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# INTERNATIONAL FUEL GAS CODE®

# 2006



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# 2006

2006 International Fuel Gas Code<sup>®</sup>

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# PREFACE

## Introduction

Internationally, code officials recognize the need for a modern, up-to-date fuel gas code addressing the design and installation of fuel gas systems and gas-fired appliances through requirements emphasizing performance. The *International Fuel Gas Code*®, in this 2006 edition, is designed to meet these needs through model code regulations that safeguard the public health and safety in all communities, large and small.

This comprehensive fuel gas code establishes minimum regulations for fuel gas systems and gas-fired appliances using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new fuel gas system and appliance designs. This 2006 edition is fully compatible with all the *International Codes*® (I-Codes®) published by the International Code Council (ICC)®, including the *International Building Code*®, *ICC Electrical Code*®, *International Energy Conservation Code*®, *International Existing Building Code*®, *International Fire Code*®, *International Mechanical Code*®, *ICC Performance Code*®, *International Plumbing Code*®, *International Private Sewage Disposal Code*®, *International Property Maintenance Code*®, *International Residential Code*®, *International Wildland-Urban Interface Code*™ and *International Zoning Code*®.

The *International Fuel Gas Code* provisions provide many benefits, among which is the model code development process that offers an international forum for fuel gas technology professionals to discuss performance and prescriptive code requirements. This forum provides an excellent arena to debate proposed revisions. This model code also encourages international consistency in the application of provisions.

## Development

The first edition of the *International Fuel Gas Code* (1997) was the culmination of an effort initiated in 1996 by a development committee appointed by ICC and consisting of representatives of the three statutory members of the International Code Council at that time, including: Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO) and Southern Building Code Congress International (SBCCI) and the gas industry. The intent was to draft a comprehensive set of regulations for fuel gas systems and gas-fired appliances consistent with and inclusive of the scope of the existing mechanical, plumbing and gas codes. Technical content of the latest model codes promulgated by BOCA, ICBO, SBCCI and ICC and the *National Fuel Gas Code* (ANSI Z223.1) was utilized as the basis for the development. This 2006 edition presents the code as originally issued, with changes reflected in subsequent editions through 2003, and with code changes approved through the ICC Code Development Process through 2005 and standard revisions correlated with ANSI Z223.1-2006. A new edition such as this is promulgated every three years.

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

## Format

The *International Fuel Gas Code* is segregated by section numbers into two categories — “code” and “standard” — all coordinated and incorporated into a single document. The sections that are “code” are designated by the acronym “IFGC” next to the main section number (e.g., Section 101). The sections that are “standard” are designated by the acronym “IFGS” next to the main section number (e.g., Section 304).

## Adoption

The *International Fuel Gas Code* is available for adoption and use by jurisdictions internationally. Its use within a governmental jurisdiction is intended to be accomplished through adoption by reference in accordance with proceedings establishing the jurisdiction’s laws. At the time of adoption, jurisdictions should insert the appropriate information in provisions requiring specific local information, such as the name of the adopting jurisdiction. These locations are shown in bracketed words in small capital letters in the code and in the sample ordinance. The sample adoption ordinance on page v addresses several key elements of a code adoption ordinance, including the information required for insertion into the code text.

## Maintenance

The *International Fuel Gas Code* is kept up to date through the review of proposed changes submitted by code enforcing officials, industry representatives, design professionals and other interested parties. Proposed changes are carefully considered through an

open code development process in which all interested and affected parties may participate. The code development process of the *International Fuel Gas Code* is slightly different than the process for the other *International Codes*.

Proposed changes to text designated “IFGC” are subject to the ICC Code Development Process. For more information regarding the code development process, contact the Code and Standard Development Department of the International Code Council.

Proposed changes to text designated as “IFGS” are subject to the standards development process which maintains the *National Fuel Gas Code* (ANSI Z223.1). For more information regarding the standard development process, contact the American Gas Association (AGA) at 400 N. Capitol Street, N.W., Washington, DC 20001.

While the development procedure of the *International Fuel Gas Code* assures the highest degree of care, the ICC, its members, the AGA and those participating in the development of this code do not accept any liability resulting from compliance or noncompliance with the provisions because the ICC, its founding members and the AGA do not have the power or authority to police or enforce compliance with the contents of this code. Only the governmental body that enacts the code into law has such authority.

## Letter Designations in Front of Section Numbers

In each code development cycle, proposed changes to the code are considered at the Code Development Hearings by the ICC Fuel Gas Code Development Committee, whose action constitutes a recommendation to the voting membership for final action on the proposed change. Proposed changes to a code section that has a number beginning with a letter in brackets are considered by a different code development committee. For example, proposed changes to code sections that have [B] in front of them (e.g., [B]302.1) are considered by the International Building Code Development Committee at the code development hearings.

The content of sections in this code that begin with a letter designation are maintained by another code development committee in accordance with the following:

[B] = International Building Code Development Committee;

[M] = International Mechanical Code Development Committee; and

[F] = International Fire Code Development Committee.

## Marginal Markings

Solid vertical lines in the margins within the body of the code indicate a technical change from the requirements of the 2003 edition. Deletion indicators in the form of an arrow (➡) are provided in the margin where an entire section, paragraph, exception or table has been deleted or item in a list of items or in a table has been deleted.

# ORDINANCE

The *International Codes* are designed and promulgated to be adopted by reference by ordinance. Jurisdictions wishing to adopt the 2006 *International Fuel Gas Code* as an enforceable regulation governing fuel gas systems and gas-fired appliances should ensure that certain factual information is included in the adopting ordinance at the time adoption is being considered by the appropriate governmental body. The following sample adoption ordinance addresses several key elements of a code adoption ordinance, including the information required for insertion into the code text.

## SAMPLE ORDINANCE FOR ADOPTION OF THE *INTERNATIONAL FUEL GAS CODE* ORDINANCE NO. \_\_\_\_\_

An ordinance of the [JURISDICTION] adopting the 2006 edition of the *International Fuel Gas Code*, regulating and governing fuel gas systems and gas-fired appliances in the [JURISDICTION]; providing for the issuance of permits and collection of fees therefor; repealing Ordinance No. \_\_\_\_\_ of the [JURISDICTION] and all other ordinances and parts of the ordinances in conflict therewith.

The [GOVERNING BODY] of the [JURISDICTION] does ordain as follows:

**Section 1.** That a certain document, three (3) copies of which are on file in the office of the [TITLE OF JURISDICTION'S KEEPER OF RECORDS] of [NAME OF JURISDICTION], being marked and designated as the *International Fuel Gas Code*, 2006 edition, including Appendix Chapters [FILL IN THE APPENDIX CHAPTERS BEING ADOPTED] (see *International Fuel Gas Code* Section 101.3, 2006 edition), as published by the International Code Council, be and is hereby adopted as the Fuel Gas Code of the [JURISDICTION], in the State of [STATE NAME] for regulating and governing fuel gas systems and gas-fired appliances as herein provided; providing for the issuance of permits and collection of fees therefor; and each and all of the regulations, provisions, penalties, conditions and terms of said Fuel Gas Code on file in the office of the [JURISDICTION] are hereby referred to, adopted, and made a part hereof, as if fully set out in this ordinance, with the additions, insertions, deletions and changes, if any, prescribed in Section 2 of this ordinance.

**Section 2.** The following sections are hereby revised:

Section 101.1. Insert: [NAME OF JURISDICTION]

Section 106.5.2. Insert: [APPROPRIATE SCHEDULE]

Section 106.5.3. Insert: [PERCENTAGES IN TWO LOCATIONS]

Section 108.4. Insert: [SPECIFY OFFENSE] [AMOUNT] [NUMBER OF DAYS]

Section 108.5. Insert: [AMOUNTS IN TWO LOCATIONS]

**Section 3.** That Ordinance No. \_\_\_\_\_ of [JURISDICTION] entitled [FILL IN HERE THE COMPLETE TITLE OF THE ORDINANCE OR ORDINANCES IN EFFECT AT THE PRESENT TIME SO THAT THEY WILL BE REPEALED BY DEFINITE MENTION] and all other ordinances or parts of ordinances in conflict herewith are hereby repealed.

**Section 4.** That if any section, subsection, sentence, clause or phrase of this ordinance is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this ordinance. The [GOVERNING BODY] hereby declares that it would have passed this ordinance, and each section, subsection, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses and phrases be declared unconstitutional.

**Section 5.** That nothing in this ordinance or in the Fuel Gas Code hereby adopted shall be construed to affect any suit or proceeding impending in any court, or any rights acquired, or liability incurred, or any cause or causes of action acquired or existing, under any act or ordinance hereby repealed as cited in Section 3 of this ordinance; nor shall any just or legal right or remedy of any character be lost, impaired or affected by this ordinance.

**Section 6.** That the [JURISDICTION'S KEEPER OF RECORDS] is hereby ordered and directed to cause this ordinance to be published. (An additional provision may be required to direct the number of times the ordinance is to be published and to specify that it is to be in a newspaper in general circulation. Posting may also be required.)

**Section 7.** That this ordinance and the rules, regulations, provisions, requirements, orders and matters established and adopted hereby shall take effect and be in full force and effect [TIME PERIOD] from and after the date of its final passage and adoption.



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# CHAPTER 1

## ADMINISTRATION

### SECTION 101 (IFGC) GENERAL

**101.1 Title.** These regulations shall be known as the *Fuel Gas Code* of [NAME OF JURISDICTION], hereinafter referred to as “this code.”

**101.2 Scope.** This code shall apply to the installation of fuel gas piping systems, fuel gas utilization equipment, gaseous hydrogen systems and related accessories in accordance with Sections 101.2.1 through 101.2.5.

**Exception:** Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) not more than three stories high with separate means of egress and their accessory structures shall comply with the *International Residential Code*.

➡ **101.2.1 Gaseous hydrogen systems.** Gaseous hydrogen systems shall be regulated by Chapter 7.

**101.2.2 Piping systems.** These regulations cover piping systems for natural gas with an operating pressure of 125 pounds per square inch gauge (psig) (862 kPa gauge) or less, and for LP-gas with an operating pressure of 20 psig (140 kPa gauge) or less, except as provided in Section 402.6.1. Coverage shall extend from the point of delivery to the outlet of the equipment shutoff valves. Piping systems requirements shall include design, materials, components, fabrication, assembly, installation, testing, inspection, operation and maintenance.

**101.2.3 Gas utilization equipment.** Requirements for gas utilization equipment and related accessories shall include installation, combustion and ventilation air and venting and connections to piping systems.

**101.2.4 Systems and equipment outside the scope.** This code shall not apply to the following:

1. Portable LP-gas equipment of all types that is not connected to a fixed fuel piping system.
2. Installation of farm equipment such as brooders, dehydrators, dryers and irrigation equipment.
3. Raw material (feedstock) applications except for piping to special atmosphere generators.
4. Oxygen-fuel gas cutting and welding systems.
5. Industrial gas applications using gases such as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen.
6. Petroleum refineries, pipeline compressor or pumping stations, loading terminals, compounding plants, refinery tank farms and natural gas processing plants.
7. Integrated chemical plants or portions of such plants where flammable or combustible liquids or gases are produced by, or used in, chemical reactions.

8. LP-gas installations at utility gas plants.
9. Liquefied natural gas (LNG) installations.
10. Fuel gas piping in power and atomic energy plants.
11. Proprietary items of equipment, apparatus or instruments such as gas-generating sets, compressors and calorimeters.
12. LP-gas equipment for vaporization, gas mixing and gas manufacturing.
13. Temporary LP-gas piping for buildings under construction or renovation that is not to become part of the permanent piping system.
14. Installation of LP-gas systems for railroad switch heating.
15. Installation of hydrogen gas, LP-gas and compressed natural gas (CNG) systems on vehicles.
16. Except as provided in Section 401.1.1, gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in the distribution of gas, other than undiluted LP-gas.
17. Building design and construction, except as specified herein.
18. Piping systems for mixtures of gas and air within the flammable range with an operating pressure greater than 10 psig (69 kPa gauge).
19. Portable fuel cell appliances that are neither connected to a fixed piping system nor interconnected to a power grid.

**101.2.5 Other fuels.** The requirements for the design, installation, maintenance, alteration and inspection of mechanical systems operating with fuels other than fuel gas shall be regulated by the *International Mechanical Code*.

**101.3 Appendices.** Provisions in the appendices shall not apply unless specifically adopted.

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

**101.5 Severability.** If a section, subsection, sentence, clause or phrase of this code is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this code.

### SECTION 102 (IFGC) APPLICABILITY

**102.1 General.** The provisions of this code shall apply to all matters affecting or relating to structures and premises, as set forth in Section 101. Where, in a specific case, different sec-

tions of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

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

**[EB] 102.2.1 Existing buildings.** Additions, alterations, renovations or repairs related to building or structural issues shall be regulated by the *International Building Code*.

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

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

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

**102.5 Change in occupancy.** It shall be unlawful to make a change in the occupancy of a structure which will subject the structure to the special provisions of this code applicable to the new occupancy without approval. The code official shall certify that such structure meets the intent of the provisions of law governing building construction for the proposed new occupancy and that such change of occupancy does not result in any hazard to the public health, safety or welfare.

**102.6 Historic buildings.** The provisions of this code relating to the construction, alteration, repair, enlargement, restoration, relocation or moving of buildings or structures shall not be mandatory for existing buildings or structures identified and classified by the state or local jurisdiction as historic buildings when such buildings or structures are judged by the code 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.

**102.7 Moved buildings.** Except as determined by Section 102.2, installations that are a part of buildings or structures moved into or within the jurisdiction shall comply with the provisions of this code for new installations.

**102.8 Referenced codes and standards.** The codes and standards referenced in this code shall be those that are listed in Chapter 8 and such codes and standards shall be considered part of the requirements of this code to the prescribed extent of

each such reference. Where differences occur between provisions of this code and the referenced standards, the provisions of this code shall apply.

**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.

**102.9 Requirements not covered by code.** Requirements necessary for the strength, stability or proper operation of an existing or proposed installation, or for the public safety, health and general welfare, not specifically covered by this code, shall be determined by the code official.

## SECTION 103 (IFGC) DEPARTMENT OF INSPECTION

**103.1 General.** The Department of Inspection is hereby created and the executive official in charge thereof shall be known as the code official.

**103.2 Appointment.** The code official shall be appointed by the chief appointing authority of the jurisdiction; and the code official shall not be removed from office except for cause and after full opportunity to be heard on specific and relevant charges by and before the appointing authority.

**103.3 Deputies.** In accordance with the prescribed procedures of this jurisdiction and with the concurrence of the appointing authority, the code official shall have the authority to appoint a deputy code official, other related technical officers, inspectors and other employees.

**103.4 Liability.** The code official, officer or employee charged with the enforcement of this code, while acting for the jurisdiction, shall not thereby be rendered liable personally, and is hereby relieved from all personal liability for any damage accruing to persons or property as a result of an act required or permitted in the discharge of official duties.

Any suit instituted against any officer or employee because of an act performed by that officer or employee in the lawful discharge of duties and under the provisions of this code shall be defended by the legal representative of the jurisdiction until the final termination of the proceedings. The code official or any subordinate shall not be liable for costs in an action, suit or proceeding that is instituted in pursuance of the provisions of this code; and any officer of the Department of Inspection, acting in good faith and without malice, shall be free from liability for acts performed under any of its provisions or by reason of any act or omission in the performance of official duties in connection therewith.

## SECTION 104 (IFGC) DUTIES AND POWERS OF THE CODE OFFICIAL

**104.1 General.** The code official shall enforce the provisions of this code and shall act on any question relative to the installation, alteration, repair, maintenance or operation of systems, except as otherwise specifically provided for by statutory requirements or as provided for in Sections 104.2 through 104.8.

**104.2 Rule-making authority.** The code official shall have authority as necessary in the interest of public health, safety and general welfare to adopt and promulgate rules and regulations; interpret and implement the provisions of this code; secure the intent thereof and designate requirements applicable because of local climatic or other conditions. Such rules shall not have the effect of waiving structural or fire performance requirements specifically provided for in this code, or of violating accepted engineering methods involving public safety.

**104.3 Applications and permits.** The code official shall receive applications and issue permits for installations and alterations under the scope of this code, inspect the premises for which such permits have been issued and enforce compliance with the provisions of this code.

**104.4 Inspections.** The code official shall make all of the required inspections, or shall accept reports of inspection by approved agencies or individuals. All reports of such inspections shall be in writing and shall be certified by a responsible officer of such approved agency or by the responsible individual. The code official is authorized to engage such expert opinion as deemed necessary to report upon unusual technical issues that arise, subject to the approval of the appointing authority.

**104.5 Right of entry.** Whenever it is necessary to make an inspection to enforce the provisions of this code, or whenever the code official has reasonable cause to believe that there exists in a building or upon any premises any conditions or violations of this code that make the building or premises unsafe, dangerous or hazardous, the code official shall have the authority to enter the building or premises at all reasonable times to inspect or to perform the duties imposed upon the code official by this code. If such building or premises is occupied, the code official shall present credentials to the occupant and request entry. If such building or premises is unoccupied, the code official shall first make a reasonable effort to locate the owner or other person having charge or control of the building or premises and request entry. If entry is refused, the code official has recourse to every remedy provided by law to secure entry.

When the code official has first obtained a proper inspection warrant or other remedy provided by law to secure entry, an owner or occupant or person having charge, care or control of the building or premises shall not fail or neglect, after proper request is made as herein provided, to promptly permit entry therein by the code official for the purpose of inspection and examination pursuant to this code.

**104.6 Identification.** The code official shall carry proper identification when inspecting structures or premises in the performance of duties under this code.

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

**104.8 Department records.** The code official shall keep official records of applications received, permits and certificates issued, fees collected, reports of inspections, and notices and orders issued. Such records shall be retained in the official records as long as the building or structure to which such records relate remains in existence, unless otherwise provided for by other regulations.

## SECTION 105 (IFGC) APPROVAL

**105.1 Modifications.** Whenever there are practical difficulties involved in carrying out the provisions of this code, the code official shall have the authority to grant modifications for individual cases, provided the code official shall first find that special individual reason makes the strict letter of this code impractical and that such modification is in compliance with the intent and purpose of this code and does not lessen health, life and fire safety requirements. The details of action granting modifications shall be recorded and entered in the files of the Department of Inspection.

