2021 Seattle Plumbing Code

2021 Uniform Plumbing Code® as
Amended by the City of Seattle

Includes 2021 State of Washington Amendments

IAPMO®

REVISION MARKINGS

| Solid vertical lines in the margins indicate a technical change from the requirements of the 2018 edition of the UPC and the 2018 Seattle Plumbing Code. Where a section, paragraph or table has been revised or relocated within the code, a solid vertical line appears next to the section number and title.

» A double right angle in the margin indicates that the text or a table has been relocated within the code.

→ An arrow in the margin indicates where an entire section, paragraph, or table has been deleted from the requirements of the 2021 edition of the UPC

⇨ A hollow arrow in the margin indicates where a 2021 Seattle or Washington State amendment has been deleted.

[S] A capital letter S in brackets [ ] before a section or paragraph indicates a Seattle amendment of the Seattle Plumbing Code.

[W] A capital letter W in brackets [ ] before a section or paragraph indicates a section of the Seattle Plumbing Code that has been amended in the Washington State Plumbing Code.

Information on referenced publications can be found in Chapter 17.

All pressures used in this code are gauge pressures unless otherwise indicated.

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To access the codes information pages for a specific code, go to http://codes.iapmo.org to select from the list of IAPMO codes. For Tentative Interim Amendments, go to the standard council decisions. For Errata, select the archived revision information.

FOREWORD

Origin and Development

The advantages of a statewide adopted *Uniform Plumbing Code* are recognized throughout the industry. Disorder in the industry because of widely divergent plumbing practices and the use of many different, often conflicting, plumbing codes by local jurisdictions influenced the Western Plumbing Officials Association (now the International Association of Plumbing and Mechanical Officials [IAPMO]) to form a committee. This committee of plumbing inspectors, master and journeyman plumbers, and plumbing engineers, backed by public utility companies and the plumbing industry to create a basic plumbing document for general use. The product of this effort, the first edition of the *Uniform Plumbing Code*® (UPC®) was adopted by IAPMO in 1945. The widespread use of this code over the past seven decades by jurisdictions throughout the United States and internationally is testament to its merit.

Publishing of the 2003 *Uniform Plumbing Code* was a significant milestone because it was the first time in the history of the United States a plumbing code was developed through a true consensus process. The 2021 edition represents the most current approaches in the plumbing field and is the seventh edition developed under the ANSI consensus process. Contributions to the content of this code consists of diverse interests as consumers, enforcing authorities, installers/maintainers, labor, manufacturers, research/standards/ testing laboratories, special experts, and users.

The *Uniform Plumbing Code* provides consumers with safe and sanitary plumbing systems while, at the same time, allowing latitude for innovation and new technologies. The public at large is invited and encouraged to take part in IAPMO's open consensus code development process. This code is updated every three years. The *Uniform Plumbing Code* is dedicated to all those who, in working to achieve "the ultimate plumbing code," have unselfishly devoted their time, effort, and personal funds to create and maintain this, the finest plumbing code in existence today.

The *Uniform Plumbing Code* updates every three years in revision cycles that begin twice each year that takes two years to complete.

Each revision cycle advances according to a published schedule that includes final dates for all major events and contains four basic steps as follows:
1. Public and Committee Proposal Stage;
2. Comment Stage;
3. Association Technical Meeting;
4. Council Appeals and Issuance of Code.

IAPMO develops "full consensus" codes built on a foundation of maximum participation and agreement by a broad range of interests. This philosophy has led to producing technically sound codes that promote health and safety, yet do not stifle design or development.

It is important to stress that the process remains committed to the principles of consensus code development where consensus Technical Committees and Correlating Committees revise codes. The public and membership is offered multiple opportunities to debate, provide input and raise concerns through Amending Motions at the annual Assembly Consideration Session. Anyone may submit an appeal related to the issuance of a document through the IAPMO Standards Council.

The 2021 *Uniform Plumbing Code* is supported by the Mechanical Contractors Association of America (MCAA), the Plumbing-Heating-Cooling Contractors National Association (PHCC-NA), the United Association (UA), and the World Plumbing Council (WPC). The presence of these logos, while reflecting support, does not imply any ownership of the copyright to the UPC, which is held exclusively by IAPMO. Further, the logos of these associations indicate the support of IAPMO's open consensus process being used to develop IAPMO's codes and standards.

The addresses of the organizations are as follows:
ASSE – 18927 Hickory Creek Drive, Suite 220 • Mokena, IL 60448 • (708) 995-3019
MCAA – 1385 Piccard Drive • Rockville, MD 20850 • (301) 869-5800
PHCC-NA – PO Box 6808 • Falls Church, VA 22040-6808 • (800) 533-7694
UA – Three Park Place • Annapolis, MD 21401 • (410) 269-2000
WPC – World Plumbing Council Secretariat, Auf der Mauer 11 • Postfach CH 8021 • Zurich, Switzerland • www.WorldPlumbing.org

Adoption

The *Uniform Plumbing Code* is available for adoption and use by jurisdictions in the United States and Internationally. Its use within a governmental jurisdiction is accomplished through adoption by reference in accordance with applicable jurisdictional laws. At adoption, jurisdictions should insert the applicable information in bracketed words in the sample ordinance. The sample legislation for adoption of the *Uniform Plumbing Code* on page xiii provides key components, regulations and resolutions.

Revision Markings

Solid vertical lines in the margins indicate a technical change from the requirements of the 2018 edition. An arrow (⬅) in the margin indicates where an entire section, paragraph, exception, figure, or table has been deleted, or an item in a list of items or a table has been deleted.

A double right angle (≪) in the margin indicates that the text or a table has been relocated within the code. The table found on page xv points out the relocations in the 2021 edition of the *Uniform Plumbing Code*.

TIA TIA indicates that the revision is the result of a Tentative Interim Amendment.
TIA
TIA For further information on tentative interim amendments see Section 5 of the IAPMO
TIA Regulations Governing Committee Projects available at http://codes.iapmo.org/

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Text that is extracted pursuant to IAPMO's Extract Guidelines, but outside of the regular revision process is denoted with the use of the source document in the margin. This text is not fully processed by IAPMO in accordance with ANSI's public announcement consensus requirements for an American National Standard (ANS) nor approved by ANSI's Board of Standards Review. The next revision cycle processes such text in accordance with those requirements.

FORMAT OF THE UNIFORM PLUMBING CODE

The format of the *Uniform Plumbing Code* (UPC) arranges each chapter in accordance with a specific subject matter. However, Chapter 3 is dedicated to general requirements that are applicable to every chapter. The subject matters are divided as follows:

CHAPTERS	SUBJECTS
1	Administration
2	Definitions
3	General Regulations
4	Plumbing Fixtures and Fixture Fittings
5	Water Heaters
6	Water Supply and Distribution
7	Sanitary Drainage
8	Indirect Wastes
9	Vents
10	Traps and Interceptors
11	Storm Drainage
12	Fuel Gas Piping
13	Health Care Facilities and Medical Gas and Medical Vacuum Systems
14	Firestop Protection
15	Alternate Water Sources for Nonpotable Applications
16	Nonpotable Rainwater Catchment Systems
17	Referenced Standards
Appendix A	Recommended Rules for Sizing the Water Supply System
Appendix B	Explanatory Notes on Combination Waste and Vent Systems
Appendix C	Alternate Plumbing Systems
Appendix D	Sizing Storm Water Drainage Systems
Appendix E	Manufactured/Mobile Home Parks and Recreational Vehicle Parks
Appendix F	Firefighter Breathing Air Replenishment Systems
Appendix G	Sizing of Venting Systems
Appendix H	Private Sewage Disposal Systems
Appendix I	Installation Standards
Appendix J	Combination of Indoor and Outdoor Combustion and Ventilation Opening Design
Appendix K	Potable Rainwater Catchment Systems
Appendix L	Sustainable Practices
Appendix M	Peak Water Demand Calculator
Appendix N	Impact of Water Temperature on the Potential for Scalding and Legionella Growth

The following is a summary of the scope and intent of the provisions addressed within the chapters and appendices of the *Uniform Plumbing Code*:

Chapter 1 Administration.

Chapter 1 regulates the application, enforcement, and administration of subsequent requirements of the code. As well as establishing the scope of the code, this chapter is concerned with enforcing the requirements contained in the body of the code. A plumbing code, as with any other code, is intended to be adopted as a legally enforceable document to safeguard health, safety, property and public welfare. The code cannot be effective without satisfactory provisions for its administration and enforcement. The Authority Having Jurisdiction is to review the proposed and completed work and to decide whether a plumbing system conforms to the code requirements. As a public servant, the Authority Having Jurisdiction enforces the code in an unbiased, proper manner. The design professional is responsible for the design of a safe plumbing system. The contractor is responsible for installing the system in accordance with the plans.

Chapter 2 Definitions.

To maintain consistency and encourage the use of common terminology, Chapter 2 establishes definitions to provide clarity of terms and promote the use of a common language throughout the code. Understanding definitions within the context of their application enables greater collaboration, efficiency, standardization and interpretation in applying and enforcing terms used throughout the code. Codes are technical documents, and every term can impact the meaning of the code text. Terms not defined have a normally accepted meaning.

Chapter 3 General Regulations.

Chapter 3 regulates the general requirements, not specific to other chapters, for installing plumbing systems. Many regulations are not specific plumbing requirements, but relate to the overall plumbing system. This chapter contains safety requirements for installing plumbing and also contains nonplumbing requirements for identifying pipe, pipe fittings, traps, fixtures, materials and devices used in plumbing systems. Listing method of approval, based on applicable nationally recognized standards, for the safe and proper installation of plumbing systems is essential to ensure protection of public health, safety, and welfare. The safety requirements provide protection for piping, material, and structures, with provisions for installation practices, removing stress and strain of the pipe, sleeving, and hanger support. The building's structural stability is protected by the regulations for cutting and notching of structural members.

Chapter 4 Plumbing Fixtures and Fixture Fittings.

This chapter regulates the minimum number of plumbing fixtures of a specific type and quality for each building. The fixtures must be properly installed to be usable by the individuals occupying the building. The quality and design of every fixture must conform to the applicable referenced standard. Compliance with this chapter will result in a building or structure having acceptable plumbing fixtures for the sanitary, hygienic, cleaning, washing and food preparation needs of the occupants.

Chapter 5 Water Heaters.

Chapter 5 regulates the design, approval, installation, and safety devices of fuel burning and other types of water heaters with the combustion air requirements for ventilation and dilution of flue gases for appliances installed in buildings. This chapter does not apply to direct-vent appliances. In addition, this chapter regulates the design, construction, installation, maintenance of chimneys, vents and their connections to fuel burning appliances. Methods to supply combustion air may be supplied from an indoor air supply, outdoor air supply, a combination of indoor and outdoor air supply, mechanical air supply, or an engineered system. Combustion air provisions are based on the number of openings and the total opening size required based on the total energy input rating of the appliance. Acceptable air supply for combustion and ventilation is necessary for proper operation of fuel burning appliances. A shortage of combustion air can result in incomplete combustion and production of poisonous gases, such as carbon monoxide or appliance overheating. Ventilation air provides cooling for the appliance casing and internal controls. Inadequate ventilation of the space in which an appliance is installed can result in increased surrounding temperatures that stress the appliance itself or other appliances in the vicinity.

Chapter 6 Water Supply and Distribution.

Chapter 6 regulates the design, material and installation of water supply and distribution systems, including residential fire sprinklers. The water supply and distribution system is designed to achieve the correct water pressure and flow rates and avoid cross connections. For fixtures to perform properly, an acceptable supply of potable water is essential to their operation

and use. Cross connections and backflow are ranked as the highest priority because of the long history of recognized health risks posed by cross connections, outbreaks, or cases of waterborne disease. Piping materials and components are evaluated for their possible effect on the potable water with which they are in contact. The intent is to control the potential adverse health effects produced by indirect additives, products, and materials that come in contact with potable water. When selecting materials for water supply and distribution systems, consider water pressure, water temperature, compatibility with the water supply, durability, support, and sustainability.

In addition, this chapter regulates the design, location, materials, and installation of multipurpose and stand-alone sprinkler systems that do not include the use of antifreeze. Where systems are installed as a portion of the water distribution system under the requirements of this chapter and are not provided with a fire department connection, backflow protection for the water supply system is not required.

Chapter 7 Sanitary Drainage.

This chapter regulates the design and installation of sanitary drainage systems to ensure they will work as intended. Drainage piping should not be oversized nor undersized, and constructed of approved materials to guard against fouling, deposit of solids, clogging, and with cleanouts so arranged that the pipes may be readily cleaned. The purpose of the sanitary drainage system is to remove effluent discharged from plumbing fixtures and other equipment to an approved point of disposal, such as a public sanitary system or private sewage disposal system.

The basics of a sanitary drainage system include public and private sewage disposal; selection of materials; installation of the building drain and sewer; joining methods for pipe and fittings; drainage fixture units for sizing the drainage system; sumps and ejectors; vent sizing and length of vents; and testing.

Chapter 8 Indirect Wastes.

Chapter 8 regulates indirect waste connections that are required for plumbing fixtures and plumbing appliances dealing with food preparation, dishwashing, potable liquids, and similar equipment. An indirect connection prevents sewage from backing up into a fixture or appliance, thus providing protection against potential health hazards. The waste pipe discharges through an air gap or air break into a waste receptor or standpipe. The protection in the form of an air gap is necessary when the contamination is a potential health hazard or cross connection with the potable water system. Where there is no possibility of contaminating the potable water (nonpotable discharge), the indirect waste pipe may connect in the form of an air break. This method is often preferred to prevent splashing. In addition, health care facilities and special wastes must be protected from contamination that may result from the connection to the drainage system. The waste must be treated to prevent any damage to the piping or sewage treatment process. Waste receptors are sized and designed to prevent splashing and allow for peak discharge conditions.

Chapter 9 Vents.

Chapter 9 regulates the material, design, and installation of vents. A vent system is a pipe or pipes installed in a drainage system that provide a flow of air to and from the system to ventilate it, provide a circulation of air to eliminate trap siphonage, and reduce back-pressure and vacuum surge. In addition, vents provide the rapid and silent flow of waste without exposing occupants of the building to any sewer gases. Proper installation of vents is crucial, as a telltale sign that there is a problem in the drain and vent system is related to the elevation of the horizontal portion of the venting. Venting is not limited to sanitary drainage systems. Venting methods are applicable to other drainage systems such as those for chemical waste, graywater waste, and clear water waste. Sizing the venting system is directly tied to the design of the drainage system. For example, the velocities in the drainage system and its peak flow rates affect the diameters in the venting system. Where the vertical distance between a fixture outlet and trap is excessive, velocities in the entire drainage system will be greater than those in the vent sizing table. All venting methods in this chapter are categorized as either dry vents or wet vents. Vent stacks, stack vents, branch vents, island vents, relief vents, and individual vents are dry vents. Wet vents (horizontal or vertical), circuit vents, combination drain and vents are versions of “wet venting” in which the vent is wetted by drainage flow.

Chapter 10 Traps and Interceptors.

Chapter 10 regulates the material, design, and installation of traps, interceptors, and separators. Traps are required on drainage type plumbing fixtures and must be self-scouring without interior partitions. Interceptors, on the other hand, are designed to control what goes down a drain. Interceptors are used to keep harmful substances from entering the sanitary

drainage system, such as grease, sand, oil and other materials. The retained materials need periodic removal to maintain efficiency and function of the separating device. The capacity of an interceptor is based on retention and flow rate. There are many types of interceptors that are used at beauty salons, hospitals, meat, fish or foul packaging, refineries, repair garages, gas stations, car washing facilities, various plants, factories, and processing sites. The designer of the building is responsible for locating interceptors with the expectation for the frequency of maintenance, ease of cleaning and floor space for equipment.

Chapter 11 Storm Drainage.

Chapter 11 regulates the removal of stormwater from roofs, yards, paved areas, and similar areas. The objective of storm drainage systems is to provide a conduit or channel through which runoff will be carried from a point of collection to a point of disposal; this protects the property and the public from the uncontrolled flow of runoff and ensures that drains and inlets are adequately sized to receive the volume of runoff that flows to the drains. For the purpose of system design, it's necessary to specify the duration of a selected storm. All methods used to determine volumes and peak flow use historical data. Drain location must be coordinated with the architectural design of the building. When selecting the type of roof drain to use, the roof construction and its thickness, along with the intended use of the roof, are required. Where the roof perimeter extends above the roof in such a manner that water is entrapped and causes ponding, or if any portion of the roof is designed so water can pond, secondary drainage is required. Where secondary drainage is required, scuppers, or a secondary system of roof drains and pipes, are installed to prevent the accumulation of excessive rainwater.

Chapter 12 Fuel Gas Piping.

Chapter 12 regulates the installation of gas piping in a building, structure or within the property lines of buildings up to 5 psi. Gas piping systems must supply the minimum volume of gas required by each gas appliance to perform their proper operation under working conditions without exceeding the maximum pressure specified by each manufacturer. Because of the hazards associated with fuel gas, it is important to ensure the gas system has been inspected and tested, and that it is safe to turn on the gas supply to the building.

Chapter 13 Health Care Facilities and Medical Gas and Medical Vacuum Systems.

Chapter 13 regulates the installation, inspection, testing, maintenance, performance, and safe practices for medical gas and vacuum systems located in health care facilities. This chapter addresses the installation and maintenance of health care fixtures, devices, and equipment. The purpose of medical gas and medical vacuum systems is to provide safe and sufficient flows at required pressures to the medical gas outlet or vacuum inlet terminals. System design and layout should allow convenient access by the medical staff to outlet and inlet terminals, valves, and equipment during patient care or emergencies, as safety is of primary concern.

Chapter 14 Firestop Protection.

Chapter 14 regulates piping penetrations of fire-resistance-rated walls, partitions, floors, floor and ceiling assemblies, roof and ceiling assemblies, or shaft enclosures through firestopping. To firestop is to create a physical barrier that impedes the spread of smoke, gases, and flames from one compartment in the building design to the next. The firestop is seen as a part that is essential to protecting the lives of people who live or work in the structure, increasing the chances of not succumbing to smoke or gases before they are able to evacuate the building. Fireproofing of this type helps to restore the fire-resistant properties of the building materials before the openings were created as part of the construction process.

Chapter 15 Alternate Water Sources for Nonpotable Applications.

Chapter 15 regulates gray water sources, reclaimed (recycled) water sources and on-site treated nonpotable water systems. Water sources include subsurface irrigation, subsoil irrigation, and mulch basin systems. Subsoil water irrigation provides a means to disperse shallow drip irrigation lines and mulch basins that collect and spread water in various applications. The reclaimed water provisions to on-site nonpotable water systems include gray water and other nonpotable water sources that are used for on-site applications. Water reuse is integral to sustainable water management because it allows water to remain in the environment and be preserved for future use while meeting the water requirements of the present. Water reuse reduces energy use by removing added potable water treatment, offsetting water demands, and providing water for energy production.

Chapter 16 Nonpotable Rainwater Catchment Systems.

Chapter 16 regulates nonpotable rainwater catchment systems that include irrigation; toilet and urinal flushing with proper treatment; provisions where permits are required; maintenance of alternate water sources; and minimum water quality. This chapter provides guidance on how to optimize rainwater use while ensuring there is a decrease of risk to consumers from poor design, installation, and maintenance. Rainwater harvesting is the process of capturing, channeling, and storing water runoff for later use. Most systems are constructed of three principal components: the catchment area, the collection device, and the conveyance system.

Chapter 17 Referenced Standards.

Chapter 17 provides two comprehensive tables with referenced standards. The standards listed in Table 1701.1 are applied as indicated in the applicable reference section(s). A list of additional approved standards, publications, practices, and guides that are not referenced in specific sections appear in Table 1701.2.

Referenced standards set forth specific details of accepted practices, materials specifications, or test methods in many specialized applications. Standards provide an efficient method of conveying complex information and specifications on the performance requirements for materials, products, systems, application, and installation. The manner and purpose for a standard's use and, in turn, code compliance, must be definitive in all references to the standard. If the standard is intended to be a requirement for judging code compliance, the code must state its intent for use. The standard should adequately address a defined need and at the same time specify the minimum performance requirements, technical characteristics and methods of testing, and required test results.

The referenced standards tables are organized in a manner that makes it easy to find specific standards in alphabetical order, and by acronym of the publishing agency of the standard. The tables list the title of the standard, the edition, and any addenda. Contact information for each publishing agency is provided at the end of the chapter.

Appendix A Recommended Rules for Sizing the Water Supply System.

Appendix A provides a method of sizing the water supply and distribution system that provides precise calculations to establish the proper pressures and flow to the system's fixtures. The goal of sizing the system is to deliver an acceptable volume of water to the most hydraulically remote fixture during minimum pressure and maximum flow conditions; provide satisfactory water pressure to the most hydraulically remote fixture during minimum pressure and maximum flow conditions; and to prevent excessive water velocity during maximum flow conditions.

Appendix B Explanatory Notes on Combination Waste and Vent Systems.

Appendix B contains general guidelines for the design and installation of combination waste and vent systems. These systems are designed for waste piping and are purposely oversized to serve as both a waste and vent pipe to avoid excessive pneumatic effects at fixture drains.

Appendix C Alternate Plumbing Systems.

The intent of this appendix is to provide clarification of procedures for the design and approval of engineered plumbing systems, alternate materials, and equipment that are not specifically covered in other parts of the code. Alternative methods are allowed to be used where approved by the authority having jurisdiction. Approval of alternatives is based on a demonstration showing that the method or material used is at least equivalent in strength, deflection, and capacity to that provided by the prescriptive methods and materials.

Appendix D Sizing Storm Water Drainage Systems.

Appendix D provides general guidelines for the sizing of stormwater drainage systems. There are two pieces of information that must always be a given. They are the roof size and the rate of rainfall for the area.

Appendix E Manufactured/Mobile Home Parks and Recreational Vehicle Parks.

The provisions of this appendix apply to the plumbing and drainage systems of mobile home and recreational vehicle parks. These provisions also apply to the use, maintenance, and installation for supplying fuel gas, water, electricity, and disposal of sewage from accessory buildings or structures, and building components.

Appendix F Firefighter Breathing Air Replenishment Systems.

Appendix F provides guidance on installing firefighter breathing air replenishment systems. System components include outside fire department connection panel, interior air fill panel or station, interconnected piping distribution system and pressure monitoring switch. Fire departments access the system through an outside connection panel and are able to pump air into the system. The firefighters inside the structure access the system at fill stations that are found throughout the building. The piping distribution system is made from stainless tubing or other approved materials. It delivers compressed air to the building interior air fill stations and interior air fill panels. The tubing also acts as a conduit in the interior of the building between the outside connection panel and the air storage system. If the system becomes over-pressurized, the air monitoring system also acts as a pressure relief. A system isolation valve is placed alongside each interior air fill station and interior air fill panel to isolate the system.

Appendix G Sizing of Venting Systems.

Appendix G provides added information on the sizing of gas vents. This appendix is useful to the end user for the proper sizing of venting systems. A series of examples are given that show how to use the tables and other requirements of Chapter 5.

Appendix H Private Sewage Disposal Systems.

Appendix H provides general guidelines for the materials, design, and installation of new or existing private sewage disposal systems. Where a building cannot be served by a public sewer system, the building site must be provided with a system for treating the waste water generated from the use of plumbing fixtures in the building. The appendix addresses site evaluations, materials, soil absorption systems, holding tanks, cesspools and on-site waste-water treatment systems. Private sewage disposal systems must be designed based on the soil conditions, constructed using approved materials, and installed according to prescribed dimensions.

Appendix I Installation Standards.

Installation Standards (IS) are industry standards that specify procedures for installation of plumbing and mechanical products, and the inspection methods and procedures employed for the examination of such systems. These comprehensive standards add detailed information and guidance where a manufacturer or product installation instructions may not fully address. They give the user confidence with options from industry experts for installing plumbing products and assemblies in a safe and professional manner.

Appendix J Combination of Indoor and Outdoor Combustion and Ventilation Opening Design.

Appendix J provides an example of how to determine the required combination of indoor and outdoor combustion air opening sizes for appliances. The combustion air example also provides a table that contains the required volume of a space per the appliance Btu/h input that is based on the standard method.

Appendix K Potable Rainwater Catchment Systems.

Potable rainwater catchment system is defined as a system that uses the principal of collecting and using rain from a rooftop or other man-made, aboveground collection surface. This appendix applies to new rainwater catchment installations, as well as changes, additions, maintenance, and repairs to existing installations. Rainwater harvesting is the practice of collecting the water produced during rainfall events before it has a chance to run off into a river or stream or soak into the ground and become groundwater.

Appendix L Sustainable Practices.

This appendix provides a comprehensive set of technically sound provisions that encourage sustainable practices and works toward improving the design and construction of plumbing systems that result in a positive long-term environmental impact. Environmental sustainability is important because it involves natural resources that human beings need for economic or manufactured capital. Their sustainability is defined by their reliance on infinitely available resources that are naturally occurring, constant, and free to access.

Appendix M Peak Water Demand Calculator.

This appendix provides a method for estimating the demand load for the building water supply and principal branches for single- and multi-family dwellings with water-conserving plumbing fixtures, fixture fittings, and appliances.

Appendix N Impact Of Water Temperature On The Potential For Scalding And Legionella Growth.

Legionnaires' disease is a serious issue that is a threat to many citizens. It is known that the higher the temperature, the lower the risk for Legionella growth, but the higher the temperature, the higher the possibility for scalding. This appendix addresses Legionella growth potential and scald potential within specified temperature ranges. It contains definitions for terms used to describe water temperatures such as cold, tepid, warm, tempered hot, and disinfecting hot. Since plumbing systems operate within various temperature ranges, the public has a document that identifies such temperature ranges and the "potential" dangers within these temperature ranges.

SAMPLE LEGISLATION FOR ADOPTION OF THE UNIFORM PLUMBING CODE

The Uniform Codes are designed to be adopted by jurisdictions through an ordinance. Jurisdictions wishing to adopt the 2021 *Uniform Plumbing Code* as an enforceable regulation governing plumbing systems by reference should ensure the legal basis under which adoption and implementation are included in the ordinance.

The following sample ordinance is a guide for drafting an ordinance for adoption that addresses key components regulations and resolutions.

ORDINANCE NO.

An ordinance of the [JURISDICTION] adopting the 2021 edition of the *Uniform Plumbing Code*, regulating and controlling the design, construction, quality of materials, erection, installation, alteration, repair, location, relocation, replacement, addition to, use or maintenance of plumbing systems 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 Codes Adopted by Reference. That certain documents, three (3) copies of which are on file in the office of the [JURISDICTION'S KEEPER OF RECORDS] and the [JURISDICTION], being marked and designated as the 2021 *Uniform Plumbing Code*, including Appendix Chapters [FILL IN THE APPENDIX CHAPTERS BEING ADOPTED], as published by the International Association of Plumbing and Mechanical Officials, be and is hereby adopted as the Code of the [JURISDICTION], in the State of [STATE NAME] regulating and controlling the design, construction, quality of materials, erection, installation, alteration, repair, location, relocation, replacement, addition to, use or maintenance of plumbing systems 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 such 2021 *Uniform Plumbing 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.

Section 2 Modifications. The following sections are hereby revised:
Section 101.1. Insert: [NAME OF JURISDICTION]
Section 104.5. Insert: [APPROPRIATE FEE SCHEDULE]

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

Section 4 Preemption. [JURISDICTION] hereby fully occupies and preempts the entire field of regulation of design, construction, quality of materials, erection, installation, alteration, repair, location, relocation, replacement, addition to, use or maintenance of plumbing systems; and provision for the issuance of permits and collection of fees therefor; within the boundaries of [JURISDICTION]. [AS APPROPRIATE] Cities, towns, and counties or other municipalities may enact only those laws and ordinances relating to this field as specifically authorized by state law and consistent with this ordinance. Local laws and ordinances that are inconsistent with, more restrictive than, or exceed the requirements of [ORDINANCE NO.] shall not be enacted and are hereby expressly preempted and repealed, regardless of the nature of the code, charter, or home rule status of such city, town, county, or municipality.

Section 5 Severability. 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 6 Legal Notice. 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 Violations and Penalties. [INCORPORATE PENALTIES FOR VIOLATIONS]

Section 8 Effective Date. 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.

COMMITTEE ON UNIFORM PLUMBING CODE

These lists represent the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred.

IAPMO Standards Council
Bill Erickson, Chairman
CJ Erickson Plumbing Company [U]

JT Baca, State of New Mexico [E]
Carl Crimmins, MN State Pipe Trades, Retired [SE]
James Majerowicz, Plumbers JAC LU 130 [L]
Rich Prospal, Prospal Consulting Services [C]
Linden Raimer, Raimer Consulting Services, LLC [U]
Ron Rice, City of St. Paul, Retired [C]
Robert "Bud" Riestenberg, Piping Systems, Inc. [U]

Nonvoting

Gabriella M. Davis, Secretary
International Association of Plumbing and Mechanical Officials
Hugo Aguilar, Recording Secretary
International Association of Plumbing and Mechanical Officials

IAPMO Uniform Plumbing Code Technical Committee
Dan Daniels, *Chairman*
Self [C]

Bob Adler, City of San Jose [E]
Sarah Aguilar McCabe Plumbing [I/M]
Julius Ballanco JB Engineering & Code Consulting [SE]
Domenico Barbato, City of Los Angeles Department of Building & Safety [E]
DJ Berger National ITC Corporation [U]
Raymond Boyd, United Association [L]
Jeremy Brown, NSF International [R/S/T]
Richard Church, Plastic Pipe & Fittings Association (PPFA) [M]
Pennie Feehan Copper Development Association (CDA) [M]
Dave Mann, CA State Pipe Trades [L]
Rick Moreno Astro Mechanical/CPMCA [I/M]
John Nielsen State of Idaho – Division of Building Safety [E]
Phil Ribbs PHR Consultants [SE]
Arnold Rodio Pace Setter Plumbing [I/M]
Robert Sewell UA Local 159 [L]
Matt Sigler Plumbing Manufacturers International (PMI) [M]
Billy Smith ASPE [SE]
Larry Soskin ACE Duraflo [M]
Jim Stack, Plumbing Heating Cooling Contractors (PHCC) [I/M]
Don Taylor Dittmann Plumbing [U]

Alternates

Gary Bonetti Jr, Local 342 [L]
Terry Burger, NSF International [R/S/T]
Michael Cudahy, Plastic Pipe & Fittings Association (PPFA) [M]
Shawn Hargis, City of Los Angeles Department of Building & Safety [E]
David Ledda, City/County of San Francisco [E]
James Pavesic, United Association [L]
Chuck White, Plumbing Heating Cooling Contractors (PHCC) [I/M]

Nonvoting

Heath Dehn, National Fire Protection Association (NFPA) [R/S/T]
Enrique Gonzalez, IAPMO Staff Liaison
Doug Marian, ASSE [R/S/T]
Laura Moreno, National Fire Protection Association (NFPA) [R/S/T]
David Straub, **Ex-Officio** IAPMO [E]

COMMITTEE MEMBERSHIP CLASSIFICATION ABBREVIATIONS

These classifications apply to Technical Committee members and represent their principal interest in the activity of a committee.

M *Manufacturer:* A representative of a maker or marketer of a product, assembly or system, or portion thereof, that is affected by the standard.
U *User:* A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.
I/M *Installer/Maintainer:* A representative of an entity that is in the business of installing or maintaining a product, assembly or system affected by the standard.
L *Labor:* A labor representative or employee concerned with safety in the workplace.
R/S/T *Research/Standards/Testing Laboratory:* A representative of an independent research organization; an organization that develops codes, standards or other similar documents; or an independent testing laboratory.
E *Enforcing Authority:* A representative or an agency or an organization that promulgates and/or enforces standards.
C *Consumer:* A person who is, or represents, the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in the *User* classification.
SE *Special Expert:* A person not representing any of the previous classifications, but who has special expertise in the scope of the standard or portion thereof.

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The following Appendices are not adopted:

Appendix C	Alternate Plumbing Systems
Appendix D	Sizing Storm Water Drainage Systems
Appendix E	Manufactured/Mobile Home Parks and Recreational Vehicle Parks
Appendix F	Firefighter Breathing Air Replenishment Systems
Appendix G	Sizing of Venting Systems
Appendix H	Private Sewage Disposal Systems
Appendix J	Combination of Indoor and Outdoor Combustion and Ventilation Opening Design
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CHAPTER 51-56 WAC
STATE BUILDING CODE ADOPTION AND AMENDMENT OF THE 2021 EDITION OF THE UNIFORM PLUMBING CODE

WAC 51-56-001 Authority.

These rules are adopted under the authority of Chapter 19.27 RCW.

WAC 51-56-002 Purpose.

The purpose of these rules is to implement the provisions of Chapter 19.27 RCW, which provides that the state building code council shall maintain the State Building Code in a status which is consistent with the purpose as set forth in RCW 19.27.020. In maintaining the codes, the council shall regularly review updated versions of the codes adopted under the act, and other pertinent information, and shall amend the codes as deemed appropriate by the council.

WAC 51-56-003 Uniform Plumbing Code.

The 2021 edition of the Uniform Plumbing Code, including Appendices A, B, I, and M published by the International Association of Plumbing and Mechanical Officials, is hereby adopted by reference with the following additions, deletions and exceptions: Provided that Chapters 12 and 14 of this code are not adopted. Provided further, that those requirements of the Uniform Plumbing Code relating to venting and combustion air of fuel fired appliances as found in Chapter 5 and those portions of the code addressing building sewers are not adopted.

WAC 51-56-004 Conflicts between Appendix I and the manufacturer's installation instructions.

Where a conflict exists between the provisions of Appendix I and the manufacturer's installation instructions, the conditions of the listing and the manufacturer's installation instructions shall apply.

WAC 51-56-007 Exceptions.

The exceptions and amendments to the model codes contained in the provisions of Chapter 19.27 RCW shall apply in cases of conflict with any of the provisions of these rules.

Codes referenced which are not adopted through RCW 19.27.031 or chapter 19.27A RCW shall not apply unless specifically adopted by the Authority Having Jurisdiction.

CHAPTER 1

ADMINISTRATION

Chapter 1 is entirely Seattle Amendments; changes from the 2021 Uniform Plumbing Code with WA State Amendments are not shown.

SECTION 101
TITLE, SCOPE, AND PURPOSE

101.1 Title. These regulations shall be known as the "Seattle Plumbing Code," may be cited as such, and are referred to herein as "this Code." All references to the Uniform Plumbing Code contained in this Code mean the Seattle Plumbing Code.

101.2 Scope. This Code applies to the erection, installation, alteration, repair, relocation, replacement, addition to, use or maintenance of plumbing systems within the City. The design and testing of equipment regulated by this Code are subject to the approval of the Authority Having Jurisdiction.

101.3 Purpose. 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 plumbing systems within the City.

The purpose of this code is to provide for and promote the health, safety and welfare of the general public, and not to create or otherwise establish or designate any particular class or group of persons who will or should be especially protected or benefited by the terms of this code.

101.4 Applicability of City Laws. A plumbing permit application shall be considered under applicable city law in effect on the date a valid and fully complete plumbing permit application is submitted or on a date as otherwise required by law.

101.4.1 Complete Plumbing Permit Applications. A plumbing permit application is complete if the Authority Having Jurisdiction determines it meets the requirements of Sections 107.1 and 107.6 through 107.7.7.

Exception: When the Authority Having Jurisdiction allows a plumbing permit application to be submitted in phases for portions of the building, each phased portion submittal shall meet the requirements of Sections 107.1 and 107.6 through 107.7.7 applicable to the scope of the allowed phased portion, and the plumbing permit application shall be considered complete for the purpose of Section 101.4 on the date the phased portion submittal is submitted.

101.4 2 Permit Conditions and Denial. The Authority Having Jurisdiction may impose on a permit any conditions authorized by this Code or other pertinent ordinances, regulations or laws. In addition, the Authority Having Jurisdiction may deny a permit if the Authority Having Jurisdiction determines that the proposed project or plumbing design documents do not conform to the requirements of this Code, or other pertinent laws, ordinances or regulations.

101.5 Internal Consistency. If in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive governs. If there is a conflict between a general requirement and a specific requirement, the specific requirement governs.

101.6 Referenced Codes and Standards. The codes and standards referenced in this code are part of the requirements of this code to the extent prescribed by each such reference. If differences occur between provisions of this code and referenced codes and standards, the provisions of this code 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 manufacturer's instructions apply.

101.7 Appendices. Provisions in the Uniform Plumbing Code appendices do not apply except Appendices A, B, I and M which are specifically adopted.

101.8 Metric Units. Wherever in this Code there is a conflict between metric units of measurement and U.S. customary units, the U.S. customary units govern.

101.9 References to Other Codes. Whenever an International, National or Uniform Code is referenced in this Code, it means the Seattle edition of that Code, including local amendments. References to the "Building Code," "Mechanical Code," "Fuel Gas Code," "Fire Code" and "Residential Code" mean the Seattle editions of those codes.

SECTION 102
ORGANIZATION AND DUTIES OF AUTHORITY HAVING JURISDICTION

102.1 Jurisdiction of Public Health—Seattle and King County. The Director of Public Health—Seattle and King County is the Authority Having Jurisdiction. The Director and the Director's authorized representative are authorized to administer and

enforce this code; provided, that the Director of Seattle Public Utilities or his or her authorized representative shall administer and enforce provisions relating to the inspection and approval of water meters and, where applicable, building supply piping.

102.2 Designees. The Authority Having Jurisdiction may appoint such officers, inspectors, assistants and employees as are authorized from time to time. The Authority Having Jurisdiction may authorize such employees and other agents as may be necessary to carry out the functions of the Authority Having Jurisdiction.

102.3 Right of Entry. With the consent of the owner or occupier of a building or premises, or pursuant to a lawfully issued warrant, the Authority Having Jurisdiction may enter a building or premises at any reasonable time to perform the duties imposed by this code.

102.4 Modifications. The Authority Having Jurisdiction may modify the provisions of this Code for individual cases if the Authority Having Jurisdiction finds: (1) there are practical difficulties involved in carrying out the provisions of this code; (2) the modification is in conformity with the intent and purpose of this code; and (3) the modification will provide a reasonable level of strength, effectiveness, fire resistance, durability, safety and sanitation when considered together with other safety features of the building or other relevant circumstances. The Authority Having Jurisdiction may, but is not required to, record the approval of modifications and any relevant information in the files of the Authority Having Jurisdiction or on the approved construction documents.

102.5 Liability. Nothing in this Code is intended to be nor shall be construed to create or form the basis for any liability on the part of the Authority Having Jurisdiction or the City, or their officers, employees or agents, for any injury or damage resulting from the failure of equipment to conform to the provisions of this Code, or by reason or as a consequence of any inspection, notice, order, certificate, permission or approval authorized or issued or done in connection with the implementation or enforcement of this Code, or by reason of any action or inaction on the part of the Authority Having Jurisdiction or the City related in any manner to the enforcement of this code by their officers, employees or agents.

This Code shall not be construed to lessen or relieve the responsibility of any person owning, operating or controlling any equipment, building or structure for any damages to persons or property caused by defects, nor shall the Authority Having Jurisdiction or the City of Seattle be held to have assumed any such liability by reason of the inspections authorized by this Code or any permits or certificates issued under this Code.

102.6 Responsibilities of Parties.

102.6.1 Responsibility for Compliance. Compliance with the requirements of this code is the obligation of the owner of the building, structure or premises, the authorized agent of the owner, and other persons responsible for the condition or work, and not of the Authority Having Jurisdiction or the City or any of their officers, employees or agents.

102.6.2 Responsibilities of Registered Design Professional in Responsible Charge. It is the responsibility of the registered design professional in responsible charge to ensure that the information in the plumbing system documents is complete, accurate, and, to the best of the design professional's knowledge, complies with the requirements of this Code.

102.6.3 Responsibilities of Contractor. It is the responsibility of the contractor to perform all the work in compliance with this Code, and in accordance with the approved plumbing design documents.

102.6.4 Responsibilities of Plans Examiner. It is the responsibility of the plans examiner to verify that the description of the work in the plumbing design documents is substantially complete, and to require corrections where, to the best of the plans examiner's knowledge, the plumbing design documents do not conform to this Code or other pertinent laws and ordinances.

102.6.5 Responsibilities of Field Inspector. It is the responsibility of the field inspector to conduct inspections to verify that the work in progress conforms with the approved plumbing design documents and to require corrections where, to the best of the field inspector's knowledge, the work either does not conform to the plumbing design documents or where the work is in violation of this Code or other pertinent laws and ordinances.

SECTION 103
RULES OF THE AUTHORITY HAVING JURISDICTION

103.1 Authority. The Authority Having Jurisdiction has authority to issue interpretations of this Code and to adopt and enforce rules and regulations supplemental to this Code as may be deemed necessary to clarify the application of the provisions of this Code. Such interpretations, rules and regulations shall be in conformity with the intent and purpose of this Code.

103.2 Procedure for Adoption of Rules. The Authority Having Jurisdiction shall promulgate, adopt and issue rules according to the procedures specified in the Administrative Code, Chapter 3.02 of the Seattle Municipal Code.

103.3 Construction Codes Advisory Board Committee. A committee of the Construction Codes Advisory Board may examine proposed administrative rules, and amendments relating to this Code and related provisions of other codes and make recommendations to the Authority Having Jurisdiction and to the City Council for changes in this code. The committee will be called on as needed by the Construction Codes Advisory Board.

SECTION 104
APPLICATION TO EXISTING PLUMBING SYSTEMS

104.1 Additions, Alterations, Renovations or Repairs. Additions, alterations, renovations or repairs may be made to any plumbing system without requiring the existing plumbing system to comply with all the requirements of this Code, if the addition, alteration, renovation or repair conforms to the standards required for a new plumbing system. Additions, alterations, renovations or repairs shall not cause an existing system to become unsafe, unhealthy or overloaded.

Minor additions, alterations, renovations, and repairs to existing plumbing systems may be installed in accordance with the law in effect at the time the original installation was made, if approved by the Authority Having Jurisdiction.

104.2 Existing Installations. Plumbing systems lawful at the time of the adoption of this Code may continue their use, be maintained or repaired, or have components replaced if the use, maintenance, repair, or component replacement is done in accordance with the basic original design and location, and no hazard to life, health or property has been or is created by such plumbing system.

104.3 Changes in Building Occupancy. Plumbing systems that are a part of a building or structure undergoing a change in occupancy as defined in the International Building Code shall comply with all requirements of this Code that are applicable to the new use or occupancy.

104.4 Maintenance. All plumbing systems, materials, equipment, appurtenances and all parts thereof shall be maintained in proper operating condition in accordance with the original design and in a safe and hazard-free condition. All devices or safeguards that were required by a code in effect when the plumbing system was installed shall be maintained in conformance with the code edition under which installed.

The owner or the owner's designated agent is responsible for maintenance of plumbing systems and equipment. To determine compliance with this subsection, the Authority Having Jurisdiction may cause a plumbing system or equipment to be reinspected.

104.5 Health and Safety. Where compliance with the provisions of this Code fails to eliminate or alleviate a nuisance, or other dangerous or insanitary condition that involves health or safety hazards, the owner or the owner’s agent shall install such additional plumbing and drainage facilities or shall make such repairs or alterations as ordered by the Authority Having Jurisdiction.

104.6 Landmarks—Historic Buildings and Structures. The Authority Having Jurisdiction may modify the specific requirements of this Code as it applies to landmarks and require in lieu thereof alternate requirements that, in the opinion of the Authority Having Jurisdiction, will result in a reasonable degree of safety to the public and the occupants of those buildings.

For purposes of this section, a landmark is a building or structure: that is subject to a requirement to obtain a certificate of approval from the City Landmarks Preservation Board before altering or making significant changes to specific features or characteristics, that has been nominated for designation and the City Landmarks Preservation Board has not issued a determination regarding designation, that has been designated for preservation by the City Landmarks Preservation Board, that has been designated for preservation by the State of Washington, that has been listed or determined eligible to be listed in the National Register of Historic Places, or that is located in a landmark or special review district subject to a requirement to obtain a certificate of approval before making a change to the external appearance of a structure.

SECTION 105
UNSAFE PLUMBING SYSTEM, EQUIPMENT AND HAZARD CORRECTION ORDER

105.1 Emergency Order. Whenever the Authority Having Jurisdiction finds that any plumbing system or equipment regulated by this Code is in such a dangerous and unsafe condition as to constitute an insanitary condition, which may cause an imminent hazard to life or limb, the Authority Having Jurisdiction may issue an emergency order. The emergency order may (1) direct that the plumbing system and equipment be restored to a safe and sanitary condition by a date certain; (2) require that the building, structure or premises, or portion thereof, containing the insanitary plumbing and equipment be vacated within a reasonable time to be specified in the order, or in the case of extreme danger and unsafe condition, the order may specify immediate vacation of the building, structure or premises, or portion thereof; or (3) authorize immediate disconnection of the utilities.

105.1.1 Service of Emergency Order. The order shall be posted on the premises or personally served on the owner of the building or premises or any person responsible for the condition. The order shall specify the time for compliance.

105.1.2 Effect of Emergency Order. No person may occupy a building, structure or premises, or portion thereof, after the date on which the building is required to be vacated until the building, structure or premises, or portion thereof, is restored to a safe and sanitary condition as required by the order and this Code. It is a violation for any person to fail to comply with an emergency order issued by the Authority Having Jurisdiction.

105.2 Hazard Correction Order. Whenever the Authority Having Jurisdiction finds that an unsafe plumbing system or equipment exists, the Authority Having Jurisdiction may issue a hazard correction order specifying the conditions causing the unsafe plumbing or equipment to be unsafe and directing the owner or other person responsible for the unsafe plumbing or equipment to correct the condition by a date certain. In lieu of correction, the owner may submit a report or analysis to the Authority Having Jurisdiction analyzing said conditions and establishing that the equipment is, in fact, safe. The Authority Having Jurisdiction may require that the report or analysis be prepared by a licensed engineer.

105.2.1 Service of Hazard Correction Order. The order shall be served upon the owner, agent or other responsible person by personal service or regular first class mail addressed to the last known address of such person or if no address is available after reasonable inquiry, the order may be posted in a conspicuous place on the premises. The order may also be posted if served by personal service or first class mail.

105.2.2 Effect of Hazard Correction Order. It is a violation for any person to fail to comply with a hazard correction order as specified in this subsection.

SECTION 106
ENFORCEMENT, VIOLATIONS AND PENALTIES

106.1 Violations. It is a violation of this code for any person to:

(1) Install, erect, construct, enlarge, alter, repair, replace, remodel, move, improve, remove, convert or demolish, equip, occupy, use or maintain any plumbing system or equipment, or cause or permit the same to be done, in the City, contrary to or in violation of any of the provisions of this Code.

(2) Knowingly aid, abet, counsel, encourage, hire, induce or otherwise procure another to violate or fail to comply with this Code.

(3) Use any material or install any device, appliance or equipment that is subject to this code and has not been approved by the Authority Having Jurisdiction.

(4) Violate or fail to comply with any order issued by the Authority Having Jurisdiction pursuant to the provisions of this code or with any requirements of this Code.

(5) Remove, mutilate, destroy or conceal any notice or order issued or posted by the Authority Having Jurisdiction pursuant to the provisions of this Code, or any notice or order issued or posted by the Authority Having Jurisdiction in response to a natural disaster or other emergency.

(6) Conduct work under a permit without requesting an inspection as required by Section 109.

106.2 Notice of Violation. When, after investigation, the Authority Having Jurisdiction determines that standards or requirements of this Code have been violated or that orders or requirements have not been complied with, the Authority Having Jurisdiction may issue a notice of violation upon the owner, agent, or other person responsible for the action or condition. The notice of violation shall state the standards or requirements violated, shall state what corrective action, if any, is necessary to comply with the standards or requirements, and shall set a reasonable time for compliance.

106.2.1 Service of Notice of Violation. The notice shall be served upon the owner, agent or other responsible person by personal service or regular first class mail addressed to the last known address of such person, or if no address is available after reasonable inquiry, the notice may be posted in a conspicuous place on the premises. The notice may also be posted if served by personal service or first class mail. Nothing in this section limits or precludes any action or proceeding to enforce this code, and nothing obligates or requires the Authority Having Jurisdiction to issue a notice of violation prior to the imposition of civil or criminal penalties.

106.2.2 Review of Notice of Violation by the Authority Having Jurisdiction. Any person affected by a notice of violation issued pursuant to Section 106.2 may obtain a review of the notice by making a request in writing to the Authority Having Jurisdiction within ten days after service of the notice. When the last day of the period computed is a Saturday, Sunday, or city holiday, the period runs until 5 p.m. of the next business day.

106.2.2.1 Review Procedure. The review shall occur not less than ten nor more than 20 days after the request is received by the Authority Having Jurisdiction unless otherwise agreed to by the person requesting the review. Any person affected by the notice of violation may submit additional information to the Authority Having Jurisdiction.

The review shall be made by a representative of the Authority Having Jurisdiction who will review any additional information that is submitted and the basis for issuance of the notice of violation. The reviewer may request clarification of the information received and a site visit.

106.2.2.2 Decision. After the review, the Authority Having Jurisdiction shall:

(1) Sustain the notice;

(2) Withdraw the notice;

(3) Amend the notice; or

(4) Continue the review to a date certain.

106.2.2.3 Order. The Authority Having Jurisdiction shall issue an order containing the decision within 15 days of the date that the review is completed and shall cause the order to be mailed by regular first class mail to the persons requesting the review and the persons named on the notice of violation, addressed to their last known address.

106.3 Stop Work Orders. The Authority Having Jurisdiction may issue a stop work order whenever any work is being done contrary to the provisions of this Code, contrary to a permit issued by the Authority Having Jurisdiction, or in the event of dangerous or unsafe conditions related to equipment or construction. The stop work order shall identify the violation and may prohibit work or other activity on the site.

106.3.1 Service of Stop Work Order. The Authority Having Jurisdiction shall serve the stop work order by posting it in a conspicuous place at the site. If posting is not physically possible, then the stop work order may be served by personal service or by regular first class mail to the last known address of: the property owner, the person doing or causing the work to be done, or the holder of a permit if work is being stopped on a permit. For purposes of this section, service is complete at the time of posting or of personal service, or if mailed, three days after the date of mailing. When the last day of the period so computed is a Saturday, Sunday or city holiday, the period runs until 5 p.m. on the next business day.

106.3.2 Effective Date of Stop Work Order. Stop work orders are effective when posted, or if posting is not physically possible, when one of the persons identified in Section 106.3.1 is served.

106.3.3 Review of Stop Work Orders by the Authority Having Jurisdiction. Any person aggrieved by a stop work order may obtain a review of the order by delivering to the Authority Having Jurisdiction a request in writing within two business days of the date of service of the stop work order.

106.3.3.1 Review Procedure. The review shall occur within two business days after receipt by the Authority Having Jurisdiction of the request for review unless otherwise agreed by the person making the request. Any person affected by the stop work order may submit additional information to the Authority Having Jurisdiction for consideration as part of the review at any time prior to the review. The review will be made by a representative of the Authority Having Jurisdiction who will review all additional information received and may also request a site visit.

106.3.3.2 Decision. After the review, the Authority Having Jurisdiction may:

(1) Sustain the stop work order;

(2) Withdraw the stop work order;

(3) Modify the stop work order; or

(4) Continue the review to a date certain.

106.3.3.3 Order. The Authority Having Jurisdiction shall issue an order containing the decision within two business days after the review is completed and shall cause the order to be sent by regular first class mail to the person or persons requesting the review, any person on whom the stop work order was served, and any other person who requested a copy before issuance of the order, addressed to their last known address.

106.4 Authority to Disconnect Utilities in Emergencies. The Authority Having Jurisdiction has the authority to disconnect water, fuel-gas utility service or energy supplies to a building, structure, premises or equipment regulated by this Code in case of emergency where necessary to eliminate an immediate hazard to life or property. The Authority Having Jurisdiction may enter any building or premises to disconnect utility service. The Authority Having Jurisdiction shall, whenever possible, notify the serving utility, the owner and the occupant of the building, structure or premises of the decision to disconnect prior to taking such action, and shall notify the serving utility, owner and occupant of the building, structure or premises in writing of such disconnection immediately thereafter.

106.5 Authority to Condemn Equipment. Whenever the Authority Having Jurisdiction determines that any equipment or portion thereof regulated by this Code is hazardous to life, health or property, the Authority Having Jurisdiction shall order in writing that such equipment either be disconnected, removed or restored to a safe or sanitary condition, as appropriate. The written notice shall fix a date certain for compliance with such order. It is a violation for any person to use or maintain defective equipment after receiving such notice.

When any equipment or installation is to be disconnected, the Authority Having Jurisdiction shall give written notice of such disconnection and causes therefore within 24 hours to the serving utility, the owner and the occupant of the building, structure or premises. When any equipment is maintained in violation of this Code, and in violation of a notice issued pursuant to the provisions of this section, the Authority Having Jurisdiction shall institute any appropriate action to prevent, restrain, correct or abate the violation.

106.6 Connection After Order to Disconnect. No person shall make connections from any water, energy, fuel or power supply nor supply water, energy or fuel to any equipment regulated by this Code that has been disconnected or ordered to be

disconnected by the Authority Having Jurisdiction, or the use of which has been ordered to be discontinued by the Authority Having Jurisdiction until the Authority Having Jurisdiction authorizes the reconnection and use of such equipment.

