Tube Furnace at 750°C**

[C202](#)

**F1973—2013(2018): Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems**

[C404.17.2](#)

**F2945—2018: Standard Specification for Polyamide 11 Gas Pressure Pipe, Tubing and Fittings**

[C403.5](#)

## CGA

Compressed Gas Association  
14501 George Carter Way, Suite 103  
Chantilly, VA 20151-2923

**S-1.1—(2011): Pressure Relief Device Standards—Part 1—Cylinders for Compressed Gases**

[C703.3](#)

**S-1.2—(2009): Pressure Relief Device Standards—Part 2—Cargo and Portable Tanks for Compressed Gases**

[C703.3](#)

**S-1.3—(2008): Pressure Relief Device Standards—Part 3—Stationary Storage Containers for Compressed Gases**

[C703.3](#)

## CSA

CSA Group  
8501 East Pleasant Valley Road  
Cleveland, OH 44131-5516

**ANSI/CSA FC1—2014: Fuel Cell Technologies—Part 3-100; Stationary fuel cell power systems-Safety**

[C633.1](#)

**CSA 8—93: Requirements for Gas-fired Log Lighters for Wood Burning Fireplaces**

[C603.1](#)

## DOTn

U.S. Department of Transportation  
400 Seventh St. SW  
Washington, DC 20590

**49 CFR—Parts 100–180(2015): Hazardous Materials Regulations**

[C703.2.2](#), [C703.3.3](#)



**49 CFR, Parts 192.281(e) & 192.283 (b)—(2009): Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards**

[C403.5.1](#)

**MSS**

Manufacturers Standardization Society of the Valve and Fittings Industry  
127 Park Street, NE  
Vienna, VA 22180

**ANSI SP 58—2018: Pipe Hangers and Supports—Materials, Design and Manufacture**

[C407.2](#)

**NFPA**

National Fire Protection Association  
1 Batterymarch Park  
Quincy, MA 02169-7471

**2—19: Hydrogen Technologies Code**

[C703.1](#), [C706.2](#)

**30A—21: Code for Motor Fuel Dispensing Facilities and Repair Garages**

[C305.4](#), [C305.10](#)

**37—18: Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines**

[C616.1](#)

**51—18: Design and Installation of Oxygen-fuel Gas Systems for Welding, Cutting and Allied Processes**

[C414.1](#)

**58—17: Liquefied Petroleum Gas Code**

[C401.2](#), [C402.7](#), [C403.5.2](#), [C403.10](#)

**82—19: Incinerators, Waste and Linen Handling Systems and Equipment**

[C503.2.5](#), T [C503.4](#), [C607.1](#)

**88A—19: Standard for Parking Structures**

[C305.9](#)

**211—19: Standard for the Chimneys, Fireplaces, Vents and Solid Fuel-burning Appliances**

[C503.5.2](#)

**409—16: Standard for the Aircraft Hangars**

[C305.11](#)

**853—20: Standard Installation of Stationary Fuel Cell Power Systems**

[C633.1](#)

**UL**

UL LLC  
333 Pfingsten Road  
Northbrook, IL 60062

**103—2010: Factory-built Chimneys, Residential Type and Building Heating Appliances—with Revisions through March 2017**

[C506.1](#)

**127—2011: Factory-built Fireplaces—with Revisions through July 2016**

[C621.7](#)

**378—2006: Draft Equipment—with revisions through September 2013**

[C503.3.3](#)

**441—2016: Gas Vents—with Revisions through July 2016**

[C502.1](#)

**641—2010: Type L Low-temperature Venting Systems—with Revisions through April 2018**

[C502.1](#)

**651—2011: Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings—with Revisions through June 2016**

[C403.5.3](#)

**795—2016: Commercial-Industrial Gas Heating Equipment**

[C610.1](#), [C618.1](#),

**959—2010: Medium Heat Appliance Factory-built Chimneys—with Revisions through June 2014**

[C506.3](#)

**1618—2015: Wall Protectors, Floor Protectors and Hearth Extensions—with Revisions through January 2018**

[C308.2](#)

**1738—2010: Venting Systems for Gas Burning Appliances, Categories II, III and IV**

[C502.1](#), [C503.4.1](#)

**1777—2007: Chimney Liners—with Revisions through April 2014**

[C501.12](#), [C501.15.4](#)

**2200—2012: Stationary Engine Generator Assemblies—with Revisions through October 2015**

[C616.1](#)