**105.2 Alternative materials, methods and equipment.** 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 or method of construction shall be approved where the code 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, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

**105.3 Required testing.** Whenever there is insufficient evidence of compliance with the provisions of this code, 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 code official shall have the authority to require tests as evidence of compliance to be made at no expense to the jurisdiction.

**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 code official shall approve the testing procedures.

**105.3.2 Testing agency.** All tests shall be performed by an approved agency.

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

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

## SECTION 106 (IFGC) PERMITS

**106.1 When required.** An owner, authorized agent or contractor who desires to erect, install, enlarge, alter, repair, remove, convert or replace an installation regulated by this code, or to cause such work to be done, shall first make application to the code official and obtain the required permit for the work.

**Exception:** Where equipment replacements and repairs are required to be performed in an emergency situation, the permit application shall be submitted within the next working business day of the Department of Inspection.

**106.2 Permits not required.** Permits shall not be required for the following:

1. Any portable heating appliance.
2. Replacement of any minor component of equipment that does not alter approval of such equipment or make such equipment unsafe.

Exemption from the permit requirements of this code shall not be deemed to grant authorization for work to be done in violation of the provisions of this code or of other laws or ordinances of this jurisdiction.

**106.3 Application for permit.** Each application for a permit, with the required fee, shall be filed with the code 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 an 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 code official.

**106.3.1 Construction documents.** Construction documents, engineering calculations, diagrams and other data shall be submitted in two or more sets with each application for a permit. The code official shall require construction documents, computations and specifications to be prepared and designed by a registered design professional when 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 installations and shall indicate the materials and methods for maintaining required structural safety, fire-resistance rating and fireblocking.

**Exception:** The code 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.

**106.4 Permit issuance.** The application, construction documents and other data filed by an applicant for a permit shall be reviewed by the code official. If the code 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 106.5 have been paid, a permit shall be issued to the applicant.

**106.4.1 Approved construction documents.** When the code 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 code official. Work shall be done in accordance with the approved construction documents.

The code official shall have the authority to issue a permit for the construction of part of an installation before the construction documents for the entire installation have been

submitted or approved, provided 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 installation will be granted.

**106.4.2 Validity.** 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 or of other ordinances of the jurisdiction. A permit presuming to give authority to violate or cancel the provisions of this code shall be invalid.

The issuance of a permit based upon construction documents and other data shall not prevent the code 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 when in violation of this code or of other ordinances of this jurisdiction.

**106.4.3 Expiration.** Every permit issued by the code 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 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 no changes have been or will be made in the original construction documents for such work, and 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 he or she will commence work under that permit when work is unable to be commenced within the time required by this section for good and satisfactory reasons. The code official shall extend the time for action by the permittee for a period not exceeding 180 days if there is reasonable cause. A permit shall not be extended more than once. The fee for an extension shall be one-half the amount required for a new permit for such work.

**106.4.5 Suspension or revocation of permit.** The code official shall revoke a permit or approval issued under the provisions of this code in case of any false statement or misrepresentation of fact in the application or on the construction documents upon which the permit or approval was based.

**106.4.6 Retention of construction documents.** One set of construction documents shall be retained by the code official until final approval of the work covered therein. 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 work at all times during which the work authorized thereby is in progress.

**106.5 Fees.** A permit shall not be issued until the fees prescribed in Section 106.5.2 have been paid, nor shall an amendment to a permit be released until the additional fee, if any, due to an increase of the installation, has been paid.

**106.5.1 Work commencing before permit issuance.** Any person who commences work on an installation before obtaining the necessary permits shall be subject to 100 percent of the usual permit fee in addition to the required permit fees.

**106.5.2 Fee schedule.** The fees for work shall be as indicated in the following schedule.

[JURISDICTION TO INSERT APPROPRIATE SCHEDULE]

**106.5.3 Fee refunds.** The code official shall authorize the refunding of fees as follows.

1. The full amount of any fee paid hereunder which was erroneously paid or collected.
2. Not more than [SPECIFY PERCENTAGE] percent of the permit fee paid when no work has been done under a permit issued in accordance with this code.
3. Not more than [SPECIFY PERCENTAGE] percent of the plan review fee paid when an application for a permit for which a plan review fee has been paid is withdrawn or canceled before any plan review effort has been expended.

The code official shall not authorize the refunding of any fee paid, except upon written application filed by the original permittee not later than 180 days after the date of fee payment.

## SECTION 107 (IFGC) INSPECTIONS AND TESTING

**107.1 Required inspections and testing.** The code 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 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, piping is installed and before backfill is put in place. When 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 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 equipment installed to replace existing heating equipment serving an occupied portion of a structure in the event a request for inspection of such heating equipment has been filed with the department not more than 48 hours after replacement work is completed, and before any portion of such equipment is concealed by any permanent portion of the structure.

**107.1.1 Approved inspection agencies.** The code official shall accept reports of approved agencies, provided that such agencies satisfy the requirements as to qualifications and reliability.

**107.1.2 Evaluation and follow-up inspection services.** Prior to the approval of a prefabricated construction assembly having concealed work and the issuance of a permit, the code official shall require the submittal of an evaluation report on each prefabricated construction assembly, indicating the complete details of the installation, including a description of the system and its components, the basis upon which the system is being evaluated, test results and similar information and other data as necessary for the code official to determine conformance to this code.

**107.1.2.1 Evaluation service.** The code official shall designate the evaluation service of an approved agency as the evaluation agency, and review such agency's evaluation report for adequacy and conformance to this code.

**107.1.2.2 Follow-up inspection.** Except where ready access is provided to installations, service equipment and accessories for complete inspection at the site without disassembly or dismantling, the code official shall conduct the in-plant inspections as frequently as necessary to ensure conformance to the approved evaluation report or shall designate an independent, approved inspection agency to conduct such inspections. The inspection agency shall furnish the code official with the follow-up inspection manual and a report of inspections upon request, and the installation shall have an identifying label permanently affixed to the system indicating that factory inspections have been performed.

**107.1.2.3 Test and inspection records.** Required test and inspection records shall be available to the code official at all times during the fabrication of the installation and the erection of the building; or such records as the code official designates shall be filed.

**107.2 Testing.** Installations shall be tested as required in this code and in accordance with Sections 107.2.1 through 107.2.3. Tests shall be made by the permit holder and observed by the code official.

**107.2.1 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.

**107.2.2 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.

**107.2.3 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 code official for inspection and testing.

**107.3 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 code official.

**107.4 Temporary connection.** The code official shall have the authority to allow the temporary connection of an installation to the sources of energy for the purpose of testing the installation or for use under a temporary certificate of occupancy.

## SECTION 108 (IFGC) VIOLATIONS

**108.1 Unlawful acts.** It shall be unlawful for a person, firm or corporation to erect, construct, alter, repair, remove, demolish or utilize an installation, or cause same to be done, in conflict with or in violation of any of the provisions of this code.

**108.2 Notice of violation.** The code official shall serve a notice of violation or order to the person responsible for the erection, installation, alteration, extension, repair, removal or demolition of 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.

**108.3 Prosecution of violation.** If the notice of violation is not complied with promptly, the code official shall request the legal counsel of the jurisdiction to institute the appropriate proceeding at law or in equity to restrain, correct or abate such violation, or to require the removal or termination of the unlawful occupancy of the structure in violation of the provisions of this code or of the order or direction made pursuant thereto.

**108.4 Violation penalties.** Persons who shall violate a provision of this code, fail to comply with any of the requirements thereof or erect, install, alter or repair work in violation of the approved construction documents or directive of the code official, or of a permit or certificate issued under the provisions of this code, shall be guilty of a [SPECIFY OFFENSE], punishable by a fine of not more than [AMOUNT] dollars or by imprisonment not exceeding [NUMBER OF DAYS], or both such fine and imprisonment. Each day that a violation continues after due notice has been served shall be deemed a separate offense.

**108.5 Stop work orders.** Upon notice from the code official that work is being done contrary to the provisions of this code or in a dangerous or unsafe manner, such work shall immediately cease. Such notice shall be in writing and shall be given to the owner of the property, the owner's agent, or the person doing the work. The notice shall state the conditions under which work is authorized to resume. Where an emergency exists, the code official shall not be required to give a written notice prior to stopping the work. Any person who shall continue any work on the system after having been served with a stop work order, except such work as that person is directed to perform to remove a violation or unsafe condition, shall be liable for a fine of not less than [AMOUNT] dollars or more than [AMOUNT] dollars.

**108.6 Abatement of violation.** The imposition of the penalties herein prescribed shall not preclude the legal officer of the jurisdiction from instituting appropriate action to prevent unlawful construction, restrain, correct or abate a violation, prevent illegal occupancy of a building, structure or premises,

or stop an illegal act, conduct, business or utilization of the installations on or about any premises.

**108.7 Unsafe installations.** An installation that is unsafe, constitutes a fire or health hazard, or is otherwise dangerous to human life, as regulated by this code, is hereby declared an unsafe installation. Use of an installation regulated by this code constituting a hazard to health, safety or welfare by reason of inadequate maintenance, dilapidation, fire hazard, disaster, damage or abandonment is hereby declared an unsafe use. Such unsafe installations are hereby declared to be a public nuisance and shall be abated by repair, rehabilitation, demolition or removal.

**108.7.1 Authority to condemn installations.** Whenever the code official determines that any installation, or portion thereof, regulated by this code has become hazardous to life, health or property, he or she shall order in writing that such installations either be removed or restored to a safe condition. A time limit for compliance with such order shall be specified in the written notice. A person shall not use or maintain a defective installation after receiving such notice.

When such installation is to be disconnected, written notice as prescribed in Section 108.2 shall be given. In cases of immediate danger to life or property, such disconnection shall be made immediately without such notice.

**108.7.2 Authority to disconnect service utilities.** The code official shall have the authority to require disconnection of utility service to the building, structure or system regulated by the technical codes in case of emergency where necessary to eliminate an immediate hazard to life or property. The code official shall notify the serving utility, and wherever possible, the owner and occupant of the building, structure or service system of the decision to disconnect prior to taking such action. If not notified prior to disconnection, the owner or occupant of the building, structure or service system shall be notified in writing, as soon as practicable thereafter.

**108.7.3 Connection after order to disconnect.** A person shall not make energy source connections to installations regulated by this code which have been disconnected or ordered to be disconnected by the code official, or the use of which has been ordered to be discontinued by the code official until the code official authorizes the reconnection and use of such installations.

When an installation is maintained in violation of this code, and in violation of a notice issued pursuant to the provisions of this section, the code official shall institute appropriate action to prevent, restrain, correct or abate the violation.

## SECTION 109 (IFGC) MEANS OF APPEAL

**109.1 Application for appeal.** A person shall have the right to appeal a decision of the code official to the board of appeals. 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 equally good or better form of construction is

proposed. The application shall be filed on a form obtained from the code official within 20 days after the notice was served.

**109.2 Membership of board.** The board of appeals shall consist of five members appointed by the chief appointing authority as follows: one for five years; one for four years; one for three years; one for two years and one for one year. Thereafter, each new member shall serve for five years or until a successor has been appointed.

**109.2.1 Qualifications.** The board of appeals shall consist of five individuals, one from each of the following professions or disciplines.

1. Registered design professional who is a registered architect; or a builder or superintendent of building construction with at least 10 years' experience, five of which shall have been in responsible charge of work.
2. Registered design professional with structural engineering or architectural experience.
3. Registered design professional with fuel gas and plumbing engineering experience; or a fuel gas contractor with at least 10 years' experience, five of which shall have been in responsible charge of work.
4. Registered design professional with electrical engineering experience; or an electrical contractor with at least 10 years' experience, five of which shall have been in responsible charge of work.
5. Registered design professional with fire protection engineering experience; or a fire protection contractor with at least 10 years' experience, five of which shall have been in responsible charge of work.

**109.2.2 Alternate members.** The chief appointing authority shall appoint two alternate members who shall be called by the board chairman to hear appeals during the absence or disqualification of a member. Alternate members shall possess the qualifications required for board membership and shall be appointed for five years, or until a successor has been appointed.

**109.2.3 Chairman.** The board shall annually select one of its members to serve as chairman.

**109.2.4 Disqualification of member.** A member shall not hear an appeal in which that member has a personal, professional or financial interest.

**109.2.5 Secretary.** The chief administrative officer shall designate a qualified clerk to serve as secretary to the board. The secretary shall file a detailed record of all proceedings in the office of the chief administrative officer.

**109.2.6 Compensation of members.** Compensation of members shall be determined by law.

**109.3 Notice of meeting.** The board shall meet upon notice from the chairman, within 10 days of the filing of an appeal, or at stated periodic meetings.

**109.4 Open hearing.** All hearings before the board shall be open to the public. The appellant, the appellant's representative, the code official and any person whose interests are affected shall be given an opportunity to be heard.

**109.4.1 Procedure.** The board shall adopt and make available to the public through the secretary procedures under which a hearing will be conducted. The procedures shall not require compliance with strict rules of evidence, but shall mandate that only relevant information be received.

**109.5 Postponed hearing.** When five members are not present to hear an appeal, either the appellant or the appellant's representative shall have the right to request a postponement of the hearing.

**109.6 Board decision.** The board shall modify or reverse the decision of the code official by a concurring vote of three members.

**109.6.1 Resolution.** The decision of the board shall be by resolution. Certified copies shall be furnished to the appellant and to the code official.

**109.6.2 Administration.** The code official shall take immediate action in accordance with the decision of the board.

**109.7 Court review.** Any person, whether or not a previous party to the appeal, shall have the right to apply to the appropriate court for a writ of certiorari to correct errors of law. Application for review shall be made in the manner and time required by law following the filing of the decision in the office of the chief administrative officer.



## CHAPTER 2

# DEFINITIONS

### SECTION 201 (IFGC) GENERAL

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

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

**201.3 Terms defined in other codes.** Where terms are not defined in this code and are defined in the *ICC Electrical Code*, *International Building Code*, *International Fire Code*, *International Mechanical Code* or *International Plumbing Code*, such terms shall have meanings ascribed to them as in those codes.

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

### SECTION 202 (IFGC) GENERAL DEFINITIONS

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

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

**AIR CONDITIONING.** The treatment of air so as to control simultaneously the temperature, humidity, cleanness and distribution of the air to meet the requirements of a conditioned space.

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

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

**AIR, MAKEUP.** Air that is provided to replace air being exhausted.

**ALTERATION.** A change in a system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

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

**APPLIANCE (EQUIPMENT).** Any apparatus or equipment that utilizes gas as a fuel or raw material to produce light, heat, power, refrigeration or air conditioning.

**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, AUTOMATICALLY CONTROLLED.** Appliances equipped with an automatic burner ignition and safety shutoff device and other automatic devices which 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 TYPE.

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

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

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

**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 outside atmosphere through an approved chimney or vent system.

**APPROVED.** Acceptable to the code official or other authority having jurisdiction.

**APPROVED AGENCY.** An established and recognized agency that is approved by the code official and regularly engaged in conducting tests or furnishing inspection services.

**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 equipment 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 equipment from both excessive draft and backdraft.

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

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

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

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

**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.

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

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

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

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

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

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

**COMBUSTION AIR.** Air necessary for complete combustion of a fuel, including theoretical air and excess air.

**COMBUSTION CHAMBER.** The portion of an appliance within which combustion occurs.

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

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

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

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

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

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

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

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

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

**COUNTER APPLIANCES.** Appliances such as coffee brewers and coffee urns and any appurtenant water-heating equipment, 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).

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

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

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

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

**DESIGN FLOOD ELEVATION.** The elevation of the “design flood,” including wave height, relative to the datum specified on the community’s legally designated flood hazard map.

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

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

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

**Mechanical or induced draft.** The pressure difference created by the action of a fan, blower or ejector, that is located between the appliance and the chimney or vent termination.

**Natural draft.** The pressure difference created by a vent or chimney because of its height, and the temperature difference between the flue gases and the atmosphere.

**DRAFT HOOD.** A nonadjustable device built into an appliance, or made as part of the vent connector from an appliance, that is designed to (1) provide for ready escape of the flue gases from the appliance in the event of no draft, backdraft or stoppage beyond the draft hood, (2) prevent a backdraft from entering the appliance, and (3) 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.

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

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

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

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

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

**EQUIPMENT.** See “Appliance.”

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

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

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

**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.

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

**FLOOD HAZARD AREA.** The greater of the following two areas:

1. The area within a floodplain subject to a 1 percent or greater chance of flooding in any given year.
2. This area designated as a flood hazard area on a community’s flood hazard map, or otherwise legally designated.

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

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

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

**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.

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

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

**FUEL GAS UTILIZATION EQUIPMENT.** See "Appliance."

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

**FURNACE, CENTRAL.** A self-contained appliance for heating air by transfer of heat of combustion through metal to the air, and designed to supply heated air through ducts to spaces remote from or adjacent to the appliance location.

**Downflow furnace.** A furnace designed with airflow discharge vertically downward at or near the bottom of the furnace.

**Forced air furnace with cooling unit.** A single-package unit, consisting of a gas-fired forced-air furnace of one of the types listed below combined with an electrically or fuel gas-powered summer air-conditioning system, contained in a common casing.

**Forced-air type.** A central furnace equipped with a fan or blower which provides the primary means for circulation of air.

**Gravity furnace with booster fan.** A furnace equipped with a booster fan that does not materially restrict free circulation of air by gravity flow when the fan is not in operation.

**Gravity type.** A central furnace depending primarily on circulation of air by gravity.

**Horizontal forced-air type.** A furnace with airflow through the appliance essentially in a horizontal path.

**Multiple-position furnace.** A furnace designed so that it can be installed with the airflow discharge in the upflow, horizontal or downflow direction.

**Upflow furnace.** A furnace designed with airflow discharge vertically upward at or near the top of the furnace. This classification includes "highboy" furnaces with the blower mounted below the heating element and "lowboy" furnaces with the blower mounted beside the heating element.