106.7 Civil Penalties. Any person violating or failing to comply with the provisions of this Code is subject to a cumulative civil penalty in an amount not to exceed $500 per day for each violation from the date the violation occurs or begins until the date compliance is achieved. In cases where the Authority Having Jurisdiction has issued a notice of violation, the violation will be deemed to begin, for purposes of determining the number of days of violation, on the date compliance is required by the notice of violation.

106.8 Enforcement in Municipal Court. Civil actions to enforce this Code shall be brought exclusively in Seattle Municipal Court, except as otherwise required by law or court rule. In any civil action for a penalty, the City has the burden of proving by a preponderance of the evidence that a violation exists or existed; the issuance of a notice of violation or of an order following a review by the Authority Having Jurisdiction is not itself evidence that a violation exists.

106.9 Judicial Review. Because civil actions to enforce this Code must be brought exclusively in Seattle Municipal Court pursuant to Section 106.8, orders of the Authority Having Jurisdiction, including notices of violation issued under this chapter, are not subject to judicial review pursuant to chapter 36.70C RCW.

106.10 Alternative Criminal Penalty. Anyone who violates or fails to comply with any notice of violation or order issued by the Authority Having Jurisdiction pursuant to this Code or who removes, mutilates, destroys or conceals a notice issued or posted by the Authority Having Jurisdiction shall, upon conviction thereof, be punished by a fine of not more than $5000 or by imprisonment for not more than 365 days, or by both such fine and imprisonment for each separate violation. Each day's violation shall constitute a separate offense.

106.11 Additional Relief. The Authority Having Jurisdiction may seek legal or equitable relief to enjoin any acts or practices and abate any condition when necessary to achieve compliance.

106.12 Administrative Review by the Authority Having Jurisdiction. Prior to issuance of the plumbing permit, applicants may request administrative review by the Authority Having Jurisdiction of decisions or actions pertaining to the administration and enforcement of this code. Requests shall be addressed to the Authority Having Jurisdiction.

106.13 Administrative Review by the Construction Codes Advisory Board. After administrative review by the Authority Having Jurisdiction, and prior to issuance of the plumbing permit, applicants may request review of decisions or actions pertaining to the application and interpretation of this Code by the Construction Codes Advisory Board according to Seattle Building Code Section 105.11, except for stop work orders, notices of violations and revocations of permits. The review will be performed by three or more members of the Construction Codes Advisory Board, chosen by the Board Chair. The Chair shall consider the subject of the review and members' expertise when selecting members to conduct a review. The decision of the review panel is advisory only; the final decision is made by the Authority Having Jurisdiction.

SECTION 107
PERMITS

107.1 Permits Required. Except as otherwise specifically provided in this Code, a permit shall be obtained from the Authority Having Jurisdiction prior to each installation, alteration, repair, replacement or remodel of any equipment or plumbing system regulated by this Code. A separate plumbing permit is required for each separate building or structure.

107.2 Work Exempt from Permit. A plumbing permit is not required for the work listed below.

(1) The stopping of leaks in drains, soil, waste, or vent pipes, provided, that when a drainpipe, soil, waste, or vent pipe becomes defective and it becomes necessary to remove and replace the same with new material, the same shall be considered as new work and a permit shall be procured and inspection made as provided in this Code.

(2) The clearing of stoppages, including the removal and reinstallation of water closets, or the repairing of leaks in pipes, valves, or fixtures, provided such repairs do not involve or require the replacement or rearrangement of valves, pipes, or fixtures.

107.3 Compliance Required. All work shall comply with this Code, even where no permit is required.

107.4 Flood Hazard Areas. In addition to the permit required by this section, all work to be performed in areas of special flood hazard as defined in Chapter 25.06 of the Seattle Municipal Code, subject to additional standards and requirements set forth in Chapter 25.06, the Seattle Floodplain Development Ordinance.

107.5 Emergency Repairs. In the case of an emergency, the installation, alteration or repair of any plumbing system or equipment may be made without a permit, provided that application for a permit is made within the later of 24 hours or one working day from the time when the emergency work was started.

107.6 Application for Permit. To obtain a permit, the applicant shall first file an application in a format determined by the Authority Having Jurisdiction. Every such application shall:

(1) Identify and describe the work to be covered by the permit for which application is made.

(2) Describe the land on which the proposed work is to be done by parcel number, property address or similar description that will readily identify and clearly locate the proposed building or project.

(3) Provide unit, space suite, floor level, or other information that will clearly identify the location of the project

(4) Provide the owner's name, address, and phone number of the property.

(5) Provide the contractor's business name, address, and phone number of the property.

(6) Be accompanied by plans, diagrams, computations and specifications, equipment schedules and other data as required by the Authority Having Jurisdiction.

(7) Be signed by the owner of the property or building, or the owner's authorized agent, who may be required to submit evidence to indicate such authority.

(8) Give such other data and information as may be required by the Authority Having Jurisdiction.

(9) State the name of the owner and the name, address and phone number of a contact person.

107.6.1 Plumbing Design Documents. Plumbing design documents shall be submitted with each application for a permit, in electronic format to the Authority Having Jurisdiction. Diagrams, schedules, and other data sufficient to show the adequacy of the plans shall be submitted when required by the Authority Having Jurisdiction.

Exception: The Authority Having Jurisdiction may waive the submission of plumbing design documents where the Authority Having Jurisdiction finds that the nature of the work applied for is such that reviewing plumbing documents is not necessary to obtain compliance with this Code.

107.6.2 Preparation by Registered Design Professionals. Plumbing design documents for all plumbing work shall be prepared and designed by or under the direct supervision of a mechanical engineer licensed to practice under the laws of the State of Washington. Each sheet of plumbing documents shall bear the seal and the signature of the registered design professional before the permit is issued.

Exceptions:

(1) Detached one- and two-family dwellings, and townhomes.

(2) Design documents that do not include systems specifically required to be designed by a registered design professional shall be permitted to be submitted without a PE stamp by any individual holding an active Certified in Plumbing Design (CPD) designation issued by the American Society of Plumbing Engineers (ASPE) or by a Washington State Certified Journeyman Plumber (PL01).

(3) Design documents provided for reference only.

(4) Other work as specified by the Authority Having Jurisdiction.

107.6.3 Registered Design Professional in Responsible Charge. The Authority Having Jurisdiction is authorized to require the owner to engage and designate on the plumbing permit application a Registered Design Professional who shall act as the Registered Design Professional in Responsible Charge. If the circumstances require, the owner shall designate a substitute Registered Design Professional in Responsible Charge who shall perform the duties required of the original Registered Design Professional in Responsible Charge. The Authority Having Jurisdiction shall be notified in writing by the owner if the Registered Design Professional in Responsible Charge is changed or is unable to continue to perform their duties. The Registered Design Professional in Responsible Charge is responsible for reviewing and coordinating submittal documents prepared by others, including phased and deferred submittal items, for compatibility with the design and scope of the project.

107.7 Information Required on Plumbing Design Documents. The documents shall include the following, as applicable:

107.7.1 Cover Sheet. The cover sheet shall include the project address, parcel number, scope of work narrative, legends, abbreviations, general notes, applicable code cycles, and other information as required by the Authority Having Jurisdiction.

107.7.2 Calculations and Notes. Calculations and/or load summaries shall be provided to determine system loading for each plumbing system included in the project scope of work. Provide a separate calculation for each separate utility point of connection. Domestic water pressure loss calculations shall be provided for each independent domestic water system or pressure zone. Notes shall include proposed material types and joining methods, insulation requirements, disinfection procedures, and similar information as required by the Authority Having Jurisdiction.

107.7.3 Schedules. Schedules shall be provided for all fixtures and equipment associated with the plumbing system design. Schedules shall include all information required to verify compliance with this code and the Seattle Energy Code. Such information may include operating weight, equipment make/model, applicable standards, connection sizes, flow rates, input/output ratings and similar information as required by the Authority Having Jurisdiction.

107.7.3.1 Energy Code Compliance. Equipment required to comply with provisions of the Seattle Energy Code shall include make/model and any other design or listing information required to determine compliance.

107.7.4 Plan Sheets. Plan sheets shall include building information, plumbing system design information, scale, key plan, north arrow, and similar information as required by the Authority Having Jurisdiction.

107.7.4.1 Building Information. Building information shown on plan sheets shall be screened (semi-opaque) and include information such as room names, walls, corridors, fixtures, footings, floor elevations, and other building elements relevant to the installation of the plumbing system(s).

107.7.4.2 Plumbing System Design Information. Plumbing system design information shown on plan sheets shall be easily identifiable and include all horizontal piping, all vertical risers, sizing, loading, notes, fixture and equipment tags, and similar information as required by the Authority Having Jurisdiction.

107.7.5 Riser Diagrams. Riser diagrams shall be provided for each distinct plumbing system type including sanitary waste and vent, domestic water, stormwater and roof drainage, natural gas, non-potable water, graywater, and any other system type referenced within the plumbing design documents. Riser diagrams shall include all piping from the utility or tenant point of connection to the furthest fixture or roof termination. Piping shown on riser diagrams shall be clearly sized and labeled and include loading at each pipe segment.

107.7.6 Construction Details. Construction details shall be provided for the installation of certain fixtures or equipment where determination of Code compliance may not be readily achievable through review of Plans, Schedules, Notes, or Riser Diagrams. Construction details may be required for the installation of water heaters, interceptors, pumps, backflow devices, and similar items. The Authority Having Jurisdiction may request additional construction details as deemed necessary.

» **107.7.7 Deferred Submittals.** Deferral of any submittal items shall have the prior approval of the Authority Having Jurisdiction. The Registered Design Professional in Responsible Charge shall list deferred submittals on the plans for review by the Authority Having Jurisdiction. Documents for deferred submittal items shall be submitted to the Registered Design Professional in Responsible Charge who shall review them and forward them to the Authority Having Jurisdiction with a notation indicating that the deferred submittal documents have been reviewed and been found to be in general conformance to the plumbing design. The deferred submittal items shall not be installed until the deferred submittal documents have been approved by the Authority Having Jurisdiction.

» **107.7.8 Application Review.** The plumbing design documents shall be reviewed by the Authority Having Jurisdiction. Such plumbing design documents may be reviewed by other departments of the City to check compliance with the laws and ordinances under their jurisdiction.

» **107.7.9 Determination of Completeness.** Within 28 days after an application is filed, the Authority Having Jurisdiction shall notify the applicant in writing either that the application is complete or that it is not complete, and if not complete, what additional information is required to make it complete. Within 14 days after receiving the additional information, the Authority Having Jurisdiction shall notify the applicant in writing whether the application is now complete or what additional information is necessary. An application shall be deemed to be complete if the Authority Having Jurisdiction does not notify the applicant in writing by the deadlines in this section that the application is incomplete.

» **107.7.10 Decision on Application.** Except as provided in Section 108.4 the Authority Having Jurisdiction shall approve, condition, or deny the application within 120 days after the Authority Having Jurisdiction notifies the applicant that the application is complete.

To determine the number of days that have elapsed after the notification that the application is complete, the following periods shall be excluded:

(1) All periods of time during which the applicant has been requested by the Authority Having Jurisdiction to correct plans, perform required studies, or provide additional required information, until the determination that the request has been satisfied. The period shall be calculated from the date the Authority Having Jurisdiction notifies the applicant of the need for additional information until the earlier of the date the Authority Having Jurisdiction determines whether the additional information satisfies the request for information or 14 days after the date the information has been provided to the Authority Having Jurisdiction.

(2) If the Authority Having Jurisdiction determines that the information submitted by the applicant under item 1 of this subsection is insufficient, the Authority Having Jurisdiction shall notify the applicant of the deficiencies, and the procedures under item 1 of this subsection shall apply as if a new request for information has been made;

(3) All extensions of time mutually agreed upon by the applicant and the Authority Having Jurisdiction.

If a plumbing permit application is substantially revised by the applicant, the time period shall start from the date at which the revised plumbing permit application is determined to be complete under Section 107.7.9.

SECTION 108
PERMIT ISSUANCE

108.1 Issuance. The application shall be reviewed by the Authority Having Jurisdiction. The application may be reviewed by other departments of the Authority Having Jurisdiction or the City to check compliance with the laws and ordinances under their jurisdiction.

108.1.1 Issuance of Permit. The Authority Having Jurisdiction shall issue a permit to the applicant if the Authority Having Jurisdiction finds the following:

(1) The work described in the construction documents substantially conforms to the requirements of this Code and other pertinent laws and ordinances;

(2) Construction documents for projects requiring Plan Review have been reviewed and Approved;

(3) The fees specified in the Seattle Municipal Code Chapter 22.504 have been paid; and

(4) The applicant has complied with all requirements to be performed prior to issuance of a permit for the work under other pertinent laws, ordinances, or regulations, or otherwise imposed by the Authority Having Jurisdiction. When the permit is issued, the applicant or the applicant's authorized agent becomes the permit holder.

108.2 Phased Permits. The Authority Having Jurisdiction may authorize installation of a portion or portions of a plumbing system before complete plumbing design documents for the whole plumbing project have been submitted or approved. The applicant shall proceed at the applicant's risk without assurance that a permit for the entire plumbing project will be granted.

108.3 Compliance with Approved Plans and Permit. When the Authority Having Jurisdiction issues a permit, the Authority Having Jurisdiction shall endorse the permit in writing or in electronic format and, where plans are required, stamp the plans "APPROVED." Such approved plans and permit shall not be changed, modified or altered without authorization from the Authority Having Jurisdiction, and all work shall be done in accordance with the approved plans and permit except as authorized by the Authority Having Jurisdiction during a field inspection to correct errors or omissions.

108.4 Revisions to the Permit. When changes to the approved work (plumbing design documents) are made during installation, approval of the Authority Having Jurisdiction shall be obtained prior to execution. The Authority Having Jurisdiction may approve minor changes to the plumbing design documents for work without revisions to the approved plumbing design documents when it is determined that the changes conform to the requirements of this Code and other pertinent laws, ordinances and other issued permits.

108.5 Validity of Permit. The issuance or granting of a permit or approval of plans shall:

(1) Not be construed to be a permit for, or an approval of, any violation of any of the provisions of this Code or other pertinent laws and ordinances.

(2) Not prevent the Authority Having Jurisdiction from requiring the correction of errors in the plans, or from preventing building operations being carried on thereunder when in violation of this Code or of other pertinent laws and ordinances of the City.

(3) Not prevent the Authority Having Jurisdiction from requiring correction of conditions found to be in violation of this Code or other pertinent laws and ordinances of the City, or

(4) Not be construed to extend the period of time for which any such permit is issued or otherwise affect any period of time for compliance specified in any notice or order issued by the Authority Having Jurisdiction or other administrative authority requiring the correction of any such conditions.

108.6 Permit Expiration and Renewal. Authority to do the work authorized by a permit expires 18 months from the date of the issuance. A permit may be renewed to extend the duration of the permit for an additional 18 months from the original expiration date.

108.7 Revocation of Approval. The Authority Having Jurisdiction may rescind prior approval of reviewed construction documents and deny permit issuance if any of the following conditions develop:

(1) Permit applicant has not responded to a Plan Review invoice notice or request for plan corrections from the assigned Plans Examiner within 90 days of request.

(2) Permit fees have not been paid within 90 days of notification to applicant that plans have been approved and an invoice generated.

Exception: The Authority Having Jurisdiction may grant an extension to the above noted timelines if mutually agreed upon by the Authority Having Jurisdiction and the permit applicant. Any request for an extension must be initiated by the permit applicant.

SECTION 109
INSPECTIONS

109.1 General. All construction or work for which a permit is required is subject to inspection by the Authority Having Jurisdiction. In addition, the Authority Having Jurisdiction may make or require inspections of any plumbing work to ascertain compliance with the provisions of this Code and other laws and ordinances that are enforced by the Authority Having Jurisdiction.

109.2 Inspection Requests. The owner of the property or the owner's authorized agent, or the person designated by the owner or agent to do the work authorized by a permit shall notify the Authority Having Jurisdiction that work requiring inspection as specified in this section is ready for inspection.

109.3 Access for Inspection. The permit holder and the person requesting any inspections required by this Code shall provide access to and means for proper inspection of such work, including safety equipment required by the Washington Industrial Safety and Health Agency. The work shall remain accessible and exposed for inspection purposes until approved by the Authority Having Jurisdiction. Neither the Authority Having Jurisdiction nor the City shall be liable for expense entailed in the required removal or replacement of any material to allow inspection.

109.4 Inspection Record. Work requiring a plumbing permit shall not be commenced until the permit holder or the permit holder's agent has posted an inspection record in a conspicuous place on the premises and in a position that allows the Authority Having Jurisdiction to conveniently make the required entries regarding inspection of the work. This record shall be maintained in such a position by the permit holder or the permit holder's agent until final approval has been granted by the Authority Having Jurisdiction.

109.5 Approvals Required. No work shall be done on any part of the building or structure beyond the point indicated in each successive inspection without first obtaining the written approval of the Authority Having Jurisdiction.

109.5.1 Effect of Approval. Approval as a result of an inspection is not approval of any violation of the provisions of this Code or of other pertinent laws and ordinances of the Authority Having Jurisdiction or the City. Inspections presuming to give authority to violate or cancel the provisions of this Code or of other pertinent laws and ordinances of the Authority Having Jurisdiction or the City are not valid.

109.6 Operation of Plumbing Equipment. The requirements of this section do not prohibit the operation of any plumbing systems installed to replace existing equipment or fixtures serving an occupied portion of the building in the event a request for inspection of such equipment or fixture has been filed with the Authority Having Jurisdiction not more than 48 hours after such replacement work is completed, and before any portion of such plumbing system is concealed by any permanent portion of the building.

109.7 Special Investigation. If work that requires a permit or approval is commenced or performed prior to making formal application and receiving the Authority Having Jurisdiction's permission to proceed, the Authority Having Jurisdiction may make a special investigation inspection before a permit is issued for the work. If a special investigation is made, a special investigation fee may be assessed in accordance with the Seattle Municipal Code.

109.8 Reinspections. The Authority Having Jurisdiction may require a reinspection if work for which inspection is called is not complete, required corrections are not made, the approved plans are not readily available to the inspector, access is not provided on the date for which inspection is requested, if deviations from the plans that require the approval of the Authority Having Jurisdiction have been made without proper approval, or as otherwise required by the Authority Having Jurisdiction.

109.8.1 Reinspection Fee. The Authority Having Jurisdiction may assess a reinspection fee as set forth in the Seattle Municipal Code Section 22.504.010 for any action for which reinspection is required. In instances where reinspection fees have been assessed, no additional inspection of the work will be performed until the required fees have been paid.

SECTION 110
FEES

110.1 Fees. A fee for each plumbing permit and for other activities related to the enforcement of this Code shall be paid as set forth in Seattle Municipal Code Chapter 22.504.

CHAPTER 2
DEFINITIONS

201.0 General.

201.1 Applicability. For the purpose of this code, the following terms have the meanings indicated in this chapter.

No attempt is made to define ordinary words, which are used in accordance with their established dictionary meanings, except where a word has been used loosely, and it is necessary to define its meaning as used in this code to avoid misunderstanding.

202.0 Definition of Terms.

202.1 General. The definitions of terms are arranged alphabetically according to the first word of the term.

203.0 – A –

ABS. Acrylonitrile-butadiene-styrene.

Accepted Engineering Practice. That which conforms to technical or scientific-based principles, tests, or standards that are accepted by the engineering profession.

Accessible. Where applied to a fixture, connection, appliance, or equipment, "accessible" means having access thereto, but which first may require the removal of an access panel, door, or similar obstruction.

Accessible, Readily. Having a direct access without the necessity of removing a panel, door, or similar obstruction.

[S] Air Admittance Valve. A device that allows air to enter the plumbing drainage system in one direction, to protect fixture traps from siphonage when negative pressures develop, and prevents sewer gases from entering the interior building atmosphere during static pressure or positive pressure conditions in the plumbing waste system.

Air Break. A physical separation which may be a low inlet into the indirect waste receptor from the fixture, appliance, or device indirectly connected.

Air Gap, Drainage. The unobstructed vertical distance through the free atmosphere between the lowest opening from a pipe, plumbing fixture, appliance, or appurtenance conveying waste to the flood-level rim of the receptor.

Air Gap, Water Distribution. The unobstructed vertical distance through the free atmosphere between the lowest opening from a pipe or faucet conveying potable water to the flood-level rim of a tank, vat, or fixture.

Alternate Water Source. Nonpotable source of water that includes but not limited to gray water, on-site treated non-potable water, rainwater, and reclaimed (recycled) water.

Anchors. See Supports.

Appliance. A device that utilizes an energy source to produce light, heat, power, refrigeration, air conditioning, or compressed fuel gas. This definition also shall include a vented decorative appliance.

Appliance, Low-Heat. A fuel-burning appliance that produces a continuous flue gas temperature, at the point of entrance to the flue, of not more than 1000°F (538°C).

Appliance, Medium-Heat. A fuel-burning appliance that produces a continuous flue gas temperature, at the point of entrance to the flue, of more than 1000°F (538°C) and less than 2000°F (1093°C).

Appliance Categorized Vent Diameter/Area. The minimum vent diameter/area permissible for Category I appliances to maintain a nonpositive vent static pressure when tested in accordance with nationally recognized standards. [NFPA 54:3.3.6]

Appliance Fuel Connector. An assembly of listed semi-rigid or flexible tubing and fittings to carry fuel between a fuel-piping outlet and a fuel-burning appliance.

Approved. Acceptable to the Authority Having Jurisdiction.

Approved Testing Agency. An organization primarily established for purposes of testing to approved standards and approved by the Authority Having Jurisdiction.

Area Drain. A receptor designed to collect surface or storm water from an open area.

Aspirator. A fitting or device supplied with water or other fluid under positive pressure that passes through an integral orifice or constriction, causing a vacuum.

Authority Having Jurisdiction. The organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, installations, or procedures. The Authority Having Jurisdiction shall be a federal, state, local, or other regional department or an individual such as a plumbing official, mechanical official, labor depart-

ment official, health department official, building official, or others having statutory authority. In the absence of statutory authority, the Authority Having Jurisdiction may be some other responsible party. This definition shall include the Authority Having Jurisdiction's duly authorized representative.

204.0 – B –

Backflow. The flow of water or other liquids, mixtures, or substances into the distributing pipes of a potable supply of water from sources other than its intended source. See Backpressure Backflow and Backsiphonage.

Backflow Connection. An arrangement whereby backflow can occur.

Backflow Preventer. A backflow prevention device, an assembly, or another method to prevent backflow into the potable water system.

Backpressure Backflow. Backflow due to an increased pressure above the supply pressure, which may be due to pumps, boilers, gravity, or other sources of pressure.

Backsiphonage. The flowing back of used, contaminated, or polluted water from a plumbing fixture or vessel into a water supply pipe due to a pressure less than atmospheric in such pipe. See Backflow.

Backwater Valve. A device installed in a drainage system to prevent reverse flow.

Bathroom. A room equipped with a shower, bathtub, or combination bath/shower.

Bathroom, Half. A room equipped with only a water closet and lavatory.

Bathroom Group. Any combination of fixtures, not to exceed one water closet, two lavatories, either one bathtub or one combination bath/shower, and one shower, and may include a bidet and an emergency floor drain.

Battery of Fixtures. A group of two or more similar, adjacent fixtures that discharge into a common horizontal waste or soil branch.

Bedpan Steamer. A fixture that is used to sterilize bedpans by way of steam.

Boiler Blowoff. An outlet on a boiler to permit emptying or discharge of sediment.

Bonding Conductor or Jumper. A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected. [NFPA 70:100(I)]

Bottle Filling Station. A plumbing fixture connected to the potable water distribution system and sanitary drainage system that is designed and intended for filling personal use drinking water bottles or containers not less than 10 inches (254 mm) in height. Such fixtures can be separate from or integral to a drinking fountain and can incorporate a water filter and a cooling system for chilling the drinking water.

Branch. A part of the piping system other than a main, riser, or stack.

Branch, Fixture. See Fixture Branch.

Branch, Horizontal. See Horizontal Branch.

Branch Vent. A vent connecting one or more individual vents with a vent stack or stack vent.

Building. A structure built, erected, and framed of component structural parts designed for the housing, shelter, enclosure, or support of persons, animals, or property of any kind.

Building Drain. That part of the lowest piping of a drainage system that receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer beginning 2 feet (610 mm) outside the building wall.

Building Drain (Sanitary). A building drain that conveys sewage only.

Building Drain (Storm). A building drain that conveys storm water or another drainage, but no sewage.

Building Sewer. That part of the horizontal piping of a drainage system that extends from the end of the building drain and that receives the discharge of the building drain and conveys it to a public sewer, private sewer, private sewage disposal system, or another point of disposal.

Building Sewer (Combined). A building sewer that conveys both sewage and storm water or other drainage.

Building Sewer (Sanitary). A building sewer that conveys sewage only.

Building Sewer (Storm). A building sewer that conveys storm water or another drainage, but no sewage.

Building Subdrain. That portion of a drainage system that does not drain by gravity into the building sewer.

Building Supply. The pipe is carrying potable water from the water meter or another source of water supply to a building or other point of use or distribution on the lot.

205.0 – C –

Category 1. Activities, systems, or equipment whose failure is likely to cause major injury or death to patients, staff, or visitors. [NFPA 99:3.3.581.1]

Category 2. Activities, systems, or equipment whose failure is likely to cause minor injury to patients, staff, or visitors. [NFPA 99:3.3.158.2]

Category 3. Activities, systems, or equipment whose failure is not likely to cause injury to patients, staff, or visitors, but can cause discomfort. [NFPA 99:3.3.158.3]

Category 3 Vacuum System. A Category 3 vacuum distribution system that can be either a wet system designed to remove liquids, air-gas, or solids from the treated area; or a dry system designed to trap liquid and solids before the service inlet and to accommodate air-gas only through the service inlet. [NFPA 99:3.3.21]

Category 4. Activities, systems, or equipment whose failure would have no impact on patient care. [NFPA 99:3.3.158.4]

[W] Certified Backflow Assembly Tester. A person certified by the Washington State Department of Health under Chapter 246-292 WAC to inspect (for correct installation and approval status) and test (for proper operation), maintain and repair (in compliance with Chapter 18.106 RCW) backflow prevention assemblies, devices, and air gaps.

Cesspool. A lined excavation in the ground that receives the discharge of a drainage system or part thereof, so designed as to retain the organic matter and solids discharging therein but permitting the liquids to seep through the bottom and sides.

Chemical Waste. See Special Wastes.

Chimney. One or more passageways, vertical or nearly so, for conveying flue or vent gases to the outdoors. [NFPA 54:3.3.18]

Chimney, Factory-Built. A chimney composed of listed factory-built components assembled in accordance with the manufacturer's installation instructions to form the completed chimney. [NFPA 54:3.3.18.2]

Chimney, Masonry. A field-constructed chimney of solid masonry units, bricks, stones, listed masonry chimney units, or reinforced portland cement concrete, lined with suitable chimney flue liners. [NFPA 54:3.3.18.3]

Chimney, Metal. A chimney constructed of metal with a minimum thickness not less than 0.127 inches (3.23 mm) (No. 10 manufacturer's standard gauge) steel sheet.

Chimney Classifications:

Chimney, High-Heat Appliance-Type. A factory-built, masonry, or metal chimney suitable for removing the products of combustion from fuel-burning high-heat appliances producing combustion gases in excess of 2000°F (1093°C), measured at the appliance flue outlet.

Chimney, Low-Heat Appliance-Type. A factory-built, masonry, or metal chimney suitable for removing the products of combustion from fuel-burning low-heat appliances producing combustion gases not in excess of 1000°F (538°C) under normal operating conditions, but capable of producing combustion gases of 1400°F (760°C) during intermittent forced firing for periods up to one hour. Temperatures are measured at the appliance flue outlet.

Chimney, Medium-Heat Appliance-Type. A factory-built, masonry, or metal chimney suitable for removing the products of combustion from fuel-burning medium-heat appliances producing combustion gases, not in excess of 2000°F (1093°C), measured at the appliance flue outlet.

Chimney, Residential Appliance-Type. A factory-built or masonry chimney suitable for removing products of combustion from residential-type appliances producing combustion gases, not in excess of 1000°F (538°C), measured at the appliance flue outlet. Factory-built Type HT chimneys have high-temperature thermal shock resistance.

Circuit Vent. The vent that connects to a horizontal drainage branch and vents two traps to a maximum of eight traps connected into a battery of fixtures.

Clarifier. See Interceptor (Clarifier).

Clear Water Waste. Cooling water and condensate drainage from refrigeration and air-conditioning equipment; cooled condensate from steam heating systems, and cooled boiler blowdown water.

Clinical Sink. A fixture that has the same flushing and cleansing characteristics of a water closet that is used to receive the wastes from a bedpan. Also, known as a bedpan washer.

Coastal High Hazard Areas. An area within the flood hazard area that is subject to high-velocity wave action, and shown on a Flood Insurance Rate Map or other flood hazard map as Zone V, VO, VE or V1-30.

Code. A standard that is an extensive compilation of provisions covering broad subject matter or that is suitable for adoption into law independently of other codes and standards.

Combination Temperature and Pressure-Relief Valve. A relief valve that actuates when a set temperature, pressure, or both is reached. Also, known as a T&P Valve.

Combination Thermostatic/Pressure Balancing Valve. A mixing valve that senses outlet temperature and incoming hot and cold water pressure and compensates for fluctuations in incoming hot and cold water temperatures, pressures, or both to stabilize outlet temperatures.

Combination Waste and Vent System. A specially designed system of waste piping embodying the horizontal wet venting of one or more sinks or floor drains using a common waste and vent pipe adequately sized to provide free movement of air above the flow line of the drain.

Combined Building Sewer. See Building Sewer (Combined).

Combustible Material. A material that, in the form in which it is used and under the conditions anticipated, will ignite and burn; a material that does not meet the definition of noncombustible. [NFPA 54:3.3.64.1]

Commercial Modular System. A drinking water treatment unit system consisting of multiple components attached to a manifold, produced specifically for food service applications, and not intended for use in residential applications.

Common. That part of a plumbing system that is so designed and installed as to serve more than one appliance, fixture, building, or system.

Condensate. The liquid phase produced by condensation of a gas or vapor.

Conductor. A pipe inside the building that conveys storm water from the roof to a storm drain, combined building sewer, or other approved point of disposal.

Confined Space. A room or space having a volume less than 50 cubic feet per 1000 British thermal units per hour (Btu/h) (4.83 m^3/kW) of the aggregate input rating of all fuel-burning appliances installed in that space.

Construction Documents. Plans, specifications, written, graphic, and pictorial documents prepared or assembled for describing the design, location, and physical characteristics of the elements of a project necessary for obtaining a permit.

Contamination. An impairment of the quality of the potable water that creates an actual hazard to the public health through poisoning or the spread of disease by sewage, industrial fluids, or waste. Also, defined as High Hazard.

Continuous Vent. A vertical vent that is a continuation of the drain to which it connects.

Continuous Waste. A drain is connecting the compartments of a set of fixtures to a trap or connecting other permitted fixtures to a common trap.

Copper Alloy. A homogenous mixture of two or more metals in which copper is the primary component, such as brass and bronze.

CPVC. Chlorinated Polyvinyl Chloride.

Critical Care Area. See Patient Care Space, Category 1.

Critical Level. The critical level (C-L or C/L) marking on a backflow prevention device or vacuum breaker is a point conforming to approved standards and established by the testing laboratory (usually stamped on the device by the manufacturer) that determines the minimum elevation above the flood- level rim of the fixture or receptor served at which the device may be installed. Where a backflow prevention device does not bear a critical level marking, the bottom of the vacuum breaker, combination valve, or the bottom of such approved device shall constitute the critical level.

Cross-Connection. A connection or arrangement, physical or otherwise, between a potable water supply system and a plumbing fixture or a tank, receptor, equipment, or device, through which it may be possible for nonpotable, used, unclean, polluted, and contaminated water, or other substances to enter into a part of such potable water system under any condition.

206.0 – D –

Dead Leg. A section of potable water pipe which contains water that has no flow or does not circulate.

Debris Excluder. A device installed on the rainwater catchment conveyance system to prevent the accumulation of leaves, needles, or other debris in the system.

Department Having Jurisdiction. The Authority Having Jurisdiction, including any other law enforcement agency affected by a provision of this code, whether such agency is specifically named or not.

Design Flood Elevation. The elevation of the "design flood," including wave height, relative to the datum specified on the community's legally designated flood hazard map. In areas designated as Zone AO, the design flood elevation is the elevation of the highest existing grade of the building's perimeter plus the depth number (in feet) specified on the flood hazard map. In areas designated as Zone AO where a depth number is not specified on the map, the depth number is taken as being equal to 2 feet (610 mm).

Developed Length. The length along the centerline of a pipe and fittings.

Diameter. Unless specifically stated, "diameter" is the nominal diameter as designated commercially.

Direct-Vent Appliances. Appliances that are constructed and installed so that all air for combustion is derived directly from the outdoors and all flue gases are discharged to the outdoors. [NFPA 54:3.3.5.3]

Domestic Sewage. The liquid and water-borne wastes derived from the ordinary living processes, free from industrial wastes, and of such character as to permit satisfactory disposal, without special treatment, into the public sewer or by means of a private sewage disposal system.

Downspout. The rain leader from the roof to the building storm drain, combined building sewer, or other means of disposal located outside of the building. See Conductor and Leader.

Drain. A pipe that carries waste or waterborne wastes in a building drainage system.

Drainage System. Includes all the piping within public or private premises that conveys sewage, storm water, or other liquid wastes to a legal point of disposal, but does not include the mains of a public sewer system or a public sewage treatment or disposal plant.

Drinking Fountain. A plumbing fixture connected to the potable water distribution system and sanitary drainage system that provides drinking water in a flowing stream so that the user can consume water directly from the fixture without the use of accessories. Drinking fountains should also incorporate a bottle filling station and can incorporate a water filter and a cooling system for chilling the drinking water.

Dry Vent. A vent that does not receive the discharge of any sewage or waste.

Durham System. Soil or waste system in which all piping is threaded pipe, tubing, or other such rigid construction, using recessed drainage fittings to correspond to the types of piping.

207.0 – E –

Effective Ground-Fault Current Path. An intentionally constructed, low-impedance electrically conductive path designed and intended to carry current under ground-fault conditions from the point of a ground fault on a wiring system to the electrical supply source and that facilitates the operation of the overcurrent protective device or ground-fault detectors on high-impedance grounded systems. [NFPA 54:3.3.34]

Effective Opening. The minimum cross-sectional area at the point of water supply discharge measured or expressed in terms of (1) diameter of a circle or (2) where the opening is not circular, the diameter of a circle of equivalent cross-sectional area. (This applies to an air gap).

Emergency Floor Drain. A floor drain that does not receive discharge from any fixture drain or indirect waste pipe, and serves to protect from damage where accidental spills, leaks or fixture backups occur.

Essentially Nontoxic Transfer Fluid. Essentially non-toxic at practically nontoxic, Toxicity Rating Class 1 (reference "Clinical Toxicology of Commercial Products" by Gosselin, Smith, Hodge, & Braddock).

Exam Room Sink. A sink used in the patient exam room of a medical or dental office with a primary purpose of the washing of hands.

Excess Flow Valve (EFV). A valve designed to activate when the fuel gas passing through it exceeds a prescribed flow rate. [NFPA 54:3.3.99.3]

Existing Work. A plumbing system or any part thereof that has been installed prior to the effective date of this code.

Expansion Joint. A fitting or arrangement of pipe and fittings that permit the contraction and expansion of a piping system.

Expansion Tank. A vessel used to protect potable water systems from excessive pressure.

208.0 – F –

F Rating. The time period that the penetration firestop system limits the spread of fire through the penetration, where tested in accordance with ASTM E814 or UL 1479.

Fixture Branch. A water supply pipe between the fixture supply pipe and the water distribution pipe.

Fixture Drain. The drain from the trap of a fixture to the junction of that drain with any other drain pipe.

Fixture Fitting. A device that controls and guides the flow of water.

Fixture Supply. A water supply pipe is connecting the fixture with the fixture branch.

Fixture Unit. A quantity in terms of which the load-producing effects on the plumbing system of different kinds of plumbing fixtures are expressed on some arbitrarily chosen scale.

Flammable Vapor or Fumes. The concentration of flammable constituents in the air that exceeds 25 percent of its lower flammability limit (LFL).

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) The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

Flood Level. See Flooded.

Flood-Level Rim. The top edge of a receptor from which water overflows.

Flooded. A fixture is flooded where the liquid therein rises to the flood-level rim.

Flue Collar. That portion of an appliance designed for the attachment of a draft hood, vent connector, or venting system. [NFPA 54:3.3.44]

Flush Tank. A tank located above or integral with water closets, urinals, or similar fixtures for the purpose of flushing the usable portion of the fixture.

Flush Valve. A valve located at the bottom of a tank for flushing water closets and similar fixtures.

Flushometer Tank. A tank integrated within an air accumulator vessel that is designed to discharge a predetermined quantity of water to fixtures for flushing purposes.

Flushometer Valve. A valve that discharges a predetermined quantity of water to fixtures for flushing purposes and is actuated by direct water pressure.

FOG Disposal System. A grease interceptor that reduces nonpetroleum fats, oils, and grease (FOG) in the effluent by separation, mass, and volume reduction.

Fuel Gas. Natural, manufactured liquefied petroleum, or a mixture of these.

209.0 – G –

Gang or Group Shower. Two or more showers in a common area.

Gas Piping. An installation of pipe, valves, or fittings that are used to convey fuel gas, installed on a premise or in a building, but shall not include:

(1) A portion of the service piping.

(2) An approved piping connection 6 feet (1829 mm) or less in length between an existing gas outlet and a gas appliance in the same room with the outlet.

Gas Piping System. An arrangement of gas piping or regulators after the point of delivery and each arrangement of gas piping serving a building, structure, or premises, whether individually metered or not.

General Anesthesia and Levels of Sedation/Analgesia.

Deep Sedation/Analgesia. A drug-induced depression of consciousness during which patients cannot be easily aroused but respond purposefully following repeated or painful stimulation. The ability to independently maintain ventilatory function may be impaired. Patients may require assistance in maintaining a patent airway, and spontaneous ventilation may be inadequate. Cardiovascular function is usually maintained. [NFPA 99:3.3.66.2]

General Anesthesia. A drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation. The ability to independently maintain ventilatory function is often impaired. Patients often require assistance in maintaining a patent airway, and positive pressure ventilation may be required because of depressed spontaneous ventilation or drug-induced depression of neuromuscular function. Cardiovascular function may be impaired. [NFPA 99:3.3.66.1]

Minimal Sedation (Anxiolysis). A drug-induced state during which patients respond normally to verbal commands. Although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected. [NFPA 99:3.3.66.4]

Moderate Sedation/Analgesia (Conscious Sedation). A drug-induced depression of consciousness during which patients respond purposefully to verbal commands, either alone or accompanied by light tactile stimulation. No interventions are required to maintain a patient airway, and spontaneous ventilation is adequate. Cardiovascular function is usually maintained. [NFPA 99:3.3.66.3]

Governing Body. The person or persons who have the overall legal responsibility for the operation of a health care facility. [NFPA 99:3.3.62]

Grade. The slope or fall of a line of pipe in reference to a horizontal plane. In drainage, it is usually expressed as the fall in a fraction of an inch (mm) or percentage slope per foot (meter) length of pipe.

Gravity Grease Interceptor. A plumbing appurtenance or appliance that is installed in a sanitary drainage system to intercept nonpetroleum fats, oils, and greases (FOG) from a wastewater discharge and is identified by volume, 30 minute retention time, baffle(s), not less than two compartments, a total volume of not less than 300 gallons (1135 L), and gravity separation. [These interceptors comply with the requirements of Chapter 10 or are designed by a registered design professional.] Gravity grease interceptors are generally installed outside.

Gray Water. Untreated wastewater that has not come into contact with toilet waste, kitchen sink waste, dishwasher waste or similarly contaminated sources. Gray water includes wastewater from bathtubs, showers, lavatories, clothes washers, and laundry tubs. Also, known as grey water, graywater, and greywater.

Gray Water Diverter Valve. A valve that directs gray water to the sanitary drainage system or a subsurface irrigation system.

Grease Interceptor. A plumbing appurtenance or appliance that is installed in a sanitary drainage system to intercept nonpetroleum fats, oil, and greases (FOG) from a wastewater discharge.

Grease Removal Device (GRD). A hydromechanical grease interceptor that automatically, mechanically removes non-petroleum fats, oils and grease (FOG) from the interceptor, the control of which are either automatic or manually initiated.

Grounding Electrode. A conducting object through which a direct connection to earth is established. [NFPA 70:100 (Part I)]

Group Wash Fixture. A lavatory that allows more than one person to utilize the fixture at the same time. The fixture has one or more drains and one or more faucets.

210.0 – H –

Hangers. See Supports.

Health Care Facility's Governing Body. The person or persons who have the overall legal responsibility for the operation of a health care facility. [NFPA 99:3.3.72]

Heat-Fusion Weld Joints. A joint used in some thermoplastic systems to connect the pipe to fittings or pipe lengths directly to one another (butt-fusion). This method of joining pipe to fittings includes socket-fusion, electro-fusion, and saddle-fusion. This method of welding involves the application of heat and pressure to the components, allowing them to fuse together forming a bond between the pipe and fitting.

[S] High Distribution Uniformity. A higher than average measurement indicating the evenness with which water is applied to the landscape by an irrigation system.

High Hazard. See Contamination.

Horizontal Branch. A drain pipe extending laterally from soil or waste stack or building drain with or without vertical sections or branches, which receives the discharge from one or more fixture drains and conducts it to the soil or waste stack or the building drain.

Horizontal Pipe. A pipe or fitting that is installed in a horizontal position or which makes an angle of less than 45 degrees (0.79 rad) with the horizontal.

[W] Hot Water. Water at a temperature exceeding or equal to 100°F.

House Drain. See Building Drain.

House Sewer. See Building Sewer.

Hydromechanical Grease Interceptor. A plumbing appurtenance or appliance that is installed in a sanitary drainage system to intercept nonpetroleum fats, oil, and grease (FOG) from a wastewater discharge and is identified by flow rate, and separation and retention efficiency. The design incorporates air entrainment, hydromechanical separation, interior baffling, or barriers in combination or separately, and one of the following:

(1) External flow control, with an air intake (vent), directly connected.

(2) External flow control, without air intake (vent), directly connected.

(3) Without external flow control, directly connected.

(4) Without external flow control, indirectly connected.

These interceptors comply with the requirements of Table 1014.2.1. Hydromechanical grease interceptors are generally installed inside.

211.0 – I –

Indirect-Fired Water Heater. A water heater consisting of a storage tank equipped with an internal or external heat exchanger used to transfer heat from an external source to heat potable water. The storage tank either contains heated potable water or water supplied from an external source, such as a boiler.

Indirect Waste Pipe. A pipe that does not connect directly to the drainage system but conveys liquid wastes by discharging into a plumbing fixture, interceptor, or receptacle that is directly connected to the drainage system.

Individual Vent. A pipe installed to vent a fixture trap, and that connects with the vent system above the fixture served or terminates in the open air.

Industrial Waste. Liquid or water-borne waste from industrial or commercial processes, except domestic sewage.

Insanitary. A condition that is contrary to sanitary principles or is injurious to health.

Conditions to which "insanitary" shall apply include the following:

(1) A trap that does not maintain a proper trap seal.

(2) An opening in a drainage system, except where lawful that is not provided with an approved liquid-sealed trap.

(3) A plumbing fixture or other waste discharging receptor or device that is not supplied with water sufficient to flush and maintain the fixture or receptor in a clean condition.

(4) A defective fixture, trap, pipe, or fitting.

(5) A trap, except where in this code exempted, directly connected to a drainage system, the seal of which is not protected against siphonage and backpressure by a vent pipe.

(6) A connection, cross-connection, construction, or condition, temporary or permanent that would permit or make possible by any means whatsoever for an unapproved foreign matter to enter a water distribution system used for domestic purposes.

(7) The preceding enumeration of conditions to which the term "insanitary" shall apply, shall not preclude the application of that term to conditions that are, in fact, insanitary.

Interceptor (Clarifier). A device designed and installed to separate and retain deleterious, hazardous, or undesirable matter from normal wastes and permit normal sewage or liquid wastes to discharge into the disposal terminal by gravity.

Invert. The lowest portion of the inside of a horizontal pipe.

212.0 – J –

Joint, Brazed. A joint obtained by joining of metal parts with alloys that melt at temperatures exceeding 840°F (449°C), but less than the melting temperature of the parts to be joined.

Joint, Compression. A multipiece joint with cup-shaped threaded nuts that, when tightened, compress tapered sleeves so that they form a tight joint on the periphery of the tubing they connect.

Joint, Flanged. One 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. The general form for gas-tight or liquid-tight joints obtained by the joining of parts through a positive holding mechanical construction.

Joint, Press-Connect. A permanent mechanical joint incorporating an elastomeric seal or an elastomeric seal and corrosion resistant grip ring. The joint is made with a pressing tool and jaw or ring that complies with the manufacturer's installation instructions.

Joint, Soldered. A joint obtained by the joining of metal parts with metallic mixtures or alloys that melt at a temperature up to and including 840°F (449°C).

Joint, Welded. A gastight joint obtained by the joining of metal parts in the plastic molten state.

213.0 – K –

No definitions.

214.0 – L –

Labeled. Equipment or materials bearing a label of a listing agency (accredited conformity assessment body). See Listed (third-party certified).

Lavatories in Sets. Two or three lavatories that are served by one trap.

Leader. An exterior vertical drainage pipe for conveying storm water from roof or gutter drains. See Downspout.

Levels of Sedation.

Deep Sedation/Analgesia. A drug-induced depression of consciousness during which patients cannot be easily aroused but respond purposefully following repeated or painful stimulation. The ability to independently maintain ventilatory function may be impaired. Patients may require assistance in maintaining a patent airway, and spontaneous ventilation may be inadequate. Cardiovascular function is usually maintained. [NFPA 99:3.3.61.2]

General Anesthesia. A drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation. The ability to independently maintain ventilatory function is often impaired. Patients often require assistance in maintaining a patent airway, and positive pressure ventilation may be required because of depressed spontaneous ventilation or drug-induced depression of neuromuscular function. Cardiovascular function may be impaired. [NFPA 99:3.3.61.1]

Minimal Sedation (Anxiolysis). A drug induced state during which patients respond normally to verbal commands. Although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected. [NFPA 99:3.3.61.4]

Moderate Sedation/Analgesia (Conscious Sedation). A drug-induced depression of consciousness during which patients respond purposefully to verbal commands, either alone or accompanied by light tactile stimulation. No interventions are required to maintain a patient airway, and spontaneous ventilation is adequate. Cardiovascular function is usually maintained. [NFPA 99:3.3.61.3]

Liquefied Petroleum Gas (LP-Gas) Facilities. Liquefied petroleum gas (LP-Gas) facilities include tanks, containers, container valves, regulating equipment, meters, appurtenances, or any combination thereof for the storage and supply of liquefied petroleum gas for a building, structure, or premises.

Liquid Waste. The discharge from a fixture, appliance, or appurtenance in connection with a plumbing system that does not receive fecal matter.

Listed (Third-party certified). Equipment or materials included in a list published by a listing agency (accredited conformity assessment body) that maintains periodic inspection of current production of listed equipment or materials and whose listing states either that the equipment or material complies with approved standards or has been tested and found suitable for use in a specified manner.

Listing Agency. An agency accredited by an independent and authoritative conformity assessment body to operate a material and product listing and labeling (certification) system and that are accepted by the Authority Having Jurisdiction, which is in the business of listing or labeling. The system includes initial and ongoing product testing, a periodic inspection on current production of listed (certified) products, and that makes available a published report of such listing in which specific information is included that the material or product is in accordance with applicable standards and found safe for use in a specific manner.

Lot. A single or individual parcel or area of land legally recorded or validated by other means acceptable to the Authority Having Jurisdiction on which is situated a building or which is the site of any work regulated by this code, together with the yards, courts, and unoccupied spaces legally required for the building or works, and that is owned by or is in the lawful possession of the owner of the building or works.

Low Hazard. See Pollution.

Low-Pressure Water Dispenser. A terminal fitting located downstream of a pressure reducing valve that dispenses drinking hot water above 71°C (160°F) or cold water or both at a pressure of 105 kPa (15 psi) or less.

215.0 – M –

Macerating Toilet System. A system comprised of a sump with macerating pump and with connections for a water closet and other plumbing fixtures, which is designed to accept, grind and pump wastes to an approved point of discharge.

Main. The principal artery of a system of continuous piping to which branches may be connected.

Main Sewer. See Public Sewer.

Main Vent. The principal artery of the venting system to which vent branches may be connected.

May. A permissive term.

Medical Air. For the purposes of this code, medical air is air supplied from cylinders, bulk containers, or medical air compressors, or reconstituted from oxygen USP and oil-free, dry nitrogen NF. [NFPA 99:3.3.96]

Medical Gas. A patient medical gas or medical support gas. (See also Patient Medical Gas and Medical Support Gas) [NFPA 99:3.3.104]

Manifold. A device for connecting the outlets of one or more gas cylinders to the central piping system for that specific gas. [NFPA 99:3.3.99]

Medical Gas System. An assembly of equipment and piping for the distribution of nonflammable medical gases such as oxygen, nitrous oxide, compressed air, carbon dioxide, and helium. [NFPA 99:3.3.105]

Medical Support Gas. Nitrogen or instrument air used for any medical support purpose (e.g., to remove excess moisture from instruments before further processing, or to operate medical-surgical tools, air-driven booms, pendants, or similar applications) and, if appropriate to the procedures, used in laboratories and are not respired as part of any treatment. Medical support gas falls under the general requirements for medical gases. [NFPA 99:3.3.107]

Medical-Surgical Vacuum. A method used to provide a source of drainage, aspiration, and suction in order to remove body fluids from patients. [NFPA 99:3.3.108]

Medical-Surgical Vacuum System. An assembly of central vacuum-producing equipment and a network of piping for patient suction in medical, medical-surgical, and waste anesthetic gas disposal (WAGD) applications. [NFPA 99:3.3.109]

Mobile Home Park Sewer. That part of the horizontal piping of a drainage system that begins 2 feet (610 mm) downstream from the last mobile home site and conveys it to a public sewer, private sewer, private sewage disposal system, or other point of disposal.

Mulch. Organic materials, such as wood chips and fines, tree bark chips, and pine needles that are used in a mulch basin to conceal gray water outlets and permit the infiltration of gray water.

Mulch Basin. A subsurface catchment area for gray water that is filled with mulch and of sufficient depth and volume to prevent ponding, surfacing, or runoff.

216.0 – N –

Nitrogen, NF. Nitrogen complying as a minimum, with nitrogen NF. [NFPA 99:3.3.109.1]

Nonwater Urinal with Drain Cleansing Action. A nonwater urinal that conveys waste into the drainage system without the use of water for flushing and automatically performs a drain-cleansing action after a predetermined amount of time.

Nuisance. Includes, but is not limited to:

(1) A public nuisance known at common law or in equity jurisprudence.

(2) Where work regulated by this code is dangerous to human life or is detrimental to health and property.

(3) Inadequate or unsafe water supply or sewage disposal system.

217.0 – O –

Offset. A combination of elbows or bends in a line of piping that brings one section of the pipe out of line but into a line parallel with the other section.

Oil Interceptor. See Interceptor (Clarifier).

On-Site Treated Nonpotable Water. Nonpotable water, including gray water that has been collected, treated, and intended to be used on-site and is suitable for direct beneficial use.

218.0 – P –

Patient Care Space. Any space of a health care facility wherein patients are intended to be examined or treated. [NFPA 99:3.3.136]

Category 1 Space. Space in which failure of equipment or a system is likely to cause major injury or death of patients, staff, or visitors. [NFPA 99:3.3.136.1]

Category 2 Space. Space in which failure of equipment or a system is likely to cause minor injury to patients, staff, or visitors. [NFPA 99:3.3.136.2]

Category 3 Space. Space in which the failure of equipment or a system is not likely to cause injury to patients, staff, or visitors but can cause discomfort. [NFPA 99:3.3.136.3]

Category 4 Space. Space in which failure of equipment or a system is not likely to have a physical impact on patient care. [NFPA 99:3.3.136.4]

Patient Medical Gas. Piped gases such as oxygen, nitrous oxide, helium, carbon dioxide, and medical air that are used in the application of human respiration and the calibration of medical devices used for human respiration. [NFPA 99:3.3.142]

PB. Polybutylene.

PE. Polyethylene.

PE-AL-PE. Polyethylene-aluminum-polyethylene.

PE-RT. Polyethylene of raised temperature.

Penetration Firestop System. A specific assemblage of field-assembled materials, or a factory-made device, which has been tested to a standard test method and, where installed properly on penetrating piping materials, is capable of maintaining the fire- resistance rating of assemblies penetrated.

Person. A natural person, his heirs, executor, administrators, or assigns and shall also include a firm, corporation, municipal or quasi-municipal corporation, or governmental agency. The singular includes the plural, male includes female.

PEX. Cross-linked polyethylene.

PEX-AL-PEX. Cross-linked polyethylene–aluminum-cross-linked polyethylene.

Pipe. A cylindrical conduit or conductor is conforming to the dimensions commonly known as “pipe size.”