**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 which forms part of an air distribution system.

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

**GASEOUS HYDROGEN SYSTEM.** See Section 702.1.

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

**GAS UTILIZATION EQUIPMENT.** An appliance that utilizes gas as a fuel or raw material or both.

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

**HOUSE PIPING.** See "Piping system."

**HYDROGEN CUT-OFF ROOM.** See Section 702.1.

**HYDROGEN GENERATING APPLIANCE.** See Section 702.1.

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

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

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

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

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

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

**JOINT, FLANGED.** A joint made by bolting together a pair of flanged ends.

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

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

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

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

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

**LABELED.** Devices, equipment, appliances or materials to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and by whose label the manufacturer attests to compliance with applicable nationally recognized standards.

**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.

**LISTED.** Equipment, appliances or materials included in a list published by a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of production of listed equipment, appliances or materials, and whose listing states either that the equipment, appliance or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner. The means for identifying listed equipment, appliances or materials may vary for each testing laboratory, inspection agency or other organization concerned with product evaluation, some of which do not recognize equipment, appliances or materials as listed unless they are also labeled. The authority having jurisdiction shall utilize the system employed by the listing organization to identify a listed product.

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

**LOG LIGHTER.** A manually operated solid fuel ignition appliance for installation in a vented solid fuel-burning fireplace.

**LUBRICATED PLUG-TYPE VALVE.** A valve of the plug and barrel type provided with means for maintaining a lubricant between the bearing surfaces.

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

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

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

**OCCUPANCY.** The purpose for which a building, or portion thereof, is utilized or occupied.

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

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

**OUTLET.** A threaded connection or bolted flange in a pipe system to which a gas-burning appliance is attached.

**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.** Where used in this code, "piping" refers to either pipe or tubing, or both.

**Pipe.** A rigid conduit of iron, steel, copper, brass or plastic.

**Tubing.** Semirigid conduit of copper, aluminum, plastic or steel.

**PIPING SYSTEM.** All fuel piping, valves and fittings from the outlet of the point of delivery to the outlets of the equipment shutoff valves.

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

**POINT OF DELIVERY.** For natural gas systems, the point of delivery is the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where a meter is not provided. Where a valve is provided at the outlet of the service meter assembly, such valve shall be considered to be downstream of the point of delivery. For undiluted liquefied petroleum gas systems, the point of delivery shall be considered to be the outlet of the first regulator that reduces pressure to 2 psig (13.8 kPag) or less.

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

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

**PRESSURE TEST.** An operation performed to verify the gas-tight integrity of gas piping following its installation or modification.

**PURGE.** To free a gas conduit of air or gas, or a mixture of gas and air.

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

**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”).

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

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

**REGULATOR, GAS APPLIANCE.** A pressure regulator for controlling pressure to the manifold of equipment. Types of appliance regulators are as follows:

**Adjustable.**

1. Spring type, limited adjustment. A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is adjustable over a range of not more than 15 percent of the outlet pressure at the midpoint of the adjustment range.
2. Spring type, standard adjustment. A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is adjustable. The adjustment means shall be concealed.

**Multistage.** A regulator for use with a single gas whose adjustment means is capable of being positioned manually or automatically to two or more predetermined outlet pressure settings. Each of these settings shall be adjustable or nonadjustable. The regulator may modulate outlet pressures automatically between its maximum and minimum predetermined outlet pressure settings.

**Nonadjustable.**

1. Spring type, nonadjustable. A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is not field adjustable.
2. Weight type. A regulator in which the regulating force acting upon the diaphragm is derived from a weight or combination of weights.

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

**REGULATOR, MEDIUM-PRESSURE (MP Regulator).** A line pressure regulator that reduces gas pressure from the

range of greater than 0.5 psig (3.4 kPa) and less than or equal to 5 psig (34.5 kPa) to a lower pressure.

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

**REGULATOR, SERVICE PRESSURE.** A device installed by the serving gas supplier to reduce and limit the service line pressure to delivery pressure.

**RELIEF OPENING.** The opening provided in a draft hood to permit the ready escape to the atmosphere of the flue products from the draft hood in the event of no draft, back draft, or stoppage beyond the draft hood, and to permit air into the draft hood in the event of a strong chimney updraft.

**RELIEF VALVE (DEVICE).** A safety valve designed to forestall the development of a dangerous condition by relieving either pressure, temperature or vacuum in the hot water supply system.

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

**RELIEF VALVE, TEMPERATURE.**

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

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

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

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

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

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

**ROOM LARGE IN COMPARISON WITH SIZE OF EQUIPMENT.** Rooms having a volume equal to at least 12 times the total volume of a furnace or air-conditioning appliance and at least 16 times the total volume of a boiler. Total volume of the appliance is determined from exterior dimensions and is to include fan compartments and burner vestibules, when used. When the actual ceiling height of a room is greater than 8 feet (2438 mm), the volume of the room is figured on the basis of a ceiling height of 8 feet (2438 mm).

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

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

**SLEEPING UNIT.** A room or space in which people sleep, which can also include permanent provisions for living, eating and either sanitation or kitchen facilities, but not both. Such

rooms and spaces that are also part of a dwelling unit are not sleeping units.

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

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

#### **THERMOSTAT.**

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

**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 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.

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

#### **UNIT HEATER.**

**High-static pressure type.** A self-contained, automatically controlled, vented appliance having integral means for circulation of air against 0.2 inch (15 mm H<sub>2</sub>O) or greater static pressure. Such appliance is equipped with provisions for attaching an outlet air duct and, where the appliance is for indoor installation remote from the space to be heated, is also equipped with provisions for attaching an inlet air duct.

**Low-static pressure type.** A self-contained, automatically controlled, vented appliance, intended for installation in the space to be heated without the use of ducts, having integral means for circulation of air. Such units are allowed to be equipped with louvers or face extensions made in accordance with the manufacturer's specifications.

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

**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 piping to control the gas supply to any section of a system of piping or to an appliance.

**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.

**Equipment shutoff.** A valve located in the piping system, used to isolate individual equipment for purposes such as service or replacement.

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

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

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

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

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

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

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

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

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

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

**VENT CONNECTOR.** See "Connector."

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

#### **VENT PIPING**

**Breather.** Piping run from a pressure-regulating device to the outdoors, designed to provide a reference to atmospheric pressure. If the device incorporates an integral pres-

sure relief mechanism, a breather vent can also serve as a relief vent.

**Relief.** Piping run from a pressure-regulating or pressure-limiting device to the outdoors, designed to provide for the safe venting of gas in the event of excessive pressure in the gas piping system.

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

**Category I.** An appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

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

**Category III.** An appliance that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

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

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

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

**VENTING SYSTEM.** A continuous open passageway from the flue collar or draft hood of an appliance to the outside 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.

**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.

**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.

**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.

**WATER HEATER.** Any heating appliance or equipment that heats potable water and supplies such water to the potable hot water distribution system.



## CHAPTER 3

# GENERAL REGULATIONS

### SECTION 301 (IFGC) GENERAL

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

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

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

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

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

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

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

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

**301.4.2.2 Equipment.** An approved agency shall have adequate equipment to perform all required tests. The equipment shall be periodically calibrated.

**301.4.2.3 Personnel.** An approved agency shall employ experienced personnel educated in conducting, supervising and evaluating tests.

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

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

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

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

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

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

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

**301.11 Flood hazard.** For structures located in flood hazard areas, the appliance, equipment and system installations regulated by this code shall be located at or above the design flood elevation and shall comply with the flood-resistant construction requirements of the *International Building Code*.

**Exception:** The appliance, equipment and system installations regulated by this code are permitted to be located below the design flood elevation 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 the design flood elevation and shall comply with the flood-resistant construction requirements of the *International Building Code*.

**301.12 Seismic resistance.** When earthquake loads are applicable in accordance with the *International Building Code*, the supports shall be designed and installed for the seismic forces in accordance with that code.

**301.13 Ducts.** All ducts required for the installation of systems regulated by this code shall be designed and installed in accordance with the *International Mechanical Code*.

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

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

### SECTION 302 (IFGC) STRUCTURAL SAFETY

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

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

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

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

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

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

**[B] 302.3.4 Bored holes.** A hole not greater in diameter than 40 percent of the stud depth is permitted to be bored in any wood stud. Bored holes not greater than 60 percent of the depth of the stud are permitted in nonload-bearing partitions or in any wall where each bored stud is doubled, provided not more than two such successive doubled studs are so bored. In no case shall the edge of the bored hole be nearer than  $\frac{5}{8}$  inch (15.9 mm) to the edge of the stud. Bored holes shall not be located at the same section of a stud as a cut or notch.

**[B] 302.4 Alterations to trusses.** Truss members and components shall not be cut, drilled, notched, spliced or otherwise altered in any way without the written concurrence and

approval of a registered design professional. Alterations resulting in the addition of loads to any member (e.g., HVAC equipment, water heaters) shall not be permitted without verification that the truss is capable of supporting such additional loading.

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

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

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

### SECTION 303 (IFGC) APPLIANCE LOCATION

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

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

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

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

4. A single wall-mounted unvented room heater is installed in a bedroom and such unvented room heater is equipped as specified in Section 621.6 and has an input rating not greater than 10,000 Btu/h (2.93 kW). The bedroom shall meet the required volume criteria of Section 304.5.
5. The appliance is installed in a room or space that opens only into a bedroom or bathroom, and such room or space is used for no other purpose and is provided with a solid weather-stripped door equipped with an approved self-closing device. All combustion air shall be taken directly from the outdoors in accordance with Section 304.6.

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

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

**303.6 Outdoor locations.** Equipment 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 equipment.

**303.7 Pit locations.** Appliances installed in pits or excavations shall not come in direct contact with the surrounding soil. The sides of the pit or excavation shall be held back a minimum of 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 a minimum of 4 inches (102 mm) above adjoining grade and shall have sufficient lateral load-bearing capacity to resist collapse. The appliance shall be protected from flooding in an approved manner.

## SECTION 304 (IFGS)

### COMBUSTION, VENTILATION AND DILUTION AIR

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

**Exception:** Type 1 clothes dryers that are provided with makeup air in accordance with Section 614.5.

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

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

**304.4 Makeup air provisions.** Makeup air requirements for the operation of exhaust fans, kitchen ventilation systems, clothes dryers and fireplaces shall be considered in determining the adequacy of a space to provide combustion air requirements.

**304.5 Indoor combustion air.** The required volume of indoor air shall be determined in accordance with Section 304.5.1 or 304.5.2, except that where the air infiltration rate is known to be less than 0.40 air changes per hour (ACH), Section 304.5.2 shall be used. The total required volume shall be the sum of the required volume calculated for all appliances located within the space. Rooms communicating directly with the space in which the appliances are installed through openings not furnished with doors, and through combustion air openings sized and located in accordance with Section 304.5.3, are considered to be part of the required volume.

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

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

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

$$\text{Required Volume}_{\text{other}} \geq \frac{21 \text{ ft}^3}{\text{ACH}} \left( \frac{I_{\text{other}}}{1,000 \text{ Btu/hr}} \right) \quad (\text{Equation 3-1})$$

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

$$\text{Required Volume}_{\text{fan}} \geq \frac{15 \text{ ft}^3}{\text{ACH}} \left( \frac{I_{\text{fan}}}{1,000 \text{ Btu/hr}} \right) \quad (\text{Equation 3-2})$$

where:

$I_{\text{other}}$  = All appliances other than fan assisted (input in Btu/h).

$I_{\text{fan}}$  = Fan-assisted appliance (input in Btu/h).

$\text{ACH}$  = 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 3-1 and 3-2.

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

**304.5.3.1 Combining spaces on the same story.** Each opening shall have a minimum free area of 1 square inch per 1,000 Btu/h (2,200 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 opening shall commence within 12 inches (305 mm) of the top and one opening shall commence within 12 inches (305 mm) of the bottom of

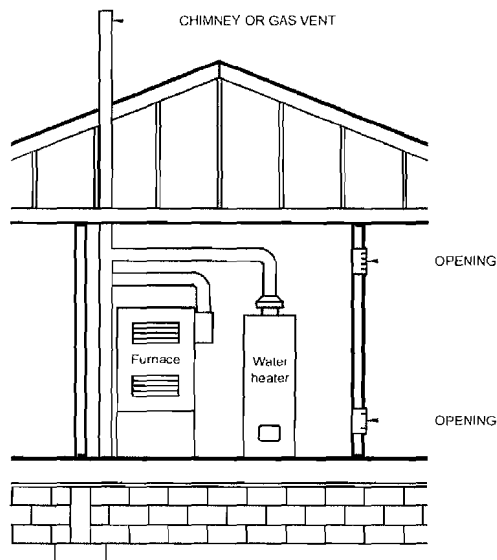


**FIGURE 304.5.3**  
**ALL AIR FROM INSIDE THE BUILDING**  
 (see Section 304.5.3)

the enclosure. The minimum dimension of air openings shall be not less than 3 inches (76 mm).

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

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

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

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

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 (1,100 mm<sup>2</sup>/kW) of total input rating of all appliances in the enclosure [see Figure 304.6.1(3)].

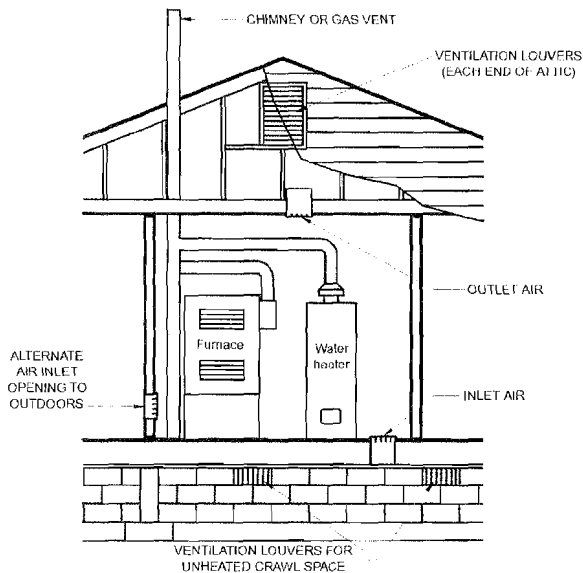
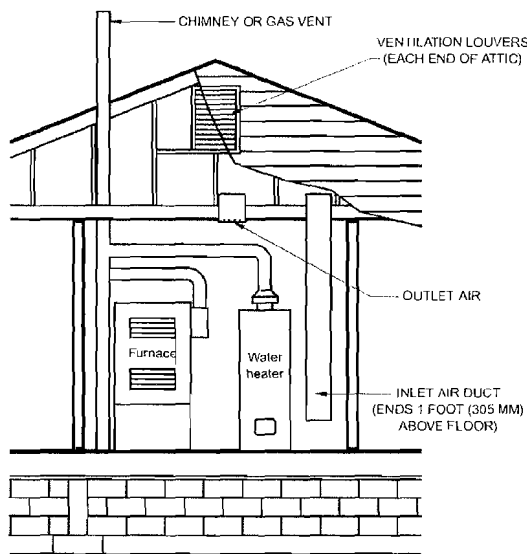


**FIGURE 304.6.1(1)**  
**ALL AIR FROM OUTDOORS—INLET AIR FROM VENTILATED CRAWL SPACE AND OUTLET AIR TO VENTILATED ATTIC**  
 (see Section 304.6.1)



For SI: 1 foot = 304.8 mm.

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

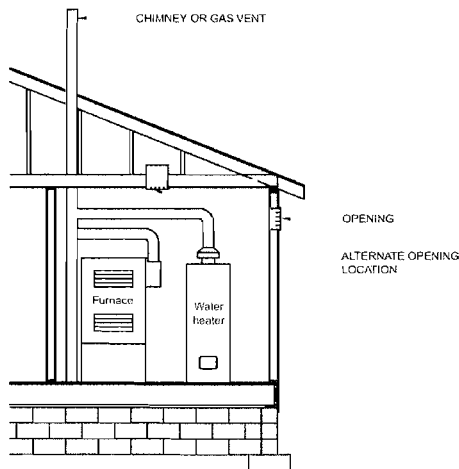


**FIGURE 304.6.2**  
**SINGLE COMBUSTION AIR OPENING,**  
**ALL AIR FROM THE OUTDOORS**  
 (see Section 304.6.2)

**304.6.2 One-permanent-opening method.** One permanent opening, commencing within 12 inches (305 mm) of the top of the enclosure, shall be provided. The appliance shall have clearances of at least 1 inch (25 mm) from the sides and back and 6 inches (152 mm) from the front of the appliance. The opening shall directly communicate with the outdoors or through a vertical or horizontal duct to the outdoors, or spaces that freely communicate with the outdoors (see Figure 304.6.2) and shall have a minimum free area of 1 square inch per 3,000 Btu/h (734 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.

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

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

**304.7.2 Outdoor opening location.** Outdoor opening(s) shall be located in accordance with Section 304.6.

**304.7.3 Outdoor opening(s) size.** The outdoor opening(s) size shall be calculated in accordance with the following:

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

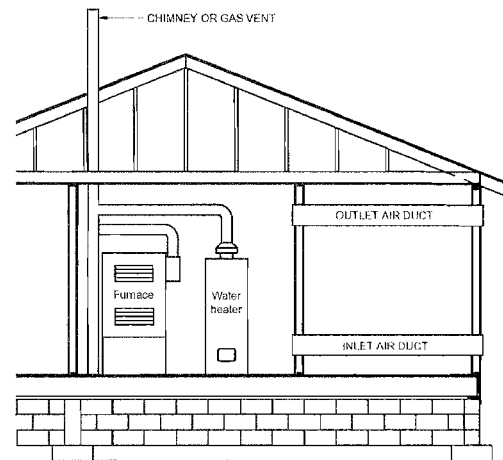


**FIGURE 304.6.1(3)**  
**ALL AIR FROM OUTDOORS**  
 (see Section 304.6.1)

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

**304.9 Mechanical combustion air supply.** Where all combustion air is provided by a mechanical air supply system, the combustion air shall be supplied from the outdoors at a rate not less than 0.35 cubic feet per minute per 1,000 Btu/h (0.034 m<sup>3</sup>/min per kW) of total input rating of all appliances located within the space.

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

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

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

**304.10 Louvers and grilles.** The required size of openings for combustion, ventilation and dilution air shall be based on the net free area of each opening. Where the free area through a design of louver, grille or screen is known, it shall be used in calculating the size opening required to provide the free area specified. Where the design and free area of louvers and grilles are not known, it shall be assumed that wood louvers will have 25-percent free area and metal louvers and grilles will have 75-percent free area. Screens shall have a mesh size not smaller than 1/4 inch (6.4 mm). Nonmotorized louvers and grilles shall be fixed in the open position. Motorized louvers shall be interlocked with the appliance so that they are proven to be in the

full open position prior to main burner ignition and during main burner operation. Means shall be provided to prevent the main burner from igniting if the louvers fail to open during burner start-up and to shut down the main burner if the louvers close during operation.

**304.11 Combustion air ducts.** Combustion air ducts shall comply with all of the following:

1. Ducts shall be constructed of galvanized steel complying with Chapter 6 of the *International Mechanical 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 grade level.

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

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

## SECTION 305 (IFGC) INSTALLATION

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

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

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

**305.3 Elevation of ignition source.** Equipment and appliances having an ignition source shall be elevated such that the source of ignition is not less than 18 inches (457 mm) above the floor in hazardous locations and public garages, private garages, repair garages, motor fuel-dispensing facilities and parking garages. For the purpose of this section, rooms or spaces that are not part of the living space of a dwelling unit and that communicate directly with a private garage through openings shall be considered to be part of the private garage.

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

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

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

**305.4 Public garages.** Appliances located in public garages, motor fuel-dispensing facilities, repair garages or other areas frequented by motor vehicles shall be installed a minimum of 8 feet (2438 mm) above the floor. Where motor vehicles exceed 6 feet (1829 mm) in height and are capable of passing under an appliance, appliances shall be installed a minimum of 2 feet (610 mm) higher above the floor than the height of the tallest vehicle.

**Exception:** The requirements of this section shall not apply where the appliances are protected from motor vehicle impact and installed in accordance with Section 305.3 and NFPA 30A.

**305.5 Private garages.** Appliances located in private garages shall be installed with a minimum clearance of 6 feet (1829 mm) above the floor.

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

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

**305.7 Clearances from grade.** Equipment and appliances installed at grade level shall be supported on a level concrete slab or other approved material extending above adjoining grade or shall be suspended a minimum of 6 inches (152 mm) above adjoining grade.

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

## SECTION 306 (IFGC) ACCESS AND SERVICE SPACE

**[M] 306.1 Clearances for maintenance and replacement.** Clearances around appliances to elements of permanent construction, including other installed appliances, shall be sufficient to allow inspection, service, repair or replacement without removing such elements of permanent construction or disabling the function of a required fire-resistance-rated assembly.

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

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

**[M] 306.3 Appliances in attics.** Attics containing appliances requiring access shall be provided with an opening and unobstructed passageway large enough to allow removal of the largest component of the appliance. The passageway shall not be less than 30 inches (762 mm) high and 22 inches (559 mm) wide and not more than 20 feet (6096 mm) in length when measured along the centerline of the passageway from the opening to the equipment. 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 equipment. The clear access opening dimensions shall be a minimum of 20 inches by 30 inches (508 mm by 762 mm), where such dimensions are large enough to allow removal of the largest component of the appliance.

### Exceptions:

1. The passageway and level service space are not required where the appliance is capable of being serviced and removed through the required opening.
2. Where the passageway is not less than 6 feet (1829 mm) high for its entire length, the passageway shall be not greater than 50 feet (15 250 mm) in length.

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

**[M] 306.4 Appliances under floors.** Under-floor spaces containing appliances requiring access shall be provided with an access opening and unobstructed passageway large enough to remove the largest component of the appliance. The passageway shall not be less than 30 inches (762 mm) high and 22 inches (559 mm) wide, nor more than 20 feet (6096 mm) in length when measured along the centerline of the passageway from the opening to the equipment. 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 a minimum of 22 inches by 30 inches (559 mm by 762 mm), where such dimensions are large enough to allow removal of the largest component of the appliance.

### Exceptions:

1. The passageway is not required where the level service space is present when the access is open and the appliance is capable of being serviced and removed through the required opening.
2. Where the passageway is not less than 6 feet high (1829 mm) for its entire length, the passageway shall not be limited in length.

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

**[M] 306.5 Appliances on roofs or elevated structures.** Where appliances requiring access are installed on roofs or elevated structures at a height exceeding 16 feet (4877 mm), such access shall be provided by a permanent approved means of access, the extent of which shall be from grade or floor level to the appliance's level service space. Such access shall not require climbing over obstructions greater than 30 inches high (762

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mm) or walking on roofs having a slope greater than four units vertical in 12 units horizontal (33-percent slope).

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

1. The side railing shall extend above the parapet or roof edge not less than 30 inches (762 mm).
2. Ladders shall have a rung spacing not to exceed 14 inches (356 mm) on center.
3. Ladders shall have a toe spacing not less than 6 inches (152 mm) deep.
4. There shall be a minimum of 18 inches (457 mm) between rails.
5. Rungs shall have a minimum diameter of 0.75-inch (19 mm) and shall be capable of withstanding a 300-pound (136.1 kg) load.
6. Ladders over 30 feet (9144 mm) in height shall be provided with offset sections and landings capable of withstanding a load of 100 pounds per square foot (488.2 kg/m<sup>2</sup>).
7. Ladders shall be protected against corrosion by approved means.

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

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

**[M] 306.5.1 Sloped roofs.** Where appliances are installed on a roof having a slope of three units vertical in 12 units horizontal (25-percent slope) or greater and having an edge more than 30 inches (762 mm) above grade at such edge, a level platform shall be provided on each side of the appliance to which access is required for service, repair or maintenance. The platform shall not be less than 30 inches (762 mm) in any dimension and shall be provided with guards. The guards shall extend not less than 42 inches (1067 mm) above the platform, shall be constructed so as to prevent the passage of a 21-inch-diameter (533 mm) sphere and shall comply with the loading requirements for guards specified in the *International Building Code*.

**[M] 306.5.2 Electrical requirements.** A receptacle outlet shall be provided at or near the equipment location in accordance with the *ICC Electrical Code*.

**[M] 306.6 Guards.** Guards shall be provided where appliances or other 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 such appliances, components and roof hatch openings and 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*.

## SECTION 307 (IFGC) CONDENSATE DISPOSAL

**307.1 Evaporators and cooling coils.** Condensate drainage systems shall be provided for equipment and appliances containing evaporators and cooling coils in accordance with the *International Mechanical Code*.

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

**[M] 307.3 Drain pipe materials and sizes.** Components of the condensate disposal system shall be cast iron, galvanized steel, copper, polybutylene, polyethylene, ABS, CPVC or PVC pipe or tubing. All components shall be selected for the pressure and temperature rating of the installation. Condensate waste and drain line size shall be not less than 3/4-inch internal diameter (19 mm) and shall not decrease in size from the drain 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. All horizontal sections of drain piping shall be installed in uniform alignment at a uniform slope.

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

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

## SECTION 308 (IFGS) CLEARANCE REDUCTION

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

**308.2 Reduction table.** The allowable clearance reduction shall be based on one of the methods specified in Table 308.2 or shall utilize an assembly listed for such application. Where required clearances are not listed in Table 308.2, the reduced clearances shall be determined by linear interpolation between the distances listed in the table. Reduced clearances shall not be derived by extrapolation below the range of the table. The reduction of the required clearances to combustibles for listed and labeled appliances and equipment shall be in accordance

with the requirements of this section except that such clearances shall not be reduced where reduction is specifically prohibited by the terms of the appliance or equipment listing [see Figures 308.2(1) through 308.2(3)].

### 308.3 Clearances for indoor air-conditioning appliances.

Clearance requirements for indoor air-conditioning appliances shall comply with Sections 308.3.1 through 308.3.5.

**308.3.1 Appliances installed in rooms that are large in comparison with the size of the appliance.** Air-conditioning appliances installed in rooms that are large in comparison with the size of the appliance shall be installed with clearances in accordance with the manufacturer's instructions.

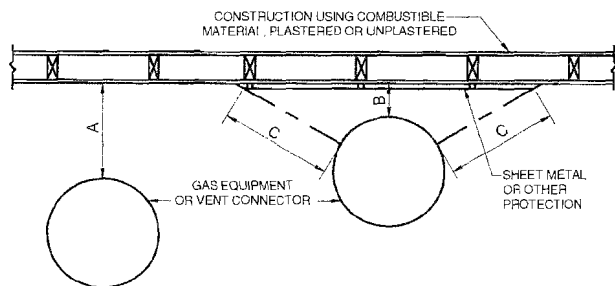
**TABLE 308.2<sup>a</sup> through k**  
**REDUCTION OF CLEARANCES WITH SPECIFIED FORMS OF PROTECTION**

| TYPE OF PROTECTION APPLIED TO<br>AND COVERING ALL SURFACES OF COMBUSTIBLE<br>MATERIAL WITHIN THE DISTANCE SPECIFIED AS THE<br>REQUIRED CLEARANCE WITH NO PROTECTION<br>[see Figures 308.2(1), 308.2(2), and 308.2(3)] | WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION FROM<br>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<br>for clearances from appliance, vertical connector, and single-wall metal pipe. |                             |                 |                             |                 |                             |                 |                             |                 |                             |
|                                                                                                                                                                                                                       | Above<br>Col. 1                                                                                                                                                     | Sides<br>and rear<br>Col. 2 | Above<br>Col. 1 | Sides<br>and rear<br>Col. 2 | Above<br>Col. 1 | Sides<br>and rear<br>Col. 2 | Above<br>Col. 1 | Sides<br>and rear<br>Col. 2 | Above<br>Col. 1 | Sides<br>and rear<br>Col. 2 |
| 1. 3½-inch-thick masonry wall without ventilated air-<br>space                                                                                                                                                        | —                                                                                                                                                                   | 24                          | —               | 12                          | —               | 9                           | —               | 6                           | —               | 5                           |
| 2. ½-inch insulation board over 1-inch glass fiber or<br>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<br>glass fiber or mineral wool batts reinforced with wire<br>on rear face with ventilated airspace                                                            | 18                                                                                                                                                                  | 12                          | 9               | 6                           | 6               | 4                           | 5               | 3                           | 3               | 3                           |
| 4. 3½-inch-thick masonry wall with ventilated air-<br>space                                                                                                                                                           | —                                                                                                                                                                   | 12                          | —               | 6                           | —               | 6                           | —               | 6                           | —               | 6                           |
| 5. 0.024-inch (nominal 24 gage) sheet metal with ven-<br>tilated airspace                                                                                                                                             | 18                                                                                                                                                                  | 12                          | 9               | 6                           | 6               | 4                           | 5               | 3                           | 3               | 2                           |
| 6. ½-inch-thick insulation board with ventilated air-<br>space                                                                                                                                                        | 18                                                                                                                                                                  | 12                          | 9               | 6                           | 6               | 4                           | 5               | 3                           | 3               | 3                           |
| 7. 0.024-inch (nominal 24 gage) sheet metal with ven-<br>tilated airspace over 0.024-inch (nominal 24 gage)<br>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<br>between two sheets 0.024-inch (nominal 24 gage)<br>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.

- Reduction of clearances from combustible materials shall not interfere with combustion air, draft hood clearance and relief, and accessibility of servicing.
- All 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.
- Spacers and ties shall be of noncombustible material. No spacer or tie shall be used directly opposite an appliance or connector.
- For all clearance reduction systems using a ventilated airspace, adequate provision for air circulation shall be provided as described [see Figures 308.2(2) and 308.2(3)].
- There shall be at least 1 inch between clearance reduction systems and combustible walls and ceilings for reduction systems using ventilated airspace.
- 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.
- Mineral wool batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot and a minimum melting point of 1500°F.
- 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.
- There shall be at least 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.
- All clearances and thicknesses are minimum; larger clearances and thicknesses are acceptable.
- Listed single-wall connectors shall be installed in accordance with the manufacturer's installation instructions.

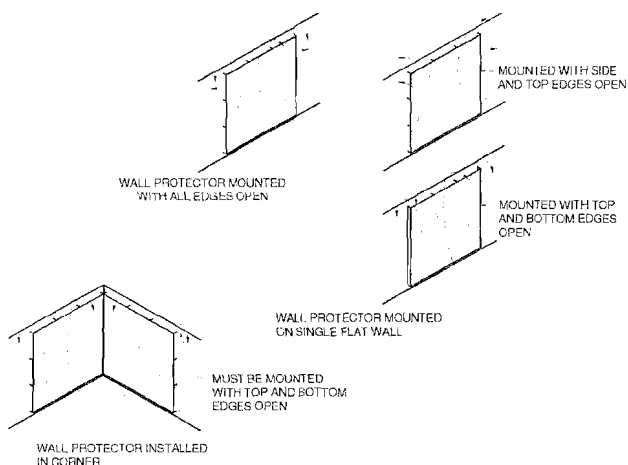
## GENERAL REGULATIONS



"A" equals the reduced clearance with no protection.

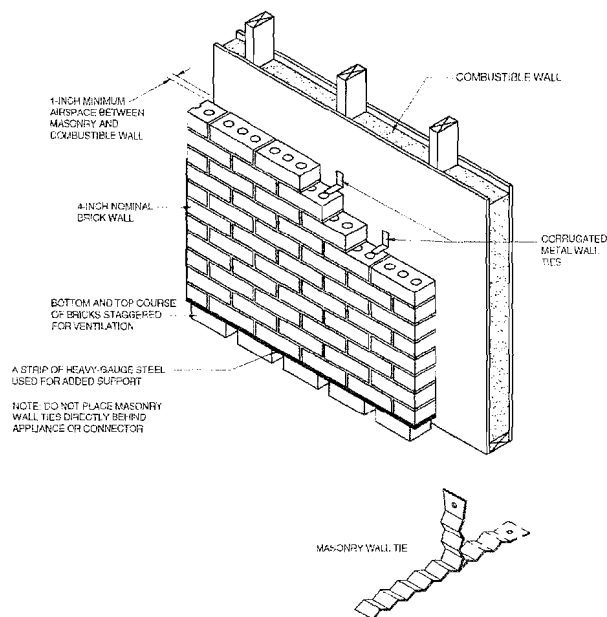
"B" equals the reduced clearance permitted in accordance with Table 308.2. The protection applied to the construction using combustible material shall extend far enough in each direction to make "C" equal to "A."

**FIGURE 308.2(1)**  
**EXTENT OF PROTECTION NECESSARY TO**  
**REDUCE CLEARANCES FROM APPLIANCE OR**  
**VENT CONNECTIONS**



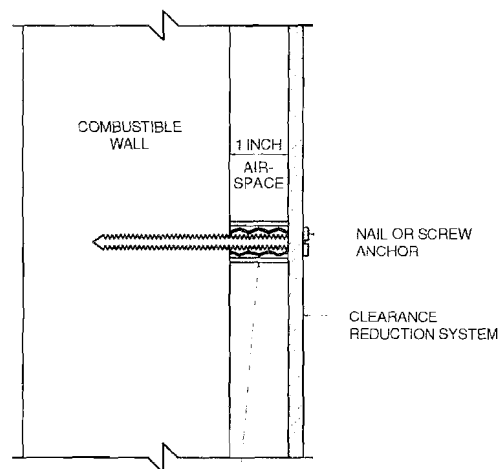
For SI: 1 inch = 25.4 mm.

**FIGURE 308.2(2)**  
**WALL PROTECTOR CLEARANCE REDUCTION SYSTEM**



For SI: 1 inch = 25.4 mm.

**FIGURE 308.2(3)**  
**MASONRY CLEARANCE REDUCTION SYSTEM**



1-INCH NONCOMBUSTIBLE SPACER SUCH AS STACKED WASHERS, SMALL-DIAMETER PIPE, TUBING OR ELECTRICAL CONDUIT.

MASONRY WALLS CAN BE ATTACHED TO COMBUSTIBLE WALLS USING WALL TIES.

DO NOT USE SPACERS DIRECTLY BEHIND APPLIANCE OR CONNECTOR.

**308.3.2 Appliances installed in rooms that are not large in comparison with the size of the appliance.** Air-conditioning appliances installed in rooms that are not large in comparison with the size of the appliance, such as alcoves and closets, shall be listed for such installations and installed in accordance with the manufacturer's instructions. Listed clearances shall not be reduced by the protection methods described in Table 308.2, regardless of whether the enclosure is of combustible or noncombustible material.

**308.3.3 Clearance reduction.** Air-conditioning appliances installed in rooms that are large in comparison with the size of the appliance shall be permitted to be installed with reduced clearances to combustible material, provided the combustible material or appliance is protected as described in Table 308.2.

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

**308.3.5 Clearance from supply ducts.** Air-conditioning appliances shall have the clearance from supply ducts within 3 feet (914 mm) of the furnace plenum be not less than that specified from the furnace plenum. Clearance is not necessary beyond this distance.

**308.4 Central-heating boilers and furnaces.** Clearance requirements for central-heating boilers and furnaces shall comply with Sections 308.4.1 through 308.4.6. The clearance to these appliances shall not interfere with combustion air; draft hood clearance and relief; and accessibility for servicing.

**308.4.1 Appliances installed in rooms that are large in comparison with the size of the appliance.** Central-heating furnaces and low-pressure boilers installed in rooms large in comparison with the size of the appliance shall be installed with clearances in accordance with the manufacturer's instructions.

**308.4.2 Appliances installed in rooms that are not large in comparison with the size of the appliance.** Central-heating furnaces and low-pressure boilers installed in rooms that are not large in comparison with the size of the appliance, such as alcoves and closets, shall be listed for such installations. Listed clearances shall not be reduced by the protection methods described in Table 308.2 and illustrated in Figures 308.2(1) through 308.2(3), regardless of whether the enclosure is of combustible or noncombustible material.

**308.4.3 Clearance reduction.** Central-heating furnaces and low-pressure boilers installed in rooms that are large in comparison with the size of the appliance shall be permitted to be installed with reduced clearances to combustible material provided the combustible material or appliance is protected as described in Table 308.2.

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

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

**308.4.6 Clearance from supply ducts.** Central-heating furnaces shall have the clearance from supply ducts within 3 feet (914 mm) of the furnace plenum be not less than that specified from the furnace plenum. No clearance is necessary beyond this distance.

## SECTION 309 (IFGC) ELECTRICAL

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

**309.2 Connections.** Electrical connections between equipment and the building wiring, including the grounding of the equipment, shall conform to the ICC *Electrical Code*.