Plumbing. The business, trade, or work having to do with the installation, removal, alteration, or repair of plumbing systems or parts thereof.

Plumbing Appliance. A special class of device or equipment that is intended to perform a special plumbing function. Its operation, control, or both may be dependent upon one or more energized components, such as motors, controls, heating elements, or pressure- or temperature-sensing elements. Such device or equipment may operate automatically through one or more of the following actions: a time cycle, a temperature range, a pressure range, a measured volume or weight; or the device or equipment may be manually adjusted or controlled by the user or operator.

Plumbing Appurtenance. A manufactured device, a prefabricated assembly, or an on-the-job assembly of component parts that is an adjunct to the basic piping system and plumbing fixtures. An appurtenance demands no additional water supply, nor does it add a discharge load to a fixture or the drainage system. It performs some useful function in the operation, maintenance, servicing, economy, or safety of the plumbing system.

Plumbing Fixture. An approved type installed receptacle, device or appliance that is supplied with water or that receives liquid or liquid-borne wastes and discharges such wastes into the drainage system to which it may be directly or indirectly con-

nected. Industrial or commercial tanks, vats, and similar processing equipment are not plumbing fixtures, but may be connected to or discharged into approved traps or plumbing fixtures where and as otherwise provided for elsewhere in this code.

Plumbing Official. See Authority Having Jurisdiction.

[W] Plumbing System. Includes all potable water, building supply, and distribution pipes, all reclaimed or other alternate source water systems, all rainwater systems, all plumbing fixtures and traps; all drainage and vent pipe(s); and all building drains, including their respective joints and connections, devices, receptors, and appurtenances within the property lines of the premises and shall include potable water piping, potable water treating or using equipment, medical gas and medical vacuum systems, and water heaters: Provided, that no certification shall be required for the installation of a plumbing system within the property lines and outside a building.

Plumbing Vent. A pipe provided to ventilate a plumbing system, to prevent trap siphonage and backpressure, or to equalize the air pressure within the drainage system.

Plumbing Vent System. A pipe or pipes installed to provide a flow of air to or from a drainage system or to provide a circulation of air within such system to protect trap seals from siphonage and backpressure.

Point-of-Entry, Water Treatment Unit. A device serving the water distribution system of a building for the purposes of altering, modifying, adding, or removing minerals, chemicals, contaminants, and suspended solids in the water.

Point-of-Use, Water Treatment Unit. A device serving a single atmospheric outlet such as a faucet for the purposes of altering, modifying, adding, or removing any minerals, chemicals, contaminants, and suspended solids in water.

Pollution. An impairment of the quality of the potable water to the degree that does not create a hazard to the public health but which does adversely and unreasonably affect the aesthetic qualities of such potable water for domestic use. Also, defined as "Low Hazard."

Potable Water. Water that is satisfactory for drinking, culinary, and domestic purposes and that meets the requirements of the Health Authority Having Jurisdiction.

PP. Polypropylene.

Pre-fabricated Shower Enclosure. A factory-assembled watertight structure with enclosing walls, a drain, and door or open access way.

Pressure. The normal force exerted by a homogeneous liquid or gas, per unit of area, on the wall of the container.

Residual Pressure. The pressure available at the fixture or water outlet after allowance is made for pressure drop due to friction loss, head, meter, and other losses in the system during maximum demand periods.

Static Pressure. The pressure is existing without any flow.

Pressure-Balancing Valve. A mixing valve that senses incoming hot and cold water pressures and compensates for fluctuations in either to stabilize outlet temperature.

Pressure-Lock-Type Connection. A mechanical connection that depends on an internal retention device to prevent pipe or tubing separation. The connection is made by inserting the pipe or tubing into the fitting to a prescribed depth.

Private or Private Use. Applies to plumbing fixtures in residences and apartments, to private bathrooms in hotels, hospitals, and health care facilities, and to restrooms in commercial establishments where the fixtures are intended for the use of a family or an individual.

Private Sewage Disposal System. A septic tank with the effluent discharging into a subsurface disposal field, into one or more seepage pits, or into a combination of subsurface disposal field and seepage pit or of such other facilities as may be permitted under the procedures set forth elsewhere in this code.

Private Sewer. A building sewer that receives the discharge from more than one building drain and conveys it to a public sewer, private sewage disposal system, or another point of disposal.

Proportioning System for Medical Air USP. A central supply that produces medical air (USP) reconstituted from oxygen USP and nitrogen NF by means of a mixer or blender. [NFPA 99:3.3.102.1]

Public or Public Use. Applies to plumbing fixtures that are not defined as private or private use.

Public Sewer. A common sewer directly controlled by public authority.

Public Water System. A system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or regularly serves an average of twenty-five individuals daily for at least 60 days per year.

Push Fit Fitting. A mechanical fitting where the connection is assembled by pushing the tube or pipe into the fitting and is sealed with an o-ring.

PVC. Polyvinyl Chloride.

PVDF. Polyvinylidene Fluoride.

219.0 – Q –

Quick-Disconnect Device. A hand-operated device that provides a means for connecting and disconnecting a hose to a water supply, and that is equipped with a means to shut off the water supply when the device is disconnected.

Quick-Disconnect Device (Fuel Gas). 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. [NFPA 54:3.3.28.3]

220.0 – R –

Rainwater. Natural precipitation that has not been contaminated by use.

Rainwater Catchment System. A system that utilizes the principal of collecting, storing, and using rainwater from a rooftop or other manmade, aboveground collection surface. Also, known as a rainwater harvesting system.

Rainwater Storage Tank. The central component of the rainwater catchment system. Also, known as a cistern or rain barrel.

Receptor. An approved plumbing fixture or device of such material, shape, and capacity as to adequately receive the discharge from indirect waste pipes, so constructed and located as to be readily cleaned.

Reclaimed Water. Nonpotable water provided by a water/wastewater utility that, as a result of tertiary treatment of domestic wastewater, meets requirements of the public health Authority Having Jurisdiction for its intended uses.

Registered Design Professional. An individual who is registered or licensed by the laws of the state to perform such design work in the jurisdiction.

Registered Design Professional in Responsible Charge. A registered design professional engaged by the owner for the owner's authorized agent to review and coordinate certain aspects of the project, as determined by the building official, for compatibility with the design of the building or structure, including submittal documents prepared by others, deferred submittal documents and phased submittal documents.

Regulating Equipment. Includes valves and controls used in a plumbing system that is required to be accessible or readily accessible.

Relief Vent. A vent, the primary function of which is to provide circulation of air between drainage and vent systems or to act as an auxiliary vent on a specially designed system.

Remote Outlet. Where used for sizing water piping, it is the furthest outlet dimension, measuring from the meter, either the developed length of the cold-water piping or through the water heater to the furthest outlet on the hot-water piping.

Rim. See Flood-Level Rim.

Riser. A water supply pipe that extends vertically one full story or more to convey water to branches or fixtures.

Roof Drain. A drain installed to receive water collecting on the surface of a roof and to discharge it into a leader, downspout, or conductor.

Roof Washer. A device or method for removal of sediment and debris from a collection surface by diverting initial rainfall from entry into the cistern(s). Also, known as a first flush device.

Roughing-In. The installation of all parts of the plumbing system that can be completed prior to the installation of fixtures. This includes drainage, water supply, gas piping, vent piping, and the necessary fixture supports.

221.0 – S –

Sand Interceptor. See Interceptor (Clarifier).

Scavenging. Evacuation of exhaled mixtures of oxygen and nitrous oxide. [NFPA 99:3.3.159]

Standard Cubic Feet per Minute (SCFM). Volumetric flow rate of gas in units of standard cubic feet per minute. [NFPA 99:3.3.156]

SDR. An abbreviation for "standard dimensional ratio," which is the specific ratio of the average specified outside diameter to the minimum wall thickness for outside controlled diameter plastic pipe.

Seam, Welded. See Joint, Welded.

Seepage Pit. A lined excavation in the ground which receives the discharge of a septic tank so designed as to permit the effluent from the septic tank to seep through its bottom and sides.

Septic Tank. A watertight receptacle that receives the discharge of a drainage system or part thereof, designed and constructed so as to retain solids, digest organic matter through a period of detention, and allow the liquids to discharge into the soil outside of the tank through a system of open joint piping or a seepage pit meeting the requirements of this code.

Service Piping. The piping and equipment between the street gas main and the gas piping system inlet that is installed by, and is under the control and maintenance of, the serving gas supplier.

Sewage. Liquid waste containing animal or vegetable matter in suspension or solution and that may include liquids containing chemicals in solution.

Sewage Ejector. A device for lifting sewage by entraining it on a high-velocity jet stream, air, or water.

Sewage Pump. A permanently installed mechanical device, other than an ejector, for removing sewage or liquid waste from a sump.

Shall. Indicates a mandatory requirement.

Shielded Coupling. An approved elastomeric sealing gasket with an approved outer shield and a tightening mechanism.

Shock Arrester. See Water Hammer Arrester.

Should. Indicates a recommendation or that which is advised but not required.

Single-Family Dwelling. A building designed to be used as a home by the owner of such building, which shall be the only dwelling located on a parcel of ground with the usual accessory buildings.

Size and Type of Tubing. See Diameter.

Slip Joint. An adjustable tubing connection, consisting of a compression nut, a friction ring, and a compression washer, designed to fit a threaded adapter fitting or a standard taper pipe thread.

Slope. See Grade.

Soil Pipe. A pipe that conveys the discharge of water closets, urinals, clinical sinks, or fixtures having similar functions of collection and removal of domestic sewage, with or without the discharge from other fixtures to the building drain or building sewer.

Special Wastes. Wastes that require some special method of handling, such as the use of indirect waste piping and receptors, corrosion-resistant piping, sand, oil or grease interceptors, condensers, or other pretreatment facilities.

[W] Spray Sprinkler Body. The exterior case or shell of a sprinkler incorporating a means of connection to the piping system designed to convey water to a nozzle or orifice.

Stack. The vertical main of a system of soil, waste, or vent piping extending through one or more stories.

Stack Vent. The extension of soil or waste stacks above the highest horizontal drain connected to the stack.

Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix, footnote, or fine print note and are not to be considered a part of the requirements of a standard.

Station Inlet. An inlet point in a piped medical/surgical vacuum distribution system at which the user makes connections and disconnections. [NFPA 99:3.3.169]

Station Outlet. An outlet point in a piped medical gas distribution system at which the user makes connections and disconnections. [NFPA 99:3.3.170]

Sterilizer. A piece of equipment that disinfects instruments and equipment by way of heat.

Storm Drain. See Building Drain (Storm).

Storm Sewer. A sewer used for conveying rainwater, surface water, condensate, cooling water, or similar liquid wastes.

Subsoil Drain. A drain that collects subsurface or seepage water and conveys it to a place of disposal.

Subsoil Irrigation Field. Gray water irrigation field installed in a trench within the layer of soil below the topsoil. This system is typically used for irrigation of deep rooted plants.

Subsurface Irrigation Field. Gray water irrigation field installed below finished grade within the topsoil.

Sump. An approved tank or pit that receives sewage or liquid waste and which is located below the normal grade of the gravity system and which must be emptied by mechanical means.

Supports. Supports, hangers, and anchors are devices for properly supporting and securing pipe, fixtures, and equipment.

Surge Tank. A reservoir to modify the fluctuation in flow rates to allow for uniform distribution of gray water to the points of irrigation.

222.0 – T –

T Rating. The time period that the penetration firestop system, including the penetrating item, limits the maximum temperature rise of 325°F (181°C) above its initial temperature through the penetration on the nonfire side, where tested in accordance with ASTM E814 or UL 1479.

Tailpiece. The pipe or tubing that connects the outlet of a plumbing fixture to a trap.

Thermostatic (Temperature Control) Valve. A mixing valve that senses outlet temperature and compensates for fluctuations in incoming hot or cold water temperatures.

Toilet Facility. A room or space containing not less than one lavatory and one water closet.

Transition Gas Riser. A listed or approved section or sections of pipe and fittings used to convey fuel gas and installed in a gas piping system to provide a transition from belowground to aboveground.

Trap. A fitting or device so designed and constructed as to provide, where properly vented, a liquid seal that will prevent the back passage of air without materially affecting the flow of sewage or wastewater through it.

Trap Arm. Those portions of a fixture drain between a trap and the vent.

Trap Primer. A device and system of piping that maintains a water seal in a remote trap.

Trap Seal. The vertical distance between the crown weir and the top dip of the trap.

Crown Weir (Trap Weir). The lowest point in the cross-section of the horizontal waterway at the exit of the trap.

Top Dip (of the trap). The highest point in the internal cross-section of the trap at the lowest part of the bend (inverted siphon). By contrast, the bottom dip is the lowest point in the internal cross-section.

223.0 – U –

Unsanitary. See Insanitary.

Urinal, Hybrid. A urinal that conveys waste into the drainage system without the use of water for flushing and automatically performs a drain-cleansing action after a predetermined amount of time.

User Outlet. See Station Outlet.

224.0 – V –

Vacuum. A pressure less than that exerted by the atmosphere.

Vacuum Breaker. See Backflow Preventer.

Vacuum Relief Valve. A device that prevents excessive vacuum in a pressure vessel.

Vacuum System-Level 1. A system consisting of central vacuum-producing equipment with pressure and operating controls, shutoff valves, alarm warning systems, gauges, and a network of piping extending to and terminating with suitable station inlets at locations where patient suction could be required.

Valve, Isolation. A valve that isolates one piece of equipment from another.

Valve, Pressure-Relief. A pressure-actuated valve held closed by a spring or other means and designed automatically to relieve pressure in excess of its setting.

Valve, Riser. A valve at the base of a vertical riser that isolates that riser.

Valve, Service. A valve is serving horizontal piping extending from a riser to a station outlet or inlet.

Valve, Source. A single valve at the source that controls a number of units that makes up the source.

Valve, Zone. A valve that controls the gas or vacuum to a particular area.

Vent. See Plumbing Vent; Dry Vent; Wet Vent.

Vent Connector, Gas. That portion of a gas venting system that connects a listed gas appliance to a gas vent and is installed within the space or area in which the appliance is located.

Vent Offset. An arrangement of two or more fittings and pipe installed for the purpose of locating a vertical section of the vent pipe in a different but parallel plane with respect to an adjacent section of a vertical vent pipe. [NFPA 54:3.3.102]

Vent Pipe. See Plumbing Vent.

Vent Stack. The vertical vent pipe installed primarily for the purpose of providing circulation of air to and from any part of the drainage system.

Vent System. See Plumbing Vent System.

Vented Flow Control Device. A device installed upstream from the hydromechanical grease interceptor having an orifice that controls the rate of flow through the interceptor, and an air intake (vent) downstream from the orifice, which allows air to be drawn into the flow stream.

Venting System. A continuous open passageway from the flue collar or draft hood of an appliance to the outdoors for the purpose of removing flue or vent gases. [NFPA 54:3.3.95.7]

Vent, Gases. A listed factory-made vent pipe and vent fittings for conveying flue gases to the outdoors.

Type B Gas Vent. A factory-made gas vent listed by a nationally recognized testing agency for venting listed or approved appliances equipped to burn only gas.

Type BW Gas Vent. A factory-made gas vent listed by a nationally recognized testing agency for venting listed or approved gas-fired vented wall furnaces.

Type L Gas Vent. A venting system consisting of listed vent piping and fittings for use with oil-burning appliances listed for use with Type L or with listed gas appliances.

Vertical Pipe. A pipe or fitting that is installed in a vertical position or that makes an angle of not more than 45 degrees (0.79 rad) with the vertical.

225.0 – W –

Wall-Hung Water Closet. A water closet installed in such a way that no part of the water closet touches the floor.

Waste. See Liquid Waste and Industrial Waste.

Waste Pipe. A pipe that conveys only liquid waste, free of fecal matter.

Water-Conditioning or Treating Device. A device that conditions or treats a water supply to change its chemical content or remove suspended solids by filtration.

Water Distribution Pipe. In a building or premises, a pipe that conveys potable water from the building supply pipe to the plumbing fixtures and other water outlets.

Water Hammer Arrester. A device designed to provide protection against hydraulic shock in the building water supply system.

[S] Water Heater. Any heating appliance or equipment that heats potable water and supplies such water to the potable hot water distribution system and does not exceed an operating temperature of 210 °F (99 °C), a maximum allowable working pressure of 160 pounds per square inch (1103 kPa), a volume of 120 gallons (454 L) or a heat input of 200,000 Btu/hr (58.6 kW). Appliances and equipment that exceed any one of these values are classified as boilers.

[W] Water Heater (consumer electric storage). A consumer product that uses electricity as the energy source to heat domestic potable water, has a nameplate input rating of twelve kilowatts or less, contains nominally forty gallons but no more than one hundred twenty gallons of rated hot water storage volume, and supplies a maximum hot water delivery temperature less than one hundred eighty degrees Fahrenheit.

[W] Water Heater (mini-tank electric). A small electric water heater that has a measured storage volume of more than one gallon and a rated storage volume of less than twenty gallons.

Water Main (Street Main). A water supply pipe for public or community use.

Water Supply System. The building supply pipe, the water distribution pipes, and the necessary connecting pipes, fittings, control valves, backflow prevention devices, and all appurtenances carrying or supplying potable water in or adjacent to the building or premises.

[W] Water/Wastewater Utility. A public or private entity, including a water purveyor as defined in chapter 246-290 WAC, which may treat, deliver or do both functions to reclaimed (recycled) water, potable water, or both to wholesale or retail customers.

Welder, Pipe. A person who specializes in the welding of pipes and holds a valid certificate of competency from a recognized testing laboratory, based on the requirements of the ASME Boiler and Pressure Vessels code, Section IX.

Wet Procedure Locations. The area in a patient care room where a procedure is performed that is normally subject to wet conditions while patients are present, including standing fluids on the floor or drenching of the work area, either of which condition is intimate to the patient or staff. [NFPA 99:3.3.183]

Wet Vent. A vent that also serves as a drain.

Whirlpool Bathtub. A bathtub fixture equipped and fitted with a circulating piping system designed to accept, circulate, and discharge bathtub water upon each use.

226.0 – X –

No definitions.

227.0 – Y –

Yoke Vent. A pipe connecting upward from soil or waste stack to a vent stack to prevent pressure changes in the stacks.

228.0 – Z –

No definitions.

CHAPTER 3
GENERAL REGULATIONS

301.0 General.

301.1 Applicability. This chapter shall govern the general requirements, not specific to other chapters, for the installation of plumbing systems.

301.2 Minimum Standards. Pipe, pipe fittings, traps, fixtures, material, and devices used in a plumbing system shall be listed (third-party certified) by a listing agency (accredited conformity assessment body) as complying with the approved applicable recognized standards referenced in this code, and shall be free from defects. Unless otherwise provided for in this code, materials, fixtures, or devices used or entering into the construction of plumbing systems, or parts thereof shall be submitted to the Authority Having Jurisdiction for approval prior to being installed.

301.2.1 Marking. Each length of pipe and each pipe fitting, trap, fixture, material, and device used in a plumbing system shall have cast, stamped, or indelibly marked on it any markings required by the applicable referenced standards and listing agency, and the manufacturer's mark or name, which shall readily identify the manufacturer to the end user of the product. Where required by the approved standard that applies, the product shall be marked with the weight and the quality of the product. Materials and devices used or entering into the construction of plumbing and drainage systems, or parts thereof shall be marked and identified in a manner satisfactory to the Authority Having Jurisdiction. Such marking shall be done by the manufacturer. Field markings shall not be acceptable.

Exception: Markings shall not be required on nipples created from cutting and threading of approved pipe.

[W] 301.2.2 Standards. Standards listed or referred to in this chapter or other chapters cover materials that will conform to the requirements of this code, when used in accordance with the limitations imposed in this or other chapters thereof and their listing. Where a standard covers materials of various grades, weights, quality, or configurations, the portion of the listed standard that is applicable shall be used. Design and materials for special conditions or materials not provided for herein shall be permitted to be used by special permission of the Authority Having Jurisdiction after the Authority Having Jurisdiction has been satisfied as to their adequacy in accordance with Section 301.2.

301.2.3 Plastic Pipe, Plastic Pipe Fittings, and Components. Plastic pipe, plastic pipe fittings, and components other than those for gas shall comply with NSF 14.

301.2.4 Cast-Iron Soil Pipe, Fittings, and Hubless Couplings. Cast-iron soil pipe, fittings, and hubless couplings shall be third party certified in accordance with ASTM C1277 and CISPI 310 for couplings and ASTM A888, ASTM A74, and CISPI 301 for pipes and fittings.

301.2.5 Existing Buildings. In existing buildings or premises in which plumbing installations are to be altered, repaired, or renovated, the Authority Having Jurisdiction has discretionary powers to permit deviation from the provisions of this code, provided that such proposal to deviate is first submitted for proper determination in order that health and safety requirements, as they pertain to plumbing, shall be observed.

301.3 Alternate Materials and Methods of Construction Equivalency. Nothing in this code is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this code. Technical documentation shall be submitted to the Authority Having Jurisdiction to demonstrate equivalency prior to installation. The Authority Having Jurisdiction shall have the authority to approve or disapprove the system, method, or device for the intended purpose.

However, the exercise of this discretionary approval by the Authority Having Jurisdiction shall have no effect beyond the jurisdictional boundaries of said Authority Having Jurisdiction. An alternate material or method of construction so approved shall not be considered as in accordance with the requirements, intent, or both of this code for a purpose other than that granted by the Authority Having Jurisdiction where the submitted data does not prove equivalency.

301.3.1 Testing. The Authority Having Jurisdiction shall have the authority to require tests, as proof of equivalency.

301.3.1.1 Tests. Tests shall be made in accordance with approved or applicable standards, by an approved testing agency at the expense of the applicant. In the absence of such standards, the Authority Having Jurisdiction shall have the authority to specify the test procedure.

301.3.1.2 Request by Authority Having Jurisdiction. The Authority Having Jurisdiction shall have the authority to require tests to be made or repeated where there is reason to believe that a material or device no longer is in accordance with the requirements on which its approval was based.

301.4 Flood Hazard Areas. Plumbing systems shall be located above the elevation in accordance with the building code for utilities and attendant equipment or the elevation of the lowest floor, whichever is higher.

Exception: Plumbing systems shall be permitted to be located below the elevation in accordance with the building code for utilities and attendant equipment or the elevation of the lowest floor, whichever is higher, provided that the systems are designed and installed to prevent water from entering or accumulating within their components, and the systems are constructed to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to such elevation.

301.4.1 Coastal High Hazard Areas. Plumbing systems in buildings located in coastal high hazard areas shall be in accordance with the requirements of Section 301.4, and plumbing systems, pipes, and fixtures shall not be mounted on or penetrate through walls that are intended to breakaway under flood loads in accordance with the building code.

301.5 Alternative Engineered Design. An alternative engineered design shall comply with the intent of the provisions of this code and shall provide an equivalent level of quality, strength, effectiveness, fire resistance, durability, and safety. Material, equipment, or components shall be designed and installed in accordance with the manufacturer's installation instructions.

301.5.1 Permit Application. The registered design professional shall indicate on the design documents that the plumbing system, or parts thereof, is an alternative engineered design so that it is noted on the construction permit application. The permit and permanent permit records shall indicate that an alternative engineered design was part of the approved installation.

301.5.2 Technical Data. The registered design professional shall submit sufficient technical data to substantiate the proposed alternative engineered design and to prove that the performance meets the intent of this code.

301.5.3 Design Documents. The registered design professional shall provide two complete sets of signed and sealed design documents for the alternative engineered design for submittal to the Authority Having Jurisdiction. The design documents shall include floor plans and a riser diagram of the work. Where appropriate, the design documents shall indicate the direction of flow, pipe sizes, grade of horizontal piping, loading, and location of fixtures and appliances.

301.5.4 Design Approval. An approval of an alternative engineered design shall be at the discretion of the Authority Having Jurisdiction. The exercise of this discretionary approval by the Authority Having Jurisdiction shall have no effect beyond the jurisdictional boundaries of said Authority Having Jurisdiction. An alternative engineered design so approved shall not be considered as in accordance with the requirements, intent, or both of this code for a purpose other than that granted by the Authority Having Jurisdiction.

301.5.5 Design Review. The Authority Having Jurisdiction shall have the authority to require testing of the alternative engineered design in accordance with Section 301.3.1, including the authority to require an independent review of the design documents by a registered design professional selected by the Authority Having Jurisdiction and at the expense of the applicant.

301.5.6 Inspection and Testing. The alternative engineered design shall be tested and inspected in accordance with the submitted testing and inspection plan and the requirements of this code.

302.0 Iron Pipe Size (IPS) Pipe.

302.1 General. Iron, steel, copper, and copper alloy pipe shall be standard-weight iron pipe size (IPS) pipe.

303.0 Disposal of Liquid Waste.

303.1 General. It shall be unlawful for a person to cause, suffer, or permit the disposal of sewage, human excrement, or other liquid wastes, in a place or manner, except through and by means of an approved drainage system, installed and maintained in accordance with the provisions of this code.

304.0 Connections to Plumbing System Required.

304.1 General. Plumbing fixtures, drains, appurtenances, and appliances, used to receive or discharge liquid wastes or sewage, shall be connected properly to the drainage system of the building or premises, in accordance with the requirements of this code.

305.0 Damage to Drainage System or Public Sewer.

305.1 Unlawful Practices. It shall be unlawful for a person to deposit, by any means whatsoever, into a plumbing fixture, floor drain, interceptor, sump, receptor, or device, which is connected to a drainage system, public sewer, private sewer, septic tank, or cesspool, any ashes; cinders; solids; rags; inflammable, poisonous, or explosive liquids or gases; oils; grease; or any other thing whatsoever that is capable of causing damage to the drainage system or public sewer.

306.0 Industrial Wastes.

306.1 Detrimental Wastes. Wastes detrimental to the public sewer system or detrimental to the functioning of the sewage treatment plant shall be treated and disposed of as found necessary and directed by the Authority Having Jurisdiction.

306.2 Safe Discharge. Sewage or other waste from a plumbing system that is capable of being deleterious to surface or subsurface waters shall not be discharged into the ground or a waterway unless it has first been rendered safe by some acceptable form of treatment in accordance with the Authority Having Jurisdiction.

307.0 Location.

307.1 System. Except as otherwise provided in this code, no plumbing system, drainage system, building sewer, private sewage disposal system, or parts thereof shall be located in a lot other than the lot that is the site of the building, structure, or premises served by such facilities.

307.2 Ownership. No subdivision, sale, or transfer of ownership of existing property shall be made in such manner that the area, clearance, and access requirements of this code are decreased.

308.0 Improper Location.

308.1 General. Piping, fixtures, or equipment shall not be so located as to interfere with the normal use thereof or with the normal operation and use of windows, doors, or other required facilities.

[S] 308.2 Exterior Installations. Unless required to meet other provisions of this Code, or where first approved by the Authority Having Jurisdiction, no plumbing or piping system or part thereof shall be installed exterior to a building.

Exceptions:

(1) Rainwater conductors, leaders, gutters, or downspouts.

(2) Natural gas, fuel oil, or condensate piping serving exterior equipment.

(3) Non-potable water serving irrigation systems, mechanical fill stations, or similar exterior uses.

309.0 Workmanship.

309.1 Engineering Practices. Design, construction, and workmanship shall be in accordance with accepted engineering practices and shall be of such character as to secure the results sought to be obtained by this code.

309.2 Concealing Imperfections. It is unlawful to conceal cracks, holes, or other imperfections in materials by welding, brazing, or soldering or by using therein or thereon paint, wax, tar, solvent cement, or other leak-sealing or repair agent.

309.3 Burred Ends. Burred ends of pipe and tubing shall be reamed to the full bore of the pipe or tube, and chips shall be removed.

309.4 Installation Practices. Plumbing systems shall be installed in a workmanlike manner which is in accordance with this code, applicable standards, and the manufacturer's installation instructions. All materials shall be installed so as not to adversely affect the systems and equipment or the structure of the building, and in compliance with all laws and other provisions of this code. All plumbing systems shall be in accordance with construction documents approved by the Authority Having Jurisdiction.

309.5 Sound Transmission. Plumbing piping systems shall be designed and installed in conformance with sound limitations as required in the building code.

309.6 Dead Legs. Dead legs shall have a method of flushing.

310.0 Prohibited Fittings and Practices.

310.1 Fittings. No double hub fitting, single or double tee branch, single or double tapped tee branch, side inlet quarter bend, running thread, band, or saddle shall be used as a drainage fitting, except that a double hub sanitary tapped tee shall be permitted to be used on a vertical line as a fixture connection.

310.2 Drainage and Vent Piping. No drainage or vent piping shall be drilled and tapped for the purpose of making connections thereto, and no cast-iron soil pipe shall be threaded.

310.3 Waste Connection. No waste connection shall be made to a closet bend or stub of a water closet or similar fixture.

[W] 310.4 Use of Vent and Waste Pipes. Except as hereinafter provided in Section 908.0 through Section 911.0 and Appendix C, no vent pipe shall be used as a soil or waste pipe, nor shall any soil or waste pipe be used as a vent.

310.5 Obstruction of Flow. No fitting, fixture and piping connection, appliance, device, or method of installation that obstructs or retards the flow of water, wastes, sewage, or air in the drainage or venting systems, in an amount exceeding the normal frictional resistance to flow, shall be used unless it is indicated as acceptable in this code or is approved in accordance with

Section 301.2 of this code. The enlargement of a 3 inch (80 mm) closet bend or stub to 4 inches (100 mm) shall not be considered an obstruction.

310.6 Dissimilar Metals. Except for necessary valves, where intermembering or mixing of dissimilar metals occurs, the point of connection shall be confined to exposed or accessible locations.

310.7 Direction of Flow. Valves, pipes, and fittings shall be installed in correct relationship to the direction of flow.

310.8 Screwed Fittings. Screwed fittings shall be ABS, cast-iron, copper, copper alloy, malleable iron, PVC, steel, or other approved materials. Threads shall be tapped out of solid metal or molded in solid ABS or PVC.

311.0 Independent Systems.

311.1 General. The drainage system of each new building and new work installed in an existing building shall be separate and independent from that of any other building, and, where available, every building shall have an independent connection with a public or private sewer.

Exception: Where one building stands in the rear of another building on an interior lot, and no private sewer is available or can be constructed to the rear building through an adjoining court, yard, or driveway, the building drain from the front building shall be permitted to be extended to the rear building.

312.0 Protection of Piping, Materials, and Structures.

312.1 General. Piping passing under or through walls shall be protected from breakage. Piping passing through or under cinders or other corrosive materials shall be protected from external corrosion in an approved manner. Approved provisions shall be made for expansion of hot water piping. Voids around piping passing through concrete floors on the ground shall be sealed.

312.2 Installation. Piping in connection with a plumbing system shall be so installed that piping or connections will not be subject to undue strains or stresses, and provisions shall be made for expansion, contraction, and structural settlement. No plumbing piping shall be directly embedded in concrete or masonry. No structural member shall be seriously weakened or impaired by cutting, notching, or otherwise, as defined in the building code.

312.3 Building Sewer and Drainage Piping. No building sewer or other drainage piping or part thereof, constructed of materials other than those approved for use under or within a building, shall be installed under or within 2 feet (610 mm) of a building or structure, or less than 1 foot (305 mm) below the surface of the ground.

312.4 Corrosion, Erosion, and Mechanical Damage. Piping subject to corrosion, erosion, or mechanical damage shall be protected in an approved manner.

312.5 Protectively Coated Pipe. Protectively coated pipe or tubing shall be inspected and tested, and a visible void, damage, or imperfection to the pipe coating shall be repaired in an approved manner.

[W] [S] 312.6 Freezing Protection. No water, soil, or waste pipe shall be installed or permitted outside of a building, in attics or crawl spaces, or in an exterior wall unless, where necessary, adequate provision is made to protect such pipe from freezing. All hot and cold water pipes installed outside the conditioned space shall be insulated to a minimum of R-3 or as required by the Seattle Energy Code, whichever is greater.

[W] 312.7 Fire-Resistant Construction. All pipes penetrating floor/ceiling assemblies, and fire-resistance rated walls or partitions shall be protected in accordance with the requirements of the building code.

312.8 Waterproofing of Openings. Joints at the roof around pipes, ducts, or other appurtenances shall be made watertight by the use of lead, copper, galvanized iron, or other approved flashings or flashing material. Exterior wall openings shall be made watertight. Counterflashing shall not restrict the required internal cross-sectional area of the vent.

312.9 Steel Nail Plates. Plastic and copper or copper alloy piping penetrating framing members to within 1 inch (25.4 mm) of the exposed framing shall be protected by steel nail plates not less than No. 18 gauge (0.0478 inches) (1.2 mm) in thickness. The steel nail plate shall extend along the framing member not less than 1½ inches (38 mm) beyond the outside diameter of the pipe or tubing.

312.10 Sleeves. Sleeves shall be provided to protect piping through concrete and masonry walls, and concrete floors.

Exception: Sleeves shall not be required where openings are drilled or bored.

312.10.1 Building Loads. Piping through concrete or masonry walls shall not be subject to a load from building construction.

312.10.2 Exterior Walls. In exterior walls, annular space between sleeves and pipes shall be sealed and made watertight, as approved by the Authority Having Jurisdiction. A penetration through fire-resistive construction shall be in accordance with Section 312.7.

312.10.3 Firewalls. A pipe sleeve through a firewall shall have space around the pipe completely sealed with an approved fire-resistive material in accordance with other codes.

312.11 Structural Members. A structural member weakened or impaired by cutting, notching, or otherwise shall be reinforced, repaired, or replaced so as to be left in a safe structural condition in accordance with the requirements of the building code.

312.12 Rodentproofing. Strainer plates on drain inlets shall be designed and installed so that no opening exceeds ½ of an inch (12.7 mm) in the least dimension.

312.12.1 Meter Boxes. Meter boxes shall be constructed in such a manner as to restrict rodents or vermin from entering a building by following the service pipes from the box into the building.

312.12.2 Metal Collars. In or on buildings where openings have been made in walls, floors, or ceilings for the passage of pipes, such openings shall be closed and protected by the installation of approved metal collars securely fastened to the adjoining structure.

312.12.3 Tub Waste Openings. Tub waste openings in framed construction to crawl spaces at or below the first floor shall be protected by the installation of approved metal collars or metal screen securely fastened to the adjoining structure with no opening exceeding ½ of an inch (12.7 mm) in the least dimension.

313.0 Hangers and Supports.

313.1 General. Piping, fixtures, appliances, and appurtenances shall be supported in accordance with this code, the manufacturer's installation instructions, and in accordance with the Authority Having Jurisdiction.

313.2 Material. Hangers and anchors shall be of sufficient strength to support the weight of the pipe and its contents. Piping shall be isolated from incompatible materials.

313.3 Suspended Piping. Suspended piping shall be supported at intervals not to exceed those shown in Table 313.3.

313.4 Alignment. Piping shall be supported in such a manner as to maintain its alignment and prevent sagging.

313.5 Underground Installation. Piping in the ground shall be laid on a firm bed for its entire length; where other support is otherwise provided, it shall be approved in accordance with Section 301.2.

313.6 Hanger Rod Sizes. Hanger rod sizes shall be not smaller than those shown in Table 313.6.

TABLE 313.6
HANGER ROD SIZES

PIPE AND TUBE SIZE (inches)	ROD SIZE (inches)
½ – 4	⅜
5 – 8	½
10 – 12	⅝

For SI units: 1 inch = 25.4 mm

314.0 Trenching, Excavation, and Backfill.

314.1 Trenches. Trenches deeper than the footing of a building or structure, and paralleling the same, shall be located not less than 45 degrees (0.79 rad) from the bottom exterior edge of the footing, or as approved in accordance with Section 301.0.

314.2 Tunneling and Driving. Tunneling and driving shall be permitted to be done in yards, courts, or driveways of a building site. Where sufficient depth is available to permit, tunnels shall be permitted to be used between open-cut trenches.

Tunnels shall have a clear height of 2 feet (610 mm) above the pipe and shall be limited in length to one-half the depth of the trench, with a maximum length of 8 feet (2438 mm). Where pipes are driven, the drive pipe shall be not less than one size larger than the pipe to be laid.

314.3 Open Trenches. Excavations required to be made for the installation of a building drainage system or part thereof, within the walls of a building, shall be open trench work and shall be kept open until the piping has been inspected, tested, and accepted.

314.4 Excavations. Excavations shall be completely backfilled as soon after inspection as practicable. Precaution shall be taken to ensure compactness of backfill around piping without damage to such piping. Trenches shall be backfilled in thin layers to 12 inches (305 mm) above the top of the piping with clean earth, which shall not contain stones, boulders, cinder fill, frozen earth, construction debris, or other materials that will damage or break the piping or cause corrosive action. Mechanical devices such as bulldozers, graders, etc., shall be permitted to be then used to complete backfill to grade. Fill shall be properly compacted. Precautions shall be taken to ensure permanent stability for pipe laid in filled or made ground.

Underground thermoplastic pipe and fittings for sewers and other gravity flow applications shall be installed in accordance with this code and Section 314.4.1.

314.4.1 Installation of Thermoplastic Pipe and Fittings. Trench width for thermoplastic sewer pipe shall be not less than 1.25 times the outside diameter of the piping plus 12 inches (305 mm) or the outside diameter of the piping plus not less than 16 inches (406 mm). Thermoplastic piping shall be bedded in not less than 4 inches (102 mm) of granular fill

supporting the piping. The backfill for thermoplastic piping shall be compacted along the sides of the piping in 6 inch (152 mm) layers and continue to not less than 12 inches (305 mm) above the piping. Compaction shall be not less than an 85 percent standard proctor density.

315.0 Joints and Connections.

315.1 Unions. Approved unions shall be permitted to be used in drainage piping where accessibly located in the trap seal or between a fixture and its trap; in the vent system, except underground or in wet vents; at any point in the water supply system.

315.2 Prohibited Joints and Connections. A fitting or connection that has an enlargement, chamber, or recess with a ledge, shoulder, or reduction of pipe area that offers an obstruction to flow through the drain shall be prohibited.

316.0 Increasers and Reducers.

316.1 General. Where different sizes of pipes and fittings are to be connected, the proper size increasers or reducers or reducing fittings shall be used between the two sizes. Copper alloy or cast-iron body cleanouts shall not be used as a reducer or adapter from cast-iron drainage pipe to iron pipe size (IPS) pipe.

317.0 Food-Handling Establishments.

317.1 General. Food or drink shall not be stored, prepared, or displayed beneath soil or drain pipes unless those areas are protected against leakage or condensation from such pipes reaching the food or drink as described below. Where building design requires that soil or drain pipes be located over such areas, the installation shall be made with the least possible number of joints and shall be installed to connect to the nearest adequately sized vertical stack with the provisions as follows:

(1) Openings through floors over such areas shall be sealed watertight to the floor construction.

(2) Floor and shower drains installed above such areas shall be equipped with integral seepage pans.

(3) Soil or drain pipes shall be of an approved material as listed in Table 1701.1 and Section 701.2. Materials shall comply with established standards. Cleanouts shall be extended through the floor construction above.

(4) Piping subject to operation at temperatures that will form condensation on the exterior of the pipe shall be thermally insulated.

(5) Where pipes are installed in ceilings above such areas, the ceiling shall be of the removable type or shall be provided with access panels to form a ready access for inspection of piping.

318.0 Test Gauges.

318.1 General. Tests in accordance with this code, which are performed utilizing dial gauges, shall be limited to gauges having the following pressure graduations or incrementations.

318.2 Pressure Tests (10 psi or less). Required pressure tests of 10 pounds-force per square inch (psi) (69 kPa) or less shall be performed with gauges of 0.10 psi (0.69 kPa) incrementation or less.

318.3 Pressure Tests (greater than 10 psi to 100 psi). Required pressure tests exceeding 10 psi (69 kPa) but less than or equal to 100 psi (689 kPa) shall be performed with gauges of 1 psi (7 kPa) incrementation or less.

318.4 Pressure Tests (exceeding 100 psi). Required pressure tests exceeding 100 psi (689 kPa) shall be performed with gauges incremented for 2 percent or less of the required test pressure.

318.5 Pressure Range. Test gauges shall have a pressure range not exceeding twice the test pressure applied.

319.0 Medical Gas and Vacuum Systems.

319.1 General. Such piping shall be in accordance with the requirements of Chapter 13. The Authority Having Jurisdiction shall require evidence of the competency of the installers and verifiers.

320.0 Rehabilitation of Piping Systems.

320.1 General. Where pressure piping systems are rehabilitated using an epoxy lining system, it shall be in accordance with ASTM F2831.

TABLE 313.3
HANGERS AND SUPPORTS

MATERIALS	TYPES OF JOINTS	HORIZONTAL	VERTICAL
Cast	Lead and Oakum	5 feet, except 10 feet where 10 foot lengths are installed[1, 2, 3]	Base and each floor, not to exceed 15 feet
	Compression Gasket	Every other joint, unless over 4 feet then support each joint[1, 2, 3]	Base and each floor, not to exceed 15 feet
Cast-Iron Hubless	Shielded Coupling	Every other joint, unless over 4 feet then support each joint[1,2,3,4]	Base and each floor, not to exceed 15 feet
Copper & Copper Alloys	Soldered, Brazed, Threaded, or Mechanical	1½ inches and smaller, 6 feet; 2 inches and larger, 10 feet	Each floor, not to exceed 10 feet[5]
Steel Pipe for Water or DWV	Threaded or Welded	¾ inch and smaller, 10 feet; 1 inch and larger, 12 feet	Every other floor, not to exceed 25 feet[5]
Steel Pipe for Gas	Threaded or Welded	½ inch, 6 feet; ¾ inch and 1 inch, 8 feet; 1¼ inches and larger, 10 feet	½ inch, 6 feet; ¾ inch and 1 inch, 8 feet; 1¼ inches every floor level
Schedule 40 PVC and ABS DWV	Solvent Cemented	All sizes, 4 feet; allow for expansion every 30 feet[3]	Base and each floor; provide mid-story guides; provide for expansion every 30 feet
CPVC	Solvent Cemented	1 inch and smaller, 3 feet; 1¼ inches and larger, 4 feet	Base and each floor; provide mid-story guides
CPVC-AL-CPVC	Solvent Cemented	½ inch, 5 feet; ¾ inch, 65 inches; 1 inch, 6 feet	Base and each floor; provide mid-story guide
Lead	Wiped or Burned	Continuous Support	Not to exceed 4 feet
Steel	Mechanical	In accordance with standards acceptable to the Authority Having Jurisdiction	
PEX	Cold Expansion, Insert and Compression	1 inch and smaller, 32 inches; 1¼ inches and larger, 4 feet	Base and each floor; provide mid-story guides
PEX-AL-PEX	Metal Insert and Metal Compression	½ inch, ¾ inch, 1 inch } All sizes 98 inches	Base and each floor; provide mid-story guides
PE-AL-PE	Metal Insert and Metal Compression	½ inch, ¾ inch, 1 inch } All sizes 98 inches	Base and each floor; provide mid-story guides
PE-RT	Insert and Compression	1 inch and smaller, 32 inches; 1¼ inches and larger, 4 feet	Base and each floor; provide mid-story guides
Polypropylene (PP)	Fusion weld (socket, butt, saddle, electrofusion), threaded (metal threads only), or mechanical	1 inch and smaller, 32 inches; 1¼ inches and larger, 4 feet	Base and each floor; provide mid-story guides

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

Notes:

[1] Support adjacent to joint, not to exceed 18 inches (457 mm).

[2] Brace not to exceed 40 foot (12 192 mm) intervals to prevent horizontal movement.

[3] Support at each horizontal branch connection.

[4] Hangers shall not be placed on the coupling.

[5] Vertical water lines shall be permitted to be supported in accordance with recognized engineering principles with regard to expansion and contraction, where first approved by the Authority Having Jurisdiction.

CHAPTER 4
PLUMBING FIXTURES AND FIXTURE FITTINGS

401.0 General.

401.1 Applicability. This chapter shall govern the materials and installation of plumbing fixtures, including faucets and fixture fittings, and the minimum number of plumbing fixtures required based on occupancy.

401.2 Quality of Fixtures. Plumbing fixtures shall be constructed of dense, durable, non-absorbent materials and shall have smooth, impervious surfaces, free from unnecessary concealed fouling surfaces.

402.0 Installation.

402.1 Cleaning. Plumbing fixtures shall be installed in a manner to afford easy access for repairs and cleaning. Pipes from fixtures shall be run to the nearest wall.

402.2 Joints. Where a fixture comes in contact with the wall or floor, the joint between the fixture and the wall or floor shall be made watertight.

402.3 Securing Fixtures. Floor-outlet or floor-mounted fixtures shall be rigidly secured to the drainage connection and to the floor, where so designed, by screws or bolts of copper, copper alloy, or other equally corrosion-resistant material.

402.4 Wall-Hung Fixtures. Wall-hung fixtures shall be rigidly supported by metal supporting members so that no strain is transmitted to the connections. Floor-affixed supports for off-the-floor plumbing fixtures for public use shall comply with ASME A112.6.1M. Framing-affixed supports for off-the-floor water closets with concealed tanks shall comply with ASME A112.6.2. Flush tanks and similar appurtenances shall be secured by approved non-corrosive screws or bolts.

[W] 402.5 Setting. Fixtures shall be set level and in proper alignment with reference to adjacent walls. No water closet or bidet shall be set closer than fifteen (15) inches (381 mm) from its center to any side wall or obstruction nor closer than thirty (30) inches (762 mm) center to center to any similar fixture. The clear space in front of any water closet or bidet shall be not less than twenty-four (24) inches (610 mm). No urinal shall be set closer than twelve (12) inches (305 mm) from its center to any side wall or partition nor closer than twenty-four (24) inches (610 mm) center to center.

Exceptions:

(1) The clear space in front of a water closet, lavatory or bidet in dwelling units and sleeping units shall be not less than twenty-one (21) inches (533 mm).

(2) The installation of paper dispensers or accessibility grab bars shall not be considered obstructions.

402.6 Flanged Fixture Connections. Fixture connections between drainage pipes and water closets, floor outlet service sinks and urinals shall be made using an approved copper alloy, hard lead, ABS, PVC, or iron flanges caulked, soldered, solvent cemented; rubber compression gaskets; or screwed to the drainage pipe. The connection shall be bolted with an approved gasket, washer, or setting compound between the fixture and the connection. The bottom of the flange shall be set on an approved firm base.

Wall-mounted water closet fixtures shall be securely bolted to an approved carrier fitting. The connecting pipe between the carrier fitting and the fixture shall be an approved material and designed to accommodate an adequately sized gasket. Gasket material shall be neoprene, felt, or similar approved types.

402.6.1 Closet Rings (Closet Flanges). Closet rings (closet flanges) for water closets or similar fixtures shall be of an approved type and shall be copper alloy, copper, hard lead, cast-iron, galvanized malleable iron, ABS, PVC, or other approved materials. Each such closet ring (closet flange) shall be approximately 7 inches (178 mm) in diameter and, where installed, shall, together with the soil pipe, present a 1½ inch (38 mm) wide flange or face to receive the fixture gasket or closet seal.

Caulked-on closet rings (closet flanges) shall be not less than ¼ of an inch (6.4 mm) thick and not less than 2 inches (51 mm) in overall depth.

Closet rings (closet flanges) shall be burned or soldered to lead bends or stubs, shall be caulked to cast-iron soil pipe, shall be solvent cemented to ABS and PVC, and shall be screwed or fastened in an approved manner to other materials.

Closet bends or stubs shall be cut-off to present a smooth surface even with the top of the closet ring before the rough inspection is called.

Closet rings (closet flanges) shall be adequately designed and secured to support fixtures connected thereto.

402.6.2 Securing Closet Flanges. Closet screws, bolts, washers, and similar fasteners shall be of copper alloy, copper, or other listed equally corrosion-resistant materials. Screws and bolts shall be of a size and number to properly support the fixture installed.

402.6.3 Securing Floor-Mounted, Back-Outlet Water Closet Bowls. Floor-mounted, back-outlet water closet bowls shall be set level with an angle of 90 degrees (1.57 rad) between the floor and wall at the centerline of the fixture outlet. The floor and wall shall have a flat mounting surface not less than 5 inches (127 mm) to the right and left of the fixture outlet centerline. The fixture shall be secured to the wall outlet flange or drainage connection and the floor by corrosion-resistant screws or bolts. The closet flange shall be secured to a firm base.

Where floor-mounted, back-outlet water closets are used, the soil pipe shall be not less than 3 inches (80 mm) in diameter. Offset, eccentric, or reducing floor flanges shall not be used.

402.7 Supply Fittings. The supply lines and fittings for every plumbing fixture shall be so installed as to prevent backflow in accordance with Chapter 6.

402.8 Installation. Fixtures shall be installed in accordance with the manufacturer's installation instructions.

402.9 Design and Installation of Plumbing Fixtures. Plumbing fixtures shall be installed in accordance with the manufacturer's installation instructions. The means of backflow prevention shall not be compromised by the designated fixture fitting mounting surface.

402.10 Slip Joint Connections. Fixtures having concealed slip joint connections shall be provided with an access panel or utility space not less than 12 inches (305 mm) in its least dimension and so arranged without obstructions as to make such connections accessible for inspection and repair.

402.11 Future Fixtures. Where provisions are made for the future installation of fixtures, those provided for shall be considered in determining the required sizes of the drain and water supply piping. Construction for future installations shall be terminated with a plugged fitting or fittings. Where the plugged fitting is at the point where the trap of a fixture is installed, the plumbing system for such fixture shall be complete and be in accordance with the plumbing requirements of this code.

403.0 Accessible Plumbing Facilities.

403.1 General. Where accessible facilities are required in applicable building regulations, the facilities shall be installed in accordance with those regulations.

403.2 Fixtures and Fixture Fittings for Persons with Disabilities. Plumbing fixtures and fixture fittings for persons with disabilities shall be in accordance with ICC A117.1 and the applicable standards referenced in Chapter 4.

403.3 Exposed Pipes and Surfaces. Water supply and drain pipes under accessible lavatories and sinks shall be insulated or otherwise be configured to protect against contact. Protectors, insulators, or both shall comply with ASME A112.18.9.

404.0 Waste Fittings and Overflows.

404.1 Waste Fittings. Waste fittings shall comply with ASME A112.18.2/CSA B125.2, ASTM F409 or Table 701.2 for aboveground drainage piping and fittings.

404.2 Overflows. Where a fixture is provided with an overflow, the waste shall be so arranged that the standing water in the fixture shall not rise in the overflow where the stopper is closed or remain in the overflow where the fixture is empty. The overflow pipe from a fixture shall be connected to the house or inlet side of the fixture trap, except that overflow on flush tanks shall be permitted to discharge into the water closets or urinals served by them, but it shall be unlawful to connect such overflows with any other part of the drainage system.

405.0 Prohibited Fixtures.

405.1 Prohibited Water Closets. Water closets having an invisible seal or an unventilated space or having walls which are not thoroughly washed at each discharge shall be prohibited. A water closet that might permit siphonage of the contents of the bowl back into the tank shall be prohibited.

405.2 Prohibited Urinals. Trough urinals and urinals with an invisible seal shall be prohibited.

405.3 Miscellaneous Fixtures. Fixed wooden, or tile wash trays or sinks for domestic use shall not be installed in a building designed or used for human habitation. No sheet metal-lined wooden bathtub shall be installed or reconnected. No dry or chemical closet (toilet) shall be installed in a building used for human habitation unless first approved by the Health Officer.

[W] 405.4 Application. No individual, public or private corporation, firm, political subdivision, government agency, or other legal entity, may, for purposes of use in the state of Washington, distribute, sell, offer for sale, import, install, or approve for installation any plumbing fixtures or fittings unless the fixtures or fittings meet the standards as provided for in this chapter.

406.0 Special Fixtures and Specialties.

406.1 Water and Waste Connections. Baptisteries, ornamental and lily ponds, aquaria, ornamental fountain basins, and similar fixtures and specialties requiring water, waste connections, or both shall be submitted for approval to the Authority Having Jurisdiction prior to installation.

406.2 Special Use Sinks. Restaurant kitchen and other special use sinks shall be permitted to be made of approved-type bonderize and galvanized sheet steel of not less than No. 16 U.S. gauge (0.0635 inches) (1.6 mm). Sheet-metal plumbing fixtures shall be adequately designed, constructed, and braced in an approved manner to accomplish their intended purpose.

406.3 Special Use Fixtures. Special use fixtures shall be made of one of the following:

(1) Soapstone
(2) Chemical stoneware
(3) Copper-based alloy
(4) Nickel-based alloy
(5) Corrosion-resistant steel
(6) Other materials suited for the intended use of the fixture

406.4 Zinc Alloy Components. Zinc alloy components shall comply with applicable nationally recognized standards and shall be used in accordance with their listing.

407.0 Lavatories.

407.1 Application. Lavatories shall comply with ASME A112.19.1/CSA B45.2, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4, ASME A112.19.12, CSA B45.5/IAPMO Z124, CSA B45.8/IAPMO Z403, CSA B45.11/IAPMO Z401 or CSA B45.12/IAPMO Z402. Group wash fixtures shall comply with the requirements of Section 401.2. Every 20 inches (508 mm) of rim space of a group wash fixture shall be considered as one lavatory for determining the number of lavatories required in accordance with Table 422.1. Lavatory assemblies with automatic soap dispensers, faucets, or hand dryers shall comply with IAPMO IGC 127.