## SECTION 310 (IFGS) ELECTRICAL BONDING

**310.1 Gas pipe bonding.** Each above-ground 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 appliances that are connected to the equipment grounding conductor of the circuit supplying that appliance.



## CHAPTER 4

# GAS PIPING INSTALLATIONS

### SECTION 401 (IFGC) GENERAL

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

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

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

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

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

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

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

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

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

### SECTION 402 (IFGS) PIPE SIZING

**402.1 General considerations.** Piping systems shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand without undue loss of pressure between the point of delivery and the appliance.

**402.2 Maximum gas demand.** The volume of gas to be provided, in cubic feet per hour, shall be determined directly from

the manufacturer's input ratings of the appliances served. Where an input rating is not indicated, the gas supplier, appliance manufacturer or a qualified agency shall be contacted, or the rating from Table 402.2 shall be used for estimating the volume of gas to be supplied.

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.

**TABLE 402.2**  
**APPROXIMATE GAS INPUT FOR TYPICAL APPLIANCES**

| APPLIANCE                                            | INPUT BTU/H<br>(Approx.) |
|------------------------------------------------------|--------------------------|
| <b>Space Heating Units</b>                           |                          |
| Hydronic boiler                                      |                          |
| Single family                                        | 100,000                  |
| Multifamily, per unit                                | 60,000                   |
| Warm-air furnace                                     |                          |
| Single family                                        | 100,000                  |
| Multifamily, per unit                                | 60,000                   |
| <b>Space and Water Heating Units</b>                 |                          |
| Hydronic boiler                                      |                          |
| Single family                                        | 120,000                  |
| Multifamily, per unit                                | 75,000                   |
| <b>Water Heating Appliances</b>                      |                          |
| Water heater, automatic instantaneous                |                          |
| Capacity at 2 gal./minute                            | 142,800                  |
| Capacity at 4 gal./minute                            | 285,000                  |
| Capacity at 6 gal./minute                            | 428,400                  |
| Water heater, automatic storage, 30- to 40-gal. tank | 35,000                   |
| Water heater, automatic storage, 50-gal. tank        | 50,000                   |
| Water heater, domestic, circulating or side-arm      | 35,000                   |
| <b>Cooking Appliances</b>                            |                          |
| Built-in oven or broiler unit, domestic              | 25,000                   |
| Built-in top unit, domestic                          | 40,000                   |
| Range, free-standing, domestic                       | 65,000                   |
| <b>Other Appliances</b>                              |                          |
| Barbecue                                             | 40,000                   |
| Clothes dryer, Type 1 (domestic)                     | 35,000                   |
| Gas fireplace, direct-vent                           | 40,000                   |
| Gas light                                            | 2,500                    |
| Gas log                                              | 80,000                   |
| Refrigerator                                         | 3,000                    |

For SI: 1 British thermal unit per hour = 0.293 W, 1 gallon = 3.785 L,  
1 gallon per minute = 3.785 L/m.

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

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

**402.4 Sizing tables and equations.** Where Tables 402.4(1) through 402.4(35) are used to size piping or tubing, the pipe length shall be determined in accordance with Section 402.4.1, 402.4.2 or 402.4.3.

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

1. Low-pressure gas equation [Less than 1.5 pounds per square inch (psi) (10.3 kPa)]:

$$D = \frac{Q^{0.381}}{1917 \left( \frac{\Delta H}{C_r \times L} \right)^{0.206}} \quad (\text{Equation 4-1})$$

2. High-pressure gas equation [1.5 psi (10.3 kPa) and above]:

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

where:

$D$  = Inside diameter of pipe, inches (mm).

$Q$  = Input rate appliance(s), cubic feet per hour at 60°F (16°C) and 30-inch mercury column

$P_1$  = Upstream pressure, psia ( $P_1 + 14.7$ )

$P_2$  = Downstream pressure, psia ( $P_2 + 14.7$ )

$L$  = Equivalent length of pipe, feet

$\Delta H$  = Pressure drop, inch water column (27.7 inch water column = 1 psi)

**TABLE 402.4**  
**C<sub>r</sub> 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 m<sup>3</sup>, 1 foot = 305 mm, 1-inch water column = 0.249 kPa, 1 pound per square inch = 6.895 kPa, 1 British thermal unit per hour = 0.293 W.

**402.4.1 Longest length method.** The pipe size of each section of gas piping shall be determined using the longest

length of piping from the point of delivery to the most remote outlet and the load of the section.

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

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

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

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

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

1. The piping system is welded.
2. The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
3. The piping is located inside buildings or separate areas of buildings used exclusively for:
  - 3.1. Industrial processing or heating;
  - 3.2. Research;
  - 3.3. Warehousing; or
  - 3.4. Boiler or mechanical rooms.
4. The piping is a temporary installation for buildings under construction.

**402.6.1 Liquefied petroleum gas systems.** The operating pressure for undiluted LP-gas systems shall not exceed 20 psig (140 kPa gauge). Buildings having 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.

**Exception:** Buildings or separate areas of buildings constructed in accordance with Chapter 10 of NFPA 58 and used exclusively to house industrial processes, research and experimental laboratories, or equipment or processing having similar hazards.

**TABLE 402.4(1)**  
**SCHEDULE 40 METALLIC PIPE**

|                         |                 |
|-------------------------|-----------------|
| <b>Gas</b>              | Natural         |
| <b>Inlet Pressure</b>   | Less than 2 psi |
| <b>Pressure Drop</b>    | 0.3 in. w.c.    |
| <b>Specific Gravity</b> | 0.60            |

| PIPE SIZE (inch) |                                        |       |       |       |       |       |       |       |        |        |        |         |         |
|------------------|----------------------------------------|-------|-------|-------|-------|-------|-------|-------|--------|--------|--------|---------|---------|
| Nominal          | 1/2                                    | 3/4   | 1     | 1 1/4 | 1 1/2 | 2     | 2 1/2 | 3     | 4      | 5      | 6      | 8       | 10      |
| Actual ID        | 0.622                                  | 0.824 | 1.049 | 1.380 | 1.610 | 2.067 | 2.469 | 3.068 | 4.026  | 5.047  | 6.065  | 7.981   | 10.020  |
| Length (ft)      | Capacity in Cubic Feet of Gas Per Hour |       |       |       |       |       |       |       |        |        |        |         |         |
| 10               | 131                                    | 273   | 514   | 1,060 | 1,580 | 3,050 | 4,860 | 8,580 | 17,500 | 31,700 | 51,300 | 105,000 | 191,000 |
| 20               | 90                                     | 188   | 353   | 726   | 1,090 | 2,090 | 3,340 | 5,900 | 12,000 | 21,800 | 35,300 | 72,400  | 132,000 |
| 30               | 72                                     | 151   | 284   | 583   | 873   | 1,680 | 2,680 | 4,740 | 9,660  | 17,500 | 28,300 | 58,200  | 106,000 |
| 40               | 62                                     | 129   | 243   | 499   | 747   | 1,440 | 2,290 | 4,050 | 8,270  | 15,000 | 24,200 | 49,800  | 90,400  |
| 50               | 55                                     | 114   | 215   | 442   | 662   | 1,280 | 2,030 | 3,590 | 7,330  | 13,300 | 21,500 | 44,100  | 80,100  |
| 60               | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,260 | 6,640  | 12,000 | 19,500 | 40,000  | 72,600  |
| 70               | 46                                     | 95    | 179   | 368   | 552   | 1,060 | 1,690 | 3,000 | 6,110  | 11,100 | 17,900 | 36,800  | 66,800  |
| 80               | 42                                     | 89    | 167   | 343   | 514   | 989   | 1,580 | 2,790 | 5,680  | 10,300 | 16,700 | 34,200  | 62,100  |
| 90               | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,610 | 5,330  | 9,650  | 15,600 | 32,100  | 58,300  |
| 100              | 38                                     | 79    | 148   | 304   | 455   | 877   | 1,400 | 2,470 | 5,040  | 9,110  | 14,800 | 30,300  | 55,100  |
| 125              | 33                                     | 70    | 131   | 269   | 403   | 777   | 1,240 | 2,190 | 4,460  | 8,080  | 13,100 | 26,900  | 48,800  |
| 150              | 30                                     | 63    | 119   | 244   | 366   | 704   | 1,120 | 1,980 | 4,050  | 7,320  | 11,900 | 24,300  | 44,200  |
| 175              | 28                                     | 58    | 109   | 224   | 336   | 648   | 1,030 | 1,820 | 3,720  | 6,730  | 10,900 | 22,400  | 40,700  |
| 200              | 26                                     | 54    | 102   | 209   | 313   | 602   | 960   | 1,700 | 3,460  | 6,260  | 10,100 | 20,800  | 37,900  |
| 250              | 23                                     | 48    | 90    | 185   | 277   | 534   | 851   | 1,500 | 3,070  | 5,550  | 8,990  | 18,500  | 33,500  |
| 300              | 21                                     | 43    | 82    | 168   | 251   | 484   | 771   | 1,360 | 2,780  | 5,030  | 8,150  | 16,700  | 30,400  |
| 350              | 19                                     | 40    | 75    | 154   | 231   | 445   | 709   | 1,250 | 2,560  | 4,630  | 7,490  | 15,400  | 28,000  |
| 400              | 18                                     | 37    | 70    | 143   | 215   | 414   | 660   | 1,170 | 2,380  | 4,310  | 6,970  | 14,300  | 26,000  |
| 450              | 17                                     | 35    | 66    | 135   | 202   | 389   | 619   | 1,090 | 2,230  | 4,040  | 6,540  | 13,400  | 24,400  |
| 500              | 16                                     | 33    | 62    | 127   | 191   | 367   | 585   | 1,030 | 2,110  | 3,820  | 6,180  | 12,700  | 23,100  |
| 550              | 15                                     | 31    | 59    | 121   | 181   | 349   | 556   | 982   | 2,000  | 3,620  | 5,870  | 12,100  | 21,900  |
| 600              | 14                                     | 30    | 56    | 115   | 173   | 333   | 530   | 937   | 1,910  | 3,460  | 5,600  | 11,500  | 20,900  |
| 650              | 14                                     | 29    | 54    | 110   | 165   | 318   | 508   | 897   | 1,830  | 3,310  | 5,360  | 11,000  | 20,000  |
| 700              | 13                                     | 27    | 52    | 106   | 159   | 306   | 488   | 862   | 1,760  | 3,180  | 5,150  | 10,600  | 19,200  |
| 750              | 13                                     | 26    | 50    | 102   | 153   | 295   | 470   | 830   | 1,690  | 3,060  | 4,960  | 10,200  | 18,500  |
| 800              | 12                                     | 26    | 48    | 99    | 148   | 285   | 454   | 802   | 1,640  | 2,960  | 4,790  | 9,840   | 17,900  |
| 850              | 12                                     | 25    | 46    | 95    | 143   | 275   | 439   | 776   | 1,580  | 2,860  | 4,640  | 9,530   | 17,300  |
| 900              | 11                                     | 24    | 45    | 93    | 139   | 267   | 426   | 752   | 1,530  | 2,780  | 4,500  | 9,240   | 16,800  |
| 950              | 11                                     | 23    | 44    | 90    | 135   | 259   | 413   | 731   | 1,490  | 2,700  | 4,370  | 8,970   | 16,300  |
| 1,000            | 11                                     | 23    | 43    | 87    | 131   | 252   | 402   | 711   | 1,450  | 2,620  | 4,250  | 8,720   | 15,800  |
| 1,100            | 10                                     | 21    | 40    | 83    | 124   | 240   | 382   | 675   | 1,380  | 2,490  | 4,030  | 8,290   | 15,100  |
| 1,200            | NA                                     | 20    | 39    | 79    | 119   | 229   | 364   | 644   | 1,310  | 2,380  | 3,850  | 7,910   | 14,400  |
| 1,300            | NA                                     | 20    | 37    | 76    | 114   | 219   | 349   | 617   | 1,260  | 2,280  | 3,680  | 7,570   | 13,700  |
| 1,400            | NA                                     | 19    | 35    | 73    | 109   | 210   | 335   | 592   | 1,210  | 2,190  | 3,540  | 7,270   | 13,200  |
| 1,500            | NA                                     | 18    | 34    | 70    | 105   | 203   | 323   | 571   | 1,160  | 2,110  | 3,410  | 7,010   | 12,700  |
| 1,600            | NA                                     | 18    | 33    | 68    | 102   | 196   | 312   | 551   | 1,120  | 2,030  | 3,290  | 6,770   | 12,300  |
| 1,700            | NA                                     | 17    | 32    | 66    | 98    | 189   | 302   | 533   | 1,090  | 1,970  | 3,190  | 6,550   | 11,900  |
| 1,800            | NA                                     | 16    | 31    | 64    | 95    | 184   | 293   | 517   | 1,050  | 1,910  | 3,090  | 6,350   | 11,500  |
| 1,900            | NA                                     | 16    | 30    | 62    | 93    | 178   | 284   | 502   | 1,020  | 1,850  | 3,000  | 6,170   | 11,200  |
| 2,000            | NA                                     | 16    | 29    | 60    | 90    | 173   | 276   | 488   | 1,000  | 1,800  | 2,920  | 6,000   | 10,900  |

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

**Notes:**

1. NA means a flow of less than 10 cth.
2. All table entries have been rounded to three significant digits.

# GAS PIPING INSTALLATIONS

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

|                         |                 |
|-------------------------|-----------------|
| <b>Gas</b>              | Natural         |
| <b>Inlet Pressure</b>   | Less than 2 psi |
| <b>Pressure Drop</b>    | 0.5 in. w.c.    |
| <b>Specific Gravity</b> | 0.60            |

| PIPE SIZE (inch) |                                        |       |       |       |       |       |       |        |        |        |        |         |         |         |
|------------------|----------------------------------------|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|
| Nominal          | 1/2                                    | 3/4   | 1     | 1 1/4 | 1 1/2 | 2     | 2 1/2 | 3      | 4      | 5      | 6      | 8       | 10      | 12      |
| Actual ID        | 0.622                                  | 0.824 | 1.049 | 1.380 | 1.610 | 2.067 | 2.469 | 3.068  | 4.026  | 5.047  | 6.065  | 7.981   | 10.020  | 11.938  |
| Length (ft)      | Capacity in Cubic Feet of Gas Per Hour |       |       |       |       |       |       |        |        |        |        |         |         |         |
| 10               | 172                                    | 360   | 678   | 1,390 | 2,090 | 4,020 | 6,400 | 11,300 | 23,100 | 41,800 | 67,600 | 139,000 | 252,000 | 399,000 |
| 20               | 118                                    | 247   | 466   | 957   | 1,430 | 2,760 | 4,400 | 7,780  | 15,900 | 28,700 | 46,500 | 95,500  | 173,000 | 275,000 |
| 30               | 95                                     | 199   | 374   | 768   | 1,150 | 2,220 | 3,530 | 6,250  | 12,700 | 23,000 | 37,300 | 76,700  | 139,000 | 220,000 |
| 40               | 81                                     | 170   | 320   | 657   | 985   | 1,900 | 3,020 | 5,350  | 10,900 | 19,700 | 31,900 | 65,600  | 119,000 | 189,000 |
| 50               | 72                                     | 151   | 284   | 583   | 873   | 1,680 | 2,680 | 4,740  | 9,660  | 17,500 | 28,300 | 58,200  | 106,000 | 167,000 |
| 60               | 65                                     | 137   | 257   | 528   | 791   | 1,520 | 2,430 | 4,290  | 8,760  | 15,800 | 25,600 | 52,700  | 95,700  | 152,000 |
| 70               | 60                                     | 126   | 237   | 486   | 728   | 1,400 | 2,230 | 3,950  | 8,050  | 14,600 | 23,600 | 48,500  | 88,100  | 139,000 |
| 80               | 56                                     | 117   | 220   | 452   | 677   | 1,300 | 2,080 | 3,670  | 7,490  | 13,600 | 22,000 | 45,100  | 81,900  | 130,000 |
| 90               | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,450  | 7,030  | 12,700 | 20,600 | 42,300  | 76,900  | 122,000 |
| 100              | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,260  | 6,640  | 12,000 | 19,500 | 40,000  | 72,600  | 115,000 |
| 125              | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,890  | 5,890  | 10,600 | 17,200 | 35,400  | 64,300  | 102,000 |
| 150              | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,610  | 5,330  | 9,650  | 15,600 | 32,100  | 58,300  | 92,300  |
| 175              | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,410  | 4,910  | 8,880  | 14,400 | 29,500  | 53,600  | 84,900  |
| 200              | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,240  | 4,560  | 8,260  | 13,400 | 27,500  | 49,900  | 79,000  |
| 250              | 30                                     | 63    | 119   | 244   | 366   | 704   | 1,120 | 1,980  | 4,050  | 7,320  | 11,900 | 24,300  | 44,200  | 70,000  |
| 300              | 27                                     | 57    | 108   | 221   | 331   | 638   | 1,020 | 1,800  | 3,670  | 6,630  | 10,700 | 22,100  | 40,100  | 63,400  |
| 350              | 25                                     | 53    | 99    | 203   | 305   | 587   | 935   | 1,650  | 3,370  | 6,100  | 9,880  | 20,300  | 36,900  | 58,400  |
| 400              | 23                                     | 49    | 92    | 189   | 283   | 546   | 870   | 1,540  | 3,140  | 5,680  | 9,190  | 18,900  | 34,300  | 54,300  |
| 450              | 22                                     | 46    | 86    | 177   | 266   | 512   | 816   | 1,440  | 2,940  | 5,330  | 8,620  | 17,700  | 32,200  | 50,900  |
| 500              | 21                                     | 43    | 82    | 168   | 251   | 484   | 771   | 1,360  | 2,780  | 5,030  | 8,150  | 16,700  | 30,400  | 48,100  |
| 550              | 20                                     | 41    | 78    | 159   | 239   | 459   | 732   | 1,290  | 2,640  | 4,780  | 7,740  | 15,900  | 28,900  | 45,700  |
| 600              | 19                                     | 39    | 74    | 152   | 228   | 438   | 699   | 1,240  | 2,520  | 4,560  | 7,380  | 15,200  | 27,500  | 43,600  |
| 650              | 18                                     | 38    | 71    | 145   | 218   | 420   | 669   | 1,180  | 2,410  | 4,360  | 7,070  | 14,500  | 26,400  | 41,800  |
| 700              | 17                                     | 36    | 68    | 140   | 209   | 403   | 643   | 1,140  | 2,320  | 4,190  | 6,790  | 14,000  | 25,300  | 40,100  |
| 750              | 17                                     | 35    | 66    | 135   | 202   | 389   | 619   | 1,090  | 2,230  | 4,040  | 6,540  | 13,400  | 24,400  | 38,600  |
| 800              | 16                                     | 34    | 63    | 130   | 195   | 375   | 598   | 1,060  | 2,160  | 3,900  | 6,320  | 13,000  | 23,600  | 37,300  |
| 850              | 16                                     | 33    | 61    | 126   | 189   | 363   | 579   | 1,020  | 2,090  | 3,780  | 6,110  | 12,600  | 22,800  | 36,100  |
| 900              | 15                                     | 32    | 59    | 122   | 183   | 352   | 561   | 992    | 2,020  | 3,660  | 5,930  | 12,200  | 22,100  | 35,000  |
| 950              | 15                                     | 31    | 58    | 118   | 178   | 342   | 545   | 963    | 1,960  | 3,550  | 5,760  | 11,800  | 21,500  | 34,000  |
| 1,000            | 14                                     | 30    | 56    | 115   | 173   | 333   | 530   | 937    | 1,910  | 3,460  | 5,600  | 11,500  | 20,900  | 33,100  |
| 1,100            | 14                                     | 28    | 53    | 109   | 164   | 316   | 503   | 890    | 1,810  | 3,280  | 5,320  | 10,900  | 19,800  | 31,400  |
| 1,200            | 13                                     | 27    | 51    | 104   | 156   | 301   | 480   | 849    | 1,730  | 3,130  | 5,070  | 10,400  | 18,900  | 30,000  |
| 1,300            | 12                                     | 26    | 49    | 100   | 150   | 289   | 460   | 813    | 1,660  | 3,000  | 4,860  | 9,980   | 18,100  | 28,700  |
| 1,400            | 12                                     | 25    | 47    | 96    | 144   | 277   | 442   | 781    | 1,590  | 2,880  | 4,670  | 9,590   | 17,400  | 27,600  |
| 1,500            | 11                                     | 24    | 45    | 93    | 139   | 267   | 426   | 752    | 1,530  | 2,780  | 4,500  | 9,240   | 16,800  | 26,600  |
| 1,600            | 11                                     | 23    | 44    | 89    | 134   | 258   | 411   | 727    | 1,480  | 2,680  | 4,340  | 8,920   | 16,200  | 25,600  |
| 1,700            | 11                                     | 22    | 42    | 86    | 130   | 250   | 398   | 703    | 1,430  | 2,590  | 4,200  | 8,630   | 15,700  | 24,800  |
| 1,800            | 10                                     | 22    | 41    | 84    | 126   | 242   | 386   | 682    | 1,390  | 2,520  | 4,070  | 8,370   | 15,200  | 24,100  |
| 1,900            | 10                                     | 21    | 40    | 81    | 122   | 235   | 375   | 662    | 1,350  | 2,440  | 3,960  | 8,130   | 14,800  | 23,400  |
| 2,000            | NA                                     | 20    | 39    | 79    | 119   | 229   | 364   | 644    | 1,310  | 2,380  | 3,850  | 7,910   | 14,400  | 22,700  |