[W] 407.2 Water Consumption. The maximum water flow rate of faucets shall comply with Section 407.2.1 through 407.2.2.

407.2.1 Maximum Flow Rate. The maximum flow rate for public lavatory faucets shall not exceed 0.5 gpm at 60 psi (1.9 L/m at 414 kPa).

407.2.1.1 Residential Lavatory Faucets. The maximum flow rate of residential lavatory faucets shall not exceed 1.2 gallons (4.54 L) per minute at 60 psi. The minimum flow rate of residential lavatory faucets shall not be less than 0.8 gallons (3.03 L) per minute at 20 psi.

407.2.1.2 Lavatory Faucets in Common and Public Use Areas. The maximum flow rate of lavatory faucets, installed in common and public use areas (outside of dwellings or sleeping units) in residential buildings, shall not exceed 0.5 gallons (1.89 L) per minute at 60 psi.

407.2.2 Metering Faucets. Metered faucets shall deliver a maximum of 0.25 gallons (1.0 L) per metering cycle in accordance with ASME A112.18.1/CSA B125.1.

407.3 Limitation of Hot Water Temperature for Public Lavatories. Hot water delivered from public-use lavatories shall be limited to a maximum temperature of 120°F (49°C). The maximum temperature shall be regulated by one of the following means:

(1) A limiting device conforming to either ASSE 1070/ASME A112.1070/CSA B125.70, or
(2) A water heater conforming to ASSE 1084.

[W] 407.4 Metering Valves. Lavatory faucets located in restrooms intended for use by the general public shall be equipped with a metering valve designed to close by spring or water pressure when left unattended (self-closing).

Exceptions:

(1) Where designed and installed for use by persons with a disability.
(2) Where installed in day care centers, for use primarily by children under 6 years of age.

407.5 Waste Outlet. Lavatories shall have a waste outlet and fixture tailpiece not less than 1¼ inches (32 mm) in diameter. Continuous wastes and fixture tailpieces shall be constructed from the materials specified in Section 701.4. Waste outlets shall be provided with an approved stopper or strainer.

407.6 Overflow. Where overflows are provided, they shall be installed in accordance with Section 404.2.

408.0 Showers.

408.1 Application. Manufactured shower receptors and shower bases shall comply with ASME A112.19.1/CSA B45.2, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSAB45.4, CSA B45.12/IAPMO Z402, or CSA B45.5/IAPMO Z124. Pre-fabricated shower enclosures shall comply with IAPMO IGC 154.

[W] 408.2 Water Consumption. Showerheads shall meet the maximum flow rate of 1.8 gallons (6.81 L) per minute measured at 80 psi. Showerheads shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Showerheads.

Exception: Emergency use showers shall be exempt from the maximum water usage rates.

408.2.1 Multiple Showerheads Serving One Shower. When a shower is served by more than one showerhead, including handheld showerheads, the combined flow rate of all showerheads and/or other shower outlets controlled by a single valve shall not exceed 1.8 gallons (6.81 L) per minute at 80 psi, or the shower shall be designed to allow only one shower outlet to be in operation at a time.

408.3 Individual Shower and Tub-Shower Combination Control Valves. Showers and tub-shower combinations shall be provided with individual control valves of the pressure balance, thermostatic, or combination pressure balance/thermostatic mixing valve type that provide scald and thermal shock protection for the rated flow rate of the installed showerhead. These valves shall be installed at the point of use and comply with ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1.

408.3.1 Gang Showers. Where gang showers are supplied with a single temperature-controlled water supply pipe, it shall be controlled by a mixing valve that complies with ASSE 1069.

408.3.2 Temperature Limiting. The maximum water temperature discharging from an individual showerhead shall be limited to 120°F (49°C) by one of the following methods:

(1) A shower or tub/shower combination valve conforming to ASSE 1016/ASME A112.1016/CSA B125.16 where either:
   (a) The valve is field-adjusted to the required maximum temperature, or
   (b) The handle position, stop, or temperature limiting control is set in accordance with the manufacturer's instructions to the required maximum temperature.

(2) For gang showers supplied by a single water supply pipe, a mixing valve that conforms to ASSE 1069 that is field-adjusted to the required maximum temperature.

(3) A limiting device conforming to either ASSE 1070/ASME A112.1070/CSA B125.70 or CSA B125.3.

(4) A water heater conforming to ASSE 1084.

(5) A temperature actuated flow reduction device conforming to ASSE 1062.

[W] 408.4 Waste Outlet. Showers shall have a waste outlet and fixture tailpiece not less than 2 inches (50 mm) in diameter. Fixture tailpieces shall be constructed from the materials specified in Section 701.2 for drainage piping. Strainers serving shower drains shall have a waterway at least equivalent to the area of the tailpiece.

Exception: In a residential dwelling unit where a 2 inch waste is not readily available and approval of the AHJ has been granted, the waste outlet, fixture tailpiece, trap and trap arm shall not be less than 1½ inch when an existing tub is being replaced by a shower sized per Section 408.2. This exception only applies where one shower head rated at 1.8 gpm is installed.

408.5 Finished Curb or Threshold. Where a shower receptor has a finished dam, curb, or threshold, it shall be not less than 1 inch (25.4 mm) lower than the sides and back of such receptor. In no case, shall a dam or threshold be less than 2 inches (51 mm) or exceeding 9 inches (229 mm) in depth where measured from the top of the dam or threshold to the top of the drain. Each such receptor shall be provided with an integral nailing flange to be located where the receptor meets the vertical surface of the finished interior of the shower compartment. The flange shall be watertight and extend vertically not less than 1 inch (25.4 mm) above the top of the sides of the receptor. The finished floor of the receptor shall slope uniformly from the sides towards the drain not less than ⅛ inch per foot (10.4 mm/m), nor more than ½ inch per foot (41.6 mm/m).

Thresholds shall be of sufficient width to accommodate a minimum 22 inch (559 mm) door. Shower doors shall open so as to maintain not less than a 22 inch (559 mm) unobstructed opening for egress. Where there is a shower without a threshold, the floor space within the same room shall be considered a wet location and shall comply with the requirements of the building, residential, and electrical codes.

Exceptions:

(1) Showers in accordance with Section 403.2.

(2) A cast-iron shower receptor flange shall be not less than 0.3 of an inch (7.62 mm) in height.

(3) For flanges not used as a means of securing, the sealing flange shall be not less than 0.3 of an inch (7.62 mm) in height.

[W] 408.6 Shower Compartments. Shower compartments, regardless of shape, shall have a minimum finished interior of nine hundred (900) square inches (0.58 m^2) and shall also be capable of encompassing a thirty (30) inch (762 mm) circle. The minimum required area and dimensions shall be measured at a height equal to the top of the threshold and at a point tangent to its centerline. The area and dimensions shall be maintained to a point of not less than seventy (70) inches (1778 mm) above the shower drain outlet with no protrusions other than the fixture valve or valves, shower head, soap dishes, shelves, and safety grab bars, or rails. Fold-down seats in accessible shower stalls shall be permitted to protrude into the thirty (30) inch (762 mm) circle.

Exceptions:

(1) Showers that are designed to comply with ICC A117.1.

(2) The minimum required area and dimension shall not apply for a shower receptor having overall dimensions of not less than thirty (30) inches (762 mm) in width and sixty (60) inches (1524 mm) in length.

408.7 Lining for Showers and Receptors. Shower receptors built on-site shall be watertight and shall be constructed from approved-type dense, nonabsorbent, and noncorrosive materials. Each such receptor shall be adequately reinforced, shall be provided with an approved flanged floor drain designed to make a watertight joint on the floor, and shall have smooth, impervious, and durable surfaces.

Shower receptors shall have the subfloor and rough side of walls to a height of not less than 3 inches (76 mm) above the top of the finished dam or threshold shall be first lined with sheet plastic, lead, or copper, or shall be lined with other durable and watertight materials. Showers that are provided with a built in place, permanent seat or seating area that is located within the shower enclosure, shall be first lined with sheet plastic, lead, copper, or shall be lined with other durable and watertight materials that extend not less than 3 inches (76 mm) above horizontal surfaces of the seat or the seating area.

Lining materials shall be pitched ¼ inch per foot (20.8 mm/m) to weep holes in the subdrain of a smooth and solidly formed subbase. Such lining materials shall extend upward on the rough jambs of the shower opening to a point not less than 3 inches (76 mm) above the horizontal surfaces of the seat or the seating area, the top of the finished dam or threshold and shall extend outward over the top of the permanent seat, permanent seating area, or rough threshold and be turned over and fastened on the outside face of both the permanent seat, permanent seating area, or rough threshold and the jambs.

Nonmetallic shower subpans or linings shall be permitted to be built up on the job site of not less than three layers of standard grade 15 pound (6.8 kg) asphalt impregnated roofing felt. The bottom layer shall be fitted to the formed subbase and each succeeding layer thoroughly hot-mopped to that below. Corners shall be carefully fitted and shall be made strong and watertight by folding or lapping, and each corner shall be reinforced with suitable webbing hot-mopped in place.

Folds, laps, and reinforcing webbing shall extend not less than 4 inches (102 mm) in all directions from the corner, and webbing shall be of approved type and mesh, producing a tensile strength of not less than 50 pounds per square foot (lb/ft^2) ($244\ kg/m^2$) in either direction. Nonmetallic shower subpans or linings shall be permitted to consist of multilayers of other approved equivalent materials suitably reinforced and carefully fitted in place on the job site as elsewhere required in this section.

Linings shall be properly recessed and fastened to the approved backing so as not to occupy the space required for the wall covering, and shall not be nailed or perforated at a point that is less than 1 inch (25.4 mm) above the finished dam or threshold. An approved type subdrain shall be installed with a shower subpan or lining. Each such subdrain shall be of the type that sets flush with the subbase and shall be equipped with a clamping ring or other device to make a tight connection between the lining and the drain. The subdrain shall have weep holes into the waste line. The weep holes located in the subdrain clamping ring shall be protected from clogging.

408.7.1 PVC Sheets. Plasticized polyvinyl chloride (PVC) sheets shall conform to ASTM D4551. Sheets shall be joined by solvent cementing in accordance with the manufacturer's installation instructions.

408.7.2 Chlorinated Polyethylene (CPE) Sheets. Nonplasticized chlorinated polyethylene sheets shall comply with ASTM D4068. The liner shall be joined in accordance with the manufacturer's installation instructions.

408.7.3 Sheet Lead. Sheet lead shall weigh not less than 4 lb/ft^2 ($19.5\ kg/m^2$) and shall be coated with an asphalt paint or other approved coating. The lead sheet shall be insulated from conducting substances, other than the connecting drain, by 15 pound (6.8 kg) asphalt felt or an equivalent. Sheet lead shall be joined by burning.

408.7.4 Sheet Copper. Sheet copper shall comply with ASTM B152 and shall weigh not less than 12 ounces per square foot (oz/ft^2) ($3.7\ kg/m^2$) or No. 24 B & S Gauge (0.02 inches) (0.51 mm). The copper sheet shall be insulated from conducting substances, other than the connecting drain, by 15 pound (6.8 kg) asphalt felt or an equivalent. Sheet copper shall be joined by brazing or soldering.

408.7.5 Tests for Shower Receptors. Shower receptors shall be tested for watertightness by filling with water to the level of the rough threshold. The test plug shall be so placed that both upper and under sides of the subpan shall be subjected to the test at the point where it is clamped to the drain.

408.8 Public Shower Floors. Floors of public shower rooms shall have a nonskid surface and shall be drained in such a manner that wastewater from one bather shall not pass over areas occupied by other bathers. Gutters in public or gang shower rooms shall have rounded corners for easy cleaning and shall be sloped not less than 2 percent toward drains. Drains in gutters shall be spaced at a maximum of 8 feet (2438 mm) from sidewalls nor more than 16 feet (4877 mm) apart.

408.9 Location of Valves and Heads. Control valves and showerheads shall be located on the sidewall of shower compartments or otherwise arranged so that the showerhead does not discharge directly at the entrance to the compartment so that the bather can adjust the valves before stepping into the shower spray.

408.10 Water Supply Riser. A water supply riser from the shower valve to the showerhead outlet, whether exposed or not, shall be securely attached to the structure.

409.0 Bathtubs and Whirlpool Bathtubs.

409.1 Application. Bathtubs shall comply with ASME A112.19.1/CSA B45.2, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4, CSA B45.5/IAPMO Z124, or CSA B45.12/IAPMO Z402. Whirlpool bathtubs shall comply with ASME A112.19.7/CSA B45.10. Pressure sealed doors within a bathtub or whirlpool bathtub enclosure shall comply with ASME A112.19.15.

409.2 Waste Outlet. Bathtubs and whirlpool bathtubs shall have a waste outlet and fixture tailpiece not less than 1½ inches (40 mm) in diameter. Fixture tailpieces shall be constructed from the materials specified in Section 701.2 for drainage piping. Waste outlets shall be provided with an approved stopper or strainer.

409.3 Overflow. Where overflows are provided, they shall be installed in accordance with Section 404.2.

409.4 Limitation of Hot Water Temperature in Bathtubs and Whirlpool Bathtubs. The maximum hot water temperature discharging from the bathtub and whirlpool bathtub filler shall be limited to 120°F (49°C). The maximum temperature shall be regulated by one of the following means:

(1) A limiting device conforming to either ASSE 1070/ASME A112.1070/CSA B125.70 or CSA B125.3.

(2) A water heater conforming to ASSE 1084.

409.5 Backflow Protection. The water supply to a bathtub and whirlpool bathtub filler valve shall be protected by an air gap or in accordance with Section 417.0.

409.6 Installation and Access. Bathtubs and whirlpool bathtubs shall be installed in accordance with the manufacturer's installation instructions. Access openings shall be of a size and opening to permit the removal and replacement of the circulation pump.

Whirlpool pump access located in the crawl space shall be located not more than 20 feet (6096 mm) from an access door, trap door, or crawl hole.

The circulation pump shall be located above the crown weir of the trap.

The pump and the circulation piping shall be self-draining to minimize water retention. Suction fittings on whirlpool bathtubs shall comply with ASME A112.19.7/CSA B45.10.

409.6.1 Flexible PVC Hoses and Tubing. Flexible PVC hoses and tubing intended to be used on whirlpool bathtub water circulation systems or pneumatic systems shall comply with IAPMO Z1033.

410.0 Bidets.

410.1 Application. Bidets shall comply with ASME A112.19.2/CSA B45.1 or ASME A112.19.3/CSA B45.4.

410.2 Backflow Protection. The water supply to the bidet shall be protected by an air gap or in accordance with Section 603.3.2, Section 603.3.5, or Section 603.3.6.

410.3 Limitation of Water Temperature in Bidets. The maximum hot water temperature discharging from a bidet shall be limited to 110°F (43°C). The maximum temperature shall be regulated by one of the following means:

(1) A limiting device conforming to either ASSE 1070/ASME A112.1070/CSA B125.70 or CSA B125.3.

(2) A water heater conforming to ASSE 1084.

411.0 Water Closets.

411.1 Application. Water closets shall comply with ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4, or CSA B45.5/IAPMO Z124. Water closet bowls for public use shall be of the elongated type. In nurseries, schools, and other similar places where plumbing fixtures are provided for the use of children less than 6 years of age, water closets shall be of a size and height suitable for children's use.

[W] 411.2 Water Consumption. The effective flush volume of all water closets shall not exceed 1.28 gallons (4.8 L) per flush when tested in accordance with ASME A112.19.2/CSA B45.1.

Exceptions:

(1) Water closets located in day care centers, intended for use by young children may have a maximum water use of 3.5 gallons per flush or 13.25 liters per flush.

(2) Water closets with bed pan washers may have a maximum water use of 3.5 gallons per flush or 13.25 liters per flush.

(3) Blow out bowls, as defined in ANSI/ASME A112.19.2M, Section 5.1.2.3 may have a maximum water use of 3.5 gallons per flush or 13.25 liters per flush.

411.2.1 Dual Flush Water Closets. Dual flush water closets shall comply with ASME A112.19.14. The effective flush volume for dual flush water closets shall be defined as the composite, average flush volume of two reduced flushes and one full flush.

[W] 411.2.2 Performance. Water closets installed shall meet or exceed the minimum performance criteria developed for certification of high-efficiency toilets under the WaterSense program sponsored by the U.S. Environmental Protection Agency (EPA).

[W] 411.2.3 Flushometer Valve Activated Water Closets. Flushometer valve activated water closets shall have a maximum flush volume of 1.28 gallons (4.8 Lpf) of water per flush in accordance with ASME A112.19.2/CSA B45.1.

411.3 Water Closet Seats. Water closet seats shall be properly sized for the water closet bowl type, and shall be of smooth, non-absorbent material. Seats, for public use, shall be of the elongated type and either of the open front type or have an automatic seat cover dispenser. Plastic seats shall comply with IAPMO Z124.5.

411.4 Personal Hygiene Devices. Water closets with integral personal hygiene devices shall comply with ASME A112.4.2/CSA B45.16.

412.0 Urinals.

[W] 412.1 Application. Urinals shall comply with ASME A112.19.2/CSA B45.1, ASME A112.19.19, or CSA B45.5/IAPMO Z124. Wall-mounted urinals shall have an average water consumption not to exceed 0.125 gallons (0.47 L) per flush. Other urinals shall have an average water consumption not to exceed 0.5 gallons (1.89 L) per flush.

412.1.1 Nonwater Urinals. Nonwater urinals shall have a liquid barrier sealant to maintain a trap seal. Nonwater urinals shall permit the uninhibited flow of waste through the urinal to the sanitary drainage system. Nonwater urinals shall be cleaned and maintained in accordance with the manufacturer's instructions after installation. Where nonwater urinals are installed, not less than one water supplied fixture rated at not less than 1 water supply fixture unit (WSFU) shall be installed upstream on the same drain line to facilitate drain line flow and rinsing. Where nonwater urinals are installed, they shall have a water distribution line rough-in to each individual urinal location to allow for the installation of an approved backflow prevention device in the event of a retrofit.

412.1.2 Nonwater Urinals with Drain Cleansing Action. Nonwater urinals with drain cleansing action shall comply with ASME A112.19.19 and shall be cleaned, maintained and installed in accordance with the manufacturer's installation instructions.

412.2 Backflow Protection. A water supply to a urinal shall be protected by an approved-type vacuum breaker or other approved backflow prevention device in accordance with Section 603.5.

413.0 Flushing Devices.

413.1 Where Required. Each water closet, urinal, clinical sink, or other plumbing fixture that depends on trap siphonage to discharge its waste contents shall be provided with a flushometer valve, flushometer tank, or flush tank designed and installed so as to supply water in sufficient quantity and rate of flow to flush the contents of the fixture to which it is connected, to cleanse the fixture, and to refill the fixture trap, without excessive water use. Flushing devices shall comply with the antisiphon requirements in accordance with Section 603.5.

413.2 Flushometer Valves. Flushometer valves and flushometer tanks shall comply with ASSE 1037/ASME A112.1037/CSA B125.37, and shall be installed in accordance with Section 603.5.1. No manually controlled flushometer valve shall be used to flush more than one urinal, and each such urinal flushometer valve shall be an approved, self-closing type discharging a predetermined quantity of water. Flushometers shall be installed so that they will be accessible for repair. Flushometer valves shall not be used where the water pressure is insufficient to operate them properly. Where the valve is operated, it shall complete the cycle of operation automatically, opening fully, and closing positively under the line water pressure. Each flushometer shall be provided with a means for regulating the flow through it.

413.3 Flush Tanks. Flush tanks for manual flushing shall be equipped with a flush valve that complies with ASME A112.19.5/CSA B45.15 and an antisiphon fill valve (ballcock) that complies with ASSE 1002/ASME A112.1002/CSA B125.12 and installed in accordance with Section 603.5.2.

413.4 Water Supply for Flush Tanks. An adequate quantity of water shall be provided to flush and clean the fixture served. The water supply for flushing tanks and flushometer tanks equipped for manual flushing shall be controlled by a float valve or other automatic device designed to refill the tank after each discharge and to shut completely off the water flow to the tank where the tank is filled to operational capacity. Provision shall be made to automatically supply water to the fixture to refill the trap seal after each flushing.

413.5 Overflows in Flush Tanks. Flush tanks shall be provided with overflows discharging into the water closet or urinal connected thereto. Overflows supplied as original parts with the fixture shall be of sufficient size to prevent tank flooding at the maximum rate at which the tank is supplied with water under normal operating conditions and where installed in accordance with the manufacturer's installation instructions.

414.0 Dishwashing Machines.

414.1 Application. Domestic dishwashing machines shall comply with UL 749. Commercial dishwashing machines shall comply with NSF 3 and UL 921.

414.2 Backflow Protection. The water supply connection to a commercial dishwashing machine shall be protected by an air gap or a backflow prevention device in accordance with Section 603.3.2, Section 603.3.5, Section 603.3.6, or that complies with ASSE 1004.

[W] 414.3 Drainage Connection. Domestic dishwashing machines shall discharge indirectly through an air gap fitting in accordance with Section 807.3 into a waste receptor, a wye branch fitting on the tailpiece of a kitchen sink, or dishwasher connection of a food waste disposer. Commercial dishwashing machines shall discharge indirectly through an air gap.

415.0 Drinking Fountains.

415.1 Application. Drinking fountains shall be self-closing and comply with ASME A112.19.1/CSA B45.2, ASME A112.19.2/CSA B45.1, or ASME A112.19.3/CSA B45.4. Drinking fountains shall also comply with NSF 61. Permanently installed electric water coolers shall also comply with UL 399.

[W] 415.2 Drinking Fountain Alternatives. This section is not adopted. See Building Code Chapter 29.

415.3 Drainage Connection. Drinking fountains shall be permitted to discharge directly into the drainage system or indirectly through an air break in accordance with Section 809.1.

415.4 Location. Drinking fountains shall not be installed in toilet rooms.

416.0 Emergency Eyewash and Shower Equipment.

416.1 Application. Emergency eyewash and shower equipment shall comply with ISEA Z358.1.

416.2 Water Supply. Emergency eyewash and shower equipment shall not be limited in the water supply flow rates. Where hot and cold water is supplied to an emergency shower or eyewash station, the temperature of the water supply shall be controlled by a temperature actuated mixing valve complying with ASSE 1071. Where water is supplied directly to an emergency shower or eyewash station from a water heater, the water heater shall comply with ASSE 1085. The flow rate, discharge pattern, and temperature of flushing fluids shall be provided in accordance with ISEA Z358.1.

416.3 Installation. Emergency eyewash and shower equipment shall be installed in accordance with the manufacturer's installation instructions.

416.4 Location. Emergency eyewash and shower equipment shall be located on the same level as the hazard and accessible for immediate use. The path of travel shall be free of obstructions and shall be clearly identified with signage.

416.5 Drain. A drain shall not be required for emergency eyewash or shower equipment. Where a drain is provided, the discharge shall be in accordance with Section 811.0.

417.0 Faucets and Fixture Fittings.

417.1 Application. Faucets and fixture fittings shall comply with ASME A112.18.1/CSA B125.1. Fixture fittings covered under the scope of NSF 61 shall comply with the requirements of NSF 61.

417.2 Deck Mounted Bath/Shower Valves. Deck mounted bath/shower transfer valves with integral backflow protection shall comply with ASME A112.18.1/CSA B125.1. This shall include handheld showers, and other bathing appliances mounted on the deck of bathtubs or other bathing appliances that incorporate a hose or pull out feature.

417.3 Handheld Showers. Handheld showers shall comply with ASME A112.18.1/CSA B125.1. Handheld showers with integral backflow protection shall comply with ASME A112.18.1/CSA B125.1 or shall have a backflow prevention device that complies with ASME A112.18.3 or ASSE 1014.

417.4 Faucets and Fixture Fittings with Hose Connected Outlets. Faucets and fixture fittings with pull out spout shall comply with ASME A112.18.1/CSA B125.1. Faucets and fixture fittings with pull out spouts with integral backflow protection shall comply with ASME A112.18.1/CSA B125.1 or shall have a backflow preventer device that complies with ASME A112.18.3.

417.5 Separate Controls for Hot and Cold Water. Where two separate handles control the hot and cold water, the left-hand control of the faucet where facing the fixture fitting outlet shall control the hot water. Faucets and diverters shall be connected to the water distribution system so that hot water corresponds to the left side of the fixture fitting.

Single-handle mixing valves installed in showers and tub-shower combinations shall have the flow of hot water corresponding to the markings on the fixture fitting.

417.6 Low-Pressure Water Dispenser. Beverage faucets shall comply with ASME A112.18.1/CSA B125.1. Low-pressure water dispensers that dispense electrically heated water and have a reservoir vented to the atmosphere shall comply with ASSE 1023. Electric devices that heat water shall comply with UL 499.

418.0 Floor Drains.

418.1 Application. Floor drains shall comply with ASME A112.3.1, ASME A112.6.3, or CSA B79.

418.2 Strainer. Floor drains shall be considered plumbing fixtures and each such drain shall be provided with an approved-type strainer having a waterway equivalent to the area of the tailpiece. Floor drains shall be of an approved type and shall provide a watertight joint on the floor.

[W] [S] 418.3 Location of Floor Drains. Floor drains shall be installed in the following areas:

(1) Any restroom, toilet facility, or similar area within a building containing two (2) or more water closets or a combination of one (1) water closet and one (1) urinal, except in a dwelling unit. The floor shall slope in accordance with the requirements of 418.5. Any enclosed space containing a water closet or urinal and constructed in such a way as to prevent spillage from a fixture overflow from reaching a floor drain located outside of the enclosed space shall be provided with a dedicated floor drain within the space.

(2) Laundry rooms in commercial buildings and common laundry facilities in multi-family dwelling buildings.

418.4 Food Storage Areas. Where drains are provided in storerooms, walk-in freezers, walk-in coolers, refrigerated equipment, or other locations where food is stored, such drains shall have indirect waste piping. Separate waste pipes shall be run from each food storage area, each with an indirect connection to the building sanitary drainage system. Traps shall be provided in accordance with Section 801.3.2 of this code and shall be vented.

Indirect drains shall be permitted to be located in freezers or other spaces where freezing temperatures are maintained, provided that traps, where supplied, shall be located where the seal will not freeze. Otherwise, the floor of the freezer shall be sloped to a floor drain located outside of the storage compartment.

[S] 418.5 Floor Slope. Floors shall be sloped to floor drains.

Exceptions:

(1) Floors of parking garages.

(2) Where existing floors are constructed such that creating a slope by recess or topping slab is not feasible, a threshold of a minimum ¼ inch, but not exceeding ½ inch in height shall be provided at each entry to the room or area to prevent spillage from entering adjacent spaces.

419.0 Food Waste Disposers.

419.1 Application. Food waste disposal units shall comply with UL 430. Residential food waste disposers shall also comply with ASSE 1008.

419.2 Drainage Connection. Approved wye or other directional-type branch fittings shall be installed in continuous wastes connecting or receiving the discharge from a food waste disposer. No dishwasher drain shall be connected to a sink tailpiece, continuous waste, or trap on the discharge side of a food waste disposer.

419.3 Water Supply. A cold water supply shall be provided for food waste disposers. Such connection to the water supply shall be protected by an air gap or backflow prevention device in accordance with Section 603.2.

420.0 Sinks.

420.1 Application. Sinks shall comply with ASME A112.19.1/CSA B45.2, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4, CSA B45.5/IAPMO Z124, CSA B45.8/IAPMO Z403, or CSA B45.12/IAPMO Z402. Moveable sink systems shall comply with ASME A112.19.12. Sink assemblies with automatic soap dispensers, faucets, or hand dryers shall comply with IAPMO IGC 127.

[W] 420.2 Water Consumption. Sink faucets shall have a maximum flow rate of not more than 2.2 gpm at 60 psi (8.3 L/m at 414 kPa) in accordance with ASME A112.18.1/CSA B125.1.

Exceptions: Clinical sinks, laundry trays, service sinks.

420.2.1 Kitchen Faucets. Kitchen faucets shall have a maximum flow rate of not more than 1.8 gallons (6.81 L) per minute at 60 psi. Kitchen faucets may temporarily increase the flow above the maximum rate, but not to exceed 2.2 gallons (8.3 L) per minute at 60 psi, and must default to a maximum flow rate of 1.8 gallons (6.81 L) per minute at 60 psi.

Exception: Where faucets meeting the maximum flow rate of 1.8 gpm (6.81 L) are unavailable, aerators or other means may be used to achieve reduction.

[W] 420.3 Pre-Rinse Spray Valve. Commercial food service pre-rinse spray valves shall have a maximum flow rate of 1.6 gallons per minute (gpm) at 60 pounds-force per square inch (psi) (6.0 L/m at 414 kPa) in accordance with ASME A112.18.1/CSA B125.1 and shall be equipped with an integral automatic shutoff.

420.3.1 Spray Sprinkler Body. Spray sprinkler bodies must include an integral pressure regulator and must meet the water efficiency and performance criteria and other requirements of Environmental Protection Agency WaterSense program product specification for spray sprinkler bodies.

Exception: Spray sprinkler bodies specifically excluded from the scope of the Environmental Protection Agency WaterSense program product specification for spray sprinkler bodies.

420.4 Waste Outlet. Kitchen and laundry sinks shall have a waste outlet and fixture tailpiece not less than 1½ inches (40 mm) in diameter. Service sinks shall have a waste outlet and fixture tailpiece not less than 2 inches (50 mm) in diameter. Fixture tailpieces shall be constructed from the materials specified in Section 701.2 for drainage piping. Waste outlets shall be provided with an approved strainer.

421.0 Floor Sinks.

421.1 Application. Floor sinks shall comply with ASME A112.6.7.

421.2 Strainers. The waste outlet of a floor sink shall be provided with an approved strainer or grate that is removable and accessible.

[W] 422.0 Minimum Number of Required Fixtures. For minimum number of plumbing fixtures required, see Building Code Chapter 29 and Table 2902.1.

[W] Sections 422.1 through 422.5 and Table 422.1 are not adopted.

[W] 423.0 Landscape Irrigation.

423.1 Spray Sprinkler Body. Spray sprinkler bodies must include an integral pressure regulator and must meet the water efficiency and performance criteria and other requirements of environmental protection agency water sense program product specification for spray sprinkler bodies.

Exception: Spray sprinkler bodies specifically excluded from the scope of the environmental protection agency water sense program product specification for spray sprinkler bodies.

CHAPTER 5
WATER HEATERS

501.0 General.

[W] 501.1 Applicability. The regulations of this chapter shall govern the construction, location, and installation of fuel-burning and other types of water heaters heating potable water. The minimum capacity for water heaters shall be in accordance with the first-hour rating listed in Table 501.1(2). See the Mechanical Code for combustion air and installation of all vents and their connectors. No water heater shall be hereinafter installed that does not comply with the manufacturer's installation instructions and the type and model of each size thereof approved by the Authority Having Jurisdiction. A list of accepted water heater appliance standards is referenced in Table 501.1(1). Listed appliances shall be installed in accordance with the manufacturer's installation instructions. Unlisted water heaters shall be permitted in accordance with Section 504.3.2.

501.1.1 Supplemental Water-Heating Devices. Potable water heating devices that utilize refrigerant-to-water heat exchangers shall be approved and installed in accordance with this code and the manufacturer's instructions.

501.1.2 Consumer Electric Storage Water Heater Requirements. Consumer electric storage water heaters must have a modular demand response communications port compliant with the March 2018 version of the ANSI/CTA–2045-A communication interface standard, or equivalent and the March 2018 version of the ANSI/CTA-2045-A application layer requirements. The interface standard and application layer requirements required in this subsection are the versions established on March 16, 2018.

Exceptions:

(1) Water heaters manufactured prior to January 1, 2021.

(2) Electric storage water heaters other than heat pump type water heaters manufactured prior to January 1, 2022.

501.1.3 Mini-tank Electric Water Heaters. The standby energy consumption of hot water dispensers and mini-tank electric water heaters manufactured on or after January 1, 2010, shall be not greater than 35 watts. Mini-tank electric water heaters shall be tested in accordance with the method specified in the California Code of 39 Regulations, Title 20, section 1604 in effect as of July 26, 2009.

[S] 501.2 Water Heaters Used for Space Heating. Water heaters utilized both to supply potable hot water and provide hot water for space-heating applications shall be listed and labeled for such applications by the manufacturer and shall be installed in accordance with the manufacturer's instructions and this code.

TABLE 501.1(1)
WATER HEATERS

TYPE	STANDARD
Electric, Household Storage	UL 174
Oil-Fired Storage Tank	UL 732
Gas-Fired, 75 000 Btu/h or less, Storage	CSA Z21.10.1
Gas-Fired, Above 75 000 Btu/h, Storage and Instantaneous	CSA Z21.10.3
Electric, Commercial Storage	UL 1453
Solid Fuel-Fired	UL 2523
Electric Instantaneous	UL 499

For SI units: 1000 British thermal units per hour = 0.293 kW

[W] [S] TABLE 501.1(2)
FIRST HOUR RATING[1, 3]

Number of Bathrooms	1 to 1.5			2 to 2.5				3 to 3.5			
Number of Bedrooms	1	2	3	2	3	4	5	3	4	5	6
First Hour Rating,[2] Gallons	38	49	49	49	62	62	74	62	74	74	74

For SI units: 1 gallon = 3.785 L

Notes:

[1] The first-hour rating is found on the "Energy Guide" label.

[2] Non-storage and solar water heaters shall be sized to meet the appropriate first-hour rating as shown in the table and shall be capable of delivering hot water at the maximum system demand flow, as calculated in Section 610.0 or Appendix A, as applicable.

[3] For replacement water heaters, see Section 104.1.

501.2.1 Sizing. Water heaters utilized for both potable water heating and space-heating applications shall be sized to prevent the space-heating load from diminishing the required potable water-heating capacity.

501.2.2 Temperature Limitation. Where a combination potable water-heating and space-heating system requires water for space heating at temperatures higher than 140°F (60°C), a temperature-actuated mixing valve that conforms to ASSE 1017 shall be provided to temper the water supplied to the potable hot water distribution system to a temperature of 140°F (60°C) or less.

502.0 Permits.

502.1 General. It shall be unlawful for a person to install, remove, or replace or cause to be installed, removed, or replaced a water heater without first obtaining a permit from the Authority Having Jurisdiction to do so.

503.0 Inspection.

503.1 Inspection of Chimneys or Vents. This inspection shall be made after chimneys, vents, or parts thereof, authorized by the permit, have been installed and before such vent or part thereof has been covered or concealed.

503.2 Final Water Heater Inspection. This inspection shall be made after work authorized by the permit has been installed. The Authority Having Jurisdiction will make such inspection as deemed necessary to be assured that the work has been installed in accordance with the intent of this code. No appliance or part thereof shall be covered or concealed until the same has been inspected and approved by the Authority Having Jurisdiction.

504.0 Water Heater Requirements.

[W] 504.1 Location. Water heater installations in bedrooms and bathrooms shall comply with one of the following:

(1) Fuel-burning water heaters shall be installed in a closet located in the bedroom or bathroom provided the closet is equipped with a listed, gasketed door assembly and a listed self-closing device. The self-closing door assembly shall meet the requirements of Section 504.1.1. The door assembly shall be installed with a threshold and bottom door seal and shall meet the requirements of Section 504.1.2. All combustion air for such installations shall be obtained from the outdoors in accordance with the International Mechanical Code. The closet shall be for the exclusive use of the water heater.

(2) Water heater shall be of the direct vent type.

504.1.1 Self-Closing Doors. Self-closing doors shall swing easily and freely, and shall be equipped with a self-closing device to cause the door to close and latch each time it is opened. The closing mechanism shall not have a hold-open feature.

504.1.2 Gasketing. Gasketing on gasketed doors or frames shall be furnished in accordance with the published listings of the door, frame, or gasketing material manufacturer.

Exception: Where acceptable to the Authority Having Jurisdiction, gasketing of non-combustible or limited-combustible material shall be permitted to be applied to the frame, provided closing and latching of the door are not inhibited.

504.2 Vent. Water heaters of other than the direct-vent type shall be located as close as practical to the chimney or gas vent.

504.3 Clearance. The clearance requirements for water heaters shall comply with Section 504.3.1 or Section 504.3.2.

504.3.1 Listed Water Heaters. The clearances shall not be such as to interfere with combustion air, draft hood clearance and relief, and accessibility for servicing. Listed water heaters shall be installed in accordance with their listings and the manufacturer's installation instructions.

504.3.2 Unlisted Water Heaters. Unlisted water heaters shall be installed with a clearance of 12 inches (305 mm) on all sides and rear. Combustible floors under unlisted water heaters shall be protected in an approved manner. [NFPA 54:10.27.2.2]

504.4 Pressure-Limiting Devices. A water heater installation shall be provided with overpressure protection using an approved, listed device installed in accordance with the terms of its listing and the manufacturer's installation instructions.

504.5 Temperature-Limiting Devices. A water heater installation or a hot water storage vessel installation shall be provided with overtemperature protection by means of an approved, listed device installed in accordance with the terms of its listing and the manufacturer's installation instructions.

504.6 Temperature, Pressure, and Vacuum Relief Devices. Temperature, pressure, and vacuum relief devices or combinations thereof, and automatic gas shutoff devices shall be installed in accordance with the terms of their listings and the manufacturer's installation instructions. A shutoff valve shall not be placed between the relief valve and the water heater or on discharge pipes between such valves and the atmosphere. The hourly British thermal units (Btu) (kW•h) discharge capacity or the rated steam relief capacity of the device shall be not less than the input rating of the water heater. Discharge piping shall be installed in accordance with Section 608.5.

505.0 Oil-Burning and Other Water Heaters.

505.1 Water Heaters. Water heaters deriving heat from fuels or types of energy other than gas shall comply with the standards referenced in Table 501.1(1), Section 505.3, or Section 505.4. Vents or chimneys for such appliances shall be of approved types. An adequate supply of air for combustion and for adequate ventilation of heater rooms or compartments shall be provided. Each such appliance shall be installed in a location approved by the Authority Having Jurisdiction and local and state fire-prevention agencies.

[W] 505.2 Safety Devices. All storage-type water heaters deriving heat from fuels or types of energy other than gas, shall be provided with, in addition to the primary temperature controls, an over-temperature safety protection device constructed, listed and installed in accordance with nationally recognized applicable standards for such devices and a combination temperature and pressure-relief valve.

505.3 Oil-Fired Water Heaters. Oil-fired water heaters shall be installed in accordance with NFPA 31.

505.4 Indirect-Fired Water Heaters. Indirect-fired water heaters shall be in accordance with the applicable sections of the ASME Boiler and Pressure Vessel Code or shall comply with one of the other applicable standards shown in Table 501.1(1). Each water heater shall bear a label in accordance with ASME requirements, or an approved testing agency, certifying and attesting that such an appliance has been tested, inspected and meets the requirements of the applicable standards or code.

505.4.1 Single-Wall Heat Exchanger. An indirect-fired water heater that incorporates a single-wall heat exchanger shall be in accordance with the following requirements:

(1) The heat transfer medium shall be either potable water or contain fluids recognized as safe by the Food and Drug Administration (FDA) as food grade.

(2) Bear a label with the word "Caution," followed by the following statements:

  (a) The heat-transfer medium shall be potable water or other nontoxic fluid recognized as safe by the FDA.

  (b) The maximum operating pressure of the heat exchanger shall not exceed the maximum operating pressure of the potable water supply.

(3) The word "Caution" and the statements in letters shall have an uppercase height of not less than 0.120 of an inch (3.048 mm). The vertical spacing between lines of type shall be not less than 0.046 of an inch (1.168 mm). Lowercase letters shall be compatible with the uppercase letter size specification.

[W] 506.0 Combustion Air. For issues relating to combustion air, see the Mechanical Code.

[W] Sections 506.1 through 506.9 are not adopted.

507.0 Appliance and Equipment Installation Requirements.

507.1 Dielectric Insulator. The Authority Having Jurisdiction shall have the authority to require the use of an approved dielectric insulator on the water piping connections of water heaters and related water heating appliances.

[W] 507.2 Seismic Provisions. Water heaters shall be anchored or strapped to resist horizontal displacement due to earthquake motion. Strapping shall be at points within the upper one-third and lower one-third of its vertical dimensions. At the lower point, a distance of not less than four (4) inches (102 mm) shall be maintained from the controls to the strapping.

507.3 Appliance Support. Appliances and equipment shall be furnished either with load-distributing bases or with a sufficient number of supports to prevent damage to either the building structure or the appliance and the equipment. [NFPA 54:9.1.8.1]

507.3.1 Structural Capacity. At the locations selected for installation of appliances and equipment, the dynamic and static load carrying capacities of the building structure shall be checked to determine whether they are adequate to carry the additional loads. The appliances and equipment shall be supported and shall be connected to the piping so as not to exert undue stress on the connections. [NFPA 54:9.1.8.2]

507.4 Ground Support. A water heater supported from the earth shall rest on level concrete or other approved base extending not less than 3 inches (76 mm) above the adjoining ground level.

507.5 Drainage Pan. Where a water heater is located in an attic, in or on an attic ceiling assembly, floor-ceiling assembly, or floor-subfloor assembly where damage results from a leaking water heater, a watertight pan of corrosion-resistant materials shall be installed beneath the water heater with not less than ¾ of an inch (20 mm) diameter drain to an approved location. Such pan shall be not less than 1½ inches (38 mm) in depth.

[W] Sections 507.6 through 507.9 are not adopted.

507.10 Protection of Gas Appliances from Fumes or Gases other than Products of Combustion. Non-direct-vent appliances installed in beauty shops, barber shops, or other facilities where chemicals that generate corrosive or flammable products such as aerosol sprays are routinely used shall be located in a mechanical room separate or partitioned off from other areas with provisions for combustion and dilution air from outdoors. Direct-vent appliances in such facilities shall be in accordance with the appliance manufacturer's installation instructions. [NFPA 54:9.1.6.2]

507.11 Process Air. In addition to air needed for combustion in commercial or industrial processes, process air shall be provided as required for cooling of appliances, equipment, or material; for controlling dew point, heating, drying, oxidation, dilution, safety exhaust, odor control, air for compressors; and for comfort and proper working conditions for personnel. [NFPA 54:9.1.7]

507.12 Flammable Vapors. Appliances shall not be installed in areas where the open use, handling, or dispensing of flammable liquids occurs, unless the design, operation, or installation reduces the potential of ignition of the flammable vapors. Appliances installed in compliance with Section 507.13 through Section 507.15 shall be considered to comply with the intent of this provision. [NFPA 54:9.1.9]

[W] 507.13 Installation in Garages. Appliances in garages and in adjacent spaces that open to the garage and are not part of the living space of a dwelling unit shall be installed so that burners, burner-ignition devices, and ignition sources are located not less than 18 inches (457 mm) above the floor unless listed as flammable vapor ignition resistant.

507.13.1 Physical Damage. Appliances installed in garages, warehouses, or other areas subject to mechanical damage shall be guarded against such damage by being installed behind protective barriers or by being elevated or located out of the normal path of vehicles.

507.13.2 Access from the Outside. Where appliances are installed in a separate, enclosed space having access only from outside of the garage, such appliances shall be permitted to be installed at floor level, providing the required combustion air is taken from the exterior of the garage. [NFPA 54:9.1.10.3]

507.14 Installation in Commercial Garages. Appliances installed in commercial garages shall comply with Section 507.14.1 and Section 507.14.2.

507.14.1 Parking Structures. Appliances installed in enclosed, basement, and underground parking structures shall be installed in accordance with NFPA 88A. [NFPA 54:9.1.11.1]

507.14.2 Repair Garages. Appliances installed in repair garages shall be installed in accordance with NFPA 30A. [NFPA 54:9.1.11.2]

507.15 Installation in Aircraft Hangars. Heaters in aircraft hangars shall be installed in accordance with NFPA 409. [NFPA 54:9.1.12]

[W] 507.16 Venting of Flue Gases. This section is not adopted.

507.17 Extra Device or Attachment. No device or attachment shall be installed on any appliance that could in any way impair the combustion of gas. [NFPA 54:9.1.15]

[W] 507.18 through 507.22 are not adopted.

507.23 Combination of Appliances and Equipment. Any combination of appliances, equipment, attachments, or devices used together in any manner shall comply with the standards that apply to the individual appliance and equipment. [NFPA 54:9.1.21]

507.24 Installation Instructions. The installing agency shall conform to the appliance and equipment manufacturer's recommendations in completing an installation. The installing agency shall leave the manufacturer's installation, operating, and maintenance instructions in a location on the premises where they are readily available for reference and guidance of the Authority Having Jurisdiction, service personnel, and the owner or operator. [NFPA 54:9.1.22]

507.25 Protection of Outdoor Appliances. Appliances not listed for outdoor installation but installed outdoors shall be provided with protection to the degree that the environment requires. Appliances listed for outdoor installation shall be permitted to be installed without protection in accordance with the provisions of its listing and the manufacturer's installation instructions.

507.26 Accessibility for Service. All appliances shall be located with respect to building construction and other equipment so as to permit access to the appliance. Sufficient clearance shall be maintained to permit cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls, and vent connections; the lubrication of moving parts where necessary; the adjustment and cleaning of burners and pilots; and the proper functioning of explosion vents, if provided. For attic installation, the passageway and servicing area adjacent to the appliance shall be floored. [NFPA 54:9.2.1]

507.27 Clearance to Combustible Materials. Appliances and their vent connectors shall be installed with clearances from combustible material so their operation does not create a hazard to persons or property. Minimum clearances between combustible walls and the back and sides of various conventional types of appliances and their vent connectors shall be according to the International Mechanical Code.

508.0 Appliances on Roofs.

508.1 General. Appliances on roofs shall be designed or enclosed so as to withstand climatic conditions in the area in which they are installed. Where enclosures are provided, each enclosure shall permit easy entry and movement, shall be of reasonable height, and shall have at least a 30 inch (762 mm) clearance between the entire service access panel(s) of the appliance, and the wall of the enclosure. [NFPA 54:9.4.1.1]

508.1.1 Load Capacity. Roofs on which appliances are to be installed shall be capable of supporting the additional load or shall be reinforced to support the additional load. [NFPA 54:9.4.1.2]

508.1.2 Fasteners. All access locks, screws, and bolts shall be of corrosion-resistant material. [NFPA 54:9.4.1.3]

508.2 Installation of Appliances on Roofs. Appliances shall be installed in accordance with the manufacturer's installation instructions. [NFPA 54:9.4.2.1]

508.2.1 Edge of Roof Clearance. Appliances shall be installed on a well-drained surface of the roof. At least 6 feet (1829 mm) of clearance shall be available between any part of the appliance and the edge of a roof or similar hazard, or rigidly fixed rails, guards, parapets, or other building structures at least 42 inches (1067 mm) in height shall be provided on the exposed side. [NFPA 54:9.4.2.2]

508.2.1.1 Guards and Rails. Guards or rails shall be required where the following exist:

(1) The clearance between the appliance and a roof edge or open end of an equipment platform is less than 6 feet (1829 mm).

(2) The open end of the equipment platform is located more than 30 inches (762 mm) above the roof, floor, or grade below.

Where guards or rails are installed, they shall be constructed so as to prevent the passage of a 21 inch (533 mm) diameter ball, resist the imposed loading conditions, and shall extend not less than 30 inches (762 mm) beyond each side of the equipment or appliance.

Exception: Guards shall not be required where a permanent fall arrest anchorage connector system in accordance with ASSE Z359.1 is installed.

508.2.2 Electrical Power. All appliances requiring an external source of electrical power for its operation shall be provided with the following:

(1) A readily accessible electrical disconnecting means within sight of the appliance that completely de-energizes the appliance.

(2) A 120 V-ac grounding-type receptacle outlet on the roof adjacent to the appliance on the supply side of the disconnect switch. [NFPA 54:9.4.2.3]

508.2.3 Platform or Walkway. Where water stands on the roof at the appliance or in the passageways to the appliance, or where the roof is of a design having a water seal, a suitable platform, walkway, or both shall be provided above the waterline. Such platform(s) or walkway(s) shall be located adjacent to the appliance and control panels so that the appliance can be safely serviced where water stands on the roof. [NFPA 54:9.4.2.4]

508.3 Appliances on Roofs. Appliances located on roofs or other elevated locations shall be accessible. [NFPA 54:9.4.3.1]

508.3.1 Access. Buildings of more than15 feet (4572 mm) in height shall have an inside means of access to the roof, unless other means acceptable to the Authority Having Jurisdiction are used. [NFPA 54:9.4.3.2]

508.3.2 Access Type. The inside means of access shall be a permanent or fold away inside stairway or ladder, terminating in an enclosure, scuttle, or trap door. Such scuttles or trap doors shall be at least 22 inches by 24 inches (559 mm by 610 mm) in size, shall open easily and safely under all conditions, especially snow; and shall be constructed so as to permit access from the roof side unless deliberately locked on the inside.

At least 6 feet (1829 mm) of clearance shall be available between the access opening and the edge of the roof or similar hazard, or rigidly fixed rails or guards a minimum of 42 inches (1067 mm) in height shall be provided on the exposed side. Where parapets or other building structures are utilized in lieu of guards or rails, they shall be a minimum of 42 inches (1067 mm) in height. [NFPA 54:9.4.3.3]

508.3.3 Permanent Lighting. Permanent lighting shall be provided at the roof access. The switch for such lighting shall be located inside the building near the access means leading to the roof. [NFPA 54:9.4.3.4]

508.4 Appliances in Attics and Under-Floor Spaces. An attic or under-floor space in which an appliance is installed shall be accessible through an opening and passageway, not less than as large as the largest component of the appliance, and not less than 22 inches by 30 inches (559 mm by 762 mm).

508.4.1 Length of Passageway. Where the height of the passageway is less than 6 feet (1829 mm), the distance from the passageway access to the appliance shall not exceed 20 feet (6096 mm) measured along the centerline of the passageway. [NFPA 54:9.5.1.1]

508.4.2 Width of Passageway. The passageway shall be unobstructed and shall have solid flooring not less than 24 inches (610 mm) wide from the entrance opening to the appliance. [NFPA 54:9.5.1.2]

508.4.3 Work Platform. A level working platform not less than 30 inches by 30 inches (762 mm by 762 mm) shall be provided in front of the service side of the appliance. [NFPA 54:9.5.2]

508.4.4 Lighting and Convenience Outlet. A permanent 120 V receptacle outlet and a lighting fixture shall be installed near the appliance. The switch controlling the lighting fixture shall be located at the entrance to the passageway. [NFPA 54:9.5.3]

[W] 509.0 Venting of Equipment. This section is not adopted.

[W] 510.0 Sizing of Category I Venting Systems. This section is not adopted.

CHAPTER 6
WATER SUPPLY AND DISTRIBUTION

601.0 General.

[W] 601.1 Applicability. This chapter shall govern the materials, design, and installation of water supply systems, including backflow prevention devices, assemblies, and methods used for backflow prevention.

601.2 Water Supply and Flushing. Each plumbing fixture shall be provided with an adequate supply of potable running water piped thereto in an approved manner, so arranged as to flush and keep it in a clean and sanitary condition without danger of backflow or cross-connection. Water closets and urinals shall be flushed using an approved flush tank or flushometer valve.

Exceptions:

(1) Listed fixtures that do not require water for their operation and are not connected to the water supply.

(2) Where not deemed necessary for safety and sanitation by the Authority Having Jurisdiction.

601.2.1 Hot and Cold Water Required. In occupancies where plumbing fixtures are installed for private use, hot water shall be required for bathing, washing, laundry, cooking purposes, dishwashing or maintenance. In occupancies where plumbing fixtures are installed for public use, hot water shall be required for bathing and washing purposes. This requirement shall not supersede the requirements for individual temperature control limitations for public lavatories and public and private bidets, bathtubs, whirlpool bathtubs, and shower control valves.

601.3 Identification of a Potable and Nonpotable Water System. In buildings where potable water and nonpotable water systems are installed, each system shall be clearly identified in accordance with Section 601.3.1 through Section 601.3.5.

601.3.1 Potable Water. Green background with white lettering.

601.3.2 Color and Information. Each system shall be identified with a colored pipe or band and coded with paints, wraps, and materials compatible with the piping.

Except as required by Section 601.3.3, nonpotable water systems shall have a yellow background with black uppercase lettering, with the words "CAUTION: NONPOTABLE WATER, DO NOT DRINK." Each nonpotable system shall be identified to designate the liquid being conveyed, and the direction of normal flow shall be clearly shown. The minimum size of the letters and length of the color field shall comply with Table 601.3.2.

The background color and required information shall be indicated every 20 feet (6096 mm) but not less than once per room, and shall be visible from the floor level.

TABLE 601.3.2
MINIMUM LENGTH OF COLOR FIELD AND SIZE OF LETTERS

OUTSIDE DIAMETER OF PIPE OR COVERING (inches)	MINIMUM LENGTH OF COLOR FIELD (inches)	MINIMUM SIZE OF LETTERS (inches)
½ to 1¼	8	½
1½ to 2	8	¾
2½ to 6	12	1¼
8 to 10	24	2½
Over 10	32	3½

For SI units: 1 inch = 25.4 mm

601.3.3 Alternate Water Sources. Alternate water source systems shall have a purple (Pantone color No. 512, 522C, or equivalent) background with uppercase lettering and shall be field or factory marked as follows:

(1) Gray water systems shall be marked in accordance with this section with the words "CAUTION: NONPOTABLE GRAY WATER, DO NOT DRINK" in black letters.

(2) Reclaimed (recycled) water systems shall be marked in accordance with this section with the words: "CAUTION: NONPOTABLE RECLAIMED (RECYCLED) WATER, DO NOT DRINK" in black letters.

(3) On-site treated water systems shall be marked in accordance with this section with the words: "CAUTION: ON-SITE TREATED NONPOTABLE WATER, DO NOT DRINK" in black letters.

(4) Rainwater catchment systems shall be marked in accordance with this section with the words: "CAUTION: NONPOTABLE RAINWATER WATER, DO NOT DRINK" in black letters.

601.3.4 Fixtures. Where vacuum breakers or backflow preventers are installed with fixtures listed in Chapter 17, identification of the discharge side shall be permitted to be omitted.

601.3.5 Outlets. Each outlet on the nonpotable water line that is used for special purposes shall be posted with black uppercase lettering as follows: "CAUTION: NONPOTABLE WATER, DO NOT DRINK."

602.0 Unlawful Connections.

602.1 Prohibited Installation. No installation of potable water supply piping, or part thereof, shall be made in such a manner that it will be possible for used, unclean, polluted, or contaminated water, mixtures, or substances to enter a portion of such piping from a tank, receptor, equipment, or plumbing fixture by reason of backsiphonage, suction, or other cause, either during normal use and operation thereof, or where such tank, receptor, equipment, or plumbing fixture is flooded or subject to pressure exceeding the operating pressure in the hot or cold water piping.

602.2 Cross-Contamination. No person shall make a connection or allow one to exist between pipes or conduits carrying domestic water supplied by a public or private building supply system, and pipes, conduits, or fixtures containing or carrying water from any other source or containing or carrying water that has been used for any purpose whatsoever, or piping carrying chemicals, liquids, gases, or substances whatsoever, unless there is provided a backflow prevention device approved for the potential hazard and maintained in accordance with this code. Each point of use shall be separately protected where potential cross-contamination of individual units exists.

602.3 Backflow Prevention. No plumbing fixture, device, or construction shall be installed or maintained, or shall be connected to a domestic water supply, where such installation or connection provides a possibility of polluting such water supply or cross-connection between a distributing system of water for drinking and domestic purposes and water that becomes contaminated by such plumbing fixture, device, or construction unless there is provided a backflow prevention device approved for the potential hazard.

602.4 Approval by Authority. No water piping supplied by a private water supply system shall be connected to any other source of supply without the approval of the Authority Having Jurisdiction, Health Department, or other department having jurisdiction.

603.0 Cross-Connection Control.

[W] 603.1 General. Cross-connection control shall be provided in accordance with the provisions of this chapter. Devices or assemblies for protection of the public water system must be models approved by the Department of Health under WAC 246-290-490. The Authority Having Jurisdiction shall coordinate with the local water purveyor where applicable in all matters concerning cross-connection control within the property lines of the premises.

No person shall install any water-operated equipment or mechanism, or use any water-treating chemical or substance, if it is found that such equipment, mechanism, chemical or substance may cause pollution or contamination of the domestic water supply. Such equipment or mechanism may be permitted only when equipped with an approved backflow prevention device or assembly.

[W] 603.2 Approval of Devices or Assemblies. Before any device or assembly is installed for the prevention of backflow, it shall have first been approved by the Authority Having Jurisdiction. Devices or assemblies shall be tested for conformity with recognized standards or other standards acceptable to the Authority Having Jurisdiction. Backflow prevention devices and assemblies shall comply with Table 603.2, except for specific applications and provisions as stated in Section 603.5.1 through Section 603.5.21.

All devices or assemblies installed in a potable water supply system for protection against backflow shall be maintained in good working condition by the person or persons having control of such devices or assemblies. Such devices or assemblies shall be tested in accordance with Section 603.4.2 and WAC 246-290-490. If found to be defective or inoperative, the device or assembly shall be replaced or repaired. No device or assembly shall be removed from use or relocated or other device or assembly substituted, without the approval of the Authority Having Jurisdiction.

Testing shall be performed by a Washington State Department of Health certified backflow assembly tester.

603.3 Backflow Prevention Devices, Assemblies, and Methods. Backflow prevention devices, assemblies, and methods shall comply with Section 603.3.1 through Section 603.3.12.

603.3.1 Air Gap. The minimum air gap to afford backflow protection shall be in accordance with Table 603.3.1.

603.3.2 Atmospheric Vacuum Breaker (AVB). An atmospheric vacuum breaker consists of a body, a checking member, and an atmospheric port.

603.3.3 Hose Connection Backflow Preventer. A hose connection backflow preventer consists of two independent check valves with an independent atmospheric vent between and a means of field testing and draining.

[W] TABLE 603.2
BACKFLOW PREVENTION DEVICES, ASSEMBLIES, AND METHODS

DEGREE OF HAZARD						
DEVICE, ASSEMBLY, OR METHOD[1]	APPLICABLE STANDARDS	POLLUTION (LOW HAZARD)		CONTAMINATION (HIGH HAZARD)		INSTALLATION[2,3]
		BACK- SIPHONAGE	BACK-PRESSURE	BACK- SIPHONAGE	BACK-PRESSURE	
Air gap	ASME A112.1.2	X	—	X	—	See Table 603.3.1 in this chapter.
Air gap fittings for use with plumbing fixtures, appliances, and appurtenances	ASME A112.1.3	X	—	X	—	Air gap fitting is a device with an internal air gap, and typical installation includes plumbing fixtures, appliances, and appurtenances. The critical level shall not be installed below the flood level rim.
Atmospheric vacuum breaker (consists of a body, checking member and atmospheric port)	ASSE 1001 or CSA B64.1.1	X	—	X	—	Upright position. No valve downstream. Minimum of 6 inches or listed distance above all downstream piping and flood level rim of receptor.[4,5]
Antisiphon fill valve (ballcocks) for gravity water closet flush tanks and urinal tanks	ASSE 1002/ ASME A112.1002/ CSA B125.12	X	—	X	—	Installation of gravity water closet flush tank and urinal tanks with the fill valve installed with the critical level not less than 1 inch above the opening of the overflow pipe.[4,5]
Vacuum breaker wall hydrants, hose bibbs, freeze resistant, automatic draining type	ASSE 1019 or CSA B64.2.1.1	X	—	X	—	Installation includes wall hydrants and hose bibbs. Such devices are not for use under continuous pressure conditions (means of shutoff downstream of device is prohibited).[4,5]
Hose connection vacuum breakers	ASSE 1011	X	—	X	—	Such devices are not for use under continuous pressure conditions. No valve downstream.[4,6]
Hose connection backflow preventers	ASSE 1052	X	—	X	—	Such devices are not for use under continuous pressure conditions.[4,6]
Dual check backflow preventer	ASSE 1024	X	X	—	—	Installation does not include carbonated drink dispensers.
Dual check backflow preventer wall hydrants, freeze resistant	ASSE 1053	X	—	X	—	Such devices are not for use under continuous pressure conditions.[4]
Freeze resistant sanitary yard hydrants	ASSE 1057	X	—	X	—	Such devices are not for use under continuous pressure conditions.[4]
Backflow preventer with intermediate atmospheric vent	ASSE 1012	X	X	—	—	Installation of potable water connections to water boilers. No high-hazard chemicals shall be introduced into the system using such devices. Designed to operate under continuous pressure conditions. May discharge water.
Backflow preventer with intermediate atmospheric vent and pressure reducing valve	ASSE 1081	X	X	—	—	Installation of potable water connections to water boilers. No high-hazard chemicals shall be introduced into the system using such devices. Designed to operate under continuous pressure conditions. May discharge water.
Spill-Resistant Pressure Vacuum Breaker (single check valve with air inlet vent and means of field testing)	ASSE 1056	X	—	X	—	Upright position. Minimum of 12 inches or listed distance above all downstream piping and flood-level rim of receptor.[5]
Double Check Valve Backflow Prevention Assembly (two independent check valves and means of field testing)	ASSE 1015; AWWA C510; CSA B64.5 or CSA B64.5.1	X	X	—	—	Horizontal unless otherwise listed. Access and clearance shall be in accordance with the manufacturer's instructions, and not less than a 12 inch clearance at the bottom for maintenance. May need platform/ladder for test and repair. Does not discharge water.

[W] TABLE 603.2
BACKFLOW PREVENTION DEVICES, ASSEMBLIES, AND METHODS (continued)

DEGREE OF HAZARD						
DEVICE, ASSEMBLY, OR METHOD[1]	APPLICABLE STANDARDS	POLLUTION (LOW HAZARD)		CONTAMINATION (HIGH HAZARD)		INSTALLATION[2,3]
		BACK- SIPHONAGE	BACK-PRESSURE	BACK- SIPHONAGE	BACK-PRESSURE	
Double Check Detector Fire Protection Backflow Prevention Assembly (two independent check valves with a parallel detector assembly consisting of a water meter and a double check valve backflow prevention assembly and means for field testing)	ASSE 1048	X	X	—	—	Horizontal unless otherwise listed. Access and clearance shall be in accordance with the manufacturer's instructions, and not less than a 12 inch clearance at the bottom for maintenance. May need platform/ladder for test and repair. Does not discharge water. Installation includes a fire protection system and is designed to operate under continuous pressure conditions.
Pressure Vacuum Breaker Backflow Prevention Assembly (loaded air inlet valve, internally loaded check valve and means for field testing)	ASSE 1020 or CSA B64.1.2	X	—	X	—	Upright position. May have valves downstream. Minimum of 12 inches above all downstream piping and flood-level rim of the receptor. May discharge water.
Reduced Pressure Principle Backflow Prevention Assembly (two independently acting loaded check valves, a differential pressure relief valve and means for field testing)	ASSE 1013; AWWA C511; CSA B64.4 or CSA B64.4.1	X	X	X	X	Horizontal unless otherwise listed. Access and clearance shall be in accordance with the manufacturer's instructions, and not less than a 12 inch clearance at the bottom for maintenance. May need platform/ladder for test and repair. May discharge water.
Reduced Pressure Detector Fire Protection Backflow Prevention Assembly (two independently acting loaded check valves, a differential pressure relief valve, with a parallel detector assembly consisting of a water meter and a reduced-pressure principle backflow prevention assembly, and means for field testing)	ASSE 1047	X	X	X	X	Horizontal unless otherwise listed. Access and clearance shall be in accordance with the manufacturer's instructions, and not less than a 12 inch clearance at the bottom for maintenance. May need platform/ladder for test and repair. May discharge water. Installation includes a fire protection system and is designed to operate under continuous pressure conditions.
Laboratory faucet backflow preventer	ASSE 1035	—	—	X	X	Installation includes laboratory faucets. Such devices are not for use under continuous pressure conditions. No valve downstream.[4]

For SI units: 1 inch = 25.4 mm

Notes:

1 See the description of devices and assemblies in this chapter.

2 Installation in pit or vault requires previous approval by the Authority Having Jurisdiction.

3 Refer to the general and specific requirement for installation.

4 Not to be subjected to operating pressure for more than 12 hours in a 24 hour period.

5 For deck-mounted and equipment-mounted vacuum breaker, see Section 603.5.13.

6 Shall be installed in accordance with Section 603.5.7.

TABLE 603.3.1
MINIMUM AIR GAPS FOR WATER DISTRIBUTION[4]

FIXTURES	WHERE NOT AFFECTED BY SIDEWALLS[1] (inches)	WHERE AFFECTED BY SIDEWALLS[2] (inches)
Effective openings[3] not greater than ½ of an inch in diameter	1	1½
Effective openings[3] not greater than ¾ of an inch in diameter	1½	2¼
Effective openings[3] not greater than 1 inch in diameter	2	3
Effective openings[3] greater than 1 inch in diameter	Two times the diameter of effective opening	Three times the diameter of effective opening

For SI units: 1 inch = 25.4 mm

Notes:

1 Sidewalls, ribs, or similar obstructions do not affect air gaps where spaced from the inside edge of the spout opening a distance exceeding three times the diameter of the effective opening for a single wall, or a distance exceeding four times the effective opening for two intersecting walls.

2 Vertical walls, ribs, or similar obstructions extending from the water surface to or above the horizontal plane of the spout opening other than specified in Footnote 1 above. The effect of three or more such vertical walls or ribs has not been determined. In such cases, the air gap shall be measured from the top of the wall.

3 The effective opening shall be the minimum cross-sectional area at the seat of the control valve or the supply pipe or tubing that feeds the device or outlet. Where two or more lines supply one outlet, the effective opening shall be the sum of the cross-sectional areas of the individual supply lines or the area of the single outlet, whichever is smaller.

4 Air gaps less than 1 inch (25.4 mm) shall be approved as a permanent part of a listed assembly that has been tested under actual backflow conditions with vacuums of 0 to 25 inches of mercury (85 kPa).

603.3.4 Double Check Valve Backflow Prevention Assembly (DC). A double check valve backflow prevention assembly consists of two independently acting internally loaded check valves, four properly located test cocks, and two isolation valves.

603.3.5 Pressure Vacuum Breaker Backflow Prevention Assembly (PVB). A pressure vacuum breaker backflow prevention assembly consists of a loaded air inlet valve, an internally loaded check valve, two properly located test cocks, and two isolation valves. This device shall be permitted to be installed indoors where provisions for spillage are provided.

603.3.6 Spill-Resistant Pressure Vacuum Breaker (SVB). A pressure-type vacuum breaker backflow prevention assembly consists of one check valve force-loaded closed and an air inlet vent valve force-loaded open to atmosphere, positioned downstream of the check valve and located between and including two tightly closing shutoff valves and test cocks.

603.3.7 Reduced-Pressure Principle Backflow Prevention Assembly (RP). A reduced-pressure principle backflow prevention assembly consists of two independently acting internally loaded check valves, a differential pressure relief valve, four properly located test cocks, and two isolation valves.

603.3.8 Double Check Detector Fire Protection Backflow Prevention Assembly. A double check valve backflow prevention assembly with a parallel detector assembly consisting of a water meter and a double check valve backflow prevention assembly (DC).

603.3.9 Reduced Pressure Detector Fire Protection Backflow Prevention Assembly. A reduced-pressure principle backflow prevention assembly with a parallel detector assembly consisting of a water meter and a reduced-pressure principle backflow prevention assembly (RP).

603.3.10 Dual Check Backflow Preventer. A dual check backflow preventer consists of two independently acting check valves, force loaded to a normally closed position.

603.3.11 Laboratory Faucet Backflow Preventers. Laboratory faucet backflow preventers shall comply with ASSE 1035.

603.3.12 Backflow Preventer with Intermediate Atmospheric Vent. A backflow preventer with intermediate atmospheric vent consists of two independently acting check valves, force loaded to a normally closed position, and an intermediate chamber with a means for automatically venting to atmosphere, force loaded to a normally open position.

603.4 General Requirements. Assemblies shall comply with listed standards and be acceptable to the Authority Having Jurisdiction, with jurisdiction over the selection and installation of backflow prevention assemblies.

603.4.1 Backflow Prevention Valve. Where more than one backflow prevention valve is installed on a single premise, and the valves are installed in one location, each separate valve shall be permanently identified by the permittee in a manner satisfactory to the Authority Having Jurisdiction.

[W] 603.4.2 Testing. For devices and assemblies other than those regulated by the Washington State Department of Health in conjunction with the local water purveyor for the protection of public water systems, the Authority Having Jurisdiction

shall ensure that the premise owner or responsible person shall have the backflow prevention assembly tested by a Washington State Department of Health certified backflow assembly tester.

(1) At the time of installation, repair, or relocation; and

(2) At least on an annual schedule thereafter, unless more frequent testing is required by the Authority Having Jurisdiction.

603.4.3 Access and Clearance. Access and clearance shall be provided for the required testing, maintenance, and repair. Access and clearance shall be in accordance with the manufacturer's instructions, and not less than 12 inches (305 mm) between the lowest portion of the assembly and grade, floor, or platform. Installations elevated that exceed 5 feet (1524 mm) above the floor or grade shall be provided with a platform capable of supporting a tester or maintenance person.

603.4.4 Connections. Direct connections between potable water piping and sewer-connected wastes shall not be permitted to exist under any condition with or without backflow protection. Where potable water is discharged to the drainage system, it shall be by means of an approved air gap of two pipe diameters of the supply inlet, but in no case shall the gap be less than 1 inch (25.4 mm). Connection shall be permitted to be made to the inlet side of a trap provided that an approved vacuum breaker is installed not less than 6 inches (152 mm), or the distance according to the device's listing, above the flood-level rim of such trapped fixture, so that at no time will such device be subjected to backpressure.

603.4.5 Hot Water Backflow Preventers. Backflow preventers for hot water exceeding 110°F (43°C) shall be a type designed to operate at temperatures exceeding 110°F (43°C) without rendering a portion of the assembly inoperative.

603.4.6 Integral Backflow Preventers. Fixtures, appliances, or appurtenances with integral backflow preventers or integral air gaps manufactured as a unit shall be installed in accordance with their listing requirements and the manufacturer's installation instructions.

603.4.7 Freeze Protection. In cold climate areas, backflow assemblies and devices shall be protected from freezing with an outdoor enclosure that complies with ASSE 1060 or by a method acceptable to the Authority Having Jurisdiction.

603.4.8 Drain Lines. Drain lines serving backflow devices or assemblies shall be sized in accordance with the discharge rates of the manufacturer's flow charts of such devices or assemblies.

603.4.9 Prohibited Locations. Backflow prevention devices with atmospheric vents or ports shall not be installed in pits, underground, or submerged locations. Backflow preventers shall not be located in an area containing fumes that are toxic, poisonous, or corrosive.

603.5 Specific Requirements. Specific requirements for backflow prevention shall comply with Section 603.5.1 through Section 603.5.21.

603.5.1 Atmospheric Vacuum Breaker. Water closet and urinal flushometer valves shall be protected against backflow by an approved backflow prevention assembly, device, or method. Where the valves are equipped with an atmospheric vacuum breaker, the vacuum breaker shall be installed on the discharge side of the flushometer valve with the critical level not less than 6 inches (152 mm), or the distance according to its listing, above the overflow rim of a water closet bowl or the highest part of a urinal.

603.5.2 Ballcock. Water closet and urinal tanks shall be equipped with a ballcock. The ballcock shall be installed with the critical level not less than 1 inch (25.4 mm) above the full opening of the overflow pipe. In cases where the ballcock has no hush tube, the bottom of the water supply inlet shall be installed 1 inch (25.4 mm) above the full opening of the overflow pipe.

603.5.3 Backflow Prevention. Water closet flushometer tanks shall be protected against backflow by an approved backflow prevention assembly, device, or method.

603.5.4 Heat Exchangers. Heat exchangers used for heat transfer, heat recovery, or solar heating shall protect the potable water system from being contaminated by the heat-transfer medium. Single-wall heat exchangers used in indirect-fired water heaters shall meet the requirements of Section 505.4.1. Double-wall heat exchangers shall separate the potable water from the heat-transfer medium by providing a space between the two walls that are vented to the atmosphere.

603.5.5 Water Supply Inlets. Water supply inlets to tanks, vats, sumps, swimming pools, and other receptors shall be protected by one of the following means:

(1) An approved air gap.

(2) A listed vacuum breaker installed on the discharge side of the last valve with the critical level not less than 6 inches (152 mm) or in accordance with its listing.

(3) A backflow preventer suitable for the degree of hazard, installed in accordance with the requirements for that type of device or assembly as set forth in this chapter.

[W] 603.5.6 Protection from Lawn Sprinklers and Irrigation Systems. Potable water supplies to systems having no pumps or connections for pumping equipment, and no chemical injection or provisions for chemical injection, shall be protected from backflow by one of the following devices:

(1) Atmospheric vacuum breaker (AVB)

(2) Pressure vacuum breaker backflow prevention assembly (PVB)

(3) Spill-resistant pressure vacuum breaker (SVB)

(4) Reduced-pressure principle backflow prevention assembly (RP)

(5) A double check valve backflow prevention assembly (DC) may be allowed when approved by the water purveyor and the Authority Having Jurisdiction.

603.5.6.1 Systems with Pumps. Where sprinkler and irrigation systems have pumps, connections for pumping equipment, or auxiliary air tanks, or are otherwise capable of creating backpressure, the potable water supply shall be protected by the following type of device where the backflow device is located upstream from the source of backpressure:

(1) Reduced-pressure principle backflow prevention assembly (RP)

603.5.6.2 Systems with Backflow Devices. Where systems have a backflow device installed downstream from a potable water supply pump or a potable water supply pump connection, the device shall be one of the following:

(1) Atmospheric vacuum breaker (AVB)

(2) Pressure vacuum breaker backflow prevention assembly (PVB)

(3) Spill-resistant pressure vacuum breaker (SVB)

(4) Reduced-pressure principle backflow prevention assembly (RP)

603.5.6.3 Systems with Chemical Injectors. Where systems include a chemical injector or provisions for chemical injection, the potable water supply shall be protected by a reduced-pressure principle backflow prevention assembly (RP).

603.5.7 Outlets with Hose Attachments. Potable water outlets with hose attachments, other than water heater drains, boiler drains, and clothes washer connections, shall be protected by a nonremovable hose bibb-type backflow preventer, a nonremovable hose bibb-type vacuum breaker, or by an atmospheric vacuum breaker installed not less than 6 inches (152 mm) above the highest point of usage located on the discharge side of the last valve. In climates where freezing temperatures occur, a listed self-draining frost-proof hose bibb with an integral backflow preventer or vacuum breaker shall be used.

603.5.8 Water-Cooled Equipment. Water-cooled compressors, degreasers, or other water-cooled equipment shall be protected by a backflow preventer installed in accordance with the requirements of this chapter. Water-cooled equipment that produces backpressure shall be equipped with the appropriate protection.

603.5.9 Aspirators. Water inlets to water-supplied aspirators shall be equipped with a vacuum breaker installed in accordance with its listing requirements and this chapter. The discharge shall drain through an air gap. Where the tailpiece of a fixture to receive the discharge of an aspirator is used, the air gap shall be located above the flood-level rim of the fixture.

[W] 603.5.10 Steam or Hot Water Boilers. Potable water connections to steam or hot water boilers shall be protected by an air gap or a reduced pressure principle backflow preventer.

603.5.11 Nonpotable Water Piping. In cases where it is impractical to correct individual cross-connections on the domestic waterline, the line supplying such outlets shall be considered a nonpotable water line. No drinking or domestic water outlets shall be connected to the nonpotable waterline. Where possible, portions of the nonpotable waterline shall be exposed, and exposed portions shall be properly identified in a manner satisfactory to the Authority Having Jurisdiction. Each outlet on the nonpotable waterline that is permitted to be used for drinking or domestic purposes shall be posted: "CAUTION: NONPOTABLE WATER, DO NOT DRINK."

[W] 603.5.12 Beverage Dispensers. Potable water supply to carbonators shall be protected by a listed reduced pressure principle backflow preventer as approved by the Authority Having Jurisdiction for the specific use. The backflow preventer shall comply with Section 603.4.3. The piping downstream of the backflow preventer shall not be of copper, copper alloy, or other materials affected by carbon dioxide.

603.5.13 Deck-Mounted and Equipment-Mounted Vacuum Breakers. Deck-mounted or equipment-mounted vacuum breakers shall be installed in accordance with their listing and the manufacturer's installation instructions, with the critical level not less than 1 inch (25.4 mm) above the flood-level rim.

603.5.14 Protection from Fire Systems. Except as provided in Section 603.5.14.1 and Section 603.5.14.2, potable water supplies to fire protection systems that are normally under pressure, including but not limited to standpipes and automatic sprinkler systems, except in one- or two-family or townhouse residential sprinkler systems, piped in materials approved for potable water distribution systems shall be protected from backpressure and backsiphonage by one of the following testable devices:

(1) Double check valve backflow prevention assembly (DC)

(2) Double check detector fire protection backflow prevention assembly

(3) Reduced pressure principle backflow prevention assembly (RP)

(4) Reduced pressure detector fire protection backflow prevention assembly

Potable water supplies to fire protection systems that are not normally under pressure shall be protected from backflow and shall be in accordance with the requirements of the appropriate standards referenced in Chapter 17.

603.5.14.1 Fire Department Connection. Where fire protection systems supplied from a potable water system include a fire department (siamese) connection that is located less than 1700 feet (518.2 m) from a nonpotable water source that is capable of being used by the fire department as a secondary water supply, the potable water supply shall be protected by one of the following:

(1) Reduced pressure principle backflow prevention assembly (RP)

(2) Reduced pressure detector fire protection backflow prevention assembly

Nonpotable water sources include fire department vehicles carrying water of questionable quality or water that is treated with antifreeze, corrosion inhibitors, or extinguishing agents.

603.5.14.2 Chemicals. Where antifreeze, corrosion inhibitors, or other chemicals are added to a fire protection system supplied from a potable water supply, the potable water system shall be protected by one of the following:

(1) Reduced pressure principle backflow prevention assembly (RP)

(2) Reduced pressure detector fire protection backflow prevention assembly

603.5.14.3 Hydraulic Design. Where a backflow device is installed in the potable water supply to a fire protection system, the hydraulic design of the system shall account for the pressure drop through the backflow device. Where such devices are retrofitted for an existing fire protection system, the hydraulics of the sprinkler system design shall be checked to verify that there will be sufficient water pressure available for satisfactory operation of the fire sprinklers.

603.5.15 Health Care or Laboratory Areas. Vacuum breakers for washer-hose bedpans shall be located not less than 5 feet (1524 mm) above the floor. Hose connections in health care or laboratory areas shall be not less than 6 feet (1829 mm) above the floor.

603.5.16 Special Equipment. Portable cleaning equipment and dental vacuum pumps shall be protected from backflow by an air gap, an atmospheric vacuum breaker, a spill-resistant vacuum breaker, or a reduced pressure principle backflow preventer.

603.5.17 Potable Water Outlets and Valves. Potable water outlets, freeze-proof yard hydrants, combination stop-and-waste valves, or other fixtures that incorporate a stop and waste feature that drains into the ground shall not be installed underground.

603.5.18 Pure Water Process Systems. The water supply to a pure water process system, such as dialysis water systems, semiconductor washing systems, and similar process piping systems, shall be protected from backpressure and backsiphonage by a reduced-pressure principle backflow preventer.

603.5.18.1 Dialysis Water Systems. The individual connections of the dialysis related equipment to the dialysis pure water system shall not require additional backflow protection.

603.5.19 Plumbing Fixture Fittings. Plumbing fixture fittings with integral backflow protection shall comply with ASME A112.18.1/CSA B125.1.

603.5.20 Swimming Pools, Spas, and Hot Tubs. Potable water supply to swimming pools, spas, and hot tubs shall be protected by an air gap or a reduced pressure principle backflow preventer in accordance with the following:

(1) The unit is equipped with a submerged fill line.

(2) The potable water supply is directly connected to the unit circulation system.

603.5.21 Chemical Dispensers. The water supply to chemical dispensers shall be protected against backflow. The chemical dispenser shall comply with ASSE 1055 or the water supply shall be protected by one of the following methods:

(1) Air gap

(2) Atmospheric vacuum breaker (AVB)

(3) Pressure vacuum breaker backflow prevention assembly (PVB)

(4) Spill-resistant pressure vacuum breaker (SVB)

(5) Reduced-pressure principle backflow prevention assembly (RP)

604.0 Materials.

604.1 Pipe, Tube, and Fittings. Pipe, tube, fittings, solvent cement, thread sealants, solders, and flux used in potable water systems intended to supply drinking water shall comply with NSF 61. Where pipe fittings and valves are made from copper alloys containing more than 15 percent zinc by weight and are used in plastic piping systems, they shall be resistant to dezincification and stress corrosion cracking in compliance with NSF 14.

Materials used in the water supply system, except valves and similar devices, shall be of a like material, except where otherwise approved by the Authority Having Jurisdiction.

Materials for building water piping and building supply piping shall comply with the applicable standards referenced in Table 604.1.

TABLE 604.1
MATERIALS FOR BUILDING SUPPLY AND WATER DISTRIBUTION PIPING AND FITTINGS

MATERIAL	BUILDING SUPPLY PIPE AND FITTINGS	WATER DISTRIBUTION PIPE AND FITTINGS	REFERENCED STANDARD(S) PIPE	REFERENCED STANDARD(S) FITTINGS
Copper and Copper Alloys	X	X	ASTM B42, ASTM B43, ASTM B75, ASTM B88, ASTM B135, ASTM B251, ASTM B302, ASTM B447	ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.26, ASME B16.50[2], ASME B16.51, ASSE 1061, ASTM F3226, IAPMO PS 117
CPVC	X	X	ASTM D2846, ASTM F441, ASTM F442, CSA B137.6	ASSE 1061, ASTM D2846, ASTM F437, ASTM F438, ASTM F439, ASTM F1970, CSA B137.6
CPVC-AL-CPVC	X	X	ASTM F2855	ASTM D2846
Ductile-Iron	X	X	AWWA C151	ASME B16.4, AWWA C110, AWWA C153
Galvanized Steel	X	X	ASTM A53	—
Malleable Iron	X	X	—	ASME B16.3
PE	X[1]	—	ASTM D2239, ASTM D2737, ASTM D3035, AWWA C901, CSA B137.1	ASTM D2609, ASTM D2683, ASTM D3261, ASTM F1055, CSA B137.1
PE-AL-PE	X	X	ASTM F1282, CSA B137.9	ASTM F1282, ASTM F1974, CSA B137.9
PE-AL-PEX	X	X	ASTM F1986	ASTM F1986
PE-RT	X	X	ASTM F2769, CSA B137.18	ASTM D3261, ASTM F1055, ASSE 1061, ASTM F1807, ASTM F2098, ASTM F2159, ASTM F2735, ASTM F2769, CSA B137.18
PEX	X	X	ASTM F876, CSA B137.5, AWWA C904[1]	ASSE 1061, ASTM F877, ASTM F1807, ASTM F1960, ASTM F2080, ASTM F2159, ASTM F2735, CSA B137.5
PEX-AL-PEX	X	X	ASTM F1281, CSA B137.10	ASTM F1281, ASTM F1974, ASTM F2434, CSA B137.10
PP	X	X	ASTM F2389, CSA B137.11	ASTM F2389, CSA B137.11
PVC	X[1]	—	ASTM D1785, ASTM D2241, AWWA C900	ASTM D2464, ASTM D2466, ASTM D2467, ASTM F1970, AWWA C907
Stainless Steel	X	X	ASTM A269, ASTM A312, ASTM A554, ASTM A778	ASTM F3226, IAPMO PS 117

Notes:
[1] For building supply or exterior cold-water applications, not for water distribution piping.
[2] For brazed fittings only.

604.2 Lead Content. The maximum allowable lead content in pipes, pipe fittings, plumbing fittings, and fixtures intended to convey or dispense water for human consumption shall be not more than a weighted average of 0.25 percent with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures. For solder and flux, the lead content shall be not more than 0.2 percent where used in piping systems that convey or dispense water for human consumption.

Exceptions:

(1) Pipes, pipe fittings, plumbing fittings, fixtures, or backflow preventers used for nonpotable services such as manufacturing, industrial processing, irrigation, outdoor watering, or any other uses where the water is not used for human consumption.

(2) Flush valves, fill valves, flushometer valves, tub fillers, shower valves, service saddles, or water distribution main gate valves that are 2 inches (50 mm) in diameter or larger.

604.2.1 Lead Content of Water Supply Pipe and Fittings. Pipes, pipe fittings, valves, and faucets utilized in the water supply system for non-drinking water applications shall have a maximum of 8 percent lead content.

604.3 Copper or Copper Alloy Tube. Copper or copper alloy tube for water piping shall have a weight of not less than Type L.

Exception: Type M copper or copper alloy tubing shall be permitted to be used for water piping where piping is aboveground in, or on, a building or underground outside of structures.

604.4 Hard-Drawn Copper or Copper Alloy Tubing. Hard-drawn copper or copper alloy tubing for water supply and distribution in addition to the required incised marking shall be marked in accordance with ASTM B88. The colors shall be: Type K, green; Type L, blue; and Type M, red.

604.5 Flexible Connectors. Flexible water connectors shall be installed in readily accessible locations, and where under continuous pressure shall comply with ASME A112.18.6/CSA B125.6. Flexible water connectors with an excess flow shutoff device shall comply with CSA B125.5/IAPMO Z600.

604.6 Cast-Iron Fittings. Cast-iron fittings up to and including 2 inches (50 mm) in size, where used in connection with potable water piping, shall be galvanized.

604.7 Malleable Iron Fittings. Malleable iron water fittings shall be galvanized.

604.8 Previously Used Piping and Tubing. Piping and tubing that has previously been used for a purpose other than for potable water systems shall not be used.

604.9 Epoxy Coating. The epoxy coating used on existing, underground steel building supply piping shall comply with NSF 61 and AWWA C210.

604.10 Plastic Materials. Approved plastic materials shall be permitted to be used in building supply piping, provided that where metal building supply piping is used for electrical grounding purposes, replacement piping, therefore, shall be of like materials.

Exception: Where a grounding system acceptable to the Authority Having Jurisdiction is installed, inspected, and approved, the metallic pipe shall be permitted to be replaced with nonmetallic pipe.

604.10.1 Tracer Wire. Plastic materials for building supply piping outside underground shall have an electrically continuous corrosion-resistant blue insulated copper tracer wire, or other approved conductor installed adjacent to the piping. Access shall be provided to the tracer wire, or the tracer wire shall terminate aboveground at each end of the nonmetallic piping. The tracer wire size shall be not less than 14 AWG, and the insulation type shall be suitable for direct burial.

604.11 Solder. Solder shall comply with the requirements of Section 604.2.

604.12 Flexible Corrugated Connectors. Flexible corrugated connectors of copper, copper alloy, or stainless steel shall be limited to the following connector lengths:

(1) Fixture Connectors – 30 inches (762 mm)

(2) Washing Machine Connectors – 72 inches (1829 mm)

(3) Dishwasher and Icemaker Connectors – 120 inches (3048 mm)

604.13 Water Heater Connectors. Flexible metallic (copper and stainless steel), reinforced flexible, braided stainless steel, or polymer braided with EPDM core connectors that connect a water heater to the piping system shall comply with ASME A112.18.6/CSA B125.6. Copper, copper alloy, or stainless steel flexible connectors shall not exceed 24 inches (610 mm). PEX, PEX-AL-PEX, PE-AL-PE, or PE-RT tubing shall not be installed within the first 18 inches (457 mm) of piping connected to a water heater.

[W] 604.14 Plastic Pipe Termination. Plastic water service piping may terminate within a building, provided the connection to the potable water distribution system shall be made as near as is practical to the point of entry and shall be accessible. Barbed insert fittings with hose clamps are prohibited as a transition fitting within the building.

605.0 Joints and Connections.

605.1 Copper or Copper Alloy Pipe, Tubing, and Joints. Joining methods for copper or copper alloy pipe, tubing, and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.1.1 through Section 605.1.5.

605.1.1 Brazed Joints. Brazed joints between copper or copper alloy pipe or tubing and fittings shall be made with brazing alloys having a liquid temperature above 1000°F (538°C). The joint surfaces to be brazed shall be cleaned bright by

either manual or mechanical means. Tubing shall be cut square and reamed to full inside diameter. Brazing flux shall be applied to the joint surfaces where required by manufacturer's recommendation. Brazing filler metal shall conform to AWS A5.8 and shall be applied at the point where the pipe or tubing enters the socket of the fitting.

605.1.2 Flared Joints. Flared joints for soft copper or copper alloy water tubing shall be made with fittings that comply with the applicable standards referenced in Table 604.1. Pipe or tubing shall be cut square using an appropriate tubing cutter. The tubing shall be reamed to full inside diameter, resized to round, and expanded with a proper flaring tool.

605.1.3 Mechanical Joints. Mechanical joints shall include, but are not limited to, compression, flanged, grooved, pressed, and push fit fittings.

605.1.3.1 Mechanically Formed Tee Fittings. Mechanically formed tee fittings shall have extracted collars that shall be formed in a continuous operation consisting of drilling a pilot hole and drawing out the pipe or tube surface to form a collar having a height not less than three times the thickness of the branch tube wall. The branch pipe or tube shall be notched to conform to the inner curve of the run pipe or tube and shall have two dimple depth stops to ensure that penetration of the branch pipe or tube into the collar is of a depth for brazing and that the branch pipe or tube does not obstruct the flow in the main line pipe or tube. Dimple depth stops shall be in line with the run of the pipe or tube. The second dimple shall be ¼ of an inch (6.4 mm) above the first and shall serve as a visual point of inspection. Fittings and joints shall be made by brazing. Soldered joints shall not be permitted.

605.1.3.2 Press-Connect Fittings. Press-connect fittings for copper or copper alloy pipe or tubing shall have an elastomeric o-ring that forms the joint. The pipe or tubing shall be fully inserted into the fitting, and the pipe or tubing marked at the shoulder of the fitting. Pipe or tubing shall be cut square, chamfered, and reamed to full inside diameter. The fitting alignment shall be checked against the mark on the pipe or tubing to ensure the pipe or tubing is inserted into the fitting. The joint shall be pressed using the tool recommended by the manufacturer.

605.1.3.3 Push Fit Fittings. Removable and nonremovable push fit fittings for copper or copper alloy tubing or pipe that employ quick assembly push fit connectors shall comply with ASSE 1061. Push fit fittings for copper or copper alloy pipe or tubing shall have an approved elastomeric o-ring that forms the joint. Pipe or tubing shall be cut square, chamfered, and reamed to full inside diameter. The tubing shall be fully inserted into the fitting, and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to ensure the tubing is inserted into the fitting and gripping mechanism has engaged on the pipe.

605.1.4 Soldered Joints. Soldered joints between copper or copper alloy pipe or tubing and fittings shall be made in accordance with ASTM B828 with the following sequence of joint preparation and operation as follows: measuring and cutting, reaming, cleaning, fluxing, assembly and support, heating, applying the solder, cooling and cleaning. Pipe or tubing shall be cut square and reamed to the full inside diameter including the removal of burrs on the outside of the pipe or tubing. Surfaces to be joined shall be cleaned bright by manual or mechanical means. Flux shall be applied to pipe or tubing and fittings and shall conform to ASTM B813, and shall become noncorrosive and nontoxic after soldering. Insert pipe or tubing into the base of the fitting and remove excess flux. Pipe or tubing and fitting shall be supported to ensure a uniform capillary space around the joint. Heat shall be applied using an air or fuel torch with the flame perpendicular to the pipe or tubing using acetylene or an LP gas. Preheating shall depend on the size of the joint. The flame shall be moved to the fitting cup and alternate between the pipe or tubing and fitting. Solder conforming to ASTM B32 shall be applied to the joint surfaces until capillary action draws the molten solder into the cup. Solder and fluxes with a lead content that exceeds 0.2 percent shall be prohibited in piping systems conveying potable water. Joint surfaces shall not be disturbed until cool and any remaining flux residue shall be cleaned.

605.1.5 Threaded Joints. Threaded joints for copper or copper alloy pipe shall be made with pipe threads that comply with ASME B1.20.1. Thread sealant tape or compound shall be applied only on male threads, and such material shall be of approved types, insoluble in water, and nontoxic.

605.2 CPVC Plastic Pipe and Joints. CPVC plastic pipe and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.2.1 through Section 605.2.3.

605.2.1 Mechanical Joints. Mechanical joints shall include compression, flanged, grooved and push fit fittings.

605.2.1.1 Push Fit Fittings. Removable and nonremovable push fit fittings that employ a quick assembly push fit connector shall comply with ASSE 1061.

605.2.2 Solvent Cement Joints. Solvent cement joints for CPVC pipe and fittings shall be clean from dirt and moisture. Solvent cements shall comply with ASTM F493, requiring the use of a primer shall be orange in color. The primer shall be colored and shall comply with ASTM F656. Listed solvent cement that complies with ASTM F493 and that does not require the use of primers, yellow or red in color, shall be permitted for pipe and fittings that comply with ASTM D2846, ½ of an inch (15 mm) through 2 inches (50 mm) in diameter or ASTM F442, ½ of an inch (15 mm) through 3 inches (80 mm) in diameter. Apply primer where required inside the fitting and to the depth of the fitting on pipe. Apply liberal coat of cement to the outside surface of pipe to depth of fitting and inside of fitting. Place pipe inside fitting to forcefully bottom the pipe in the socket and hold together until joint is set.

605.2.3 Threaded Joints. Threads shall comply with ASME B1.20.1. A minimum of Schedule 80 shall be permitted to be threaded; however, the pressure rating shall be reduced by 50 percent. The use of molded fittings shall not result in a 50 percent reduction in the pressure rating of the pipe provided that the molded fittings shall be fabricated so that the wall thickness of the material is maintained at the threads. Thread sealant compound that is compatible with the pipe and fitting, insoluble in water, and nontoxic shall be applied to male threads. Caution shall be used during assembly to prevent over tightening of the CPVC components once the thread sealant has been applied. Female CPVC threaded fittings shall be used with plastic male threads only.

605.3 CPVC/AL/CPVC Plastic Pipe and Joints. Chlorinated polyvinyl chloride/aluminum/chlorinated polyvinyl chloride (CPVC/AL/CPVC) plastic pipe and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.3.1 or Section 605.3.2.

605.3.1 Solvent Cement Joints. Solvent cement joints for CPVC/AL/CPVC pipe and fittings shall be clean from dirt and moisture. Solvent cements that comply with ASTM F493, requiring the use of a primer shall be orange in color. The primer shall be colored and shall comply with ASTM F656. Listed solvent cement that complies with ASTM F493 and that does not require the use of primers, yellow in color, shall be permitted to join pipe that comply with ASTM F2855 and fittings that comply with ASTM D2846, ½ of an inch (15 mm) through 2 inches (50 mm) in diameter. Apply primer where required inside the fitting and to the depth of the fitting on pipe. Apply liberal coat of cement to the outside surface of pipe to depth of fitting and inside of fitting. Place pipe inside fitting to forcefully bottom the pipe in the socket and hold together until joint is set.

605.3.2 Mechanical Joints. Mechanical joints shall include flanged, grooved, and push fit fittings.

605.3.2.1 Push Fit Fittings. Removable and nonremovable push fit fittings that employ a quick assembly push fit connector shall comply with ASSE 1061.

605.4 Ductile Iron Pipe and Joints. Ductile iron pipe and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.4.1 or Section 605.4.2.

605.4.1 Mechanical Joints. Mechanical joints for ductile iron pipe and fittings shall consist of a bell that is cast integrally with the pipe or fitting and provided with an exterior flange having bolt holes and a socket with annular recesses for the sealing gasket and the plain end of the pipe or fitting. The elastomeric gasket shall comply with AWWA C111. Lubricant recommended for potable water application by the pipe manufacturer shall be applied to the gasket and plain end of the pipe.

605.4.2 Push-On Joints. Push-on joints for ductile iron pipe and fittings shall consist of a single elastomeric gasket that shall be assembled by positioning the elastomeric gasket in an annular recess in the pipe or fitting socket and forcing the plain end of the pipe or fitting into the socket. The plain end shall compress the elastomeric gasket to form a positive seal and shall be designed so that the elastomeric gasket shall be locked in place against displacement. The elastomeric gasket shall comply with AWWA C111. Lubricant recommended for potable water application by the pipe manufacturer shall be applied to the gasket and plain end of the pipe.

605.5 Galvanized Steel Pipe and Joints. Galvanized steel pipe and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.5.1 or Section 605.5.2.

605.5.1 Mechanical Joints. Mechanical joints shall be made with an approved and listed elastomeric gasket.

605.5.2 Threaded Joints. Threaded joints shall be made with pipe threads that comply with ASME B1.20.1. Thread sealant tape or compound shall be applied only on male threads, and such material shall be of approved types, insoluble in water, and nontoxic.

605.6 PE Plastic Pipe/Tubing and Joints. PE plastic pipe or tubing and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.6.1 or Section 605.6.2.

605.6.1 Heat-Fusion Joints. Heat-fusion joints between PE pipe or tubing and fittings shall be assembled in accordance with Section 605.6.1.1 through Section 605.6.1.3 using butt, socket, or electro-fusion heat methods.

605.6.1.1 Butt-Fusion Joints. Butt-fusion joints shall be made in accordance with ASTM F2620. Joints shall be made by heating the squared ends of two pipes, pipe and fitting, or two fittings by holding ends against a heated element. The heated element shall be removed where the proper melt is obtained and joined ends shall be placed together with applied force.

605.6.1.2 Electro-Fusion Joints. Electro-fusion joints shall be heated internally by a conductor at the interface of the joint. Align and restrain fitting to pipe to prevent movement and apply electric current to the fitting. Turn off the current when the proper time has elapsed to heat the joint. The joint shall fuse together and remain undisturbed until cool.

605.6.1.3 Socket-Fusion Joints. Socket-fusion joints shall be made in accordance with ASTM F2620. Joints shall be made by simultaneously heating the outside surface of a pipe end and the inside of a fitting socket. Where the proper melt is obtained, the pipe and fitting shall be joined by inserting one into the other with applied force. The joint shall fuse together and remain undisturbed until cool.

605.6.2 Mechanical Joints. Mechanical joints between PE pipe or tubing and fittings shall include insert and mechanical compression fittings that provide a pressure seal resistance to pullout. Joints for insert fittings shall be made by cutting the pipe square, using a cutter designed for plastic piping, and removal of sharp edges. Two stainless steel clamps shall be placed over the end of the pipe. Fittings shall be checked for proper size based on the diameter of the pipe. The end of pipe shall be placed over the barbed insert fitting, making contact with the fitting shoulder. Clamps shall be positioned equal to 180 degrees (3.14 rad) apart and shall be tightened to provide a leak tight joint. Compression type couplings and fittings shall be permitted for use in joining PE piping and tubing. Stiffeners that extend beyond the clamp or nut shall be prohibited. Bends shall be not less than 30 pipe diameters, or the coil radius where bending with the coil. Bends shall not be permitted closer than 10 pipe diameters of a fitting or valve. Mechanical joints shall be designed for their intended use.

605.7 PE-AL-PE Plastic Pipe/Tubing and Joints. PE-AL-PE plastic pipe or tubing and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.7.1 and Section 605.7.1.1.

605.7.1 Mechanical Joints. Mechanical joints for PE-AL-PE pipe or tubing and fittings shall be either of the metal insert fittings with a split ring and compression nut or metal insert fittings with copper crimp rings. Metal insert fittings shall comply with ASTM F1974. Crimp insert fittings shall be joined to the pipe by placing the copper crimp ring around the outer circumference of the pipe, forcing the pipe material into the space formed by the ribs on the fitting until the pipe contacts the shoulder of the fitting. The crimp ring shall then be positioned on the pipe so the edge of the crimp ring is ⅛ of an inch (3.2 mm) to ¼ of an inch (6.4 mm) from the end of the pipe. The jaws of the crimping tool shall be centered over the crimp ring and tool perpendicular to the barb. The jaws shall be closed around the crimp ring and shall not be crimped more than once.

605.7.1.1 Compression Joints. Compression joints for PE-AL-PE pipe or tubing and fittings shall be joined through the compression of a split ring, by a compression nut around the circumference of the pipe. The compression nut and split ring shall be placed around the pipe. The ribbed end of the fitting shall be inserted into the pipe until the pipe contacts the shoulder of the fitting. Position and compress the split ring by tightening the compression nut onto the insert fitting.

605.8 PE-RT. Polyethylene of raised temperature (PE-RT) tubing and fitting joining methods and shall comply with Section 605.8.1.

605.8.1 Mechanical Joints. Fittings for PE-RT tubing shall comply with the applicable standards listed in Table 604.1. Mechanical joints for PE-RT tubing shall be installed in accordance with the manufacturer's installation instructions.

605.9 PEX Plastic Tubing and Joints. PEX plastic tubing and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.9.1 through Section 605.9.3.

605.9.1 Fittings. Fittings for PEX tubing shall comply with the applicable standards referenced in Table 604.1. PEX tubing that complies with ASTM F876 shall be marked with the applicable standard designation for the fittings, specified by the tubing manufacturer for use with the tubing.

605.9.2 Mechanical Joints. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

605.9.3 Push Fit Fittings. Removable and nonremovable push fit fittings that employ a quick assembly push fit connector shall comply with ASSE 1061.

605.10 PEX-AL-PEX Plastic Tubing and Joints. PEX-AL-PEX plastic pipe or tubing and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.10.1 and Section 605.10.1.1.

605.10.1 Mechanical Joints. Mechanical joints between PEX-AL-PEX tubing and fittings shall include mechanical and compression type fittings and insert fittings with a crimping ring. Insert fittings utilizing a crimping ring shall comply with ASTM F1974 or ASTM F2434. Crimp joints for crimp insert fittings shall be joined to PEX-AL-PEX pipe by the compression of a crimp ring around the outer circumference of the pipe, forcing the pipe material into annular spaces formed by ribs on the fitting.

605.10.1.1 Compression Joints. Compression joints shall include compression insert fittings and shall be joined to PEX-AL-PEX pipe through the compression of a split ring or compression nut around the outer circumference of the pipe, forcing the pipe material into the annular space formed by the ribs on the fitting.

605.11 Polypropylene (PP) Piping and Joints. PP pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.11.1 through Section 605.11.3.

605.11.1 Heat-Fusion Joints. Heat-fusion joints for polypropylene (PP) pipe and fitting joints shall be installed with socket-type heat-fused polypropylene fittings, fusion outlets, butt-fusion polypropylene fittings or pipe, or electro-fusion polypropylene fittings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F2389 or CSA B137.11.

605.11.2 Mechanical and Compression Sleeve Joints. Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer's installation instructions.

605.11.3 Threaded Joints. PP pipe shall not be threaded. PP transition fittings for connection to other piping materials shall only be threaded by use of copper alloy or stainless steel inserts molded in the fitting.

605.12 PVC Plastic Pipe and Joints. PVC plastic pipe and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.12.1 through Section 605.12.3.

PVC piping shall not be exposed to direct sunlight unless the piping does not exceed 24 inches (610 mm) and is wrapped with not less than 0.04 of an inch (1.02 mm) thick tape or otherwise protected from UV degradation.

605.12.1 Mechanical Joints. Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint. The mechanical joint shall include a pipe spigot that has a wall thickness to withstand without deformation or collapse; the compressive force exerted where the fitting is tightened. The push-on joint shall have a minimum wall thickness of the bell at any point between the ring and the pipe barrel. The elastomeric gasket shall comply with ASTM D3139, and be of such size and shape as to provide a compressive force against the spigot and socket after assembly to provide a positive seal.

605.12.2 Solvent Cement Joints. Solvent cement joints for PVC pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square and pipe shall be deburred. Where surfaces to be joined are cleaned and free of dirt, moisture, oil, and other foreign material, apply primer purple in color that complies with ASTM F656. Primer shall be applied to the surface of the pipe and fitting is softened. Solvent cement that complies with ASTM D2564 shall be applied to all joint surfaces. Joints shall be made while both the inside socket surface and outside surface of pipe are wet with solvent cement. Hold joint in place and undisturbed for 1 minute after assembly.

605.12.3 Threaded Joints. Threads shall comply with ASME B1.20.1. A minimum of Schedule 80 shall be permitted to be threaded; however, the pressure rating shall be reduced by 50 percent. The use of molded fittings shall not result in a 50 percent reduction in the pressure rating of the pipe provided that the molded fittings shall be fabricated so that the wall thickness of the material is maintained at the threads. Thread sealant compound that is compatible with the pipe and fitting, insoluble in water and nontoxic shall be applied to male threads. Caution shall be used during assembly to prevent over tightening of the PVC components once the thread sealant has been applied. Female PVC threaded fittings shall be used with plastic male threads only.

605.13 Stainless Steel Pipe and Joints. Joining methods for stainless steel pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.13.1 or Section 605.13.2.

605.13.1 Mechanical Joints. Mechanical joints shall be designed for their intended use. Such joints shall include compression, flanged, grooved, press-connect, and threaded.

605.13.2 Welded Joints. Welded joints shall be either fusion or resistance welded based on the selection of the base metal. The chemical composition of the filler metal shall comply with AWS A5.9 based on the alloy content of the piping material.

605.14 Slip Joints. In water piping, slip joints shall be permitted to be used only on the exposed fixture supply.

605.15 Dielectric Unions. Dielectric unions where installed at points of connection where there is a dissimilarity of metals shall be in accordance with ASSE 1079.

605.16 Joints Between Various Materials. Joints between various materials shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 605.16.1 through Section 605.16.3.

605.16.1 Copper or Copper Alloy Pipe or Tubing to Threaded Pipe Joints. Joints from copper or copper alloy pipe or tubing to threaded pipe shall be made using copper alloy adapter, copper alloy nipple [minimum 6 inches (152 mm)], dielectric fitting, or dielectric union in accordance with ASSE 1079. The joint between the copper or copper alloy pipe or tubing and the fitting shall be a soldered, brazed, flared, or press-connect joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size threaded joint.

605.16.2 Plastic Pipe to Other Materials. Where connecting plastic pipe to other types of piping, approved types of adapter or transition fittings designed for the specific transition intended shall be used.

605.16.3 Stainless Steel to Other Materials. Where connecting stainless steel pipe to other types of piping, mechanical joints of the compression type, dielectric fitting, or dielectric union in accordance with ASSE 1079 and designed for the specific transition intended shall be used.