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

## Notes:

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

**TABLE 402.4(3)**  
**SCHEDULE 40 METALLIC PIPE**

|                         |         |
|-------------------------|---------|
| <b>Gas</b>              | Natural |
| <b>Inlet Pressure</b>   | 2.0 psi |
| <b>Pressure Drop</b>    | 1.0 psi |
| <b>Specific Gravity</b> | 0.60    |

| PIPE SIZE (inch) |                                        |       |       |        |        |        |        |        |         |
|------------------|----------------------------------------|-------|-------|--------|--------|--------|--------|--------|---------|
| Nominal          | 1/2                                    | 3/4   | 1     | 1 1/4  | 1 1/2  | 2      | 2 1/2  | 3      | 4       |
| Actual ID        | 0.622                                  | 0.824 | 1.049 | 1.380  | 1.610  | 2.067  | 2.469  | 3.068  | 4.026   |
| Length (ft)      | Capacity in Cubic Feet of Gas Per Hour |       |       |        |        |        |        |        |         |
| 10               | 1,510                                  | 3,040 | 5,560 | 11,400 | 17,100 | 32,900 | 52,500 | 92,800 | 189,000 |
| 20               | 1,070                                  | 2,150 | 3,930 | 8,070  | 12,100 | 23,300 | 37,100 | 65,600 | 134,000 |
| 30               | 869                                    | 1,760 | 3,210 | 6,590  | 9,880  | 19,000 | 30,300 | 53,600 | 109,000 |
| 40               | 753                                    | 1,520 | 2,780 | 5,710  | 8,550  | 16,500 | 26,300 | 46,400 | 94,700  |
| 50               | 673                                    | 1,360 | 2,490 | 5,110  | 7,650  | 14,700 | 23,500 | 41,500 | 84,700  |
| 60               | 615                                    | 1,240 | 2,270 | 4,660  | 6,980  | 13,500 | 21,400 | 37,900 | 77,300  |
| 70               | 569                                    | 1,150 | 2,100 | 4,320  | 6,470  | 12,500 | 19,900 | 35,100 | 71,600  |
| 80               | 532                                    | 1,080 | 1,970 | 4,040  | 6,050  | 11,700 | 18,600 | 32,800 | 67,000  |
| 90               | 502                                    | 1,010 | 1,850 | 3,810  | 5,700  | 11,000 | 17,500 | 30,900 | 63,100  |
| 100              | 462                                    | 934   | 1,710 | 3,510  | 5,260  | 10,100 | 16,100 | 28,500 | 58,200  |
| 125              | 414                                    | 836   | 1,530 | 3,140  | 4,700  | 9,060  | 14,400 | 25,500 | 52,100  |
| 150              | 372                                    | 751   | 1,370 | 2,820  | 4,220  | 8,130  | 13,000 | 22,900 | 46,700  |
| 175              | 344                                    | 695   | 1,270 | 2,601  | 3,910  | 7,530  | 12,000 | 21,200 | 43,300  |
| 200              | 318                                    | 642   | 1,170 | 2,410  | 3,610  | 6,960  | 11,100 | 19,600 | 40,000  |
| 250              | 279                                    | 583   | 1,040 | 2,140  | 3,210  | 6,180  | 9,850  | 17,400 | 35,500  |
| 300              | 253                                    | 528   | 945   | 1,940  | 2,910  | 5,600  | 8,920  | 15,800 | 32,200  |
| 350              | 232                                    | 486   | 869   | 1,790  | 2,670  | 5,150  | 8,210  | 14,500 | 29,600  |
| 400              | 216                                    | 452   | 809   | 1,660  | 2,490  | 4,790  | 7,640  | 13,500 | 27,500  |
| 450              | 203                                    | 424   | 759   | 1,560  | 2,330  | 4,500  | 7,170  | 12,700 | 25,800  |
| 500              | 192                                    | 401   | 717   | 1,470  | 2,210  | 4,250  | 6,770  | 12,000 | 24,400  |
| 550              | 182                                    | 381   | 681   | 1,400  | 2,090  | 4,030  | 6,430  | 11,400 | 23,200  |
| 600              | 174                                    | 363   | 650   | 1,330  | 2,000  | 3,850  | 6,130  | 10,800 | 22,100  |
| 650              | 166                                    | 348   | 622   | 1,280  | 1,910  | 3,680  | 5,870  | 10,400 | 21,200  |
| 700              | 160                                    | 334   | 598   | 1,230  | 1,840  | 3,540  | 5,640  | 9,970  | 20,300  |
| 750              | 154                                    | 322   | 576   | 1,180  | 1,770  | 3,410  | 5,440  | 9,610  | 19,600  |
| 800              | 149                                    | 311   | 556   | 1,140  | 1,710  | 3,290  | 5,250  | 9,280  | 18,900  |
| 850              | 144                                    | 301   | 538   | 1,100  | 1,650  | 3,190  | 5,080  | 8,980  | 18,300  |
| 900              | 139                                    | 292   | 522   | 1,070  | 1,600  | 3,090  | 4,930  | 8,710  | 17,800  |
| 950              | 135                                    | 283   | 507   | 1,040  | 1,560  | 3,000  | 4,780  | 8,460  | 17,200  |
| 1,000            | 132                                    | 275   | 493   | 1,010  | 1,520  | 2,920  | 4,650  | 8,220  | 16,800  |
| 1,100            | 125                                    | 262   | 468   | 960    | 1,440  | 2,770  | 4,420  | 7,810  | 15,900  |
| 1,200            | 119                                    | 250   | 446   | 917    | 1,370  | 2,640  | 4,220  | 7,450  | 15,200  |
| 1,300            | 114                                    | 239   | 427   | 878    | 1,320  | 2,530  | 4,040  | 7,140  | 14,600  |
| 1,400            | 110                                    | 230   | 411   | 843    | 1,260  | 2,430  | 3,880  | 6,860  | 14,000  |
| 1,500            | 106                                    | 221   | 396   | 812    | 1,220  | 2,340  | 3,740  | 6,600  | 13,500  |
| 1,600            | 102                                    | 214   | 382   | 784    | 1,180  | 2,260  | 3,610  | 6,380  | 13,000  |
| 1,700            | 99                                     | 207   | 370   | 759    | 1,140  | 2,190  | 3,490  | 6,170  | 12,600  |
| 1,800            | 96                                     | 200   | 358   | 736    | 1,100  | 2,120  | 3,390  | 5,980  | 12,200  |
| 1,900            | 93                                     | 195   | 348   | 715    | 1,070  | 2,060  | 3,290  | 5,810  | 11,900  |
| 2,000            | 91                                     | 189   | 339   | 695    | 1,040  | 2,010  | 3,200  | 5,650  | 11,500  |

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

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

# GAS PIPING INSTALLATIONS

**TABLE 402.4(4)**  
**SCHEDULE 40 METALLIC PIPE**

|                         |         |
|-------------------------|---------|
| <b>Gas</b>              | Natural |
| <b>Inlet Pressure</b>   | 3.0 psi |
| <b>Pressure Drop</b>    | 2.0 psi |
| <b>Specific Gravity</b> | 0.60    |

| PIPE SIZE (inch) |                                        |       |       |        |        |        |        |         |         |
|------------------|----------------------------------------|-------|-------|--------|--------|--------|--------|---------|---------|
| Nominal          | 1/2                                    | 3/4   | 1     | 1 1/4  | 1 1/2  | 2      | 2 1/2  | 3       | 4       |
| Actual ID        | 0.622                                  | 0.824 | 1.049 | 1.380  | 1.610  | 2.067  | 2.469  | 3.068   | 4.026   |
| Length (ft)      | Capacity in Cubic Feet of Gas Per Hour |       |       |        |        |        |        |         |         |
| 10               | 2,350                                  | 4,920 | 9,270 | 19,000 | 28,500 | 54,900 | 87,500 | 155,000 | 316,000 |
| 20               | 1,620                                  | 3,380 | 6,370 | 13,100 | 19,600 | 37,700 | 60,100 | 106,000 | 217,000 |
| 30               | 1,300                                  | 2,720 | 5,110 | 10,500 | 15,700 | 30,300 | 48,300 | 85,400  | 174,000 |
| 40               | 1,110                                  | 2,320 | 4,380 | 8,990  | 13,500 | 25,900 | 41,300 | 73,100  | 149,000 |
| 50               | 985                                    | 2,060 | 3,880 | 7,970  | 11,900 | 23,000 | 36,600 | 64,800  | 132,000 |
| 60               | 892                                    | 1,870 | 3,520 | 7,220  | 10,800 | 20,800 | 33,200 | 58,700  | 120,000 |
| 70               | 821                                    | 1,720 | 3,230 | 6,640  | 9,950  | 19,200 | 30,500 | 54,000  | 110,000 |
| 80               | 764                                    | 1,600 | 3,010 | 6,180  | 9,260  | 17,800 | 28,400 | 50,200  | 102,000 |
| 90               | 717                                    | 1,500 | 2,820 | 5,800  | 8,680  | 16,700 | 26,700 | 47,100  | 96,100  |
| 100              | 677                                    | 1,420 | 2,670 | 5,470  | 8,200  | 15,800 | 25,200 | 44,500  | 90,800  |
| 125              | 600                                    | 1,250 | 2,360 | 4,850  | 7,270  | 14,000 | 22,300 | 39,500  | 80,500  |
| 150              | 544                                    | 1,140 | 2,140 | 4,400  | 6,590  | 12,700 | 20,200 | 35,700  | 72,900  |
| 175              | 500                                    | 1,050 | 1,970 | 4,040  | 6,060  | 11,700 | 18,600 | 32,900  | 67,100  |
| 200              | 465                                    | 973   | 1,830 | 3,760  | 5,640  | 10,900 | 17,300 | 30,600  | 62,400  |
| 250              | 412                                    | 862   | 1,620 | 3,330  | 5,000  | 9,620  | 15,300 | 27,100  | 55,300  |
| 300              | 374                                    | 781   | 1,470 | 3,020  | 4,530  | 8,720  | 13,900 | 24,600  | 50,100  |
| 350              | 344                                    | 719   | 1,350 | 2,780  | 4,170  | 8,020  | 12,800 | 22,600  | 46,100  |
| 400              | 320                                    | 669   | 1,260 | 2,590  | 3,870  | 7,460  | 11,900 | 21,000  | 42,900  |
| 450              | 300                                    | 627   | 1,180 | 2,430  | 3,640  | 7,000  | 11,200 | 19,700  | 40,200  |
| 500              | 283                                    | 593   | 1,120 | 2,290  | 3,430  | 6,610  | 10,500 | 18,600  | 38,000  |
| 550              | 269                                    | 563   | 1,060 | 2,180  | 3,260  | 6,280  | 10,000 | 17,700  | 36,100  |
| 600              | 257                                    | 537   | 1,010 | 2,080  | 3,110  | 5,990  | 9,550  | 16,900  | 34,400  |
| 650              | 246                                    | 514   | 969   | 1,990  | 2,980  | 5,740  | 9,150  | 16,200  | 33,000  |
| 700              | 236                                    | 494   | 931   | 1,910  | 2,860  | 5,510  | 8,790  | 15,500  | 31,700  |
| 750              | 228                                    | 476   | 897   | 1,840  | 2,760  | 5,310  | 8,470  | 15,000  | 30,500  |
| 800              | 220                                    | 460   | 866   | 1,780  | 2,660  | 5,130  | 8,180  | 14,500  | 29,500  |
| 850              | 213                                    | 445   | 838   | 1,720  | 2,580  | 4,960  | 7,910  | 14,000  | 28,500  |
| 900              | 206                                    | 431   | 812   | 1,670  | 2,500  | 4,810  | 7,670  | 13,600  | 27,700  |
| 950              | 200                                    | 419   | 789   | 1,620  | 2,430  | 4,670  | 7,450  | 13,200  | 26,900  |
| 1,000            | 195                                    | 407   | 767   | 1,580  | 2,360  | 4,550  | 7,240  | 12,800  | 26,100  |
| 1,100            | 185                                    | 387   | 729   | 1,500  | 2,240  | 4,320  | 6,890  | 12,200  | 24,800  |
| 1,200            | 177                                    | 369   | 695   | 1,430  | 2,140  | 4,120  | 6,570  | 11,600  | 23,700  |
| 1,300            | 169                                    | 353   | 666   | 1,370  | 2,050  | 3,940  | 6,290  | 11,100  | 22,700  |
| 1,400            | 162                                    | 340   | 640   | 1,310  | 1,970  | 3,790  | 6,040  | 10,700  | 21,800  |
| 1,500            | 156                                    | 327   | 616   | 1,270  | 1,900  | 3,650  | 5,820  | 10,300  | 21,000  |
| 1,600            | 151                                    | 316   | 595   | 1,220  | 1,830  | 3,530  | 5,620  | 10,000  | 20,300  |
| 1,700            | 146                                    | 306   | 576   | 1,180  | 1,770  | 3,410  | 5,440  | 9,610   | 19,600  |
| 1,800            | 142                                    | 296   | 558   | 1,150  | 1,720  | 3,310  | 5,270  | 9,320   | 19,000  |
| 1,900            | 138                                    | 288   | 542   | 1,110  | 1,670  | 3,210  | 5,120  | 9,050   | 18,400  |
| 2,000            | 134                                    | 280   | 527   | 1,080  | 1,620  | 3,120  | 4,980  | 8,800   | 18,000  |

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

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

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

**TABLE 402.4(5)**  
**SCHEDULE 40 METALLIC PIPE**

|                         |         |
|-------------------------|---------|
| <b>Gas</b>              | Natural |
| <b>Inlet Pressure</b>   | 5.0 psi |
| <b>Pressure Drop</b>    | 3.5 psi |
| <b>Specific Gravity</b> | 0.60    |

| PIPE SIZE (inch) |                                        |       |        |        |        |        |         |         |         |
|------------------|----------------------------------------|-------|--------|--------|--------|--------|---------|---------|---------|
| Nominal          | 1/2                                    | 3/4   | 1      | 1 1/4  | 1 1/2  | 2      | 2 1/2   | 3       | 4       |
| Actual ID        | 0.622                                  | 0.824 | 1.049  | 1.380  | 1.610  | 2.067  | 2.469   | 3.068   | 4.026   |
| Length (ft)      | Capacity in Cubic Feet of Gas Per Hour |       |        |        |        |        |         |         |         |
| 10               | 3,190                                  | 6,430 | 11,800 | 24,200 | 36,200 | 69,700 | 111,000 | 196,000 | 401,000 |
| 20               | 2,250                                  | 4,550 | 8,320  | 17,100 | 25,600 | 49,300 | 78,600  | 139,000 | 283,000 |
| 30               | 1,840                                  | 3,720 | 6,790  | 14,000 | 20,900 | 40,300 | 64,200  | 113,000 | 231,000 |
| 40               | 1,590                                  | 3,220 | 5,880  | 12,100 | 18,100 | 34,900 | 55,600  | 98,200  | 200,000 |
| 50               | 1,430                                  | 2,880 | 5,260  | 10,800 | 16,200 | 31,200 | 49,700  | 87,900  | 179,000 |
| 60               | 1,300                                  | 2,630 | 4,800  | 9,860  | 14,800 | 28,500 | 45,400  | 80,200  | 164,000 |
| 70               | 1,200                                  | 2,430 | 4,450  | 9,130  | 13,700 | 26,400 | 42,000  | 74,300  | 151,000 |
| 80               | 1,150                                  | 2,330 | 4,260  | 8,540  | 12,800 | 24,700 | 39,300  | 69,500  | 142,000 |
| 90               | 1,060                                  | 2,150 | 3,920  | 8,050  | 12,100 | 23,200 | 37,000  | 65,500  | 134,000 |
| 100              | 979                                    | 1,980 | 3,620  | 7,430  | 11,100 | 21,400 | 34,200  | 60,400  | 123,000 |
| 125              | 876                                    | 1,770 | 3,240  | 6,640  | 9,950  | 19,200 | 30,600  | 54,000  | 110,000 |
| 150              | 786                                    | 1,590 | 2,910  | 5,960  | 8,940  | 17,200 | 27,400  | 48,500  | 98,900  |
| 175              | 728                                    | 1,470 | 2,690  | 5,520  | 8,270  | 15,900 | 25,400  | 44,900  | 91,600  |
| 200              | 673                                    | 1,360 | 2,490  | 5,100  | 7,650  | 14,700 | 23,500  | 41,500  | 84,700  |
| 250              | 558                                    | 1,170 | 2,200  | 4,510  | 6,760  | 13,000 | 20,800  | 36,700  | 74,900  |
| 300              | 506                                    | 1,060 | 1,990  | 4,090  | 6,130  | 11,800 | 18,800  | 33,300  | 67,800  |
| 350              | 465                                    | 973   | 1,830  | 3,760  | 5,640  | 10,900 | 17,300  | 30,600  | 62,400  |
| 400              | 433                                    | 905   | 1,710  | 3,500  | 5,250  | 10,100 | 16,100  | 28,500  | 58,100  |
| 450              | 406                                    | 849   | 1,600  | 3,290  | 4,920  | 9,480  | 15,100  | 26,700  | 54,500  |
| 500              | 384                                    | 802   | 1,510  | 3,100  | 4,650  | 8,950  | 14,300  | 25,200  | 51,500  |
| 550              | 364                                    | 762   | 1,440  | 2,950  | 4,420  | 8,500  | 13,600  | 24,000  | 48,900  |
| 600              | 348                                    | 727   | 1,370  | 2,810  | 4,210  | 8,110  | 12,900  | 22,900  | 46,600  |
| 650              | 333                                    | 696   | 1,310  | 2,690  | 4,030  | 7,770  | 12,400  | 21,900  | 44,600  |
| 700              | 320                                    | 669   | 1,260  | 2,590  | 3,880  | 7,460  | 11,900  | 21,000  | 42,900  |
| 750              | 308                                    | 644   | 1,210  | 2,490  | 3,730  | 7,190  | 11,500  | 20,300  | 41,300  |
| 800              | 298                                    | 622   | 1,170  | 2,410  | 3,610  | 6,940  | 11,100  | 19,600  | 39,900  |
| 850              | 288                                    | 602   | 1,130  | 2,330  | 3,490  | 6,720  | 10,700  | 18,900  | 38,600  |
| 900              | 279                                    | 584   | 1,100  | 2,260  | 3,380  | 6,520  | 10,400  | 18,400  | 37,400  |
| 950              | 271                                    | 567   | 1,070  | 2,190  | 3,290  | 6,330  | 10,100  | 17,800  | 36,400  |
| 1,000            | 264                                    | 551   | 1,040  | 2,130  | 3,200  | 6,150  | 9,810   | 17,300  | 35,400  |
| 1,100            | 250                                    | 524   | 987    | 2,030  | 3,030  | 5,840  | 9,320   | 16,500  | 33,600  |
| 1,200            | 239                                    | 500   | 941    | 1,930  | 2,900  | 5,580  | 8,890   | 15,700  | 32,000  |
| 1,300            | 229                                    | 478   | 901    | 1,850  | 2,770  | 5,340  | 8,510   | 15,000  | 30,700  |
| 1,400            | 220                                    | 460   | 866    | 1,780  | 2,660  | 5,130  | 8,180   | 14,500  | 29,500  |
| 1,500            | 212                                    | 443   | 834    | 1,710  | 2,570  | 4,940  | 7,880   | 13,900  | 28,400  |
| 1,600            | 205                                    | 428   | 806    | 1,650  | 2,480  | 4,770  | 7,610   | 13,400  | 27,400  |
| 1,700            | 198                                    | 414   | 780    | 1,600  | 2,400  | 4,620  | 7,360   | 13,000  | 26,500  |
| 1,800            | 192                                    | 401   | 756    | 1,550  | 2,330  | 4,480  | 7,140   | 12,600  | 25,700  |
| 1,900            | 186                                    | 390   | 734    | 1,510  | 2,260  | 4,350  | 6,930   | 12,300  | 25,000  |
| 2,000            | 181                                    | 379   | 714    | 1,470  | 2,200  | 4,230  | 6,740   | 11,900  | 24,300  |

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

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

# GAS PIPING INSTALLATIONS

**TABLE 402.4(6)**  
**SEMRIGID COPPER TUBING**

|                         |                 |
|-------------------------|-----------------|
| <b>Gas</b>              | Natural         |
| <b>Inlet Pressure</b>   | Less than 2 psi |
| <b>Pressure Drop</b>    | 0.3 in. w.c.    |
| <b>Specific Gravity</b> | 0.60            |

| TUBE SIZE (inch) |       |                                        |       |       |       |       |       |       |       |       |
|------------------|-------|----------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Nominal          | K & L | 1/4                                    | 3/8   | 1/2   | 3/4   | 1     | 1 1/4 | 1 1/2 | 2     |       |
|                  | ACR   | 3/8                                    | 1/2   | 3/4   | 1     | 1 1/4 | 1 3/4 | 2     | 2 1/2 | 3     |
| Outside          |       | 0.375                                  | 0.500 | 0.625 | 0.750 | 0.875 | 1.125 | 1.375 | 1.625 | 2.125 |
| Inside           |       | 0.305                                  | 0.402 | 0.527 | 0.652 | 0.745 | 0.995 | 1.245 | 1.481 | 1.959 |
| Length (ft)      |       | Capacity in Cubic Feet of Gas Per Hour |       |       |       |       |       |       |       |       |
| 10               |       | 20                                     | 42    | 85    | 148   | 210   | 448   | 806   | 1,270 | 2,650 |
| 20               |       | 14                                     | 29    | 58    | 102   | 144   | 308   | 554   | 873   | 1,820 |
| 30               |       | 11                                     | 23    | 47    | 82    | 116   | 247   | 445   | 701   | 1,460 |
| 40               |       | 10                                     | 20    | 40    | 70    | 99    | 211   | 381   | 600   | 1,250 |
| 50               |       | NA                                     | 17    | 35    | 62    | 88    | 187   | 337   | 532   | 1,110 |
| 60               |       | NA                                     | 16    | 32    | 56    | 79    | 170   | 306   | 482   | 1,000 |
| 70               |       | NA                                     | 14    | 29    | 52    | 73    | 156   | 281   | 443   | 924   |
| 80               |       | NA                                     | 13    | 27    | 48    | 68    | 145   | 262   | 413   | 859   |
| 90               |       | NA                                     | 13    | 26    | 45    | 64    | 136   | 245   | 387   | 806   |
| 100              |       | NA                                     | 12    | 24    | 43    | 60    | 129   | 232   | 366   | 761   |
| 125              |       | NA                                     | 11    | 22    | 38    | 53    | 114   | 206   | 324   | 675   |
| 150              |       | NA                                     | 10    | 20    | 34    | 48    | 103   | 186   | 294   | 612   |
| 175              |       | NA                                     | NA    | 18    | 31    | 45    | 95    | 171   | 270   | 563   |
| 200              |       | NA                                     | NA    | 17    | 29    | 41    | 89    | 159   | 251   | 523   |
| 250              |       | NA                                     | NA    | 15    | 26    | 37    | 78    | 141   | 223   | 464   |
| 300              |       | NA                                     | NA    | 13    | 23    | 33    | 71    | 128   | 202   | 420   |
| 350              |       | NA                                     | NA    | 12    | 22    | 31    | 65    | 118   | 186   | 387   |
| 400              |       | NA                                     | NA    | 11    | 20    | 28    | 61    | 110   | 173   | 360   |
| 450              |       | NA                                     | NA    | 11    | 19    | 27    | 57    | 103   | 162   | 338   |
| 500              |       | NA                                     | NA    | 10    | 18    | 25    | 54    | 97    | 153   | 319   |
| 550              |       | NA                                     | NA    | NA    | 17    | 24    | 51    | 92    | 145   | 303   |
| 600              |       | NA                                     | NA    | NA    | 16    | 23    | 49    | 88    | 139   | 289   |
| 650              |       | NA                                     | NA    | NA    | 15    | 22    | 47    | 84    | 133   | 277   |
| 700              |       | NA                                     | NA    | NA    | 15    | 21    | 45    | 81    | 128   | 266   |
| 750              |       | NA                                     | NA    | NA    | 14    | 20    | 43    | 78    | 123   | 256   |
| 800              |       | NA                                     | NA    | NA    | 14    | 20    | 42    | 75    | 119   | 247   |
| 850              |       | NA                                     | NA    | NA    | 13    | 19    | 40    | 73    | 115   | 239   |
| 900              |       | NA                                     | NA    | NA    | 13    | 18    | 39    | 71    | 111   | 232   |
| 950              |       | NA                                     | NA    | NA    | 13    | 18    | 38    | 69    | 108   | 225   |
| 1,000            |       | NA                                     | NA    | NA    | 12    | 17    | 37    | 67    | 105   | 219   |
| 1,100            |       | NA                                     | NA    | NA    | 12    | 16    | 35    | 63    | 100   | 208   |
| 1,200            |       | NA                                     | NA    | NA    | 11    | 16    | 34    | 60    | 95    | 199   |
| 1,300            |       | NA                                     | NA    | NA    | 11    | 15    | 32    | 58    | 91    | 190   |
| 1,400            |       | NA                                     | NA    | NA    | 10    | 14    | 31    | 56    | 88    | 183   |
| 1,500            |       | NA                                     | NA    | NA    | NA    | 14    | 30    | 54    | 84    | 176   |
| 1,600            |       | NA                                     | NA    | NA    | NA    | 13    | 29    | 52    | 82    | 170   |
| 1,700            |       | NA                                     | NA    | NA    | NA    | 13    | 28    | 50    | 79    | 164   |
| 1,800            |       | NA                                     | NA    | NA    | NA    | 13    | 27    | 49    | 77    | 159   |
| 1,900            |       | NA                                     | NA    | NA    | NA    | 12    | 26    | 47    | 74    | 155   |
| 2,000            |       | NA                                     | NA    | NA    | NA    | 12    | 25    | 46    | 72    | 151   |

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

## Notes:

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

**TABLE 402.4(7)**  
**SEMI-RIGID COPPER TUBING**

|                         |                 |
|-------------------------|-----------------|
| <b>Gas</b>              | Natural         |
| <b>Inlet Pressure</b>   | Less than 2 psi |
| <b>Pressure Drop</b>    | 0.5 in. w.c.    |
| <b>Specific Gravity</b> | 0.60            |

| TUBE SIZE (inch) |       |                                        |               |               |               |               |                |                |                |       |
|------------------|-------|----------------------------------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|-------|
| Nominal          | K & L | $\frac{1}{4}$                          | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{5}{8}$ | $\frac{3}{4}$ | 1              | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2     |
|                  | ACR   | $\frac{3}{8}$                          | $\frac{1}{2}$ | $\frac{5}{8}$ | $\frac{3}{4}$ | $\frac{7}{8}$ | $1\frac{1}{8}$ | $1\frac{3}{8}$ | —              | —     |
| Outside          |       | 0.375                                  | 0.500         | 0.625         | 0.750         | 0.875         | 1.125          | 1.375          | 1.625          | 2.125 |
| Inside           |       | 0.305                                  | 0.402         | 0.527         | 0.652         | 0.745         | 0.995          | 1.245          | 1.481          | 1.959 |
| Length (ft)      |       | Capacity in Cubic Feet of Gas Per Hour |               |               |               |               |                |                |                |       |
| 10               |       | 27                                     | 55            | 111           | 195           | 276           | 590            | 1,060          | 1,680          | 3,490 |
| 20               |       | 18                                     | 38            | 77            | 134           | 190           | 406            | 730            | 1,150          | 2,400 |
| 30               |       | 15                                     | 30            | 61            | 107           | 152           | 326            | 586            | 925            | 1,930 |
| 40               |       | 13                                     | 26            | 53            | 92            | 131           | 279            | 502            | 791            | 1,650 |
| 50               |       | 11                                     | 23            | 47            | 82            | 116           | 247            | 445            | 701            | 1,460 |
| 60               |       | 10                                     | 21            | 42            | 74            | 105           | 224            | 403            | 635            | 1,320 |
| 70               |       | NA                                     | 19            | 39            | 68            | 96            | 206            | 371            | 585            | 1,220 |
| 80               |       | NA                                     | 18            | 36            | 63            | 90            | 192            | 345            | 544            | 1,130 |
| 90               |       | NA                                     | 17            | 34            | 59            | 84            | 180            | 324            | 510            | 1,060 |
| 100              |       | NA                                     | 16            | 32            | 56            | 79            | 170            | 306            | 482            | 1,000 |
| 125              |       | NA                                     | 14            | 28            | 50            | 70            | 151            | 271            | 427            | 890   |
| 150              |       | NA                                     | 13            | 26            | 45            | 64            | 136            | 245            | 387            | 806   |
| 175              |       | NA                                     | 12            | 24            | 41            | 59            | 125            | 226            | 356            | 742   |
| 200              |       | NA                                     | 11            | 22            | 39            | 55            | 117            | 210            | 331            | 690   |
| 250              |       | NA                                     | NA            | 20            | 34            | 48            | 103            | 186            | 294            | 612   |
| 300              |       | NA                                     | NA            | 18            | 31            | 44            | 94             | 169            | 266            | 554   |
| 350              |       | NA                                     | NA            | 16            | 28            | 40            | 86             | 155            | 245            | 510   |
| 400              |       | NA                                     | NA            | 15            | 26            | 38            | 80             | 144            | 228            | 474   |
| 450              |       | NA                                     | NA            | 14            | 25            | 35            | 75             | 135            | 214            | 445   |
| 500              |       | NA                                     | NA            | 13            | 23            | 33            | 71             | 128            | 202            | 420   |
| 550              |       | NA                                     | NA            | 13            | 22            | 32            | 68             | 122            | 192            | 399   |
| 600              |       | NA                                     | NA            | 12            | 21            | 30            | 64             | 116            | 183            | 381   |
| 650              |       | NA                                     | NA            | 12            | 20            | 29            | 62             | 111            | 175            | 365   |
| 700              |       | NA                                     | NA            | 11            | 20            | 28            | 59             | 107            | 168            | 350   |
| 750              |       | NA                                     | NA            | 11            | 19            | 27            | 57             | 103            | 162            | 338   |
| 800              |       | NA                                     | NA            | 10            | 18            | 26            | 55             | 99             | 156            | 326   |
| 850              |       | NA                                     | NA            | 10            | 18            | 25            | 53             | 96             | 151            | 315   |
| 900              |       | NA                                     | NA            | NA            | 17            | 24            | 52             | 93             | 147            | 306   |
| 950              |       | NA                                     | NA            | NA            | 17            | 24            | 50             | 90             | 143            | 297   |
| 1,000            |       | NA                                     | NA            | NA            | 16            | 23            | 49             | 88             | 139            | 289   |
| 1,100            |       | NA                                     | NA            | NA            | 15            | 22            | 46             | 84             | 132            | 274   |
| 1,200            |       | NA                                     | NA            | NA            | 15            | 21            | 44             | 80             | 126            | 262   |
| 1,300            |       | NA                                     | NA            | NA            | 14            | 20            | 42             | 76             | 120            | 251   |
| 1,400            |       | NA                                     | NA            | NA            | 13            | 19            | 41             | 73             | 116            | 241   |
| 1,500            |       | NA                                     | NA            | NA            | 13            | 18            | 39             | 71             | 111            | 232   |
| 1,600            |       | NA                                     | NA            | NA            | 13            | 18            | 38             | 68             | 108            | 224   |
| 1,700            |       | NA                                     | NA            | NA            | 12            | 17            | 37             | 66             | 104            | 217   |
| 1,800            |       | NA                                     | NA            | NA            | 12            | 17            | 36             | 64             | 101            | 210   |
| 1,900            |       | NA                                     | NA            | NA            | 11            | 16            | 35             | 62             | 98             | 204   |
| 2,000            |       | NA                                     | NA            | NA            | 11            | 16            | 34             | 60             | 95             | 199   |