606.0 Valves.

606.1 General. Valves up to and including 2 inches (50 mm) in size shall be copper alloy or other approved material. Sizes exceeding 2 inches (50 mm) shall be permitted to have cast iron or copper alloy bodies. Each gate or ball valve shall be a fullway or full-port type with working parts of the non-corrosive material. Valves carrying water used in potable water systems intended to supply drinking water shall comply with the requirements of NSF 61 and ASME A112.4.14, ASME B16.34, ASTM F1970, ASTM F2389, AWWA C500, AWWA C504, AWWA C507, IAPMO Z1157, MSS SP-67, MSS SP-70, MSS SP-71, MSS SP-72, MSS SP-78, MSS SP-80, MSS SP-110, MSS SP-122, or NSF 359.

606.2 Fullway Valve. A fullway valve controlling outlets shall be installed on the discharge side of each water meter and each unmetered water supply. Water piping supplying more than one building on one premise shall be equipped with a separate fullway valve to each building, so arranged that the water supply can be turned on or off to an individual or separate building provided; however, that supply piping to a single-family residence and building accessory thereto shall be permitted to be controlled by one valve. Such shutoff valves shall be accessible. A fullway valve shall be installed on the discharge piping from water supply tanks at or near the tank. A fullway valve shall be installed on the cold water supply pipe to each water heater at or near the water heater.

606.3 Multidwelling Units. In multidwelling units, one or more shutoff valves shall be provided in each dwelling unit so that the water supply to a plumbing fixture or group of fixtures in that dwelling unit can be shut off without stopping water supply to fixtures in other dwelling units. These valves shall be accessible in the dwelling unit that they control.

606.4 Multiple Openings. Valves used to control two or more openings shall be fullway gate valves, ball valves, or other approved valves designed and approved for the service intended.

606.5 Control Valve. A control valve shall be installed immediately ahead of each water-supplied appliance and immediately ahead of each slip joint or appliance supply.

Parallel water distribution systems shall provide a control valve either immediately ahead of each fixture being supplied or installed at the manifold, and shall be identified with the fixture being supplied. Where parallel water distribution system manifolds are located in attics, crawl spaces, or other locations not accessible, a separate shutoff valve shall be required immediately ahead of each individual fixture or appliance served.

606.6 Accessible. Required shutoff or control valves shall be accessible.

606.7 Multiple Fixtures. A single control valve shall be installed on a water supply line ahead of an automatic metering valve that supplies a battery of fixtures.

606.8 Check Valve Required. All systems that circulate water by means of a pump or other mechanical device or method shall have a check valve(s) or equal device(s) installed so as to ensure the direction of flow.

606.9 Leak Detection Devices. Where leak detection devices for water supply and distribution are installed, they shall comply with IAPMO IGC 115 or IAPMO IGC 349.

607.0 Potable Water Supply Tanks.

607.1 General. Potable water supply tanks shall be installed in accordance with the manufacturer's installation instructions and supported in accordance with the building code.

607.2 Potable Water Tanks. Potable water supply tanks, interior tank coatings, or tank liners intended to supply drinking water shall comply with NSF 61.

607.3 Venting. Tanks used for potable water shall be tightly covered and vented in accordance with the manufacturer's installation instructions. Such vent shall be screened with a corrosion-resistant material of not less than number 24 mesh.

607.4 Overflow. Tanks shall have not less than a 16 square inch (0.01 m^2) overflow that is screened with a corrosion-resistant material of not less than number 24 mesh.

607.5 Valves. Pressurized tanks shall be provided with a listed pressure-relief valve installed in accordance with the manufacturer's installation instructions. The relief valve shall be discharged in accordance with Section 608.5. Where a potable water supply tank is located above the fixtures, appliances, or system components it serves, it shall be equipped with a vacuum relief valve that complies with CSA Z21.22.

608.0 Water Pressure, Pressure Regulators, Pressure Relief Valves, and Vacuum Relief Valves.

[S] 608.1 Inadequate Water Pressure. Where the water pressure in the main or other source of supply will not provide a residual water pressure of not less than 15 pounds force per square inch (psi) (103 kPa), after allowing for friction and other pressure losses, a tank and a pump or other means that will provide said 15 psi (103 kPa) pressure shall be installed. Where fixtures, fixture fittings, or both are installed that, require residual pressure exceeding 15 psi (103 kPa), that minimum residual pressure shall be provided. ASSE listed temperature and/or pressure compensating valves shall be provided with a minimum residual pressure equal to or greater than the minimum test pressure of the applicable standard or 20 psi (138 kPa), whichever is greater.

608.2 Excessive Water Pressure. Where static water pressure in the water supply piping is exceeding 80 psi (552 kPa), an approved-type pressure regulator preceded by an adequate strainer shall be installed and the static pressure reduced to 80 psi (552 kPa) or less. Pressure regulators for potable water distribution systems shall comply with ASSE 1003. Pressure regulator(s) equal to or exceeding 1½ inches (40 mm) shall not require a strainer. Such regulator(s) shall control the pressure to water outlets in the building unless otherwise approved by the Authority Having Jurisdiction. Each such regulator and strainer shall be accessibly located aboveground or in a vault equipped with a properly sized and sloped boresighted drain to daylight, shall be protected from freezing, and shall have the strainer readily accessible for cleaning without removing the regulator or strainer body or disconnecting the supply piping.

Pipe size determinations shall be based on 80 percent of the reduced pressure where using Table 610.4.

An approved expansion tank shall be installed in the cold water distribution piping downstream of each such regulator to prevent excessive pressure from developing due to thermal expansion and to maintain the pressure setting of the regulator. Expansion tanks used in potable water systems intended to supply drinking water shall comply with NSF 61. The expansion tank shall be properly sized and installed in accordance with the manufacturer's installation instructions and listing. Systems designed by registered design professionals shall be permitted to use approved pressure relief valves in lieu of expansion tanks provided such relief valves have a maximum pressure relief setting of 100 psi (689 kPa) or less.

608.3 Expansion Tanks, and Combination Temperature and Pressure-Relief Valves. A water system provided with a check valve, backflow preventer, or other normally closed device that prevents dissipation of building pressure back into the water main, independent of the type of water heater used, shall be provided with an approved, listed, and adequately sized expansion tank or other approved device having a similar function to control thermal expansion. Prepressurized water expansion tanks shall comply with IAPMO Z1088. Such expansion tank or other approved device shall be installed on the building side of the check valve, backflow preventer, or other device and shall be sized and installed in accordance with the manufacturer's installation instructions.

A water system containing storage water heating equipment shall be provided with an approved, listed, adequately sized combination temperature and pressure-relief valve, except for listed nonstorage instantaneous heaters having an inside diameter of not more than 3 inches (80 mm). Each such approved combination temperature and pressure-relief valve shall be installed on the water-heating device in an approved location based on its listing requirements and the manufacturer's installation instructions. Each such combination temperature and pressure-relief valve shall be provided with a drain in accordance with Section 608.5.

608.4 Pressure Relief Valves. Each pressure relief valve shall be an approved automatic type with drain, and each such relief valve shall be set at a pressure of not more than 150 psi (1034 kPa). No shutoff valve shall be installed between the relief valve and the system.

[W] 608.5 Discharge Piping. The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall have no valves, obstructions, or means of isolation and be provided with the following:

(1) Not less than the size of the valve outlet and shall discharge full size to the flood level of the area receiving the discharge and pointing down.

(2) Materials shall be rated at not less than the operating temperature of the system and approved for such use or shall comply with ASME A112.4.1, Materials shall be straight, rigid lengths only, without coils or flexes.

(3) Discharge pipe shall discharge independently by gravity through an air gap into the drainage system or outside of the building with the end of the pipe not exceeding 2 feet (610 mm) and not less than 6 inches (152 mm) above the ground and pointing downwards.

(4) Discharge in such a manner that does not cause personal injury or structural damage.

(5) No part of such discharge pipe shall be trapped or subject to freezing.

(6) The terminal end of the pipe shall not be threaded.

(7) Discharge from a relief valve into a water heater pan shall be prohibited.

(8) The discharge termination point shall be readily observable.

Exception: Where no drainage was provided, replacement water heating equipment shall only be required to provide a drain pointing downward from the relief valve to extend between 2 feet (610 mm) and 6 inches (152 mm) from the floor. No additional floor drain need be provided.

608.6 Water-Heating Devices. A water-heating device connected to a separate storage tank and having valves between said heater and tank shall be provided with an approved water pressure relief valve.

608.7 Vacuum Relief Valves. Where a hot-water storage tank or an indirect water heater is located at an elevation above the fixture outlets in the hot-water system, a vacuum relief valve that complies with CSA Z21.22 shall be installed on the storage tank or heater.

609.0 Installation, Testing, Unions, and Location.

609.1 Installation. Water piping shall be adequately supported in accordance with Table 313.3. Burred ends shall be reamed to the full bore of the pipe or tube. Changes in direction shall be made by the appropriate use of fittings, except that changes in direction in copper or copper alloy tubing shall be permitted to be made with bends, provided that such bends are made with bending equipment that does not deform or create a loss in the cross-sectional area of the tubing. Changes in direction are allowed with flexible pipe and tubing without fittings in accordance with the manufacturer's instructions. Provisions shall be made for expansion in hot-water piping. Piping, equipment, appurtenances, and devices shall be installed in a workmanlike manner in accordance with the provisions and intent of the code. Building supply yard piping shall be not less than 12 inches (305 mm) below the average local frost depth. The cover shall be not less than 12 inches (305 mm) below finish grade.

609.2 Trenches. Water pipes shall not be run or laid in the same trench as building sewer or drainage piping constructed of clay or materials that are not approved for use within a building unless both of the following conditions are met:

(1) The bottom of the water pipe shall be not less than 12 inches (305 mm) above the top of the sewer or drain line.

(2) The water pipe shall be placed on a solid shelf excavated at one side of the common trench with a clear horizontal distance of not less than 12 inches (305 mm) from the sewer or drain line.

Water pipes crossing sewer or drainage piping constructed of clay or materials that are not approved for use within a building shall be laid not less than 12 inches (305 mm) above the sewer or drain pipe.

609.3 Under Concrete Slab. Water piping installed within a building and in or under a concrete floor slab resting on the ground shall be installed in accordance with the following requirements:

(1) Ferrous piping shall have a protective coating of an approved type; machine applied and in accordance with recognized standards. Field wrapping shall provide equivalent protection and shall be restricted to those short sections and fittings necessarily stripped for threading. Zinc coating (galvanizing) shall not be deemed adequate protection for piping or fittings. Approved nonferrous piping shall not be required to be wrapped.

(2) Copper or copper alloy tubing shall be installed without joints where possible. Where joints are permitted, they shall be brazed, and fittings shall be wrought copper.

For the purpose of this section, "within a building" shall mean within the fixed limits of the building foundation.

609.4 Testing. Upon completion of a section or of the entire hot and cold water supply system, the system shall be tested with water or air. The potable water test pressure shall be greater than or equal to the working pressure under which the system is to be used. The air pressure shall be a minimum of 50 psi (345 kPa). Plastic pipe shall not be tested with air. The piping system shall withstand the test pressure without showing evidence of leakage for a period of not less than 15 minutes.

Exception: PEX, PP or PE-RT tube shall be permitted to be tested with air where permitted by the manufacturer's instructions.

609.5 Unions. Unions shall be installed in the water supply piping not more than 12 inches (305 mm) of regulating equipment, water heating, conditioning tanks, and similar equipment that requires service by removal or replacement in a manner that will facilitate its ready removal.

609.6 Location. Except as provided in Section 609.7, no building supply shall be located in a lot other than the lot that is the site of the building or structure served by such building supply.

609.7 Abutting Lot. Nothing contained in this code shall be construed to prohibit the use of an abutting lot to:

(1) Provide access to connect a building supply to an available public water service where proper cause and legal easement not in violation of other requirements have been first established to the satisfaction of the Authority Having Jurisdiction.

(2) Provide additional space for a building supply where the proper cause, transfer of ownership, or change of boundary not in violation of other requirements have been first established to the satisfaction of the Authority Having Jurisdiction. The instrument recording such action shall constitute an agreement with the Authority Having Jurisdiction, which shall clearly state and show that the areas so joined or used shall be maintained as a unit during the time they are so used. Such an agreement shall be recorded in the office of the County Recorder as a part of the conditions of ownership of said properties, and shall be binding on heirs, successors, and assigns to such properties. A copy of the instrument recording such proceedings shall be filed with the Authority Having Jurisdiction.

609.8 Pumps. Pumps shall be installed in accordance with the manufacturer's installation instructions.

609.8.1 Access. Pumps shall be accessible for repairs.

609.8.2 Potable Water Pumps. Pumps intended to supply drinking water shall be in accordance with NSF 61.

609.9 Low-Pressure Cutoff Required on Booster Pumps for Water Distribution Systems. Where a booster pump (excluding a fire pump) is connected to a building supply or underground water pipe, a low-pressure cutoff switch on the inlet side of the pump shall be installed not more than 5 feet (1524 mm) of the inlet. The cutoff switch shall be set for not less than 10 psi (69 kPa). A pressure gauge shall be installed between the shutoff valve and the pump.

609.10 Disinfection of Potable Water System. New or repaired potable water systems shall be disinfected prior to use where required by the Authority Having Jurisdiction. The method to be followed shall be that prescribed by the Health Authority or, in case no method is prescribed by it, the following:

(1) The pipe system shall be flushed with clean, potable water until potable water appears at the points of the outlet.

(2) The system or parts thereof shall be filled with a water-chlorine solution containing not less than 50 parts per million of chlorine, and the system or part thereof shall be valved-off and allowed to stand for 24 hours; or, the system or part thereof shall be filled with a water-chlorine solution containing not less than 200 parts per million of chlorine and allowed to stand for 3 hours.

(3) Following the allowed standing time, the system shall be flushed with clean, potable water until the chlorine residual in the water coming from the system does not exceed the chlorine residual in the flushing water.

(4) The procedure shall be repeated where it is shown by a bacteriological examination made by an approved agency that contamination persists in the system.

609.11 Water Hammer. Building water supply systems where quick-acting valves are installed shall be provided with water hammer arrester(s) to absorb high pressures resulting from the quick closing of these valves. Water hammer arresters shall be approved mechanical devices that comply with ASSE 1010 or PDI-WH 201 and shall be installed as close as possible to quick-acting valves.

609.11.1 Mechanical Devices. Where listed mechanical devices are used, the manufacturer's specifications as to location and method of installation shall be followed.

[W] [S] 609.12 Pipe Insulation. Domestic water piping within commercial buildings shall be insulated in accordance with the Seattle Energy Code.

610.0 Size of Potable Water Piping.

610.1 Size. The size of each water meter and each potable water supply pipe from the meter or other source of supply to the fixture supply branches, risers, fixtures, connections, outlets, or other uses shall be based on the total demand and shall be determined according to the methods and procedures outlined in this section. Water piping systems shall be designed to ensure that the maximum velocities allowed by the code and the applicable standard are not exceeded.

610.2 Pressure Loss. Where a water filter, water softener, backflow prevention device, tankless water heater, or similar device is installed in a water supply line, the pressure loss through such devices shall be included in the pressure loss calculations of the system, and the water supply pipe and meter shall be adequately sized to provide for such a pressure loss.

No water filter, water softener, backflow prevention device, or similar device regulated by this code shall be installed in a potable water supply piping where the installation of such device produces an excessive pressure drop in such water supply piping. In the absence of specific pressure drop information, the diameter of the inlet or outlet of such device or its connecting piping shall be not less than the diameter of such water distribution piping to the fixtures served by the device.

Such devices shall be of a type approved by the Authority Having Jurisdiction and shall be tested for flow rating and pressure loss by an approved laboratory or recognized testing agency to standards consistent with the intent of this chapter.

610.3 Quantity of Water. The quantity of water required to be supplied to every plumbing fixture shall be represented by fixture units, as shown in Table 610.3. Equivalent fixture values shown in Table 610.3 include both hot and cold water demand.

[W] 610.4 Sizing Water Supply and Distribution Systems. Systems within the range of Table 610.4 may be sized from that table or by the method set forth in Section 610.5.

Listed parallel water distribution systems shall be installed in accordance with their listing.

610.5 Sizing per Appendix A. Except as provided in Section 610.4, the size of each water piping system shall be determined in accordance with the procedure set forth in Appendix A.

610.6 Friction and Pressure Loss. Except where the type of pipe used and the water characteristics are such that no decrease in capacity due to the length of service (age of system) is expected, friction-loss data shall be obtained from the "Fairly Rough" or "Rough" charts in Appendix A of this code. Friction or pressure losses in a water meter, valve, and fittings shall be obtained from the same sources. Pressure losses through water-treating equipment, backflow prevention devices, or other flow-restricting devices shall be computed in accordance with Section 610.2.

610.7 Conditions for Using Table 610.4. On a proposed water piping installation sized using Table 610.4, the following conditions shall be determined:

(1) Total number of fixture units as determined from Table 610.3, Equivalent Fixture Units, for the fixtures to be installed.

(2) Developed length of supply pipe from meter to the most remote outlet.

(3) Difference in elevation between the meter or other source of supply and the highest fixture or outlet.

(4) Pressure in the street main or another source of supply at the locality where the installation is to be made.

(5) In localities where there is a fluctuation of pressure in the main throughout the day, the water piping system shall be designed on the basis of the minimum pressure available.

[S] TABLE 610.3
WATER SUPPLY FIXTURE UNITS (WSFU) AND MINIMUM FIXTURE BRANCH PIPE SIZES[3]

APPLIANCES, APPURTENANCES OR FIXTURES[2]	MINIMUM FIXTURE BRANCH PIPE SIZE[1,4] (inches)	PRIVATE	PUBLIC	ASSEMBLY[6]
Bathtub or Combination Bath/Shower (fill)	½	4.0	4.0	—
¾ inch Bathtub Fill Valve	¾	10.0	10.0	—
Bidet	½	1.0	—	—
Clothes Washer	½	4.0	4.0	—
Dental Unit, cuspidor	½	—	1.0	—
Dishwasher, domestic	½	1.5	1.5	—
Drinking Fountain or Water Cooler	½	0.5	0.5	0.75
Hose Bibb	½	2.5	2.5	—
Hose Bibb, each additional[8]	½	1.0	1.0	—
Lavatory[9]	½	1.0	1.0	1.0
Lawn Sprinkler, each head[5]	—	1.0	1.0	—
Mobile Home, each (minimum)	—	12.0	—	—
Sinks	—	—	—	—
Bar	½	1.0	2.0	—
Clinical Faucet	½	—	3.0	—
Clinical Flushometer Valve with or without faucet	1	—	8.0	—
Kitchen, domestic with or without dishwasher	½	1.5	1.5	—
Laundry	½	1.5	1.5	—
Service or Mop Basin	½	1.5	3.0	—
Washup, each set of faucets	½	—	2.0	—
Shower, per head	½	2.0	2.0	—
Urinal, 1.0 GPF Flushometer Valve	¾	See Footnote[7]		—
Urinal, greater than 1.0 GPF Flushometer Valve	¾	See Footnote[7]		—
Urinal, flush tank	½	2.0	2.0	3.0
Nonwater Urinal with Drain Cleansing Action	½	1.0	1.0	1.0
Wash Fountain, circular spray	¾	—	4.0	—
Water Closet, 1.6 GPF Gravity Tank	½	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Tank	½	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Valve	1	See Footnote[7]		—
Water Closet, greater than 1.6 GPF Gravity Tank	½	3.0	5.5	7.0
Water Closet, greater than 1.6 GPF Flushometer Valve	1	See Footnote[7]		—

For SI units: 1 inch = 25 mm

Notes:

1 Size of the cold branch pipe, or both the hot and cold branch pipes.

2 Appliances, appurtenances, or fixtures not referenced in this table shall be permitted to be sized by reference to fixtures having a similar flow rate and frequency of use.

3 The listed fixture unit values represent their load on the cold water building supply. The separate cold water and hot water fixture unit value for fixtures having both hot and cold water connections shall be permitted to be each taken as three-quarter of the listed total value of the fixture.

4 The listed minimum supply branch pipe sizes for individual fixtures are the nominal (I.D.) pipe size.

5 For fixtures or supply connections likely to impose continuous flow demands, determine the required flow in gallons per minute (gpm) (L/s), and add it separately to the demand in gpm (L/s) for the distribution system or portions.

6 Assembly [Public Use (See Table 422.1)].

7 Where sizing flushometer systems, see Section 610.10.

8 Reduced fixture unit loading for additional hose bibbs is to be used where sizing total building demand and for pipe sizing where more than one hose bibb is supplied by a segment of water distribution pipe. The fixture branch to each hose bibb shall be sized on the basis of 2.5 fixture units.

9 The minimum fixture branch size may be reduced to ⅜" when serving a single lavatory.

TABLE 610.4
FIXTURE UNIT TABLE FOR DETERMINING WATER PIPE AND METER SIZES

METER AND STREET SERVICE (inches)	BUILDING SUPPLY AND BRANCHES (inches)	MAXIMUM ALLOWABLE LENGTH (feet)														
		40	60	80	100	150	200	250	300	400	500	600	700	800	900	1000
PRESSURE RANGE – 30 to 45 psi[1]																
¾	½[2]	6	5	4	3	2	1	1	1	0	0	0	0	0	0	0
¾	¾	16	16	14	12	9	6	5	5	4	4	3	2	2	2	1
¾	1	29	25	23	21	17	15	13	12	10	8	6	6	6	6	6
1	1	36	31	27	25	20	17	15	13	12	10	8	6	6	6	6
¾	1¼	36	33	31	28	24	23	21	19	17	16	13	12	12	11	11
1	1¼	54	47	42	38	32	28	25	23	19	17	14	12	12	11	11
1½	1¼	78	68	57	48	38	32	28	25	21	18	15	12	12	11	11
1	1½	85	84	79	65	56	48	43	38	32	28	26	22	21	20	20
1½	1½	150	124	105	91	70	57	49	45	36	31	26	23	21	20	20
2	1½	151	129	129	110	80	64	53	46	38	32	27	23	21	20	20
1	2	85	85	85	85	85	85	82	80	66	61	57	52	49	46	43
1½	2	220	205	190	176	155	138	127	120	104	85	70	61	57	54	51
2	2	370	327	292	265	217	185	164	147	124	96	70	61	57	54	51
2	2½	445	418	390	370	330	300	280	265	240	220	198	175	158	143	133
PRESSURE RANGE – 46 to 60 psi[1]																
¾	½[2]	7	7	6	5	4	3	2	2	1	1	1	0	0	0	0
¾	¾	20	20	19	17	14	11	9	8	6	5	4	4	3	3	3
¾	1	39	39	36	33	28	23	21	19	17	14	12	10	9	8	8
1	1	39	39	39	36	30	25	23	20	18	15	12	10	9	8	8
¾	1¼	39	39	39	39	39	39	34	32	27	25	22	19	19	17	16
1	1¼	78	78	76	67	52	44	39	36	30	27	24	20	19	17	16
1½	1¼	78	78	78	78	66	52	44	39	33	29	24	20	19	17	16
1	1½	85	85	85	85	85	85	80	67	55	49	41	37	34	32	30
1½	1½	151	151	151	151	128	105	90	78	62	52	42	38	35	32	30
2	1½	151	151	151	151	150	117	98	84	67	55	42	38	35	32	30
1	2	85	85	85	85	85	85	85	85	85	85	85	85	85	83	80
1½	2	370	370	340	318	272	240	220	198	170	150	135	123	110	102	94
2	2	370	370	370	370	368	318	280	250	205	165	142	123	110	102	94
2	2½	654	640	610	580	535	500	470	440	400	365	335	315	285	267	250
PRESSURE RANGE – Over 60 psi[1]																
¾	½[2]	7	7	7	6	5	4	3	3	2	1	1	1	1	1	0
¾	¾	20	20	20	20	17	13	11	10	8	7	6	6	5	4	4
¾	1	39	39	39	39	35	30	27	24	21	17	14	13	12	12	11
1	1	39	39	39	39	38	32	29	26	22	18	14	13	12	12	11
¾	1¼	39	39	39	39	39	39	39	39	34	28	26	25	23	22	21
1	1¼	78	78	78	78	74	62	53	47	39	31	26	25	23	22	21
1½	1¼	78	78	78	78	78	74	65	54	43	34	26	25	23	22	21
1	1½	85	85	85	85	85	85	85	85	81	64	51	48	46	43	40
1½	1½	151	151	151	151	151	151	130	113	88	73	51	51	46	43	40
2	1½	151	151	151	151	151	151	142	122	98	82	64	51	46	43	40
1	2	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
1½	2	370	370	370	370	360	335	305	282	244	212	187	172	153	141	129
2	2	370	370	370	370	370	370	370	340	288	245	204	172	153	141	129
2	2½	654	654	654	654	654	650	610	570	510	460	430	404	380	356	329

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm, 1 pound-force per square inch = 6.8947 kPa

Notes:

[1] Available static pressure after head loss.

[2] Building supply, not less than ¾ of an inch (20 mm) nominal size.

610.8 Size of Meter and Building Supply Pipe Using Table 610.4. The size of the meter and the building supply pipe shall be determined as follows:

(1) Determine the available pressure at the water meter or other source of supply.

(2) Add or subtract depending on positive or negative elevation change, ½ psi (3.4 kPa) for each foot (305 mm) of difference in elevation between such source of supply and the highest water supply outlet in the building or on the premises.

(3) Use the "pressure range" group within which this pressure will fall using Table 610.4.

(4) Select the "length" column that is equal to or longer than the required length.

(5) Follow down the column to a fixture unit value equal to or exceeding the total number of fixture units required by the installation.

(6) Having located the proper fixture unit value for the required length, sizes of meter and building supply pipe as found in the two left-hand columns shall be applied.

No building supply pipe shall be less than ¾ of an inch (20 mm) in diameter.

610.9 Size of Branches. Where Table 610.4 is used, the minimum size of each branch shall be determined by the total fixture units served by that branch and then following the steps in Section 610.8. No branch piping shall exceed the total demand in fixture units for the system computed from Table 610.3.

610.10 Sizing for Flushometer Valves. Where using Table 610.4 to size water supply systems serving flushometer valves, the number of flushometer fixture units assigned to every section of pipe, whether branch or main, shall be determined by the number and category of flushometer valves served by that section of pipe, in accordance with Table 610.10. Piping supplying a flushometer valve shall be not less in size than the valve inlet.

Where using Table 610.10 to size water piping, care shall be exercised to assign flushometer fixture units based on the number and category of fixtures served.

TABLE 610.10
FLUSHOMETER FIXTURE UNITS FOR WATER SIZING USING TABLE 610.3

FIXTURE CATEGORY: WATER CLOSET WITH FLUSHOMETER VALVES		
NUMBER OF FLUSHOMETER VALVES	INDIVIDUAL FIXTURE UNITS ASSIGNED IN DECREASING VALUE	FIXTURE UNITS ASSIGNED FOR WATER CLOSETS AND SIMILAR 10-UNIT FIXTURES IN ACCUMULATIVE VALUES
1	40	40
2	30	70
3	20	90
4	15	105
5 or more	10 each	115 plus 10 for each additional fixture in excess of 5
FIXTURE CATEGORY: URINALS WITH FLUSHOMETER VALVES		
NUMBER OF FLUSHOMETER VALVES	INDIVIDUAL FIXTURE UNITS ASSIGNED IN DECREASING VALUE	FIXTURE UNITS ASSIGNED FOR URINALS AND SIMILAR 5-UNIT FIXTURES IN ACCUMULATIVE VALUES
1	20	20
2	15	35
3	10	45
4	8	53
5 or more	5 each	58 plus 5 for each additional fixture in excess of 5

In the example below, fixture units assigned to each section of pipe are computed. Each capital letter refers to the section of pipe above it unless otherwise shown.

A: 1 WC = 40 F.U.
B: 2 WC = 70 F.U.
C: 2 WC (70) + 1 UR (20) = 90 F.U.
D: 2 WC (70) + 2 UR (35) = 105 F.U.
E: 2 WC (70) + 2 UR (35) + 1 LAV (1) = 106 F.U.
F: 2 WC (70) + 2 UR (35) + 2 LAV (2) = 107 F.U.
G: 1 LAV = 1 F.U.
H: 2 LAV = 2 F.U.
I: 2 LAV (2) + 1 UR (20) = 22 F.U.
J: 2 LAV (2)+ 2 UR (35) = 37 F.U.
K: 2 LAV (2) + 2 UR (35) + 1 WC (40) = 77 F.U.
L: 2 LAV (2) + 2 UR (35) + 2 WC (70) = 107 F.U.
M: 4 WC (105) + 4 UR (53) + 4 LAV (4) = 162 F.U.
N: 1 WC = 40 F.U.
O: 1 WC (40) + 1 UR (20) = 60 F.U.
P: 1 WC (40) + 1 UR (20) + 1 LAV (1) = 61 F.U.
Q: 2 WC (70) + 1 UR (20) + 1 LAV (1) = 91 F.U.
R: 2 WC (70) + 2 UR (35) + 1 LAV (1) = 106 F.U.
S: 2 WC (70) + 2 UR (35) + 2 LAV (2) = 107 F.U.
T: 6 WC (125) + 6 UR (63) + 6 LAV (6) = 194 F.U.

EXAMPLE 610.10
SIZING METHOD FOR PUBLIC USE FIXTURES
USING TABLE 610.10

610.11 Sizing Systems for Flushometer Tanks. The size of branches and mains serving flushometer tanks shall be consistent with the sizing procedures for flush tank water closets.

610.12 Sizing for Velocity. Water piping systems shall not exceed the maximum velocities listed in this section or Appendix A.

610.12.1 Copper Tube Systems. Maximum velocities in copper and copper alloy tube and fitting systems shall not exceed 8 feet per second (ft/s) (2.4 m/s) in cold water and 5 ft/s (1.5 m/s) in hot water.

610.12.2 Tubing Systems Using Copper Fittings. Maximum velocities through copper fittings in tubing other than copper shall not exceed 8 ft/s (2.4 m/s) in cold water and 5 ft/s (1.5 m/s) in hot water.

610.13 Exceptions. The provisions of this section relative to the size of water piping shall not apply to the following:

(1) Water supply piping systems designed in accordance with recognized engineering procedures acceptable to the Authority Having Jurisdiction.
(2) Alteration of or minor additions to existing installations provided the Authority Having Jurisdiction finds that there will be an adequate supply of water to operate fixtures.
(3) Replacement of existing fixtures or appliances.
(4) Piping that is part of fixture equipment.
(5) Unusual conditions where, in the judgment of the Authority Having Jurisdiction, an adequate supply of water is provided to operate fixtures and equipment.
(6) The size and material of irrigation water piping installed outside of a building or structure and separated from the potable water supply by means of an approved air gap or backflow prevention device are not regulated by this code. The potable water piping system supplying each such irrigation system shall be adequately sized as required elsewhere in this chapter to deliver the full connected demand of both the domestic use and the irrigation systems.

611.0 Drinking Water Treatment Units.

[W] [S] 611.1 Application. The owner of a building that serves potable water to twenty-five or more people at least sixty or more days per year and that installs drinking water treatment units including, but not limited to, the treatment units in Section 611.1, may be regulated (as a Group A public water system) by the Washington State Department of Health under Chapter 246-290 WAC. See Washington State Department of Health publication 331-488 for guidance.

611.1.1 Alkaline Water Treatment. Alkaline water treatment devices shall comply with IAPMO IGC 322.

611.1.2 Scale Reduction Devices. Scale reduction devices shall comply with IAPMO Z601.

TABLE 611.1
DRINKING WATER TREATMENT UNITS

APPLICATION	RESIDENTIAL		COMMERCIAL
	POINT OF USE	POINT OF ENTRY	
Aesthetic Coetaminant Reduction (filters)	NSF 42	NSF 42	ASSE 1087 and NSF 42*
Health Related Contaminant Reduction (filters)	NSF 53	NSF 53	ASSE 1087 and NSF 42*
Water Softener	-	NSF 44	ASSE 1087
Ultraviolet Water Treatment	NSF 55	NSF 55	ASSE 1087
Reverse Osmosis	NSF 58	NSF 61	ASSE 1087
Distillation	NSF 62	NSF 62	ASSE 1087

* Required for commercial modular systems only.

611.2 Air Gap Discharge. Discharge from drinking water treatment units shall enter the drainage system through an air gap in accordance with Table 603.3.1 or an air gap device that complies with Table 603.2, NSF 58, or IAPMO PS 65.

611.3 Connection Tubing. The tubing to and from drinking water treatment units shall be of a size and material as recommended by the manufacturer.

611.4 Sizing of Residential Softeners. Residential-use water softeners shall be sized in accordance with Table 611.4.

612.0 Residential Fire Sprinkler Systems.

[W] 612.1 General. Where residential fire sprinkler systems are installed, they shall be installed in accordance with the International Building Code or International Residential Code.

TABLE 611.4
SIZING OF RESIDENTIAL WATER SOFTENERS[4]

REQUIRED SIZE OF SOFTENER CONNECTION (inches)	NUMBER OF BATHROOM GROUPS SERVED[1]
¾	up to 2[2]
1	up to 4[3]

For SI units: 1 inch = 25 mm

Notes:

1 Installation of a kitchen sink and dishwasher, laundry tray, and automatic clothes washer permitted without additional size increase.

2 An additional water closet and lavatory permitted.

3 Over four bathroom groups, the softener size shall be engineered for the specific installation.

4 See also Appendix A, Recommended Rules for Sizing the Water Supply System.

SECTIONS 612.2 THROUGH 612.7.2 ARE NOT ADOPTED.

CHAPTER 7
SANITARY DRAINAGE

Part I – Drainage Systems.

701.0 General.

701.1 Applicability. This chapter shall govern the materials, design, and installation of sanitary drainage systems and building sewers.

[W] 701.2 Drainage Piping. Materials for drainage piping shall be in accordance with one of the referenced standards in Table 701.2 except that:

(1) No galvanized wrought-iron or galvanized steel pipe shall be used underground and shall be kept not less than 6 inches (152 mm) above ground.

(2) ABS and PVC DWV piping installations shall be installed in accordance with applicable standards in Table 1701.1. Except for individual single-family dwelling units, materials exposed within ducts or plenums shall have a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, when tested in accordance with ASTM E84 and UL 723.

(3) No vitrified clay pipe or fittings shall be used above ground or where pressurized by a pump or ejector. They shall be kept not less than 12 inches (305 mm) below ground.

(4) Copper tube for drainage and vent piping shall have a weight of not less than that of copper drainage tube type DWV.

(5) Stainless steel 304 pipe and fittings shall not be installed underground and shall be kept not less than 6 inches (152 mm) aboveground.

(6) Cast-iron soil pipe and fittings shall be listed and tested in accordance with standards referenced in Table 1701.1. Such pipe and fittings shall be marked with country of origin and identification of the original manufacturer in addition to markings required by referenced standards.

701.3 Drainage Fittings. Materials for drainage fittings shall comply with the applicable standards referenced in Table 701.2 of the same diameter as the piping served, and such fittings shall be compatible with the type of pipe used.

701.3.1 Screwed Pipe. Fittings on screwed pipe shall be of the recessed drainage type. Burred ends shall be reamed to the full bore of the pipe.

701.3.2 Threads. The threads of drainage fittings shall be tapped to allow ¼ inch per foot (20.8 mm/m) grade.

701.3.3 Type. Fittings used for drainage shall be of the drainage type, have a smooth interior water-way, and be constructed to allow ¼ inch per foot (20.8 mm/m) grade.

701.4 Continuous Wastes. Continuous wastes and fixture tailpieces shall be constructed from the materials specified in Section 701.2 for drainage piping, provided, however, that such connections where exposed or accessible shall be permitted to be of seamless drawn brass not less than No. 20 B & S Gauge (0.032 inches) (0.8 mm).

701.5 Lead. (See Chapter 17) Sheet lead shall comply with the following:

(1) For safe pans – not less than 4 pounds per square foot (lb/ft^2) (19 kg/m^2) or 1/16 of an inch (1.6 mm) thick.

(2) For flashings or vent terminals – not less than 3 lb/ft^2 (15 kg/m^2) or 0.0472 of an inch (1.2 mm) thick.

(3) Lead bends and lead traps shall be not less than ⅛ of an inch (3.2 mm) in wall thickness.

701.6 Caulking Ferrules. Caulking ferrules shall be manufactured from copper or copper alloy and shall be in accordance with Table 701.6.

701.7 Soldering Bushings. Soldering bushings shall be of copper or copper alloy and shall be in accordance with Table 701.7.

TABLE 701.6
CAULKING FERRULES

PIPE SIZE (inches)	INSIDE DIAMETER (inches)	LENGTH (inches)	MINIMUM WEIGHT EACH	
			pounds	ounces
2	2¼	4½	1	0
3	3¼	4½	1	12
4	4¼	4½	2	8

For SI units: 1 inch = 25 mm, 1 pound = 0.453 kg, 1 ounce = 0.02834 kg

TABLE 701.7
SOLDERING BUSHINGS

PIPE SIZE (inches)	MINIMUM WEIGHT EACH		PIPE SIZE (inches)	MINIMUM WEIGHT EACH	
	pounds	ounces		pounds	ounces
1¼	0	6	2½	1	6
1½	0	8	3	2	0
2	0	14	4	3	8

For SI units: 1 inch = 25 mm, 1 pound = 0.453 kg, 1 ounce = 0.02834 kg

702.0 Fixture Unit Equivalents.

702.1 Trap Size. The unit equivalent of plumbing fixtures shown in Table 702.1 shall be based on the size of the trap required, and the unit equivalent of fixtures and devices not shown in Table 702.1 shall be based on the size of trap or trap arm.

Maximum drainage fixture units for a fixture trap and trap arm loadings for sizes up to 4 inches (100 mm) shall be in accordance with Table 702.2(1).

702.2 Intermittent Flow. Drainage fixture units for intermittent flow into the drainage system shall be computed on the rated discharge capacity in gallons per minute (gpm) (L/s) in accordance with Table 702.2(2).

TABLE 701.2
MATERIALS FOR DRAIN, WASTE, VENT PIPE AND FITTINGS

MATERIAL	UNDERGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS	ABOVEGROUND DRAIN, WASTE, VENT PIPE AND FITTINGS	BUILDING SEWER PIPE AND FITTINGS	REFERENCED STANDARD(S) PIPE	REFERENCED STANDARD(S) FITTINGS
ABS (Schedule 40)	X	X	X	ASTM D2661, ASTM D2680*	ASME A112.4.4, ASTM D2661, ASTM D2680*
Cast-Iron	X	X	X	ASTM A74, ASTM A888, CISPI 301	ASME B16.12, ASTM A74, ASTM A888, CISPI 301
Co-Extruded ABS (Schedule 40)	X	X	X	ASTM F628	ASME A112.4.4, ASTM D2661, ASTM D2680*
Co-Extruded Composite (Schedule 40)	X	X	X	ASTM F1488	ASME A112.4.4, ASTM D2661, ASTM D2665, ASTM F794*, ASTM F1866
Co-Extruded PVC (Schedule 40)	X	X	X	ASTM F891, ASTM F1760	ASME A112.4.4, ASTM D2665, ASTM F794*, ASTM F1336*, ASTM F1866
Copper and Copper Alloys (Type DWV)	X	X	X	ASTM B43, ASTM B75, ASTM B251, ASTM B302, ASTM B306	ASME B16.23, ASME B16.29
Galvanized Malleable Iron	—	X	—	—	ASME B16.3
Galvanized Steel	—	X	—	ASTM A53	—
Polyethylene	—	—	X	ASTM F714, ASTM F894	—
PVC (Schedule 40)	X	X	X	ASTM D1785, ASTM D2665, ASTM F794*	ASME A112.4.4, ASTM D2665, ASTM F794*, ASTM F1866
PVC (Sewer and Drain)	—	—	X	ASTM D2729	ASTM D2729
PVC PSM	—	—	X	ASTM D3034	ASTM D3034
Stainless Steel 304	—	X	—	ASME A112.3.1	ASME A112.3.1
Stainless Steel 316L	X	X	X	ASME A112.3.1	ASME A112.3.1
Vitrified Clay (Extra strength)	—	—	X	ASTM C700	ASTM C700

* For building sewer applications.

TABLE 702.1
DRAINAGE FIXTURE UNIT VALUES (DFU)

PLUMBING APPLIANCES, APPURTENANCES, OR FIXTURES	MINIMUM SIZE TRAP AND TRAP ARM[7] (inches)	PRIVATE	PUBLIC	ASSEMBLY[8]
Bathtub or Combination Bath/Shower	1½	2.0	2.0	—
Bidet	1¼	1.0	—	—
Bidet	1½	2.0	—	—
Clothes Washer, domestic, standpipe[5]	2	3.0	3.0	3.0
Dental Unit, cuspidor	1¼	—	1.0	1.0
Dishwasher, domestic, with independent drain[2]	1½	2.0	2.0	2.0
Drinking Fountain or Water Cooler	1¼	0.5	0.5	1.0
Food Waste Disposer, commercial	2	—	3.0	3.0
Floor Drain, emergency	2	—	0.0	0.0
Floor Drain (for additional sizes see Section 702.0)	2	2.0	2.0	2.0
Shower, single-head trap[9]	2	2.0	2.0	2.0
Multi-head, each additional	2	1.0	1.0	1.0
Lavatory	1¼	1.0	1.0	1.0
Lavatories in sets	1½	2.0	2.0	2.0
Washfountain	1½	—	2.0	2.0
Washfountain	2	—	3.0	3.0
Mobile Home, trap	3	12.0	—	—
Receptor, indirect waste[1,3]	1½	See footnote[1,3]		
Receptor, indirect waste[1,4]	2	See footnote[1,4]		
Receptor, indirect waste[1]	3	See footnote[1]		
Sinks	—	—	—	—
Bar	1½	1.0	—	—
Bar[2]	1½	—	2.0	2.0
Clinical	3	—	6.0	6.0
Commercial with food waste[2]	1½	—	3.0	3.0
Exam Room	1½	—	1.0	—
Special Purpose[2]	1½	2.0	3.0	3.0
Special Purpose	2	3.0	4.0	4.0
Special Purpose	3	—	6.0	6.0
Kitchen, domestic[2] (with or without food waste disposer, dishwasher, or both)	1½	2.0	2.0	—
Laundry[2] (with or without discharge from a clothes washer)	1½	2.0	2.0	2.0
Service or Mop Basin	2	—	3.0	3.0
Service or Mop Basin	3	—	3.0	3.0
Service, flushing rim	3	—	6.0	6.0
Wash, each set of faucets	—	—	2.0	2.0
Nonwater Urinal with Drain Cleansing Action	2	1.0	1.0	1.0
Urinal, Hybrid	2	1.0	1.0	1.0
Urinal, integral trap 1.0 GPF[2]	2	2.0	2.0	5.0
Urinal, integral trap greater than 1.0 GPF	2	2.0	2.0	6.0
Urinal, exposed trap[2]	1½	2.0	2.0	5.0
Water Closet, 1.6 GPF Gravity Tank[6]	3	3.0	4.0	6.0
Water Closet, 1.6 GPF Flushometer Tank[6]	3	3.0	4.0	6.0
Water Closet, 1.6 GPF Flushometer Valve[6]	3	3.0	4.0	6.0
Water Closet, greater than 1.6 GPF Gravity Tank[6]	3	4.0	6.0	8.0
Water Closet, greater than 1.6 GPF Flushometer Valve[6]	3	4.0	6.0	8.0

For SI units: 1 inch = 25 mm

Notes:

1 Indirect waste receptors shall be sized based on the total drainage capacity of the fixtures that drain thereinto, in accordance with Table 702.2(2).
2 Provide a 2 inch (50 mm) minimum drain.
3 For refrigerators, coffee urns, water stations, and similar low demands.
4 For commercial sinks, dishwashers, and similar moderate or heavy demands.
5 Buildings having a clothes-washing area with clothes washers in a battery of three or more clothes washers shall be rated at 6 fixture units each for purposes of sizing common horizontal and vertical drainage piping.
6 Water closets shall be computed as 6 fixture units where determining septic tank sizes.
7 Trap sizes shall not be increased to the point where the fixture discharge is capable of being inadequate to maintain their self-scouring properties.
8 Assembly [Public Use (see Table 422.1)].
9 For a bathtub to shower retrofit, a 1½ inch (40 mm) trap and trap arm shall be permitted with a maximum shower size of 36 inches (914 mm) in width and 60 inches (1524 mm) in length. See Section 408.5 and Section 408.6.

TABLE 702.2(1)
MAXIMUM DRAINAGE FIXTURE UNITS FOR A TRAP AND TRAP ARM*

SIZE OF TRAP AND TRAP ARM (inches)	DRAINAGE FIXTURE UNIT VALUES (DFU)
1¼	1 unit
1½	3 units
2	4 units
3	6 units
4	8 units

For SI Units: 1 inch = 25 mm

*** Exception:** On self-service laundries.

[S] TABLE 702.2(2)
DISCHARGE CAPACITY IN GALLONS PER MINUTE FOR INTERMITTENT FLOW ONLY*

GPM	FIXTURE UNITS
Up to 7½	Equals 1 Fixture Unit
Greater than 7½ to 15	Equals 2 Fixture Units
Greater than 15 to 30	Equals 4 Fixture Units
Greater than 30 to 50	Equals 6 Fixture Units
Greater than 50 to 100	Equals 12 Fixture Units
Greater than 100 to 200	Equals 18 Fixture Units
Greater than 200 to 350	Equals 24 Fixture Units

For SI units: 1 gallon per minute = 0.06 L/s

* Discharge capacity exceeding 350 gallons per minute (3.15 L/s) shall be determined by the Authority Having Jurisdiction.

702.3 Continuous Flow. For a continuous flow into a drainage system, such as from a pump, sump ejector, air conditioning equipment, or similar device, 2 fixture units shall be equal to each gallon per minute (gpm) (L/s) of flow.

703.0 Size of Drainage Piping.

703.1 Minimum Size. The minimum sizes of vertical, horizontal, or both drainage piping shall be determined from the total of fixture units connected thereto, and additionally, in the case of vertical drainage pipes, in accordance with their length.

703.2 Maximum Number of Fixture Units. Table 703.2 shows the maximum number of fixture units allowed on a vertical or horizontal drainage pipe, building drain, or building sewer of a given size; the maximum number of fixture units allowed on a branch interval of a given size; and the maximum length (in feet and meters) of a vertical drainage pipe of a given size.

TABLE 703.2
MAXIMUM UNIT LOADING AND MAXIMUM LENGTH OF DRAINAGE AND VENT PIPING

SIZE OF PIPE (inches)	1¼	1½	2	3	4	5	6	8	10	12
Maximum Units										
Drainage Piping[1]										
Vertical	1	2[2, 7]	16[3]	48[4]	256	600	1380	3600	5600	8400
Horizontal	1	1[7]	8[3]	35[4]	216[5]	428[5]	720[5]	2640[5]	4680[5]	8200[5]
Maximum Length										
Drainage Piping										
Vertical, (feet)	45	65	85	212	300	390	510	750	–	–
Horizontal (unlimited)										
Vent Piping										
Horizontal and Vertical[6]										
Maximum Units	1	8[3]	24	84	256	600	1380	3600	–	–
Maximum Lengths, (feet)	45	60	120	212	300	390	510	750		

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

Notes:

1 Excluding trap arm.

2 Except for sinks, urinals, and dishwashers – exceeding 1 fixture unit.

3 Except for six-unit traps or water closets.

4 Not to exceed five water closets or five six-unit traps.

5 Based on ¼ inch per foot (20.8 mm/m) slope. For ⅛ of an inch per foot (10.4 mm/m) slope, multiply horizontal fixture units by a factor of 0.8.

6 The diameter of an individual vent shall be not less than 1¼ inches (32 mm) nor less than one-half the diameter of the drain to which it is connected. Fixture unit load values for drainage and vent piping shall be computed from Table 702.1 and Table 702.2(2). Not to exceed one-third of the total permitted length of a vent shall be permitted to be installed in a horizontal position. Where vents are increased one pipe size for their entire length, the maximum length limitations specified in this table do not apply. This table is in accordance with the requirements of Section 901.3.

7 Up to 8 public lavatories are permitted to be installed on a 1½ inch (40 mm) vertical branch or horizontal sanitary branch sloped at ¼ inch per foot (20.8 mm/m).

704.0 Fixture Connections (Drainage).

704.1 Inlet Fittings. Drainage piping shall be provided with approved inlet fittings for fixture connections, correctly located according to the size and type of fixture proposed to be connected.

704.2 Single Vertical Drainage Pipe. Two fixtures set back-to-back, or side-by-side, within the distance allowed between a trap and its vent, shall be permitted to be served by a single vertical drainage pipe provided that each fixture wastes separately into an approved double-fixture fitting having inlet openings at the same level.

[W] [S] 704.3 Commercial Sinks. Except where specifically required to be connected indirectly to the drainage system, or when first approved by the Authority Having Jurisdiction, all plumbing fixtures, drains, appurtenances, and appliances, including 3-compartment sinks, shall be directly connected to the drainage system of the building or premises.

705.0 Joints and Connections.

705.1 ABS and ABS Co-Extruded Plastic Pipe and Joints. Joining methods for ABS plastic pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 705.1.1 through Section 705.1.3.

705.1.1 Mechanical Joints. Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint. The push-on joint shall include an elastomeric gasket that complies with ASTM D3212 and shall provide a compressive force against the spigot and socket after assembly to provide a permanent seal.

705.1.2 Solvent Cement Joints. Solvent cement joints for ABS pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square and shall be deburred. Where surfaces to be joined are cleaned, and free of dirt, moisture, oil, and other foreign material, the solvent cement that complies with ASTM D2235 shall be applied to all joint surfaces. Joints shall be made while both the inside socket surface and outside surface of pipe are wet with solvent cement. Hold joint in place and undisturbed for 1 minute after assembly.

705.1.3 Threaded Joints. Threads shall comply with ASME B1.20.1. A minimum of Schedule 80 shall be permitted to be threaded. Molded threads on adapter fittings for the transition to threaded joints shall be permitted. Thread sealant compound shall be applied to male threads, insoluble in water, and nontoxic. The joint between the pipe and transition fitting shall be of the solvent cement type. Caution shall be used during assembly to prevent over tightening of the ABS components once the thread sealant compound has been applied.

705.2 Cast-Iron Pipe and Joints. Joining methods for cast-iron pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 705.2.1 or Section 705.2.2.

705.2.1 Caulked Joints. Caulked joints shall be firmly packed with oakum or hemp and filled with molten lead to a depth of not less than 1 inch (25.4 mm) in one continuous pour. The lead shall be caulked thoroughly at the inside and outside edges of the joint. After caulking, the finished joint shall not exceed ⅛ of an inch (3.2 mm) below the rim of the hub. No paint, varnish, or other coatings shall be permitted on the joining material until after the joint has been tested and approved.

705.2.2 Mechanical Joints and Compression Joints. Mechanical joints for cast-iron pipe and fittings shall be of the elastomeric compression type or mechanical joint couplings. Compression type joints with an elastomeric gasket for cast-iron hub and spigot pipe shall comply with ASTM C564 and be tested in accordance with ASTM C1563. Hub and spigot shall be clean and free of dirt, mud, sand, and foreign materials. Cut pipe shall be free from sharp edges. Fold and insert gasket into the hub. Lubricate the joint following manufacturer's instructions. Insert spigot into hub until the spigot end of the pipe bottom out in the hub. Use the same procedure for the installation of fittings.

A mechanical joint shielded coupling type for hubless cast-iron pipe and fittings shall have a metallic shield that complies with ASTM A1056, ASTM C1277, ASTM C1540, or CISPI 310. The elastomeric gasket shall comply with ASTM C564. Hubless cast-iron pipe and fittings shall be clean and free of dirt, mud, sand, and foreign materials. Cut pipe shall be free from sharp edges. Gasket shall be placed on the end of the pipe or fitting and the stainless steel shield and clamp assembly on the end of the other pipe or fitting. Pipe or fittings shall be seated against the center stop inside the elastomeric sleeve. Slide the stainless steel shield and clamp assembly into a position centered over the gasket and tighten. Bands shall be tightened using an approved calibrated torque wrench specifically set by the manufacturer of the couplings.

705.3 Copper or Copper Alloy Pipe (DWV) and Joints. Joining methods for copper or copper alloy pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 705.3.1 through Section 705.3.4.

705.3.1 Brazed Joints. Brazed joints between copper or copper alloy pipe and fittings shall be made with brazing alloys having a liquid temperature above 1000°F (538°C). The joint surfaces to be brazed shall be cleaned bright by either manual or mechanical means. Piping shall be cut square and reamed to full inside diameter. Brazing flux shall be applied to the joint surfaces where required by manufacturer's recommendation. Brazing filler metal shall conform to AWS A5.8 and shall be applied at the point where the pipe or tubing enters the socket of the fitting.

705.3.2 Mechanical Joints. Mechanical joints in copper or copper alloy piping shall be made with a mechanical coupling with grooved end piping or approved joint designed for the specific application.

705.3.3 Soldered Joints. Soldered joints between copper or copper alloy pipe and fittings shall be made in accordance with ASTM B828 with the following sequence of joint preparation and operation as follows: measuring and cutting, reaming, cleaning, fluxing, assembly and support, heating, applying the solder, cooling, and cleaning. Pipe shall be cut square and reamed to the full inside diameter including the removal of burrs on the outside of the pipe. Surfaces to be joined shall be cleaned bright by manual or mechanical means. Flux shall be applied to pipe and fittings and shall conform to ASTM B813, and shall become noncorrosive and nontoxic after soldering. Insert pipe into the base of the fitting and remove excess flux. Pipe and fitting shall be supported to ensure a uniform capillary space around the joint. Heat shall be applied using air or fuel torch with the flame perpendicular to the pipe using acetylene or an LP gas. Preheating shall depend on the size of the joint. The flame shall be moved to the fitting cup and alternate between the pipe and fitting. Solder conforming to ASTM B32 shall be applied to the joint surfaces until capillary action draws the molten solder into the cup. Joint surfaces shall not be disturbed until cool, and any remaining flux residue shall be cleaned.

705.3.4 Threaded Joints. Threaded joints for copper or copper alloy pipe shall be made with pipe threads that comply with ASME B1.20.1. Thread sealant tape or compound shall be applied only to male threads, and such material shall be approved types, insoluble in water, and nontoxic.

705.4 Galvanized Steel Pipe and Joints. Joining methods for galvanized steel pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 705.4.1 or Section 705.4.2.

705.4.1 Mechanical Joints. Mechanical joints shall be made with an elastomeric gasket.

705.4.2 Threaded Joints. Threaded joints shall be made with pipe threads that comply with ASME B1.20.1. Thread sealant tape or compound shall be applied only to male threads, and such material shall be of approved types, insoluble in water, and nontoxic.

705.5 Polyethylene (PE) Sewer Pipe. Polyethylene (PE) sewer pipe or tubing and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 705.5.1 through Section 705.5.1.3.

705.5.1 Heat-Fusion Joints. Heat-fusion joints between PE sewer pipe or tubing and fittings shall be assembled in accordance with Section 705.5.1.1 through Section 705.5.1.3 using butt-fusion, electro-fusion, or socket-fusion heat methods. Do not disturb the joint until cooled to ambient temperature.

705.5.1.1 Butt-Fusion Joints. Butt-fusion joints for PE pipe shall be installed in accordance with ASTM F2620 and shall be made by heating the prepared ends of two pipes, pipe and fitting, or two fittings by holding ends against a heated element. The heated element shall be removed when the required melt or times are obtained and heated ends shall be placed together with applied force. Do not disturb the joint until cooled to ambient temperature.

705.5.1.2 Electro-Fusion Joints. Electro-fusion joints shall be heated internally by a conductor at the interface of the joint. Fittings shall comply with ASTM F1055 for the performance requirements of polyethylene electro-fusion fittings. The specified electro-fusion cycle used to form the joint requires consideration of the properties of the materials being joined, the design of the fitting being used, and the environmental conditions. Align and restrain fitting to pipe to prevent movement and apply electric current to the fitting. Turn off the current when the required time has elapsed to heat the joint. Do not disturb the joint until cooled to ambient temperature.

705.5.1.3 Socket-Fusion Joints. Socket fusion joints shall be installed in accordance with ASTM F2620 and shall be made by simultaneously heating the outside surface of a pipe end and the inside of a fitting socket. Where the required melt is obtained, the pipe and fitting shall be joined by inserting one into the other with applied force. Do not disturb the joint until cooled to ambient temperature.

705.6 PVC and PVC Co-Extruded Plastic Pipe and Joining Methods. Joining methods for PVC plastic pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 705.6.1 through Section 705.6.3.

705.6.1 Mechanical Joints. Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint type. The push-on joint shall include an elastomeric gasket that complies with ASTM D3212 and shall provide a compressive force against the spigot and socket after assembly to provide a permanent seal.

705.6.2 Solvent Cement Joints. Solvent cement joints for PVC pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square, and pipe shall be deburred. Where surfaces to be joined are cleaned and free of dirt, moisture, oil, and other foreign material, apply primer purple in color that complies with ASTM F656. Primer shall be applied to the surface of the pipe and fitting is softened. Solvent cement that comply with ASTM D2564 shall be applied to all joint surfaces. Joints shall be made while both the inside socket surface and outside surface of pipe are wet with solvent cement. Hold joint in place and undisturbed for 1 minute after assembly.

705.6.3 Threaded Joints. Threads shall comply with ASME B1.20.1. A minimum of Schedule 80 shall be permitted to be threaded. Molded threads on adapter fittings for the transition to threaded joints shall be permitted. Thread sealant com-

pound that is compatible with the pipe and fitting, insoluble in water and nontoxic shall be applied to male threads. The joint between the pipe and transition fitting shall be of the solvent cement type. Caution shall be used during assembly to prevent over tightening of the PVC components once the thread sealant has been applied. Female PVC threaded fittings shall be used with plastic male threads only.

705.7 Stainless Steel Pipe and Joints. Joining methods for stainless steel pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 705.7.1 or Section 705.7.2.

705.7.1 Mechanical Joints. Mechanical joints between stainless steel pipe and fittings shall be of the compression, grooved coupling, hydraulic press-connect fittings, or flanged.

705.7.2 Welded Joints. Welded joints between stainless steel pipe and fittings shall be made in accordance with ASME A112.3.1 and shall be welded autogenously. Pipe shall be cleaned, free of scale and contaminating particles. Pipe shall be cut with a combination cutting and beveling tool that provides a square cut, and free of burrs. Mineral oil lubricant shall be used during the cutting and beveling process.

705.8 Vitrified Clay Pipe and Joints. Joining methods for vitrified clay pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 705.8.1.

705.8.1 Mechanical Joints. Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint type. The push-on joint shall include an elastomeric gasket that complies with ASTM C425 and shall provide a compressive force against the spigot and socket after assembly to provide a permanent seal.

705.9 Special Joints. Special joints shall comply with Section 705.9.1 through Section 705.9.4.

705.9.1 Slip Joints. In fixture drains and traps, slip joints of approved materials shall be permitted to be used in accordance with their approvals.

705.9.2 Expansion Joints. Expansion joints shall be accessible, except where in vent piping or drainage stacks, and shall be permitted to be used where necessary to provide for expansion and contraction of the pipes.

705.9.3 Ground Joint, Flared, or Ferrule Connections. Copper or copper alloy ground joint flared, or ferrule-type connections that allow adjustment of tubing, but provide a rigid joint where made up, shall not be considered as slip joints.

705.9.4 Transition Joint A solvent cement transition joint between ABS and PVC building drain and building sewer shall be made using listed transition solvent cement in accordance with ASTM D3138.

705.10 Joints Between Various Materials. Joints between various materials shall be installed in accordance with the manufacturer's installation instructions and with Section 705.10.1 through Section 705.10.4. Mechanical couplings used to join different materials shall comply with ASTM C1173 for belowground use, ASTM C1460 for aboveground use, or ASTM C1461 for aboveground and belowground use.

705.10.1 Copper or Copper Alloy Pipe to Cast-Iron Pipe. Joints from copper or copper alloy pipe or tubing to cast-iron pipe shall be made with a listed compression-type joint or copper alloy ferrule. The copper or copper alloy pipe or tubing shall be soldered or brazed to the ferrule, and the ferrule shall be joined to the cast-iron hub by a compression or caulked joint.

705.10.2 Copper or Copper Alloy Pipe to Threaded Pipe Joints. Joints from copper or copper alloy pipe or tubing to threaded pipe shall be made by the use of a listed copper alloy adapter or dielectric fitting. The joint between the copper or copper alloy pipe and the fitting shall be a soldered or brazed, and the connection between the threaded and the fittings shall be made with a standard pipe size threaded joint.

705.10.3 Plastic Pipe to Other Materials. Where connecting plastic pipe to other types of plastic or other types of piping material; approved listed adapter or transition fittings and listed for the specific transition intended shall be used.

705.10.4 Stainless Steel Pipe to Other Materials. Where connecting stainless steel pipe to other types of piping, listed mechanical joints of the compression type and listed for the specific transition intended shall be used.

706.0 Changes in Direction of Drainage Flow.

706.1 Approved Fittings. Changes in the direction of drainage piping shall be made by the appropriate use of approved fittings and shall be of the angles presented by a one-sixteenth bend, one-eighth bend, or one-sixth bend, or other approved fittings of equivalent sweep.

706.2 Horizontal to Vertical. Horizontal drainage lines, connecting with a vertical stack, shall enter through 45 degree (0.79 rad) wye branches, 60 degree (1.05 rad) wye branches, combination wye and one-eighth bend branches, sanitary tee or sanitary tapped tee branches, or other approved fittings of equivalent sweep. No fitting having more than one inlet at the same level shall be used unless such fitting is constructed so that the discharge from one inlet cannot readily enter any other inlet. Double sanitary tees shall be permitted to be used where the barrel of the fitting is not less than two pipe sizes larger than the largest inlet, (pipe sizes recognized for this purpose are 2 inches, 2½ inches, 3 inches, 3½ inches, 4 inches, 4½ inches, 5 inches, 6 inches, etc.) (50 mm, 65 mm, 80 mm, 90 mm, 100 mm, 115 mm, 125 mm, 150 mm, etc.).

706.3 Horizontal to Horizontal. Horizontal drainage lines connecting with other horizontal drainage lines shall enter through 45 degree (0.79 rad) wye branches, combination wye and one-eighth bend branches, or other approved fittings of equivalent sweep.

706.4 Vertical to Horizontal. Vertical drainage lines connecting with horizontal drainage lines shall enter through 45 degree (0.79 rad) wye branches, combination wye and one-eighth bend branches, or other approved fittings of equivalent sweep. Branches or offsets of 60 degrees (1.05 rad) shall be permitted to be used where installed in a true vertical position.

707.0 Cleanouts.

707.1 Plug. Each cleanout fitting for cast-iron pipe shall consist of a cast-iron or copper alloy body and an approved plug. Each cleanout for galvanized wrought iron, galvanized steel, copper, or copper alloy pipe shall consist of a plug as specified in Table 707.1, or a standard weight copper alloy cap, or an approved ABS or PVC plastic plug, or an approved stainless steel cleanout or plug. Plugs shall have raised square heads or approved countersunk rectangular slots.

TABLE 707.1
CLEANOUTS

SIZE OF PIPE (inches)	SIZE OF CLEANOUT (inches)	THREADS (per inches)
1½	1½	11½
2	1½	11½
2½	2½	8
3	2½	8
4 & larger	3½	8

For SI units: 1 inch = 25 mm

707.2 Approved. Each cleanout fitting and each cleanout plug or cap shall be of an approved type. A list of approved standards for cleanouts are referenced in Table 707.2.

TABLE 707.2
CLEANOUT MATERIALS FOR DRAIN, WASTE, AND VENT

MATERIAL	STANDARD
ABS	ASTM D2661, CSA B79, IAPMO IGC 78, IAPMO IGC 224
Cast Iron	ASME A112.36.2, ASTM A888, CISPI 301, CSA B79, IAPMO IGC 224
Copper or Copper Alloy	ASME A112.36.2, CSA B79
Ductile Iron	CSA B79
Elastomers	CSA B79, IAPMO PS 90
Polyethylene (PE)	CSA B79
Polypropylene (PP)	CSA B79
PVC	ASTM D2665, CSA B79, IAPMO IGC 78, IAPMO IGC 224
Polyvinylidene Fluoride (PVDF)	CSA B79
Stainless Steel	CSA B79

707.3 Watertight and Gastight Cleanouts shall be designed to be watertight and gastight.

[W] 707.4 Location. Each horizontal drainage pipe shall be provided with a cleanout at its upper terminal, and each run of piping, that is more than 100 feet (30 480 mm) in total developed length, shall be provided with a cleanout for each 100 feet (30 480 mm), or fraction thereof, in length of such piping. An additional cleanout shall be provided in a drainage line for each aggregate horizontal change in direction exceeding 135 degrees (2.36 rad).

Exceptions:

(1) Cleanouts shall be permitted to be omitted on a horizontal drain line less than 5 feet (1524 mm) in length unless such line is serving sinks or urinals.

(2) Cleanouts shall be permitted to be omitted on a horizontal drainage pipe installed on a slope of 72 degrees (1.26 rad) or less from the vertical angle (one-fifth bend).

(3) Excepting the building drain, its horizontal branches, and urinals, a cleanout shall not be required on a pipe or piping that is above the floor level of the lowest floor of the building.

(4) An approved type of two-way cleanout fitting, installed inside the building wall near the connection between the building drain and the building sewer or installed outside of a building at the lower end of a building drain and extended to grade, shall be permitted to be substituted for an upper terminal cleanout.

707.5 Cleaning. Each cleanout shall be installed so that it opens to allow cleaning in the direction of flow of the soil or waste or at right angles thereto and, except in the case of wye branch and end-of-line cleanouts, shall be installed vertically above the flow line of the pipe.

707.6 Extension. Each cleanout extension shall be considered as drainage piping and each 90 degree (1.57 rad) cleanout extension shall be extended from a wye-type fitting or other approved fitting of equivalent sweep.

707.7 Interceptor. Each cleanout for an interceptor shall be outside of such interceptor.

707.8 Access. Each cleanout, unless installed under an approved cover plate, shall be above grade, readily accessible, and so located as to serve the purpose for which it is intended. Cleanouts located under cover plates shall be so installed as to provide the clearances and accessibility required by this section.

[W] 707.9 Clearance. Each cleanout in piping 2 inches (50 mm) or less in size shall be so installed that there is a clearance of not less than 12 inches (305 mm) in front of the cleanout. Cleanouts in piping exceeding 2 inches (50 mm) shall have a clearance of not less than 18 inches (457 mm) in front of the cleanout. Cleanouts in under-floor piping shall be extended to or above the finished floor or shall be extended outside the building where there is less than 18 inches (457 mm) vertical overall, allowing for obstructions such as ducts, beams, and piping, and 30 inches of (762 mm) horizontal clearance from the means of access to such cleanout. No under-floor cleanout shall be located exceeding 20 feet (6096 mm) from an access door, trap door, or crawl hole.

707.10 Fittings. Cleanout fittings shall be not less in size than those given in Table 707.1.

707.11 Pressure Drainage Systems. Cleanouts shall be provided for pressure drainage systems as classified under Section 710.7.

707.12 Countersunk Cleanout Plugs. Countersunk cleanout plugs shall be installed where raised heads cause a hazard.

707.13 Hubless Blind Plugs. Where a hubless blind plug is used for a required cleanout, the complete coupling and plug shall be accessible for removal or replacement.

707.14 Trap Arms. Cleanouts for trap arms shall be installed in accordance with Section 1002.3.

708.0 Grade of Horizontal Drainage Piping.

708.1 General. Horizontal drainage piping shall be run in practical alignment and a uniform slope of not less than ¼ inch per foot (20.8 mm/m) or 2 percent toward the point of disposal provided that, where it is impractical due to the depth of the street sewer, to the structural features, or to the arrangement of a building or structure to obtain a slope of ¼ inch per foot (20.8 mm/m) or 2 percent, such pipe or piping 4 inches (100 mm) or larger in diameter shall be permitted to have a slope of not less than ⅛ inch per foot (10.4 mm/m) or 1 percent, where first approved by the Authority Having Jurisdiction.

709.0 Gravity Drainage Required.

[S] 709.1 General. Plumbing fixtures shall be drained to the sanitary waste system by gravity flow and are permitted to be pumped or ejected as allowed per Section 710.2 or when approved by the Authority Having Jurisdiction.

710.0 Drainage of Fixtures Located Below the Next Upstream Manhole or Below the Main Sewer Level.

710.1 Backflow Protection. Fixtures installed on a floor level that is lower than the next upstream manhole cover of the public, or private sewer shall be protected from backflow of sewage by installing an approved type of backwater valve. Fixtures on such floor level that are not below the next upstream manhole cover shall not be required to be protected by a backwater valve. Fixtures on floor levels above such elevation shall not discharge through the backwater valve. Cleanouts for drains that pass through a backwater valve shall be clearly identified with a permanent label stating “backwater valve downstream.”

710.2 Sewage Discharge. Drainage piping serving fixtures that are located below the crown level of the main sewer shall discharge into an approved watertight sump or receiving tank, so located as to receive the sewage or wastes by gravity. From such sump or receiving tank, the sewage or other liquid wastes shall be lifted and discharged into the building drain or building sewer by approved ejectors, pumps, or other equally efficient approved mechanical devices.

710.3 Sewage Ejector and Pumps. A sewage ejector or sewage pump receiving the discharge of water closets or urinals:

(1) Shall have a discharge capacity of not less than 20 gpm (1.26 L/s).

(2) In single dwelling units, the ejector or pump shall be capable of passing an 1½ inch (38 mm) diameter solid ball, and the discharge piping of each ejector or pump shall have a backwater valve and gate valve, and be not less than 2 inches (50 mm) in diameter.

(3) In other than single-dwelling units, the ejector or pump shall be capable of passing a 2 inch (51 mm) diameter solid ball, and the discharge piping of each ejector or pump shall have a backwater valve and gate valve, and be not less than 3 inches (80 mm) in diameter.

[S] 710.4 Discharge Line. The discharge line from such ejector, pump, or another mechanical device shall be of approved pressure rated material and be provided with an accessible backwater or swing check valve and gate or ball valve. Where the gravity drainage line to which such discharge line connects is horizontal, the method of connection shall be from the top through a wye branch fitting. The gate or ball valve shall be located on the discharge side of the backwater or check valve.

Gate or ball valves, where installed in drainage piping, shall be fullway type with working parts of corrosion-resistant metal. Sizes 4 inches (100 mm) or more in diameter shall have cast-iron bodies and sizes less than 4 inches (100 mm), cast-iron or copper alloy bodies. Discharge lines from elevator hoistway pumps shall be provided with a check valve and lockable gate or ball valve locked in the open position and located outside of the hoistway.

Exception: The discharge line of a pump serving an elevator hoistway shall be routed through an air break to an approved indirect receptor. The indirect receptor shall be provided with an outlet, tailpiece, and trap (if applicable) large enough to accommodate the design flow rate of the largest pump discharging to the indirect receptor. The trap seal of such receptor (if applicable) shall be maintained by a trap primer in accordance with section 1007.0.

[S] 710.5 Size of Building Drains and Sewers. Building drains or building sewers receiving a discharge from a pump or ejector shall be adequately sized to prevent overloading. Two fixture units shall be allowed for each gallon per minute (L/s) of flow.

Exception: Where first approved by the Authority Having Jurisdiction, the discharge from pumps or ejectors provided for periodic testing or emergency use only may be assigned fixture unit loading in accordance with Table 702.2(2). All gravity drainage piping and/or pretreatment devices downstream of such pumps shall be adequately sized for continuous full flow of the pumped discharge under emergency or test conditions.

710.6 Backwater Valves. Backwater valves, gate valves, fullway ball valves, unions, motors, compressors, air tanks, and other mechanical devices required by this section shall be located where they will be accessible for inspection and repair and, unless continuously exposed, shall be enclosed in a masonry pit fitted with an adequately sized removable cover.

Backwater valves shall comply with ASME A112.14.1, and have bodies of cast-iron, plastic, copper alloy, or other approved materials; shall have noncorrosive bearings, seats, and self-aligning discs; and shall be constructed to ensure a positive mechanical seal. Such backwater valves shall remain open during periods of low flows to avoid screening of solids and shall not restrict capacities or cause excessive turbulence during peak loads. Unless otherwise listed, valve access covers shall be bolted type with gasket, and each valve shall bear the manufacturer's name cast into the body and the cover.

710.7 Drainage and Venting Systems. The drainage and venting systems, in connection with fixtures, sumps, receiving tanks, and mechanical waste-lifting devices shall be installed under the same requirements as provided for in this code for gravity systems.

710.8 Sump and Receiving Tank Construction. Sumps and receiving tanks shall be watertight and shall be constructed of concrete, metal, or other approved materials. Where constructed of poured concrete, the walls and bottom shall be adequately reinforced and designed to recognized acceptable standards. Metal sumps or tanks shall be of such thickness as to serve their intended purpose and shall be treated internally and externally to resist corrosion.

710.9 Alarm. Such sumps and receiving tanks shall be automatically discharged and, wherein a "public use" occupancy, shall be provided with dual pumps or ejectors arranged to function alternately in normal use and independently in case of overload or mechanical failure. The pumps shall have an audio and visual alarm, readily accessible, that signals pump failure or an overload condition. The lowest inlet shall have a clearance of not less than 2 inches (51 mm) from the high-water or "starting" level of the sump.

710.10 Sump and Receiving Tank Covers and Vents. Sumps and receiving tanks shall be provided with substantial covers having a bolt-and-gasket-type manhole or equivalent opening to permit access for inspection, repairs, and cleaning. The top shall be provided with a vent pipe that shall extend separately through the roof or, where permitted, be combined with other vent pipes. Such vent shall be large enough to maintain atmospheric pressure within the sump under normal operating conditions and, in no case, shall be less in size than that required by Table 703.2 for the number and type of fixtures discharging into the sump, nor less than 1½ inches (40 mm) in diameter. Where the preceding requirements are met and the vent, after leaving the sump, is combined with vents from fixtures discharging into the sump, the size of the combined vent need not exceed that required for the total number of fixtures discharging into the sump. No vent from an air-operating sewage ejector shall combine with other vents.

710.11 Air Tanks. Air tanks shall be so proportioned as to be of equal cubical capacity to the ejectors connected in addition to that in which there shall be maintained an air pressure of not less than 2 pounds per foot (lb/ft) (3 kg/m) of height the sewage is to be raised. No water-operated ejectors shall be permitted.

710.12 Grinder Pump Ejector. Grinder pumps shall be permitted to be used.

710.12.1 Discharge Piping. The discharge piping shall be sized in accordance with the manufacturer's installation instructions and shall be not less than 1¼ inches (32 mm) in diameter. A check valve and fullway-type shutoff valve shall be located on the discharge line.

710.13 Macerating Toilet Systems and Pumped Waste Systems. Fixtures shall be permitted to discharge to a macerating toilet system, or pumped waste system shall be permitted as an alternate to a sewage pump system where approved by the Authority Having Jurisdiction. Such systems shall comply with ASME A112.3.4/CSA B45.9 and shall be installed in accordance with the manufacturer's installation instructions.

710.13.1 Sumps. The sump shall be watertight and gastight.

710.13.2 Discharge Piping. The discharge piping shall be sized in accordance with manufacturer's instructions and shall be not less than ¾ of an inch (20 mm) in diameter. The developed length of the discharge piping shall not exceed the manufacturer's instructions. A check valve and fullway-type shutoff valve shall be located within the discharge line or internally within the device.

710.13.3 Venting. The plumbing fixtures that discharge into the macerating device shall be vented in accordance with this code. The sump shall be vented in accordance with the manufacturer's instructions, and such vent shall be permitted to connect to the fixture venting.

711.0 Suds Relief.

711.1 General. Drainage connections shall not be made into a drainage piping system within 8 feet (2438 mm) of a vertical to horizontal change of direction of a stack containing suds-producing fixtures. Bathtubs, laundries, washing machine standpipes, kitchen sinks, and dishwashers shall be considered suds-producing fixtures. Where parallel vent stacks are required, they shall connect to the drainage stack at a point 8 feet (2438 mm) above the lowest point of the drainage stack.

Exceptions:

(1) Single-family residences.

(2) Stacks receiving the discharge from less than three stories of plumbing fixtures.

712.0 Testing.

712.1 Media. The piping of the plumbing, drainage, and venting systems shall be tested with water or air except that plastic pipe shall not be tested with air. The Authority Having Jurisdiction shall be permitted to require the removal of cleanouts, etc., to ascertain whether the pressure has reached all parts of the system. After the plumbing fixtures have been set and their traps filled with water, they shall be submitted to a final test.

712.2 Water Test The water test shall be applied to the drainage and vent systems either in its entirety or in sections. Where the test is applied to the entire system, openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to the point of overflow. Where the system is tested in sections, each opening shall be tightly plugged, except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10 foot head of water (30 kPa). In testing successive sections, not less than the upper 10 feet (3048 mm) of the next preceding section shall be tested, so that no joint or pipe in the building (except the uppermost 10 feet (3048 mm) of the system) shall have been submitted to a test of less than a 10 foot head of water (30 kPa). The water shall be kept in the system, or in the portion under test, for not less than 15 minutes before inspection starts. The system shall then be tight at all points.

712.3 Air Test The air test shall be made by attaching an air compressor testing apparatus to a suitable opening and, after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of 5 pounds-force per square inch (psi) (34 kPa) or sufficient to balance a column of mercury 10 inches (34 kPa) in height. The pressure shall be held without the introduction of additional air for a period of not less than 15 minutes.

Part II – Building Sewers.

[W] Delete all of Part II, Sections 713.0 to 723.0 and Tables 717.1 and 721.1.

CHAPTER 8
INDIRECT WASTES

801.0 General.

801.1 Applicability. This chapter shall govern the materials, design, and installation of indirect waste piping, receptors, and connections; and provisions for discharge and disposal of condensate wastes, chemical wastes, industrial wastes, and clear water wastes.

801.2 Air Gap or Air Break Required. Indirect waste piping shall discharge into the building drainage system through an air gap or air break as set forth in this code. Where a drainage air gap is required by this code, the minimum vertical distance as measured from the lowest point of the indirect waste pipe or the fixture outlet to the flood-level rim of the receptor shall be not less than 1 inch (25.4 mm).

801.3 Food and Beverage Handling Establishments. Establishments engaged in the storage, preparation, selling, serving, processing, or other handling of food and beverage involving the following equipment that requires drainage shall provide indirect waste piping for refrigerators, refrigeration coils, freezers, walk-in coolers, iceboxes, ice-making machines, steam tables, egg boilers, coffee urns and brewers, hot-and-cold drink dispensers, and similar equipment.

801.3.1 Size of Indirect Waste Pipes. Except for refrigeration coils and ice-making machines, the size of the indirect waste pipe shall be not smaller than the drain on the unit, but shall be not smaller than 1 inch (25 mm), and the maximum developed length shall not exceed 15 feet (4572 mm). Indirect waste pipe for ice-making machines shall be not less than the drain on the unit and in no case less than ¾ of an inch (20 mm).

801.3.2 Walk-In Coolers. For walk-in coolers, floor drains shall be permitted to be connected to a separate drainage line discharging into an outside receptor. The flood-level rim of the receptor shall be not less than 6 inches (152 mm) lower than the lowest floor drain. Such floor drains shall be trapped and individually vented. Cleanouts shall be provided at 90 degree (1.57 rad) turns and shall be accessibly located. Such waste shall discharge through an air gap or air break into a trapped and vented receptor, except that a full-size air gap is required where the indirect waste pipe is under vacuum.

801.3.3 Food-Handling Fixtures. Food-preparation sinks, steam kettles, potato peelers, ice cream dipper wells, and similar equipment shall be indirectly connected to the drainage system by means of an air gap. Bins, sinks, and other equipment having drainage connections and used for the storage of unpackaged ice used for human ingestion, or used in direct contact with ready-to-eat food, shall be indirectly connected to the drainage system by means of an air gap. Each indirect waste pipe from food-handling fixtures or equipment shall be separately piped to the indirect waste receptor and shall not combine with other indirect waste pipes. The piping from the equipment to the receptor shall be not less than the drain on the unit and in no case less than ½ of an inch (15 mm).

801.4 Bar and Fountain Sink Traps. Where the sink in a bar, soda fountain, or counter is so located that the trap serving the sink cannot be vented, the sink drain shall discharge through an air gap or air break (see Section 801.3.3) into an approved receptor that is vented. The developed length from the fixture outlet to the receptor shall not exceed 5 feet (1524 mm).

801.5 Connections from Water Distribution System. Indirect waste connections shall be provided for drains, overflows, or relief pipes from potable water pressure tanks, water heaters, boilers, and similar equipment that is connected to the potable water distribution system. Such indirect waste connections shall be made using a water-distribution air gap constructed in accordance with Table 603.3.1.

801.6 Sterilizers. Lines, devices, or apparatus such as stills, sterilizers, and similar equipment requiring waste connections and used for sterile materials shall be indirectly connected using an air gap. Each such indirect waste pipe shall be separately piped to the receptor and shall not exceed 15 feet (4572 mm). Such receptors shall be located in the same room.

801.7 Drip or Drainage Outlets. Appliances, devices, or apparatus not regularly classified as plumbing fixtures, but which have a drip or drainage outlets, shall be permitted to be drained by indirect waste pipes discharging into an open receptor through either an air gap or air break (see Section 801.3.1).

802.0 Approvals.

802.1 General. No plumbing fixtures served by indirect waste pipes or receiving discharge therefrom shall be installed until first approved by the Authority Having Jurisdiction.

803.0 Indirect Waste Piping.

803.1 Materials. Pipe, tube, and fittings conveying indirect waste shall be of such materials and design as to perform their intended function to the satisfaction of the Authority Having Jurisdiction.

803.2 Copper and Copper Alloys. Joints and connections in copper and copper alloy pipe and tube shall be installed in accordance with Section 705.3.

[S] 803.3 Pipe Size and Length. Except as hereinafter provided, the size of indirect waste piping shall be in accordance with other sections of this code applicable to drainage and vent piping. No vent from indirect waste piping shall combine with a sewer-connected vent, but shall extend separately to the outside air. Indirect waste pipes exceeding 5 feet (1524 mm), but less than 15 feet (4572 mm) in length shall be directly trapped, but such traps need not be vented.

Indirect waste pipes less than 15 feet (4572 mm) in length shall be not less than the diameter of the drain outlet or tailpiece of the fixture, appliance, or equipment served, and in no case less than ½ of an inch (15 mm). Angles and changes of direction in such indirect waste pipes shall be provided with cleanouts to permit flushing and cleaning.

Exceptions:

(1) Gravity indirect waste pipes connected to elevator hoistway drains shall be provided with a normally closed backwater valve or a vented running trap installed in accordance with section 1008.1. Where a trap is provided, the trap seal shall be maintained by an automatic electronic trap primer.

(2) Unless required by the Authority Having Jurisdiction, traps and vents shall not be required in indirect waste piping from backflow or pressure relief devices or other similar applications intended for emergency use only.

804.0 Indirect Waste Receptors.

804.1 Standpipe Receptors. Plumbing fixtures or other receptors receiving the discharge of indirect waste pipes shall be approved for the use proposed and shall be of such shape and capacity as to prevent splashing or flooding and shall be located where they are readily accessible for inspection and cleaning. No standpipe receptor for a clothes washer shall extend more than 30 inches (762 mm), or not less than 18 inches (457 mm) above its trap weir. No trap for a clothes washer standpipe receptor shall be installed below the floor, but shall be roughed in not less than 6 inches (152 mm) and not more than 18 inches (457 mm) above the floor. No indirect waste receptor shall be installed in a toilet room, closet, cupboard, or storeroom, or in a portion of a building not in general use by the occupants thereof; except standpipes for clothes washers shall be permitted to be installed in toilet and bathroom areas where the clothes washer is installed in the same room.

805.0 Pressure Drainage Connections.

805.1 General. Indirect waste connections shall be provided for drains, overflows, or relief vents from the water supply system, and no piping or equipment carrying wastes or producing wastes or other discharges under pressure shall be directly connected to a part of the drainage system.

The preceding shall not apply to an approved sump pump or to an approved pressure-wasting plumbing fixture or device where the Authority Having Jurisdiction has been satisfied that the drainage system is adequately sized to accommodate the anticipated discharge thereof.

806.0 Sterile Equipment.

806.1 General. Appliances, devices, or apparatus such as stills, sterilizers, and similar equipment requiring water and waste and used for sterile materials shall be drained through an air gap.

807.0 Appliances.

807.1 Non-Classed Apparatus. Commercial dishwashing machines, silverware washing machines, and other appliances, devices, equipment, or other apparatus not regularly classed as plumbing fixtures, which are equipped with pumps, drips, or drainage outlets, shall be permitted to be drained by indirect waste pipes discharging into an approved type of open receptor.

807.2 Undiluted Condensate Waste. Where undiluted condensate waste from a fuel-burning condensing appliance is discharged into the drainage system, the material in the drainage system shall be cast-iron, galvanized iron, plastic, or other materials approved for this use.

Exceptions:

(1) Where the above condensate is discharged to an exposed fixture tailpiece and trap, such tailpiece and trap shall be permitted to be a copper alloy.

(2) Materials approved in Section 701.0 shall be permitted to be used where data is provided that the condensate waste is adequately diluted.

807.3 Domestic Dishwashing Machine. No domestic dishwashing machine shall be directly connected to a drainage system or food waste disposer without the use of an approved dishwasher air gap fitting on the discharge side of the dishwashing machine. Listed air gaps shall be installed with the flood-level (FL) marking at or above the flood level of the sink or drainboard, whichever is higher.

808.0 Cooling Water.

808.1 General. Where permitted by the Authority Having Jurisdiction, clean running water used exclusively as a cooling medium in an appliance, device, or apparatus shall be permitted to discharge into the drainage system through the inlet side of a fixture trap in the event that a suitable fixture is not available to receive such discharge. Such trap connection shall be by means of a pipe connected to the inlet side of an approved fixture trap, the upper end terminating in a funnel-shaped receptacle set adjacent, and not less than 6 inches (152 mm) above the overflow rim of the fixture.

809.0 Drinking Fountains.

809.1 General. Drinking fountains shall be permitted to be installed with indirect wastes.

810.0 Steam and Hot Water Drainage Condensers and Sumps.

810.1 High-Temperature Discharge. No steam pipe shall be directly connected to plumbing or drainage system, nor shall water having a temperature above 140°F (60°C) be discharged under pressure directly into a drainage system. Pipes from boilers shall discharge by means of indirect waste piping as determined by the Authority Having Jurisdiction or the boiler manufacturer's recommendations. Such pipes shall be permitted to be indirectly connected by discharging into an open or closed condenser or an intercepting sump of an approved type that will prevent the entrance of steam or such water under pressure into the drainage system. Closed condensers or sumps shall be provided with a vent that shall be taken off the top and extended separately, full size above the roof. Condensers and sumps shall be properly trapped at the outlet with a deep seal trap extending to within 6 inches (152 mm) of the bottom of the tank. The top of the deep seal trap shall have a ¾ of an inch (19.1 mm) opening located at the highest point of the trap to serve as a siphon breaker. Outlets shall be taken off from the side in such a manner as to allow a waterline to be maintained that will permanently occupy not less than one-half the capacity of the condenser or sump. Inlets shall enter above the waterline. Wearing plates or baffles shall be installed in the tank to protect the shell. The sizes of the blowoff line inlet, the water outlets, and the vent shall be as shown in Table 810.1. The contents of condensers receiving steam or hot water under pressure shall pass through an open sump before entering the drainage system.

TABLE 810.1
PIPE CONNECTIONS IN BLOWOFF CONDENSERS AND SUMPS
(inches)

BOILER BLOWOFF	WATER OUTLET	VENT
¾*	¾*	2
1	1	2½
1¼	1¼	3
1½	1½	4
2	2	5
2½	2½	6

For SI units: 1 inch = 25 mm

* To be used only with boilers of 100 square feet (9.29 m^2) of heating surface or less.

810.2 Sumps, Condensers, and Intercepting Tanks. Sumps, condensers, or intercepting tanks that are constructed of concrete shall have walls and bottom, not less than 4 inches (102 mm) in thickness, and the inside shall be cement plastered not less than ½ of an inch (12.7 mm) in thickness. Condensers constructed of metal shall be not less than No. 12 U.S. standard gauge (0.109 inch) (2.77 mm), and such metal condensers shall be protected from external corrosion by an approved bituminous coating.

810.3 Cleaning. Sumps and condensers shall be provided with suitable means of access for cleaning and shall contain a volume of not less than twice the volume of water removed from the boiler or boilers connected to it where the normal water level of such boiler or boilers is reduced not less than 4 inches (102 mm).

810.4 Strainers. An indirect waste interceptor is receiving discharge-containing particles that would clog the receptor drain shall have a readily removable beehive strainer.

811.0 Chemical Wastes.

811.1 Pretreatment. Chemical or liquid industrial wastes that are likely to damage or increase maintenance costs on the sanitary sewer system, detrimentally affect sewage treatment or contaminate surface or subsurface waters shall be pretreated to render them innocuous before discharge into a drainage system. Detailed construction documents of the pretreatment facilities shall be required by the Authority Having Jurisdiction.

Piping conveying industrial, chemical, or process wastes from their point of origin to sewer-connected pretreatment facilities shall be of such material and design as to adequately perform its intended function to the satisfaction of the Authority Having Jurisdiction. Drainage discharge piping from pretreatment facilities or interceptors shall be in accordance with standard drainage installation procedures.

Copper or copper alloy tube shall not be used for chemical or industrial wastes as defined in this section.

811.2 Waste and Vent Pipes. Each waste pipe receiving or intended to receive the discharge of a fixture into which acid or corrosive chemical is placed, and each vent pipe connected thereto, shall be constructed of chlorinated polyvinyl chloride (CPVC), polypropylene (PP), polyvinylidene fluoride (PVDF), chemical-resistant glass, high-silicon iron pipe, or lead pipe with a wall thickness of not less than ⅛ of an inch (3.2 mm); an approved type of ceramic glazed or unglazed vitrified clay; or other approved corrosion-resistant materials. CPVC pipe and fittings shall comply with ASTM F2618. PP pipe and fittings shall comply with ASTM F1412 or CSA B181.3. PVDF pipe and fittings shall comply with ASTM F1673 or CSA B181.3. Chemical-resistant glass pipe and fittings shall comply with ASTM C1053. High-silicon iron pipe and fittings shall comply with ASTM A861.

811.3 Joining Materials. Joining materials shall be of approved type and quality.

811.4 Access. Where practicable, the piping shall be readily accessible and installed with the maximum of clearance from other services.

811.5 Permanent Record. The owner shall make and keep a permanent record of the location of piping and venting carrying chemical waste.

811.6 Chemical Vent. No chemical vent shall intersect vents for other services.

811.7 Discharge. Chemical wastes shall be discharged in a manner approved by the Authority Having Jurisdiction.

811.8 Diluted Chemicals. The provisions of this section about materials and methods of construction shall not apply to installations such as photographic or x-ray darkrooms or research or control laboratories where minor amounts of adequately diluted chemicals are discharged.

812.0 Clear Water Wastes.

812.1 General. Water lifts, expansion tanks, cooling jackets, sprinkler systems, drip or overflow pans, or similar devices that discharge clear wastewater into the building drainage system shall discharge through an indirect waste.

813.0 Swimming Pools.

813.1 General. Pipes carrying wastewater from swimming or wading pools, including pool drainage and backwash from filters, shall be installed as an indirect waste. Where a pump is used to discharge pool waste water to the drainage system, the pump discharge shall be installed as an indirect waste.

814.0 Condensate Waste and Control.

814.1 Condensate Disposal. Condensate from air washers, air-cooling coils, condensing appliances, and the overflow from evaporative coolers and similar water-supplied equipment or similar air-conditioning equipment shall be collected and discharged to an approved plumbing fixture or disposal area. Where discharged into the drainage system, equipment shall drain using an indirect waste pipe. The waste pipe shall have a slope of not less than ⅛ inch per foot (10.4 mm/m) or 1 percent slope and shall be of an approved corrosion-resistant material not smaller than the outlet size in accordance with Section 814.3 or Section 814.4 for air-cooling coils or condensing appliances, respectively. Condensate or wastewater shall not drain over a public way.

814.1.1 Condensate Pumps. Where approved by the Authority Having Jurisdiction, condensate pumps shall be installed in accordance with the manufacturer's installation instructions. Pump discharge shall rise vertically to a point where it is possible to connect to a gravity condensate drain and discharged to an approved disposal point. Each condensing unit shall be provided with a separate sump and interlocked with the equipment to prevent the equipment from operating during a failure. Separate pumps shall be permitted to connect to a single gravity indirect waste where equipped with check valves and approved by the Authority Having Jurisdiction.

814.2 Condensate Control. Where an equipment or appliance is installed in a space where damage is capable of resulting from condensate overflow, a drain line shall be provided and shall be drained in accordance with Section 814.1. An additional protection method for condensate overflow shall be provided in accordance with one of the following:

(1) A water level detecting device that will shut off the equipment or appliance in the event the primary drain is blocked.

(2) An additional watertight pan of corrosion-resistant material, with a separate drain line, installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain.

(3) An additional drain line at a level that is higher than the primary drain line connection of the drain pan.

(4) An additional watertight pan of corrosion-resistant material with a water level detection device installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain and to shut off the equipment.

The additional pan or the additional drain line connection shall be provided with a drain pipe of not less than ¾ of an inch (20 mm) nominal pipe size, discharging at a point that is readily observed.

814.2.1 Protection of Appurtenances. Where insulation or appurtenances are installed where damage is capable of resulting from a condensate drain pan overfill, such installations shall occur above the rim of the drain pan with supports. Where the supports are in contact with the condensate waste, the supports shall be of approved corrosion-resistant material.

814.3 Condensate Waste Pipe Material and Sizing. Condensate waste pipes from air-cooling coils shall be sized in accordance with the equipment capacity as specified in Table 814.3. The material of the piping shall comply with the pressure and temperature rating of the appliance or equipment and shall be approved for use with the liquid being discharged.

TABLE 814.3
MINIMUM CONDENSATE PIPE SIZE

EQUIPMENT CAPACITY IN TONS OF REFRIGERATION	MINIMUM CONDENSATE PIPE DIAMETER (inches)
Up to 20	¾
21 – 40	1
41 – 90	1¼
91 – 125	1½
126 – 250	2

For SI units: 1 ton of refrigerant = 3.52 kW, 1 inch = 25 mm

The size of condensate waste pipes is for one unit or a combination of units, or as recommended by the manufacturer. The capacity of waste pipes assumes a ⅛ inch per foot (10.4 mm/m) or 1 percent slope, with the pipe running three-quarters full at the following pipe conditions:

Outside Air – 20%		Room Air – 80%	
DB	WB	DB	WB
90°F	73°F	75°F	62.5°F

For SI units: °C = (°F-32)/1.8

Condensate drain sizing for other slopes or other conditions shall be approved by the Authority Having Jurisdiction.

Air-conditioning waste pipes shall be constructed of materials specified in Chapter 7.

814.3.1 Cleanouts. Condensate drain lines shall be configured or provided with a cleanout to permit the clearing of blockages and for maintenance without requiring the drain line to be cut.

814.4 Appliance Condensate Drains. Condensate drain lines from individual condensing appliances shall be sized as required by the manufacturer's instructions. Condensate drain lines serving more than one appliance shall be approved by the Authority Having Jurisdiction prior to installation.

814.5 Point of Discharge. Air-conditioning condensate waste pipes shall connect indirectly, except where permitted in Section 814.6, to the drainage system through an air gap or air break to trapped and vented receptors, dry wells, leach pits, or the tailpiece of plumbing fixtures. A condensate drain shall be trapped in accordance with the appliance manufacturer's instructions or as approved.

814.6 Condensate Waste From Air-Conditioning Coils. Where the condensate waste from air-conditioning coils discharges by direct connection to a lavatory tailpiece or to an approved accessible inlet on a bathtub overflow, the connection shall be located in the area controlled by the same person controlling the air-conditioned space.

814.7 Plastic Fittings. Female plastic screwed fittings shall be used with male plastic fittings and plastic threads.

CHAPTER 9
VENTS

901.0 General.

901.1 Applicability. This chapter shall govern the materials, design, and installation of plumbing vent systems.

901.2 Vents Required. Each plumbing fixture trap, except as otherwise provided in this code, shall be protected against siphonage and backpressure, and air circulation shall be ensured throughout all parts of the drainage system by means of vent pipes installed in accordance with the requirements of this chapter and as otherwise required by this code.

901.3 Trap Seal Protection. The vent system shall be designed to prevent a trap seal from being exposed to a pressure differential that exceeds 1 inch water column (0.24 kPa) on the outlet side of the trap.

902.0 Vents Not Required.

902.1 Interceptor. Vent piping shall be permitted to be omitted on an interceptor where such interceptor acts as a primary settling tank and discharges through a horizontal indirect waste pipe into a secondary interceptor. The second interceptor shall be properly trapped and vented.

902.2 Bars, Soda Fountains, and Counter. Traps serving sinks that are part of the equipment of bars, soda fountains, and counters need not be vented where the location and construction of such bars, soda fountains, and counters are such as to make it impossible to do so. Where such conditions exist, said sinks shall discharge using approved indirect waste pipes into a floor sink or other approved type of receptor.

903.0 Materials.

[S] 903.1 Applicable Standards. Vent pipe and fittings shall comply with the applicable standards referenced in Table 701.2, except that:

(1) No galvanized steel or 304 stainless steel pipe shall be installed underground and shall be not less than 6 inches (152 mm) aboveground.

(2) ABS and PVC DWV piping installations shall be in accordance with the applicable standards referenced in Table 1701.1. Except for individual single-family dwelling units, materials exposed within ducts or plenums shall have a flame-spread index of not more than 25 and a smoke-developed index of not more than 50 where tested in accordance with ASTM E84 or UL 723. These tests shall comply with all requirements of the standards to include the sample size, both for width and length. Plastic pipe shall not be tested filled with water.

903.2 Use of Copper or Copper Alloy Tubing. Copper or copper alloy tube for underground drainage and vent piping shall have a weight of not less than that of copper or copper alloy drainage tube type DWV.

903.2.1 Aboveground. Copper or copper alloy tube for aboveground drainage and vent piping shall have a weight of not less than that of copper or copper alloy drainage tube type DWV.

903.2.2 Prohibited Use. Copper or copper alloy tube shall not be used for chemical or industrial wastes as defined in Section 811.0.

903.2.3 Marking. Copper or copper alloy tubing, in addition to the required incised marking, shall be marked in accordance with either ASTM B306 or ASTM B88. The colors shall be Type K, green; Type L, blue; Type M, red; and Type DWV, yellow.

903.3 Changes in Direction. Changes in the direction of vent piping shall be made by the appropriate use of approved fittings, and no such pipe shall be strained or bent. Burred ends shall be reamed to the full bore of the pipe.

904.0 Size of Vents.

904.1 Size. The size of vent piping shall be determined from its length and the total number of fixture units connected thereto, in accordance with Table 703.2. The diameter of an individual vent shall be not less than 1¼ inches (32 mm) nor less than one-half the diameter of the drain to which it is connected. In addition, the drainage piping of each building and each connection to a public sewer or a private sewage disposal system shall be vented by means of one or more vent pipes, the aggregate cross-sectional area of which shall be not less than that of the largest required building sewer as determined from Table 703.2. Vent pipes from fixtures located upstream from pumps, ejectors, backwater valves, or other devices that obstruct the free flow of air and other gases between the building sewer and the outside atmosphere shall not be used for meeting the cross-sectional area venting requirements of this section.

Exception: Where connected to a common building sewer, the drainage piping of two or more buildings located on the same lot and under one ownership shall be permitted to be vented by means of piping sized in accordance with Table 703.2, provided the aggregate cross-sectional area of vents is not less than that of the largest required common building sewer.

904.2 Length. Not more than one-third of the total permitted length, in accordance with Table 703.2, of a minimum-sized vent shall be installed in a horizontal position. Where a minimum-sized vent is increased one pipe size for its entire length, the maximum length limitation shall not apply.

905.0 Vent Pipe Grades and Connections.

905.1 Grade. Vent and branch vent pipes shall be free from drops or sags, and each such vent shall be level or shall be so graded and connected as to drip back by gravity to the drainage pipe it serves.

905.2 Horizontal Drainage Pipe. Where vents connect to a horizontal drainage pipe, each vent pipe shall have its invert taken off above the drainage centerline of such pipe downstream of the trap being served.

905.3 Vent Pipe Rise. Unless prohibited by structural conditions, each vent shall rise vertically to a point not less than 6 inches (152 mm) above the flood-level rim of the fixture served before offsetting horizontally, and where two or more vent pipes converge, each such vent pipe shall rise to a point not less than 6 inches (152 mm) in height above the flood-level rim of the plumbing fixture it serves before being connected to any other vent. Vents less than 6 inches (152 mm) above the flood-level rim of the fixture shall be installed with approved drainage fittings, material, and grade to the drain.

905.4 Roof Termination. Vent pipes shall extend undiminished in size above the roof, or shall be reconnected with soil or waste vent of the proper size.

905.5 Location of Opening. The vent pipe opening from soil or waste pipe, except for water closets and similar fixtures, shall not be below the weir of the trap.

905.6 Common Vertical Pipe. Two fixtures shall be permitted to be served by a common vertical pipe where each such fixture wastes separately into an approved double fitting having inlet openings at the same level.

906.0 Vent Termination.

906.1 Roof Termination. Each vent pipe or stack shall extend through its flashing and shall terminate vertically not less than 6 inches (152 mm) above the roof nor less than 1 foot (305 mm) from a vertical surface. ABS and PVC piping exposed to sunlight shall be protected by water based synthetic latex paints.

906.2 Clearance. Each vent shall terminate not less than 10 feet (3048 mm) from, or not less than 3 feet (914 mm) above, an openable window, door, opening, air intake, or vent shaft, or not less than 3 feet (914 mm) in every direction from a lot line, alley and street excepted.

906.3 Use of Roof. Vent pipes shall be extended separately or combined, of full required size, not less than 6 inches (152 mm) above the roof or firewall. Flagpoling of vents shall be prohibited except where the roof is used for assembly purposes or parking. Vents within 10 feet (3048 mm) of a part of the roof that is used for assembly purposes or parking shall extend not less than 7 feet (2134 mm) above such roof and shall securely stay.

906.4 Outdoor Installations. Vent pipes for outdoor installations shall extend not less than 10 feet (3048 mm) above the surrounding ground and shall be securely supported.

906.5 Joints. Joints at the roof around vent pipes shall be made watertight by the use of approved flashings or flashing material.

906.6 Lead. (See Chapter 17) Sheet lead shall comply with the following:

(1) For safe pans – not less than 4 pounds per square foot (lb/ft^2) (19 kg/m^2) or 1/16 of an inch (1.6 mm) thick.

(2) For flashings or vent terminals – not less than 3 lb/ft^2 (15 kg/m^2) or 0.0472 of an inch (1.2 mm) thick.

(3) Lead bends and lead traps shall be not less than 1/8 of an inch (3.2 mm) in wall thickness.

906.7 Frost or Snow Closure. Where frost or snow closure is likely to occur in locations having minimum design temperature below 0°F (-17.8°C), vent terminals shall be not less than 2 inches (50 mm) in diameter, but in no event smaller than the required vent pipe. The change in diameter shall be made inside the building not less than 1 foot (305 mm) below the roof in an insulated space and terminate not less than 10 inches (254 mm) above the roof, or in accordance with the Authority Having Jurisdiction.

907.0 Vent Stacks and Relief Vents.

907.1 Drainage Stack. Each drainage stack that extends 10 or more stories shall be served by a parallel vent stack, which shall extend undiminished in size from its upper terminal and connect to the drainage stack at or immediately below the lowest fixture drain. Each such vent stack shall also be connected to the drainage stack at each fifth floor, counting down from the up-

permost fixture drain, using a yoke vent, the size of which shall be not less in diameter than either the drainage or the vent stack, whichever is smaller.

907.2 Yoke Vent. The yoke vent connection to the vent stack shall be placed not less than 42 inches (1067 mm) above the floor level, and the yoke vent connection to the drainage stack shall be using a wye-branch fitting placed below the lowest drainage branch connection serving that floor.

908.0 Wet Venting.

908.1 Vertical Wet Venting. Wet venting is limited to vertical drainage piping receiving the discharge from the trap arm of one and two fixture unit fixtures that also serves as a vent not exceeding four fixtures. Wet-vented fixtures shall be within the same story; provided, further, that fixtures with a continuous vent discharging into a wet vent shall be within the same story as the wet-vented fixtures. No wet vent shall exceed 6 feet (1829 mm) in developed length.

908.1.1 Size. The vertical piping between two consecutive inlet levels shall be considered a wet-vented section. Each wet-vented section shall be not less than one pipe size exceeding the required minimum waste pipe size of the upper fixture or shall be one pipe size exceeding the required minimum pipe size for the sum of the fixture units served by such wet-vented section, whichever is larger, but in no case less than 2 inches (50 mm) in diameter.

908.1.2 Vent Connection. Common vent sizing shall be the sum of the fixture units served but, in no case, smaller than the minimum vent pipe size required for a fixture served, or by Section 904.0.

908.2 Horizontal Wet Venting for a Bathroom Group. A bathroom group located on the same floor level shall be permitted to be vented by a horizontal wet vent where all of the conditions of Section 908.2.1 through Section 908.2.5 are met.

908.2.1 Vent Connection. The dry vent connection to the wet vent shall be an individual vent for the bidet, shower, or bathtub. One or two vented lavatory(s) shall be permitted to serve as a wet vent for a bathroom group. Only one wet-vented fixture drain or trap arm shall discharge upstream of the dry-vented fixture drain connection. Dry vent connections to the horizontal wet vent shall be in accordance with Section 905.2 and Section 905.3.

908.2.2 Size. The wet vent shall be sized based on the fixture unit discharge into the wet vent. The wet vent shall be not less than 2 inches (50 mm) in diameter for 4 drainage fixture units (dfu) or less, and not less than 3 inches (80 mm) in diameter for 5 dfu or more. The dry vent shall be sized in accordance with Table 702.1 and Table 703.2 based on the total fixture units discharging into the wet vent.

908.2.3 Trap Arm. The length of the trap arm shall not exceed the limits in Table 1002.2. The trap size shall be in accordance with Section 1003.3. The vent pipe opening from the horizontal wet vent, except for water closets and similar fixtures, shall not be below the weir of the trap.

908.2.4 Water Closet. The water closet fixture drain or trap arm connection to the wet vent shall be downstream of fixture drain or trap arm connections to the horizontal wet vent.