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

**Notes:**

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

# GAS PIPING INSTALLATIONS

**TABLE 402.4(8)**  
**SEMRIGID COPPER TUBING**

|                         |                 |
|-------------------------|-----------------|
| <b>Gas</b>              | Natural         |
| <b>Inlet Pressure</b>   | Less than 2 psi |
| <b>Pressure Drop</b>    | 1.0 in. w.c.    |
| <b>Specific Gravity</b> | 0.60            |

| TUBE SIZE (inch) |                                        |       |       |       |       |       |       |       |       |       |
|------------------|----------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Nominal          | K & L                                  | 1/4   | 3/8   | 1/2   | 5/8   | 3/4   | 1     | 1 1/4 | 1 1/2 | 2     |
|                  | ACR                                    | 3/8   | 1/2   | 5/8   | 3/4   | 7/8   | 1 1/8 | 1 3/8 | —     | —     |
| <b>Outside</b>   |                                        | 0.375 | 0.500 | 0.625 | 0.750 | 0.875 | 1.125 | 1.375 | 1.625 | 2.125 |
| <b>Inside</b>    |                                        | 0.305 | 0.402 | 0.527 | 0.652 | 0.745 | 0.995 | 1.245 | 1.481 | 1.959 |
| Length (ft)      | Capacity in Cubic Feet of Gas Per Hour |       |       |       |       |       |       |       |       |       |
| 10               | 39                                     | 80    | 162   | 283   | 402   | 859   | 1,550 | 2,440 | 5,080 |       |
| 20               | 27                                     | 55    | 111   | 195   | 276   | 590   | 1,060 | 1,680 | 3,490 |       |
| 30               | 21                                     | 44    | 89    | 156   | 222   | 474   | 853   | 1,350 | 2,800 |       |
| 40               | 18                                     | 38    | 77    | 134   | 190   | 406   | 730   | 1,150 | 2,400 |       |
| 50               | 16                                     | 33    | 68    | 119   | 168   | 359   | 647   | 1,020 | 2,130 |       |
| 60               | 15                                     | 30    | 61    | 107   | 152   | 326   | 586   | 925   | 1,930 |       |
| 70               | 13                                     | 28    | 57    | 99    | 140   | 300   | 539   | 851   | 1,770 |       |
| 80               | 13                                     | 26    | 53    | 92    | 131   | 279   | 502   | 791   | 1,650 |       |
| 90               | 12                                     | 24    | 49    | 86    | 122   | 262   | 471   | 742   | 1,550 |       |
| 100              | 11                                     | 23    | 47    | 82    | 116   | 247   | 445   | 701   | 1,460 |       |
| 125              | NA                                     | 20    | 41    | 72    | 103   | 219   | 394   | 622   | 1,290 |       |
| 150              | NA                                     | 18    | 37    | 65    | 93    | 198   | 357   | 563   | 1,170 |       |
| 175              | NA                                     | 17    | 34    | 60    | 85    | 183   | 329   | 518   | 1,080 |       |
| 200              | NA                                     | 16    | 32    | 56    | 79    | 170   | 306   | 482   | 1,000 |       |
| 250              | NA                                     | 14    | 28    | 50    | 70    | 151   | 271   | 427   | 890   |       |
| 300              | NA                                     | 13    | 26    | 45    | 64    | 136   | 245   | 387   | 806   |       |
| 350              | NA                                     | 12    | 24    | 41    | 59    | 125   | 226   | 356   | 742   |       |
| 400              | NA                                     | 11    | 22    | 39    | 55    | 117   | 210   | 331   | 690   |       |
| 450              | NA                                     | 10    | 21    | 36    | 51    | 110   | 197   | 311   | 647   |       |
| 500              | NA                                     | NA    | 20    | 34    | 48    | 103   | 186   | 294   | 612   |       |
| 550              | NA                                     | NA    | 19    | 32    | 46    | 98    | 177   | 279   | 581   |       |
| 600              | NA                                     | NA    | 18    | 31    | 44    | 94    | 169   | 266   | 554   |       |
| 650              | NA                                     | NA    | 17    | 30    | 42    | 90    | 162   | 255   | 531   |       |
| 700              | NA                                     | NA    | 16    | 28    | 40    | 86    | 155   | 245   | 510   |       |
| 750              | NA                                     | NA    | 16    | 27    | 39    | 83    | 150   | 236   | 491   |       |
| 800              | NA                                     | NA    | 15    | 26    | 38    | 80    | 144   | 228   | 474   |       |
| 850              | NA                                     | NA    | 15    | 26    | 36    | 78    | 140   | 220   | 459   |       |
| 900              | NA                                     | NA    | 14    | 25    | 35    | 75    | 135   | 214   | 445   |       |
| 950              | NA                                     | NA    | 14    | 24    | 34    | 73    | 132   | 207   | 432   |       |
| 1,000            | NA                                     | NA    | 13    | 23    | 33    | 71    | 128   | 202   | 420   |       |
| 1,100            | NA                                     | NA    | 13    | 22    | 32    | 68    | 122   | 192   | 399   |       |
| 1,200            | NA                                     | NA    | 12    | 21    | 30    | 64    | 116   | 183   | 381   |       |
| 1,300            | NA                                     | NA    | 12    | 20    | 29    | 62    | 111   | 175   | 365   |       |
| 1,400            | NA                                     | NA    | 11    | 20    | 28    | 59    | 107   | 168   | 350   |       |
| 1,500            | NA                                     | NA    | 11    | 19    | 27    | 57    | 103   | 162   | 338   |       |
| 1,600            | NA                                     | NA    | 10    | 18    | 26    | 55    | 99    | 156   | 326   |       |
| 1,700            | NA                                     | NA    | 10    | 18    | 25    | 53    | 96    | 151   | 315   |       |
| 1,800            | NA                                     | NA    | NA    | 17    | 24    | 52    | 93    | 147   | 306   |       |
| 1,900            | NA                                     | NA    | NA    | 17    | 24    | 50    | 90    | 143   | 297   |       |
| 2,000            | NA                                     | NA    | NA    | 16    | 23    | 49    | 88    | 139   | 289   |       |

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

## Notes:

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

**TABLE 402.4(9)**  
**SEMI-RIGID COPPER TUBING**

|                         |                   |
|-------------------------|-------------------|
| <b>Gas</b>              | Natural           |
| <b>Inlet Pressure</b>   | Less than 2.0 psi |
| <b>Pressure Drop</b>    | 17.0 in w.c.      |
| <b>Specific Gravity</b> | 0.60              |

| <b>TUBE SIZE (inch)</b> |                  |                                               |               |               |               |               |                |                |                |        |
|-------------------------|------------------|-----------------------------------------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|--------|
| <b>Nominal</b>          | <b>K &amp; L</b> | $\frac{1}{4}$                                 | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{5}{8}$ | $\frac{3}{4}$ | 1              | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2      |
|                         | <b>ACR</b>       | $\frac{3}{8}$                                 | $\frac{1}{2}$ | $\frac{5}{8}$ | $\frac{3}{4}$ | $\frac{7}{8}$ | $1\frac{1}{8}$ | $1\frac{3}{8}$ | ---            | ---    |
| <b>Outside</b>          |                  | 0.375                                         | 0.500         | 0.625         | 0.750         | 0.875         | 1.125          | 1.375          | 1.625          | 2.125  |
| <b>Inside</b>           |                  | 0.305                                         | 0.402         | 0.527         | 0.652         | 0.745         | 0.995          | 1.245          | 1.481          | 1.959  |
| <b>Length (ft)</b>      |                  | <b>Capacity in Cubic Feet of Gas Per Hour</b> |               |               |               |               |                |                |                |        |
| 10                      |                  | 190                                           | 391           | 796           | 1,390         | 1,970         | 4,220          | 7,590          | 12,000         | 24,900 |
| 20                      |                  | 130                                           | 269           | 547           | 956           | 1,360         | 2,900          | 5,220          | 8,230          | 17,100 |
| 30                      |                  | 105                                           | 216           | 439           | 768           | 1,090         | 2,330          | 4,190          | 6,610          | 13,800 |
| 40                      |                  | 90                                            | 185           | 376           | 657           | 932           | 1,990          | 3,590          | 5,650          | 11,800 |
| 50                      |                  | 79                                            | 164           | 333           | 582           | 826           | 1,770          | 3,180          | 5,010          | 10,400 |
| 60                      |                  | 72                                            | 148           | 302           | 528           | 749           | 1,600          | 2,880          | 4,540          | 9,460  |
| 70                      |                  | 66                                            | 137           | 278           | 486           | 689           | 1,470          | 2,650          | 4,180          | 8,700  |
| 80                      |                  | 62                                            | 127           | 258           | 452           | 641           | 1,370          | 2,460          | 3,890          | 8,090  |
| 90                      |                  | 58                                            | 119           | 243           | 424           | 601           | 1,280          | 2,310          | 3,650          | 7,590  |
| 100                     |                  | 55                                            | 113           | 229           | 400           | 568           | 1,210          | 2,180          | 3,440          | 7,170  |
| 125                     |                  | 48                                            | 100           | 203           | 355           | 503           | 1,080          | 1,940          | 3,050          | 6,360  |
| 150                     |                  | 44                                            | 90            | 184           | 321           | 456           | 974            | 1,750          | 2,770          | 5,760  |
| 175                     |                  | 40                                            | 83            | 169           | 296           | 420           | 896            | 1,610          | 2,540          | 5,300  |
| 200                     |                  | 38                                            | 77            | 157           | 275           | 390           | 834            | 1,500          | 2,370          | 4,930  |
| 250                     |                  | 33                                            | 69            | 140           | 244           | 346           | 739            | 1,330          | 2,100          | 4,370  |
| 300                     |                  | 30                                            | 62            | 126           | 221           | 313           | 670            | 1,210          | 1,900          | 3,960  |
| 350                     |                  | 28                                            | 57            | 116           | 203           | 288           | 616            | 1,110          | 1,750          | 3,640  |
| 400                     |                  | 26                                            | 53            | 108           | 189           | 268           | 573            | 1,030          | 1,630          | 3,390  |
| 450                     |                  | 24                                            | 50            | 102           | 177           | 252           | 538            | 968            | 1,530          | 3,180  |
| 500                     |                  | 23                                            | 47            | 96            | 168           | 238           | 508            | 914            | 1,440          | 3,000  |
| 550                     |                  | 22                                            | 45            | 91            | 159           | 226           | 482            | 868            | 1,370          | 2,850  |
| 600                     |                  | 21                                            | 43            | 87            | 152           | 215           | 460            | 829            | 1,310          | 2,720  |
| 650                     |                  | 20                                            | 41            | 83            | 145           | 206           | 441            | 793            | 1,250          | 2,610  |
| 700                     |                  | 19                                            | 39            | 80            | 140           | 198           | 423            | 762            | 1,200          | 2,500  |
| 750                     |                  | 18                                            | 38            | 77            | 135           | 191           | 408            | 734            | 1,160          | 2,410  |
| 800                     |                  | 18                                            | 37            | 74            | 130           | 184           | 394            | 709            | 1,120          | 2,330  |
| 850                     |                  | 17                                            | 35            | 72            | 126           | 178           | 381            | 686            | 1,080          | 2,250  |
| 900                     |                  | 17                                            | 34            | 70            | 122           | 173           | 370            | 665            | 1,050          | 2,180  |
| 950                     |                  | 16                                            | 33            | 68            | 118           | 168           | 359            | 646            | 1,020          | 2,120  |
| 1,000                   |                  | 16                                            | 32            | 66            | 115           | 163           | 349            | 628            | 991            | 2,060  |
| 1,100                   |                  | 15                                            | 31            | 63            | 109           | 155           | 332            | 597            | 941            | 1,960  |
| 1,200                   |                  | 14                                            | 29            | 60            | 104           | 148           | 316            | 569            | 898            | 1,870  |
| 1,300                   |                  | 14                                            | 28            | 57            | 100           | 142           | 303            | 545            | 860            | 1,790  |
| 1,400                   |                  | 13                                            | 27            | 55            | 96            | 136           | 291            | 524            | 826            | 1,720  |
| 1,500                   |                  | 13                                            | 26            | 53            | 93            | 131           | 280            | 505            | 796            | 1,660  |
| 1,600                   |                  | 12                                            | 25            | 51            | 89            | 127           | 271            | 487            | 768            | 1,600  |
| 1,700                   |                  | 12                                            | 24            | 49            | 86            | 123           | 262            | 472            | 744            | 1,550  |
| 1,800                   |                  | 11                                            | 24            | 48            | 84            | 119           | 254            | 457            | 721            | 1,500  |
| 1,900                   |                  | 11                                            | 23            | 47            | 81            | 115           | 247            | 444            | 700            | 1,460  |
| 2,000                   |                  | 11                                            | 22            | 45            | 79            | 112           | 240            | 432            | 681            | 1,420  |

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

**Notes:**

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

# GAS PIPING INSTALLATIONS

**TABLE 402.4(10)**  
**SEMRIGID COPPER TUBING**

|                         |         |
|-------------------------|---------|
| <b>Gas</b>              | Natural |
| <b>Inlet Pressure</b>   | 2.0 psi |
| <b>Pressure Drop</b>    | 1.0 psi |
| <b>Specific Gravity</b> | 0.60    |

| TUBE SIZE (inch) |                                        |       |       |       |       |       |       |        |        |       |
|------------------|----------------------------------------|-------|-------|-------|-------|-------|-------|--------|--------|-------|
| Nominal          | K & L                                  | 1/4   | 3/8   | 1/2   | 5/8   | 3/4   | 1     | 1 1/4  | 1 1/2  | 2     |
| ACR              |                                        | 3/8   | 1/2   | 5/8   | 3/4   | 7/8   | 1 1/8 | 1 3/8  | —      | —     |
| Outside          |                                        | 0.375 | 0.500 | 0.625 | 0.750 | 0.875 | 1.125 | 1.375  | 1.625  | 2.125 |
| Inside           |                                        | 0.305 | 0.402 | 0.527 | 0.652 | 0.745 | 0.995 | 1.245  | 1.481  | 1.959 |
| Length (ft)      | Capacity in Cubic Feet of Gas Per Hour |       |       |       |       |       |       |        |        |       |
| 10               | 245                                    | 506   | 1,030 | 1,800 | 2,550 | 5,450 | 9,820 | 15,500 | 32,200 |       |
| 20               | 169                                    | 348   | 708   | 1,240 | 1,760 | 3,750 | 6,750 | 10,600 | 22,200 |       |
| 30               | 135                                    | 279   | 568   | 993   | 1,410 | 3,010 | 5,420 | 8,550  | 17,800 |       |
| 40               | 116                                    | 239   | 486   | 850   | 1,210 | 2,580 | 4,640 | 7,310  | 15,200 |       |
| 50               | 103                                    | 212   | 431   | 754   | 1,070 | 2,280 | 4,110 | 6,480  | 13,500 |       |
| 60               | 93                                     | 192   | 391   | 683   | 969   | 2,070 | 3,730 | 5,870  | 12,200 |       |
| 70               | 86                                     | 177   | 359   | 628   | 891   | 1,900 | 3,430 | 5,400  | 11,300 |       |
| 80               | 80                                     | 164   | 334   | 584   | 829   | 1,770 | 3,190 | 5,030  | 10,500 |       |
| 90               | 75                                     | 154   | 314   | 548   | 778   | 1,660 | 2,990 | 4,720  | 9,820  |       |
| 100              | 71                                     | 146   | 296   | 518   | 735   | 1,570 | 2,830 | 4,450  | 9,280  |       |
| 125              | 63                                     | 129   | 263   | 459   | 651   | 1,390 | 2,500 | 3,950  | 8,220  |       |
| 150              | 57                                     | 117   | 238   | 416   | 590   | 1,260 | 2,270 | 3,580  | 7,450  |       |
| 175              | 52                                     | 108   | 219   | 383   | 543   | 1,160 | 2,090 | 3,290  | 6,850  |       |
| 200              | 49                                     | 100   | 204   | 356   | 505   | 1,080 | 1,940 | 3,060  | 6,380  |       |
| 250              | 43                                     | 89    | 181   | 315   | 448   | 956   | 1,720 | 2,710  | 5,650  |       |
| 300              | 39                                     | 80    | 164   | 286   | 406   | 866   | 1,560 | 2,460  | 5,120  |       |
| 350              | 36                                     | 74    | 150   | 263   | 373   | 797   | 1,430 | 2,260  | 4,710  |       |
| 400              | 33                                     | 69    | 140   | 245   | 347   | 741   | 1,330 | 2,100  | 4,380  |       |
| 450              | 31                                     | 65    | 131   | 230   | 326   | 696   | 1,250 | 1,970  | 4,110  |       |
| 500              | 30                                     | 61    | 124   | 217   | 308   | 657   | 1,180 | 1,870  | 3,880  |       |
| 550              | 28                                     | 58    | 118   | 206   | 292   | 624   | 1,120 | 1,770  | 3,690  |       |
| 600              | 27                                     | 55    | 112   | 196   | 279   | 595   | 1,070 | 1,690  | 3,520  |       |
| 650              | 26                                     | 53    | 108   | 188   | 267   | 570   | 1,030 | 1,620  | 3,370  |       |
| 700              | 25                                     | 51    | 103   | 181   | 256   | 548   | 986   | 1,550  | 3,240  |       |
| 750              | 24                                     | 49    | 100   | 174   | 247   | 528   | 950   | 1,500  | 3,120  |       |
| 800              | 23                                     | 47    | 96    | 168   | 239   | 510   | 917   | 1,450  | 3,010  |       |
| 850              | 22                                     | 46    | 93    | 163   | 231   | 493   | 888   | 1,400  | 2,920  |       |
| 900              | 22                                     | 44    | 90    | 158   | 224   | 478   | 861   | 1,360  | 2,830  |       |
| 950              | 21                                     | 43    | 88    | 153   | 217   | 464   | 836   | 1,320  | 2,740  |       |
| 1,000            | 20                                     | 42    | 85    | 149   | 211   | 452   | 813   | 1,280  | 2,670  |       |
| 1,100            | 19                                     | 40    | 81    | 142   | 201   | 429   | 772   | 1,220  | 2,540  |       |
| 1,200            | 18                                     | 38    | 77    | 135   | 192   | 409   | 737   | 1,160  | 2,420  |       |
| 1,300            | 18                                     | 36    | 74    | 129   | 183   | 392   | 705   | 1,110  | 2,320  |       |
| 1,400            | 17                                     | 35    | 71    | 124   | 176   | 376   | 678   | 1,070  | 2,230  |       |
| 1,500            | 16                                     | 34    | 68    | 120   | 170   | 363   | 653   | 1,030  | 2,140  |       |
| 1,600            | 16                                     | 33    | 66    | 116   | 164   | 350   | 630   | 994    | 2,070  |       |
| 1,700            | 15                                     | 31    | 64    | 112   | 159   | 339   | 610   | 962    | 2,000  |       |
| 1,800            | 15                                     | 30    | 62    | 108   | 154   | 329   | 592   | 933    | 1,940  |       |
| 1,900            | 14                                     | 30    | 60    | 105   | 149   | 319   | 575   | 906    | 1,890  |       |
| 2,000            | 14                                     | 29    | 59    | 102   | 145   | 310   | 559   | 881    | 1,830  |       |

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

## Notes:

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