908.2.5 Additional Fixtures. Additional fixtures shall discharge downstream of the wet vent system and be conventionally vented. Only the fixtures within the bathroom group shall connect to the wet-vented horizontal branch.

909.0 Special Venting for Island Fixtures.

909.1 General. Traps for island sinks and similar equipment shall be roughed in above the floor and shall be permitted to be vented by extending the vent as high as possible, but not less than the drainboard height and then returning it downward and connecting it to the horizontal sink drain immediately downstream from the vertical fixture drain. The return vent shall be connected to the horizontal drain through a wye-branch fitting and shall, in addition, be provided with a foot vent taken off the vertical fixture vent by means of a wye branch immediately below the floor and extending to the nearest partition and then through the roof to the open air, or shall be permitted to be connected to other vents at a point not less than 6 inches (152 mm) above the flood-level rim of the fixtures served. Drainage fittings shall be used on the vent below the floor level, and a slope of not less than ¼ inch per foot (20.8 mm/m) back to the drain shall be maintained. The return bend used under the drainboard shall be a one-piece fitting or an assembly of a 45 degree (0.79 rad), a 90 degree (1.57 rad), and a 45 degree (0.79 rad) elbow in the order named. Pipe sizing shall be as elsewhere required in this code. The island sink drain, upstream of the returned vent, shall serve no other fixtures. An accessible cleanout shall be installed in the vertical portion of the foot vent.

910.0 Combination Waste and Vent Systems.

910.1 Where Permitted. Combination waste and vent systems shall be permitted where structural conditions preclude the installation of conventional systems as otherwise prescribed by this code.

910.2 Approval. Construction documents for each combination waste and vent system shall first be approved by the Authority Having Jurisdiction before a portion of such system is installed.

910.3 Vents. Each combination waste and vent system, as defined in Chapter 2, shall be provided with a vent or vents adequate to ensure free circulation of air. A branch exceeding 15 feet (4572 mm) in length shall be separately vented in an approved manner. The area of a vent installed in a combination waste and vent system shall be not less than one-half the inside cross-sectional area of the drain pipe served. The vent connection shall be downstream of the uppermost fixture.

910.4 Size. Each waste pipe and each trap in such a system shall be not less than two pipe sizes exceeding the sizes required by Chapter 7 of this code, and not less than two pipe sizes exceeding a fixture tailpiece or connection.

910.5 Vertical Waste Pipe. No vertical waste pipe shall be used in such a system, except the tailpiece or connection between the outlet of a plumbing fixture and the trap. Such tailpieces or connections shall be as short as possible, and in no case shall exceed 2 feet (610 mm).

Exception: Branch lines shall be permitted to have 45 degree (0.79 rad) vertical offsets.

910.6 Cleanouts. An accessible cleanout shall be installed in each vent for the combination waste and vent system. Cleanouts shall not be required on a wet-vented branch serving a single trap where the fixture tailpiece or connection is not less than 2 inches (50 mm) in diameter and provides ready access for cleaning through the trap.

910.7 Fixtures. No water closet or urinal shall be installed on such a system. Other one, two, or three unit fixtures remotely located from the sanitary system and adjacent to a combination waste and vent system shall be permitted to be connected to such system in the conventional manner by means of waste and vent pipes of regular sizes, providing that the two pipe size increase required in Section 910.4 is based on the total fixture unit load connected to the system.

See Appendix B of this code for explanatory notes on the design of combination waste and vent systems.

911.0 Circuit Venting.

[W] 911.1 Circuit Vent Permitted. A maximum of eight floor-outlet fixtures connected to a horizontal branch drain shall be permitted to be circuit vented. Each fixture drain shall connect horizontally to the horizontal branch being circuit vented. The horizontal branch drain shall be classified as a vent from the most downstream fixture drain connection to the most upstream fixture drain connection to the horizontal branch. Given its grease-producing potential, restaurant kitchen equipment shall not be connected to a circuit vented system. Each trap arm shall connect horizonal to the horizontal branch being circuit vented in accordance with table 1002.2.

Exception: Back-outlet and wall-hung water closets shall be permitted to be circuit vented provided that no floor-outlet fixtures are connected to the same horizontal branch.

911.2 Circuit Vent Size and Connection. The circuit vent size shall be in accordance with Table 703.2 according to the number of circuit vented fixtures connected to the horizontal branch but shall be not less than 2 inches (50 mm) in diameter. The vent shall connect to the horizontal branch on the vertical between the two most upstream trap arms. The circuit vent pipe shall not receive the discharge of soil or waste.

911.2.1 Multiple Circuit Vents. When multiple circuit vents are interconnected according to Section 911.4.1, each individual circuit vent shall be sized according to Section 911.2. The vent pipe connecting each circuit vent shall be sized according to Table 703.2.

911.3 Relief Vent. A 2 inch (50 mm) relief vent shall be provided for circuit-vented horizontal branches receiving the discharge of four or more water closets when connecting to a drainage stack that receives the discharge of soil or waste from upper horizontal branches.

911.3.1 Connection and Installation. The relief vent shall connect to the horizontal branch between the stack and the most downstream trap arm of the circuit vent. The relief vent shall be installed on the vertical to the horizontal branch.

911.3.2 Fixture Drain. The relief vent is permitted to serve as a fixture drain. Fixtures discharging to a relief vent shall be one or two fixture unit fixtures but shall not exceed a total of 4 fixture units.

911.4 Slope and Size of Horizontal Branch. The vented section of the horizontal branch shall be uniformly sloped and not more than 1 inch per foot (83.3 mm/m). The entire length of the vented section of the horizontal branch shall be sized for the total drainage discharge to the branch according to Table 703.2.

911.4.1 Multiple Circuit-Vented Branches. Circuit-vented horizontal branches are permitted to be connected together. Each group of a maximum of eight fixtures shall be considered a separate circuit vent and shall be in accordance with Section 911.4.1.1 and Section 911.4.1.2.

911.4.1.1 Size of Parallel Horizontal Branches. Parallel horizontal circuit vented branches shall be permitted to connect on the same floor level. Each separate circuit-vented horizontal branch that is interconnected shall be sized independently in accordance with Section 911.4.

911.4.1.2 Size of Continuous Horizontal Branches. Two or more circuit vented systems continuous on the same horizontal branch shall be uniformly sized for the total discharge into the branch.

911.5 Additional Fixtures. Fixtures, other than the circuit-vented fixtures, are permitted to discharge to the horizontal branch drain. Such fixtures shall be located on the same floor as the circuit-vented fixtures and shall be either individually or common vented.

912.0 Engineered Vent System.

912.1 General. The design and sizing of a vent system shall be permitted to be determined by accepted engineering practices. The system shall be designed by a registered design professional and approved in accordance with Section 301.5.

912.2 Minimum Requirements. An engineered vent system shall provide protection of the trap seal in accordance with Section 901.3.

[S] 913.0 Air Admittance Valves.

913.1 General. Vent systems utilizing air admittance valves shall comply with this section.

913.2 Where Permitted. Individual fixtures, a branch vent, a vertical wet vent, and a horizontal wet vent shall be permitted to terminate with a connection to an air admittance valve. Fixtures connected to an air admittance valve shall be located on the same floor level.

913.3 Installation. Air admittance valves shall conform to ASSE 1051 for single fixtures, and ASSE 1050 for multiple fixtures, and shall be installed as required in this section and the manufactures installations guidelines.

913.3.1 Location.

(1) Air admittance valves shall be accessible and located in an area that allows air to enter the valve.

(2) The air admittance valve shall be located a minimum of four (4) inches above the trap arm.

(3) The air admittance valve that serves as a vent termination for a branch vent, or vertical and horizontal wet vent, shall be located at a minimum of six (6) inches above the flood level rim of the highest fixture being vented.

(4) The air admittance valve shall be located within the maximum developed length permitted for the vent as shown in Table 703.2.

(5) The air admittance valve shall be installed not less than six (6) inches above insulation materials.

913.4 Size. The air admittance valve shall be rated in accordance with the standard for the vent size as determined in Table 703.2.

913.5 Vent Required. Not less than one plumbing vent sized as required by Section 904.1, shall extend to the exterior of the building as required in Section 906.1.

913.6 Relief Vent. When a horizontal branch drain utilizes an individual or branch type air admittance valve, a relief vent shall be installed when the horizontal branch drain is located more than four (4) branch intervals from the top of the building drain (waste stack), and the relief vent shall extend to the outdoors or connect to a vent stack.

The relief vent shall be sized in accordance with Section 904.1, installed in accordance with Sections 905.0, and shall be permitted to serve as the vent for other fixtures.

913.6.1 Prior Approval. Installations that require a relief vent shall be submitted for an installation design review.

913.7 Prohibited Installations.

913.7.1 Sumps. Air admittance valves shall not be utilized to vent sumps or tanks of any type.

913.7.2 Chemical Waste Systems. Air admittance valves shall not be installed in nonneutralized chemical waste systems without a design review and approval by the Authority Having Jurisdiction.

913.7.3 FOG Disposal Systems. Air admittance valves shall not be installed on any fixtures that are connected to a *FOG disposal system*.

913.7.4 Plenums. Air admittance valves shall not be located in spaces utilized as supply or return air plenums.

CHAPTER 10
TRAPS AND INTERCEPTORS

1001.0 General.

1001.1 Applicability. This chapter shall govern the materials, design, and installation of traps and interceptors.

1001.2 Where Required. Each plumbing fixture shall be separately trapped by an approved type of liquid seal trap. This section shall not apply to fixtures with integral traps. Not more than one trap shall be permitted on a trap arm. Food waste disposers installed with a set of restaurant, commercial, or industrial sinks shall be connected to a separate trap. Each domestic clothes washer and each laundry tub shall be connected to a separate and independent trap, except that a trap serving a laundry tub shall also be permitted to receive the waste from a clothes washer set adjacent to it. The vertical distance between a fixture outlet and the trap weir shall be as short as practicable, but in no case shall the tailpiece exceed 24 inches (610 mm) in length. One trap shall be permitted to serve a set of not more than three single compartment sinks or laundry tubs of the same depth or three lavatories immediately adjacent to each other and in the same room where the waste outlets are not more than 30 inches (762 mm) apart, and the trap is centrally located where three compartments are installed.

1002.0 Traps Protected by Vent Pipes.

1002.1 Vent Pipes. Each plumbing fixture trap, except as otherwise provided in this code, shall be protected against siphonage, backpressure, and air circulation shall be assured throughout the drainage system using a vent pipe installed in accordance with the requirements of this code.

1002.2 Fixture Traps. Each fixture trap shall have a protecting vent so located that the developed length of the trap arm from the trap weir to the inner edge of the vent shall be within the distance given in Table 1002.2 but in no case less than two times the diameter of the trap arm.

TABLE 1002.2
HORIZONTAL LENGTHS OF TRAP ARMS (EXCEPT FOR WATER CLOSETS AND SIMILAR FIXTURES)[1, 2]

TRAP ARM PIPE DIAMETER (inches)	DISTANCE TRAP TO VENT MINIMUM (inches)	LENGTH MAXIMUM (inches)
1¼	2½	30
1½	3	42
2	4	60
3	6	72
4	8	120
Exceeding 4	2 x Diameter	120

For SI units: 1 inch = 25.4 mm

Notes:

[1] Maintain ¼ inch per foot slope (20.8 mm/m).

[2] The developed length between the trap of a water closet or similar fixture (measured from the top of the closet flange to the inner edge of the vent) and its vent shall not exceed 6 feet (1829 mm).

1002.3 Change of Direction. A trap arm shall be permitted to change direction without the use of a cleanout where such change of direction does not exceed 90 degrees (1.57 rad). Horizontal changes in the direction of trap arms shall be in accordance with Section 706.3.

Exception: For trap arms, 3 inches (80 mm) in diameter and larger, the change of direction shall not exceed 135 degrees (2.36 rad) without the use of a cleanout.

1002.4 Vent Pipe Opening. The vent pipe opening from soil or waste pipe, except for water closets and similar fixtures, shall not be below the weir of the trap.

1003.0 Traps — Described.

1003.1 General Requirements. Each trap, except for traps within an interceptor or similar device shall be self-cleaning. Traps for bathtubs, showers, lavatories, sinks, laundry tubs, floor drains, urinals, drinking fountains, dental units, and similar fixtures shall be of standard design, weight and shall be of ABS, cast-brass, cast-iron, lead, PP, PVC, or other approved material. An exposed and readily accessible drawn-copper alloy tubing trap, not less than 17 B & S Gauge (0.045 inch) (1.143 mm), shall be permitted to be used on fixtures discharging domestic sewage.

Exception: Drawn-copper alloy tubing traps shall not be used for urinals. Each trap shall have the manufacturer's name stamped legibly in the metal of the trap, and each tubing trap shall have the gauge of the tubing in addition to the manufacturer's name. A trap shall have a smooth and uniform interior waterway.

1003.2 Slip Joint Fittings. A maximum of one approved slip joint fitting shall be permitted to be used on the outlet side of a trap, and no tubing trap shall be installed without a listed tubing trap adapter. Listed plastic trap adapters shall be permitted to be used to connect listed metal tubing traps.

1003.3 Size. The size (nominal diameter) of a trap for a given fixture shall be sufficient to drain the fixture rapidly but in no case less than nor more than one pipe size larger than given in Table 702.1. The trap shall be the same size as the trap arm to which it is connected.

1004.0 Traps.

1004.1 Prohibited. No form of trap that depends for its seal upon the action of movable parts shall be used. No trap that has concealed interior partitions, except those of plastic, glass, or similar corrosion-resisting material, shall be used. "S" traps, bell traps, and crown-vented traps shall be prohibited. No fixture shall be double trapped. Drum and bottle traps shall be installed for special conditions. No trap shall be installed without a vent, except as otherwise provided in this code.

1004.2 Movable Parts. Bladders, check valves or another type of devices with moveable parts shall be prohibited to serve as a trap.

1005.0 Trap Seals.

1005.1 General. Each fixture trap shall have a liquid seal of not less than 2 inches (51 mm) and not more than 4 inches (102 mm), except where a deeper seal is found necessary by the Authority Having Jurisdiction. Traps shall be set true with respect to their liquid seals and, where necessary, they shall be protected from freezing.

1006.0 Floor Drain Traps.

1006.1 General. Floor drains shall connect into a trap so constructed that it can be readily cleaned and of a size to serve efficiently the purpose for which it is intended. The drain inlet shall be so located that it is in full view. Where subject to the reverse flow of sewage or liquid waste, such drains shall be equipped with an approved backwater valve.

1007.0 Trap Seal Protection.

1007.1 General. Floor drain or similar traps directly connected to the drainage system and subject to infrequent use shall be protected with a trap seal primer, except where not deemed necessary for safety or sanitation by the Authority Having Jurisdiction. Trap seal primers shall be accessible for maintenance.

1007.2 Trap Seal Primers. Potable water supply trap seal primer valves shall comply with ASSE 1018. Drainage and electronic design type trap seal primer devices shall comply with ASSE 1044.

[S] 1007.3 Trap Priming Water. Trap primers serving floor drains located in rooms that contain fixtures served by a nonpotable water system complying with Chapter 15 or 16 shall also be served by the nonpotable water system.

1008.0 Building Traps.

1008.1 General. Building traps shall not be installed except where required by the Authority Having Jurisdiction. Each building trap where installed shall be provided with a cleanout and with a relieving vent or fresh-air intake on the inlet side of the trap, which needs not be larger than one-half the diameter of the drain to which it connects. Such relieving vent or fresh-air intake shall be carried above grade and terminate in a screened outlet located outside the building.

1009.0 Interceptors (Clarifiers) and Separators.

1009.1 Where Required. Interceptors (clarifiers) (including grease, oil, sand, solid interceptors, etc.) shall be required by the Authority Having Jurisdiction where they are necessary for the proper handling of liquid wastes containing grease, flammable wastes, sand, solids, acid or alkaline substances, or other ingredients harmful to the building drainage system, the public or private sewer, or to public or private sewage disposal.

1009.2 Approval. The size, type, and location of each interceptor (clarifier) or separator shall be approved by the Authority Having Jurisdiction. Except where otherwise specifically permitted, no wastes other than those requiring treatment or separation shall be discharged into an interceptor (clarifier).

1009.3 Design. Interceptors (clarifiers) for sand and similar heavy solids shall be so designed and located as to be readily accessible for cleaning and shall have a water seal of not less than 6 inches (152 mm).

1009.4 Relief Vent. Interceptors (clarifiers) shall be so designed that they will not become air-bound where closed covers are used. Each interceptor (clarifier) shall be properly vented.

1009.5 Location. Each interceptor (clarifier) cover shall be readily accessible for servicing and maintaining the interceptor (clarifier) in working and operating condition. The use of ladders or the removal of bulky equipment to service interceptors (clarifiers) shall constitute a violation of accessibility. Location of interceptors (clarifiers) shall be shown on the approved building plan.

1009.6 Maintenance of Interceptors. Interceptors shall be maintained in efficient operating condition by periodic removal of accumulated grease, scum, oil, or other floating substances and solids deposited in the interceptor.

1009.7 Discharge. The waste pipe from oil and sand interceptors shall discharge as approved by the Authority Having Jurisdiction.

1010.0 Slaughterhouses, Packing Establishments, etc.

1010.1 General. A fish, fowl, and animal slaughterhouse or establishment; a fish, fowl, and meat packing or curing establishment; a soap factory, tallow-rendering, fat-rendering, and a hide-curing establishment shall be connected to and shall drain or discharge into an approved grease interceptor (clarifier).

1011.0 Minimum Requirements for Auto Wash Racks.

1011.1 General. A private or public wash rack or floor or slab used for cleaning machinery or machine parts shall be adequately protected against storm or surface water and shall drain or discharge into an approved interceptor (clarifier).

1012.0 Commercial and Industrial Laundries.

1012.1 General. Laundry equipment in commercial and industrial buildings that do not have integral strainers shall discharge into an interceptor having a wire basket or similar device that is removable for cleaning and that will prevent passage into the drainage system of solids ½ of an inch (12.7 mm) or larger in maximum dimensions, such as string, rags, buttons, or other solid materials detrimental to the public sewerage system.

1013.0 Bottling Establishments.

1013.1 General. Bottling plants shall discharge their process wastes into an interceptor that will provide for the separation of broken glass or other solids, before discharging liquid wastes into the drainage system.

1014.0 Grease Interceptors.

1014.1 General. Where it is determined by the Authority Having Jurisdiction that waste pretreatment is required, an approved type of grease interceptor(s) shall comply with ASME A112.14.3, ASME A112.14.4, CSA B481, PDI G-101, or PDI G-102, and sized in accordance with Section 1014.2.1 or Section 1014.3.6, shall be installed in accordance with the manufacturer's installation instructions to receive the drainage from fixtures or equipment that produce grease-laden waste. Grease-laden waste fixtures shall include, but not be limited to, sinks and drains, such as floor drains, floor sinks, and other fixtures or equipment in serving establishments, such as restaurants, cafes, lunch counters, cafeterias, bars and clubs, hotels, hospitals, sanitariums, factory or school kitchens, or other establishments where grease is introduced into the drainage or sewage system in quantities that can effect line stoppage or hinder sewage treatment or private sewage disposal systems. A combination of hydromechanical, gravity grease interceptors and engineered systems shall be allowed to meet this code and other applicable requirements of the Authority Having Jurisdiction where space or existing physical constraints of existing buildings necessitate such installations. A grease interceptor shall not be required for individual dwelling units or private living quarters. Water closets, urinals, and other plumbing fixtures conveying human waste shall not drain into or through the grease interceptor.

1014.1.1 Trapped and Vented. Each fixture discharging into a grease interceptor shall be individually trapped and vented in an approved manner.

1014.1.2 Maintenance. Grease interceptors shall be maintained in efficient operating condition by periodic removal of the accumulated grease and latent material. No such collected grease shall be introduced into drainage piping or a public or private sewer. Where the Authority Having Jurisdiction determines that a grease interceptor is not being properly cleaned

or maintained, the Authority Having Jurisdiction shall have the authority to mandate the installation of additional equipment or devices and to mandate a maintenance program.

[S] 1014.1.3 Food Waste Disposers and Dishwashers. No food waste disposer or dishwasher shall be connected to or discharge into a grease interceptor.

Exception: Food waste disposers shall be permitted to discharge to grease interceptors that are designed to receive the discharge of food waste, or a listed food solids interceptor shall be installed at the discharge of the food waste disposer.

1014.2 Hydromechanical Grease Interceptors. Plumbing fixtures or equipment connected to a Type A and B hydromechanical grease interceptor shall discharge through an approved type of vented flow control installed in a readily accessible and visible location. Flow control devices shall be designed and installed so that the total flow through such device or devices shall at no time be greater than the rated flow of the connected grease interceptor. No flow control device having adjustable or removable parts shall be approved. The vented flow control device shall be located such that no system vent shall be between the flow control and the grease interceptor inlet. The vent or air inlet of the flow control device shall connect with the sanitary drainage vent system, as elsewhere required by this code, or shall terminate through the roof of the building, and shall not terminate to the free atmosphere inside the building.

Exception: Listed grease interceptors with integral flow controls or restricting devices shall be installed in an accessible location in accordance with the manufacturer's installation instructions.

1014.2.1 Capacity. The total capacity in gallons (gal) (L) of fixtures discharging into a hydromechanical grease interceptor shall not exceed two and one-half times the certified gallon per minute (gpm) (L/s) flow rate of the interceptor in accordance with Table 1014.2.1.

For this section, the term "fixture" shall mean and include each plumbing fixture, appliance, apparatus, or other equipment required to be connected to or discharged into a grease interceptor by a provision of this section.

TABLE 1014.2.1
HYDROMECHANICAL GREASE INTERCEPTOR SIZING USING GRAVITY FLOW RATES[1]

DIAMETER OF GREASE WASTE PIPE (inches)	MAXIMUM FULL PIPE FLOW (gpm)[2]	SIZE OF GREASE INTERCEPTOR	
		ONE-MINUTE DRAINAGE PERIOD (gpm)	TWO-MINUTE DRAINAGE PERIOD (gpm)
2	20	20	10
3	60	75	35
4	125	150	75
5	230	250	125
6	375	400	200

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s

Notes:

[1] For interceptor sizing by the fixture capacity see the example below.

[2] ¼ inch slope per foot (20.8 mm/m) based on Manning's formula with friction factor N =.012.

EXAMPLE 1014.2.1
SIZING HYDROMECHANICAL GREASE INTERCEPTOR(S) USING FIXTURE CAPACITY

Step 1: Determine the flow rate from each fixture.

[Length] X [Width] X [Depth] / [231] = Gallons X [.75 fill factor] / [Drain Period (1 minute or 2 minutes)]

Step 2: Calculate the total load from fixtures that discharge into the interceptor.

FIXTURES	COMPARTMENTS	LOAD (gallons)	SIZE OF GREASE INTERCEPTOR ONE-MINUTE DRAINAGE PERIOD (gpm)	TWO-MINUTE DRAINAGE PERIOD (gpm)
Compartment size	—	—	—	—
24 inches x 24 inches x 12 inches	2	44.9	—	—
Hydrant	—	3	—	—
Rated Appliance	—	2	—	—
—	—	49.9	50	25

For SI units: 1 inch = 25.4 mm, 1 gallon per minute = 0.06 L/s, 1 gallon = 3.785 L

1014.2.2 Vent. A vent shall be installed downstream of hydromechanical grease interceptors in accordance with the requirements of this code.

1014.3 Gravity Grease Interceptors. Required gravity grease interceptors shall comply with the provisions of Section 1014.3.1 through Section 1014.3.7.

1014.3.1 General. The provisions of this section shall apply to the design, construction, installation, and testing of commercial kitchen gravity grease interceptors.

1014.3.2 Waste Discharge Requirements. Waste discharge in establishments from fixtures and equipment which contain grease, including but not limited to, scullery sinks, pot and pan sinks, dishwashers, soup kettles, and floor drains located in areas where grease-containing materials exist, shall be permitted to be drained into the sanitary waste through the interceptor where approved by the Authority Having Jurisdiction.

1014.3.2.1 Toilets and Urinals. Toilets, urinals, and other similar fixtures shall not drain through the interceptor.

1014.3.2.2 Inlet Pipe. Waste shall enter the interceptor through the inlet pipe.

1014.3.3 Design. Gravity interceptors shall be constructed in accordance with the applicable standard in Chapter 17 or the design approved by the Authority Having Jurisdiction.

1014.3.4 Location. Each grease interceptor shall be so installed and connected that it shall be easily accessible for inspection, cleaning, and removal of the intercepted grease. A gravity grease interceptor that complies with IAPMO Z1001 shall not be installed in a building where food is handled. Location of the grease interceptor shall meet the approval of the Authority Having Jurisdiction.

1014.3.4.1 Interceptors. Interceptors shall be placed as close as practical to the fixtures they serve.

1014.3.4.2 Business Establishment. Each business establishment for which a gravity grease interceptor is required shall have an interceptor which shall serve that establishment unless otherwise approved by the Authority Having Jurisdiction.

1014.3.4.3 Access. Each gravity grease interceptor shall be located to be readily accessible to the equipment required for maintenance.

1014.3.5 Construction Requirements. Gravity grease interceptors shall be designed to remove grease from effluent and shall be sized in accordance with this section. Gravity grease interceptors shall also be designed to retain grease until accumulations can be removed by pumping the interceptor. It is recommended that a sample box is located at the outlet end of gravity grease interceptors so that the Authority Having Jurisdiction can periodically sample effluent quality.

1014.3.6 Sizing Criteria. The volume of the interceptor shall be determined by using Table 1014.3.6. Where drainage

TABLE 1014.3.6
GRAVITY GREASE INTERCEPTOR SIZING

DRAINAGE FIXTURE UNITS[1, 3] (DFUs)	INTERCEPTOR VOLUME[2] (gallons)
8	500
21	750
35	1000
90	1250
172	1500
216	2000
307	2500
342	3000
428	4000
576	5000
720	7500
2112	10 000
2640	15 000

For SI units: 1 gallon = 3.785 L

Notes:

1 The maximum allowable DFUs plumbed to the kitchen drain lines that will be connected to the grease interceptor.

2 This size is based on DFUs, the pipe size from this code; Table 703.2; Useful Tables for flow in half-full pipes (ref: Mohinder Nayyar Piping Handbook, 3rd Edition, 1992). Based on 30-minute retention time (ref.: George Tchobanoglous and Metcalf & Eddy. Wastewater Engineering Treatment, Disposal, and Reuse, 3rd Ed. 1991 & Ronald Crites and George Tchobanoglous. Small and Decentralized Wastewater Management Systems, 1998). Rounded up to nominal interceptor volume.

3 Where the flow rate of directly connected fixture(s) or appliance(s) have no assigned DFU values, the additional grease interceptor volume shall be based on the known flow rate (gpm) (L/s) multiplied by 30 minutes.

fixture units (DFUs) are not known, the interceptor shall be sized based on the maximum DFUs allowed for the pipe size connected to the inlet of the interceptor. Refer to Table 703.2, Drainage Piping, Horizontal.

EXAMPLE 1014.3.6
GRAVITY GREASE INTERCEPTOR SIZING EXAMPLE

Given: A restaurant with the following fixtures and equipment.

One food preparation sink; three-floor drains - one in the food prep area, one in the grill area, and one receiving the indirect waste from the ice machine and a mop sink.

Kitchen Drain Line DFU Count (from Table 702.1):

3 floor drains at 2 DFUs each	=	6 DFUs
Mop sink at 3 DFUs each	=	3 DFUs
Food prep sink at 3 DFUs each	=	3 DFUs
Total	=	12 DFUs

Using Table 1014.3.6, the grease interceptor will be sized at 750 gallons (2389 L).

1014.3.7 Abandoned Gravity Grease Interceptors. Abandoned grease interceptors shall be pumped and filled as required for abandoned sewers and sewage disposal facilities in Section 722.0.

1015.0 FOG (Fats, Oils, and Greases) Disposal System.

1015.1 Purpose. The purpose of this section is to provide the necessary criteria for the sizing, application, and installation of FOG disposal systems designated as a pretreatment or discharge water quality compliance strategy.

1015.2 Components, Materials, and Equipment. FOG disposal systems, including components, materials, and equipment necessary for the proper function of the system, shall comply with ASME A112.14.6.

1015.3 Sizing and Installation. FOG disposal systems shall be sized and installed in accordance with the manufacturer's installation instructions.

1015.4 Performance. FOG disposal systems shall produce an effluent quality not to exceed 5.84 grains per gallon (gr/gal) (100 mg/L) FOG.

1016.0 Sand Interceptors.

1016.1 Discharge. Where the discharge of a fixture or drain contains solids or semi-solids heavier than water that would be harmful to a drainage system or cause a stoppage within the system, the discharge shall be through a sand interceptor. Multiple floor drains shall be permitted to discharge into one sand interceptor.

1016.2 Authority Having Jurisdiction. Sand interceptors are required where the Authority Having Jurisdiction deems it advisable to have a sand interceptor to protect the drainage system.

1016.3 Construction and Size. Sand interceptors shall be built of brick or concrete, prefabricated coated steel, or other watertight material. The interceptor shall have an interior baffle for full separation of the interceptor into two sections. The outlet pipe shall be the same size as the inlet pipe of the sand interceptor, the minimum being 3 inches (80 mm), and the baffle shall have two openings of the same diameter as the outlet pipe and at the same invert as the outlet pipe. These openings shall be staggered so that there cannot be a straight line flow between the inlet pipe and the outlet pipe. The invert of the inlet pipe shall be no lower than the invert of the outlet pipe.

The sand interceptor shall have a minimum dimension of 2 square feet (0.2 m^2) for the net free opening of the inlet section and a minimum depth under the invert of the outlet pipe of 2 feet (610 mm).

For each 5 gpm (0.3 L/s) flow or fraction thereof over 20 gpm (1.26 L/s), the area of the sand interceptor inlet section is to be increased by 1 square foot (0.09 m^2). The outlet section shall at all times have a minimum area of 50 percent of the inlet section.

The outlet section shall be covered by a solid removable cover, set flush with the finished floor, and the inlet section shall have an open grating, set flush with the finished floor and suitable for the traffic in the area in which it is located.

1016.4 Separate Use. Sand and similar interceptors for every solid shall be so designed and located as to be readily accessible for cleaning, shall have a water seal of not less than 6 inches (152 mm), and shall be vented.

1017.0 Oil and Flammable Liquid Interceptors.

1017.1 Interceptors Required. Repair garages and gasoline stations with grease racks or grease pits, and factories that have oily, flammable, or both types of wastes as a result of manufacturing, storage, maintenance, repair, or testing processes, shall be provided with an oil or flammable liquid interceptor that shall be connected to necessary floor drains. The separation or vapor compartment shall be independently vented to the outer air. Where two or more separation or vapor compartments are used, each shall be vented to the outer air or shall be permitted to connect to a header that is installed at a minimum of 6 inches (152 mm) above the spill line of the lowest floor drain and vented independently to the outer air. The minimum size of a flammable vapor vent shall be not less than 2 inches (50 mm), and, where vented through a sidewall, the vent shall be not less than 10 feet (3048 mm) above the adjacent level at an approved location. The interceptor shall be vented on the sewer side and shall not connect to a flammable vapor vent. Oil and flammable interceptors shall be provided with gastight cleanout covers that shall be readily accessible. The waste line shall be not less than 3 inches (80 mm) in diameter with a full-size cleanout to grade. Where an interceptor is provided with an overflow, it shall be provided with an overflow line [not less than 2 inches (50 mm) in diameter] to an approved waste oil tank having a minimum capacity of 550 gallons (2082 L) and meeting the requirements of the Authority Having Jurisdiction. The waste oil from the separator shall flow by gravity or shall be pumped to a higher elevation by an automatic pump. Pumps shall be adequately sized and accessible. Waste oil tanks shall have a 2 inch (50 mm) minimum pump-out connection at grade and an 1½ inch (40 mm) minimum vent to atmosphere at an approved location not less than 10 feet (3048 mm) above grade.

1017.2 Design of Interceptors. Each manufactured interceptor that is rated shall be stamped or labeled by the manufacturer with an indication of its full discharge rate in gpm (L/s). The full discharge rate to such an interceptor shall be determined at full flow. Each interceptor shall be rated equal to or greater than the incoming flow and shall be provided with an overflow line to an underground tank.

Interceptors not rated by the manufacturer shall have a depth of not less than 2 feet (610 mm) below the invert of the discharge drain. The outlet opening shall have not less than an 18 inch (457 mm) water seal and shall have a minimum capacity as follows: Where not more than three motor vehicles are serviced, stored, or both, interceptors shall have a minimum capacity of 6 cubic feet (0.2 m^3), and 1 cubic foot (0.03 m^3) of capacity shall be added for each vehicle up to 10 vehicles. Above 10 vehicles, the Authority Having Jurisdiction shall determine the size of the interceptor required. Where vehicles are serviced and not stored, interceptor capacity shall be based on a net capacity of 1 cubic foot (0.03 m^3) for each 100 square feet (9.29 m^2) of the surface to be drained into the interceptor, with a minimum of 6 cubic feet (0.2 m^3).

[S] 1018.0 Parking Garage Drainage Systems.

[S] 1018.0 Parking Garage Drainage Systems. Parking garage drainage systems shall comply with Sections 1018.1 and 1018.2. All plans for parking garage floor drainage systems shall be submitted to the Authority Having Jurisdiction and approved prior to installation.

[S] 1018.1 Parking Garage Drains. Drains connected to the parking garage drainage system shall comply with the following:

(1) Unless otherwise approved by the Authority Having Jurisdiction, drains serving parking or loading dock areas exposed to precipitation and greater than 200 square feet shall be connected to the building storm drainage system. All other parking garage and/or loading dock drainage shall be connected to the sanitary drainage system through the use of a sand interceptor or oil/water separator.

(2) Parking garage drain outlets and connected drainage waste lines shall be a minimum of three inches in diameter. Waste unit loading for parking garage drains shall be sized in accordance with Table 702.2(1) or Table 702.2(2). Drainage piping serving parking garage drains shall be sized in accordance with Table 703.2.

(3) Drains of any type connected to the parking garage drainage system shall be equipped with approved strainers and need not be trapped or vented when connected to the building drain though a properly trapped and vented sand interceptor or oil/water separator. Drains at floor level and subject to vehicular traffic shall be equipped with strainers with a load rating appropriate to the use of the parking area served.

(4) Traps shall not be used when drains are located in areas exposed to freezing temperatures.

(5) The waste line from drains entering a sand interceptor or oil/water separator shall be at an elevation equal to or above the waste line discharging from the sand interceptor or oil/water separator .

(6) The sand interceptor or oil/water separator receiving the discharge from parking garage floor drains shall have a water seal of not less than six inches. Sand interceptors shall meet the requirements of Section 1016.0. Oil/water separators shall meet the requirements of Section 1009.0. Submittal information shall be provided to the Authority Having Jurisdiction prior to installation. The water seal of the sand interceptor or oil/water separator shall be maintained by an automatic electronic trap primer discharging not less than ½ gallon per day.

[S] 1018.2 Drainage From Other Plumbing Fixtures. Drainage from any plumbing fixture other than a parking garage floor drain shall not be interconnected with the parking garage drainage system.

Exception: Where first approved by the Authority Having Jurisdiction, the following types of drains may be connected to the parking garage drainage system upstream of the sand interceptor or oil/water separator and need not be individually trapped or vented, provided that all drainage piping downstream of such drains, including the sand interceptor or oil/water separator, is sized to accommodate the largest flow of effluent anticipated from any single connected drain under worst case or emergency conditions:

(1) Drains within car or truck washing areas and drainage lines from car or truck washing equipment.

(2) Approved indirect receptors located within the parking garage and accepting drainage from fire/sprinkler standpipes, fire water storage tanks, mechanical condensate, relief valves, or other similar clear water waste only.

(3) Approved indirect receptors located within the parking garage and accepting drainage from hoistway pumps or drains required by ASME A17.1, provided the discharge from the sand interceptor or oil/water separator connects to the building drain by gravity and not to a sanitary lift station.

(4) Where the sand interceptor or oil/water separator discharges to a sanitary lift station, an approved indirect receptor located within the parking garage and accepting drainage from a pump serving a hoistway containing a Fire Service Access or Occupant Evacuation Operation Elevator that is required to be on Emergency Power per Seattle Building Code Section 403.4.8.4 may only be connected to the parking garage drainage system when the floor of the hoistway enclosure is above the flood level rim of the sanitary lift station, and/or the hoistway enclosure is protected in accordance with Seattle Building Code Section 403.6.1.2. Sanitary lift station pumps shall not be connected to Emergency Power.

(5) Floor drains and indirect receptors within mechanical rooms, water entry rooms, fire pump rooms, and similar spaces where no graywater or blackwater producing fixtures are located, provided such rooms have a door or doors that open directly into the parking garage and are directly and continuously exhausted by mechanical means or provided with permanent fixed openings into the parking garage.

Note: For the purposes of this section, a mop sink, utility sink, or similar fixture shall not be considered an approved indirect receptor.

CHAPTER 11
STORM DRAINAGE

1101.0 General.

1101.1 Applicability. This chapter shall govern the materials, design, and installation of storm water drainage systems.

1101.2 Where Required. Roofs, paved areas, yards, courts, courtyards, vent shafts, light wells, or similar areas having rainwater, shall be drained into a separate storm sewer system, or into a combined sewer system where a separate storm sewer system is not available, or to some other place of disposal satisfactory to the Authority Having Jurisdiction. In the case of one- and two-family dwellings, storm water shall be permitted to be discharged on flat areas, such as streets or lawns, so long as the storm water shall flow away from the building and away from adjoining property, and shall not create a nuisance.

1101.3 Storm Water Drainage to Sanitary Sewer Prohibited. Storm water shall not be drained into sewers intended for sanitary drainage.

[W] [S] 1101.4 Material Uses. Pipe, tube, and fittings conveying rainwater shall be of such materials and design as to perform their intended function to the satisfaction of the Authority Having Jurisdiction. Conductors within a vent or shaft shall be of cast-iron, galvanized steel, wrought iron, copper, copper alloy, lead, Schedule 40 ABS DWV, Schedule 40 PVC DWV, stainless steel 304 or 316L [stainless steel 304 pipe and fittings shall not be installed underground and shall be kept not less than 6 inches (152 mm) aboveground], or other approved materials, and changes in direction shall conform to the requirements of Section 706.0.

ABS and PVC DWV piping installations shall be installed in accordance with applicable standards referenced in Table 1701.1. Except for individual single-family dwelling units, materials exposed within ducts or plenums shall have a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, when tested in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with ASTM E84 and UL 723.

1101.4.1 Copper and Copper Alloys. Joints and connections in copper and copper alloy pipe and tube shall be installed in accordance with Section 705.3.

1101.4.2 Conductors. Conductors installed aboveground in buildings shall comply with the applicable standards referenced in Table 701.2 for aboveground drain, waste, and vent pipe. Conductors installed aboveground level shall be of seamless copper water tube, Type K, L, or M; Schedule 40 copper pipe or Schedule 40 copper alloy pipe; Type DWV copper drainage tube; service weight cast-iron soil pipe or hubless cast-iron soil pipe; standard weight galvanized steel pipe; stainless steel 304 or 316L [stainless steel 304 pipe and fittings shall not be installed underground and shall be kept not less than 6 inches (152 mm) aboveground], or Schedule 40 ABS or Schedule 40 PVC plastic pipe.

1101.4.3 Leaders. Leaders installed outside shall comply with the applicable standards referenced in Table 701.2 for aboveground drain, waste, and vent pipe; aluminum sheet metal; galvanized steel sheet metal; or copper sheet metal.

1101.4.4 Underground Building Storm Drains. Underground building storm drains shall comply with the applicable standards referenced in Table 701.2 for underground drain, waste, and vent pipe.

1101.4.5 Building Storm Sewers. Building storm sewers shall comply with the applicable standards referenced in Table 701.2 for building sewer pipe.

1101.4.6 Subsoil Drains. Subsoil drains shall be open jointed, perforated, or both and constructed of materials in conformance with Table 1101.4.6.

TABLE 1101.4.6
MATERIALS FOR SUBSOIL DRAIN PIPE AND FITTINGS

MATERIAL	REFERENCED STANDARD(S)
PE	ASTM F667
PVC	ASTM D2729
Vitrified Clay (Extra strength)	ASTM C4, ASTM C700

1101.5 Expansion Joints Required. Expansion joints or sleeves shall be provided where warranted by temperature variations or physical conditions.

1101.6 Subsoil Drains. Subsoil drains shall be provided around the perimeter of buildings having basements, cellars, crawl spaces, or floors below grade. Such subsoil drains shall be permitted to be positioned inside or outside of the footing, shall be of perforated or open-jointed approved drain tile or pipe, not less than 3 inches (80 mm) in diameter, and shall be laid in gravel, slag, crushed rock, approved ¾ of an inch (19.1 mm) crushed, recycled glass aggregate, or other approved porous material with not less than 4 inches (102 mm) surrounding the pipe. Filter media shall be provided for exterior subsoil piping.

1101.6.1 Discharge. Subsoil drains shall be piped to a storm drain, to an approved water course, to the front street curb or gutter, to an alley, or the discharge from the subsoil drains shall be conveyed to the alley by a concrete gutter. Where a continuously flowing spring or groundwater is encountered, subsoil drains shall be piped to a storm drain or an approved water course.

1101.6.2 Sump. Where it is not possible to convey the drainage by gravity, subsoil drains shall discharge to an accessible sump provided with an approved automatic electric pump. The sump shall be not less than 15 inches (381 mm) in diameter, 18 inches (457 mm) in depth, and provided with a fitted cover. The sump pump shall have an adequate capacity to discharge water coming into the sump as it accumulates to the required discharge point, and the capacity of the pump shall be not less than 15 gallons per minute (gpm) (0.95 L/s). The discharge piping from the sump pump shall be not less than 1½ inches (40 mm) in diameter and have a union or other approved quick-disconnect assembly to make the pump accessible for servicing.

1101.6.3 Splash Blocks. For separate dwellings not serving continuously flowing springs or groundwater, the sump discharge pipe shall be permitted to discharge onto a concrete splash block with a minimum length of 24 inches (610 mm). This pipe shall be within 4 inches (102 mm) of the splash block and positioned to direct the flow parallel to the recessed line of the splash block.

1101.6.4 Backwater Valve. Subsoil drains subject to backflow where discharging into a storm drain shall be provided with a backwater valve in the drain line so located as to be accessible for inspection and maintenance.

1101.6.5 Open Area. Nothing in Section 1101.6 shall prevent drains that serve either subsoil drains or areaways of a detached building from discharging to a properly graded open area, provided that:

(1) They do not serve continuously flowing springs or groundwater.

(2) The point of discharge is not less than 10 feet (3048 mm) from a property line.

(3) It is impracticable to discharge such drains to a storm drain, to an approved water course, to the front street curb or gutter, or to an alley.

1101.7 Building Subdrains. Building subdrains located below the public sewer level shall discharge into a sump or receiving tank, the contents of which shall be automatically lifted and discharged into the drainage system as required for building sumps.

1101.8 Areaway Drains. Open subsurface space adjacent to a building, serving as an entrance to the basement or cellar of a building, shall be provided with a drain or drains. The areaway drains shall be not less than 2 inches (50 mm) in diameter for areaways at a maximum of 100 square feet (9.29 m^2) in area, and shall be discharged in the manner provided for subsoil drains not serving continuously flowing springs or groundwater (see Section 1101.6.1). Areaways exceeding 100 square feet (9.29 m^2) shall not drain into subsoil drains. The drains for areaways exceeding 100 square feet (9.29 m^2) shall be sized in accordance with Table 1103.2.

1101.9 Window Areaway Drains. Window areaways at a maximum of 10 square feet (0.93 m^2) in area shall be permitted to discharge to the subsoil drains through a 2 inch (50 mm) diameter pipe. However, window areaways exceeding 10 square feet (0.93 m^2) in area shall be handled in the manner provided for entrance areaways (see Section 1101.8).

1101.10 Filling Stations and Motor Vehicle Washing Establishments. Public filling stations and motor vehicle washing establishments shall have the paved area sloped toward sumps or gratings within the property lines. Curbs not less than 6 inches (152 mm) high shall be placed where required to direct water to gratings or sumps.

1101.11 Paved Areas. Where the occupant creates surface water drainage, the sumps, gratings, or floor drains shall be piped to a storm drain or an approved water course.

1101.12 Roof Drainage. Roof drainage shall comply with Section 1101.12.1 and Section 1101.12.2.

1101.12.1 Primary Roof Drainage. Roof areas of a building shall be drained by roof drains or gutters. The location and sizing of drains and gutters shall be coordinated with the structural design and pitch of the roof. Unless otherwise required by the Authority Having Jurisdiction, roof drains, gutters, vertical conductors or leaders, and horizontal storm drains for primary drainage shall be sized based on a storm of 60 minutes duration and 100 year return period.

[W] 1101.12.2 Secondary Drainage. Secondary (emergency) roof drainage shall be provided by one of the methods specified in Section 1101.12.2.1 or Section 1101.12.2.2.

[W] 1101.12.2.1 Roof Scuppers or Open Side. Secondary roof drainage shall be provided by an open-sided roof or scuppers where the roof perimeter construction extends above the roof in such a manner that water will be entrapped. An open-sided roof or scuppers shall be sized to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1101.12.1. Scupper openings shall be not less than 4 inches (102 mm) high and have a width equal to the circumference of the roof drain required for the area served, sized in accordance with Table 1103.1, based on double the rainfall rate for the local area.

Exception: Scupper openings shall be permitted to be sized for the normal rainfall rate where the structural design of the roof includes a ponding instability analysis in accordance with ASCE 7 for the additional ponding load resulting from twice the normal rainfall rate or a 15-minute duration/100-year return period storm. The analysis shall assume the primary drain system is blocked.

1101.12.2.2 Secondary Roof Drain. Secondary roof drains shall be provided. The secondary roof drains shall be located not less than 2 inches (51 mm) above the roof surface. The maximum height of the roof drains shall be a height to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1101.12.1. The secondary roof drains shall connect to a piping system in accordance with Section 1101.12.2.2.1 or Section 1101.12.2.2.2.

[W] 1101.12.2.2.1 Separate Piping System. The secondary roof drainage system shall be a separate system of piping, independent of the primary roof drainage system. The discharge shall be above grade, in a location observable by the building occupants or maintenance personnel. Secondary roof drain systems shall be sized in accordance with Section 1101.12.1 based on double the rainfall rate for local area.

Exception: The secondary drainage system shall be permitted to be sized for the normal rainfall rate where the structural design of the roof includes a ponding instability analysis in accordance with ASCE 7 for the additional ponding load resulting from twice the normal rainfall rate or a 15-minute duration/100-year return period storm. The analysis shall assume the primary drain system is blocked.

[W] [S] 1101.12.2.2.2 Combined System. The secondary roof drains shall connect to the vertical piping of the primary storm drainage conductor downstream of the last horizontal offset located below the roof. The primary storm drainage system shall connect to the building storm water that connects to an underground public storm sewer. The combined secondary and primary roof drain systems shall be sized in accordance with Section 1103.0 based on double the rainfall rate for the local area. A relief drain shall be connected to the combined vertical drainage piping, within 20 feet of grade, using a wye-type fitting piped to daylight on the exterior of the building. The piping shall be sized as required for a secondary drain with a 4 inch maximum.

[W] 1101.13 Cleanouts. Cleanouts for building storm drains shall comply with the requirements of this section.

1101.13.1 Locations. Rain leaders and conductors connected to a building storm sewer shall have a cleanout installed at the base of the outside leader or outside conductor before it connects to the horizontal drain. Cleanouts shall be placed inside the building near the connection between the building drain and the building sewer or installed outside the building at the lower end of the building drain and extended to grade.

1101.13.2 Cleaning. Each cleanout shall be installed so that it opens to allow cleaning in the direction of flow of the soil or waste or at right angles thereto, and except in the case of wye branch and end-of-line cleanouts, shall be installed vertically above the flow line of the pipe.

1101.13.3 Access. Cleanouts installed under concrete or asphalt paving shall be made accessible by yard boxes, or extending flush with paving with approved materials and be adequately protected.

1101.13.4 Manholes. Approved manholes may be installed in lieu of cleanouts when first approved by the authority having jurisdiction. The maximum distance between manholes shall not exceed three hundred (300) feet (91.4 m).

The inlet and outlet connections shall be made by the use of a flexible compression joint no closer than twelve (12) inches (305 mm) to, and not farther than three (3) feet (914 mm) from the manhole. No flexible compression joints shall be embedded in the manhole base.

1101.14 Rainwater Sumps. Rainwater sumps serving "public use" occupancy buildings shall be provided with dual pumps arranged to function alternately in the case of overload or mechanical failure. Pumps rated 600 V or less shall comply with UL 778 and shall be installed in accordance with the manufacturer's installation instructions.

1101.15 Traps on Storm Drains and Leaders. Leaders and storm drains, where connected to a combined sewer, shall be trapped. Floor and area drains connected to a storm drain shall be trapped.

Exception: Traps shall not be required where roof drains, rain leaders, and other inlets are at locations permitted under Section 906.0, Vent Termination.

1101.15.1 Where Not Required. No trap shall be required for leaders or conductors that are connected to a sewer carrying storm water exclusively.

1101.15.2 Trap Size. Traps, where installed for individual conductors, shall be the same size as the horizontal drain to which they are connected.

1101.15.3 Method of Installation of Combined Sewer. Individual storm-water traps shall be installed on the storm-water drain branch serving each storm-water inlet, or a single trap shall be installed in the main storm drain just before its connection with the combined building sewer. Such traps shall be provided with an accessible cleanout on the outlet side of the trap.

1101.16 Leaders, Conductors, and Connections. Leaders or conductors shall not be used as soil, waste, or vent pipes nor shall soil, waste, or vent pipes be used as leaders or conductors.

1101.16.1 Protection of Leaders. Leaders installed along alleyways, driveways, or other locations where exposed to damage shall be protected by metal guards, recessed into the wall, or constructed from the ferrous pipe.

[S] 1101.16.2 Combining Storm with Sanitary Drainage. The sanitary and storm drainage systems of a building shall be entirely separate from the building to the property line.

1102.0 Roof Drains.

1102.1 Applications. Roof drains shall be constructed of aluminum, cast-iron, copper alloy of not more than 15 percent zinc, leaded nickel bronze, stainless steel, ABS, PVC, polypropylene, polyethylene, or nylon and shall comply with ASME A112.3.1 or ASME A112.6.4.

1102.2 Dome Strainers Required. Roof drains shall have domed strainers.

Exception: Roof drain strainers for use on sun decks, parking decks, and similar areas that are normally serviced and maintained, shall be permitted to be of the flat surface type. Such roof drain strainers shall be level with the deck.

1102.3 Roof Drain Flashings. The connection between the roof and roof drains that pass through the roof and into the interior of the building shall be made watertight by the use of proper flashing material.

1102.3.1 Lead Flashing. Where lead flashing material is used, it shall be not less than 4 pounds per square foot (lb/ft^2) ($19\ kg/m^2$).

1102.3.2 Copper Flashing. Where copper flashing material is used, it shall be not less than 12 ounces per square foot (oz/ft^2) ($3.7\ kg/m^2$).

1103.0 Size of Leaders, Conductors, and Storm Drains.

[W] 1103.1 Vertical Conductors and Leaders. Vertical conductors and leaders shall be sized by the maximum projected roof area and Table 1103.1. Vertical conductors and leaders for secondary roof drains shall be sized based on double the rainfall rate for the local area.

Exception: Vertical conductors and leaders for secondary drainage systems shall be permitted to be sized for the normal rainfall rate where the structural design of the roof includes a ponding instability analysis in accordance with ASCE 7 for the additional ponding load resulting from twice the normal rainfall rate or a 15-minute duration/100-year return period storm. The analysis shall assume the primary drain system is blocked.

[W] 1103.2 Size of Horizontal Storm Drains and Sewers. The size of building storm drains, or building storm sewers or their horizontal branches shall be based on the maximum projected roof or paved area to be handled and Table 1103.2. Building storm drains, building storm sewers, or their horizontal branches receiving drainage from secondary roof drain systems shall be sized based on double the rainfall rate for the local area.

Exception: Building storm drains, building storm sewers, or their horizontal branches receiving drainage from secondary drainage systems shall be permitted to be sized for the normal rainfall rate where the structural design of the roof includes a ponding instability analysis in accordance with ASCE 7 for the additional ponding load resulting from twice the normal rainfall rate or a 15-minute duration/100-year return period storm. The analysis shall assume the primary drain system is blocked.

1103.3 Size of Roof Gutters. The size of semi-circular gutters shall be based on the maximum projected roof area and Table 1103.3.

[W] 1103.4 Side Walls Draining onto a Roof. Where vertical walls project above a roof to permit storm water to drain into the roof area below, the adjacent roof area shall be permitted to be computed from Table 1103.1 as follows:

(1) For one wall – add 50 percent of the wall area to the roof area figures.
(2) For two adjacent walls of equal height – add 35 percent of the total wall areas.
(3) For two adjacent walls of unequal height – add 35 percent of the total common height and add 50 percent of the remaining height of the highest wall.
(4) Two opposite walls of same height – add no additional area.
(5) Two opposite walls of differing heights – add 50 percent of the wall area above the top of the lower wall.
(6) Walls on three sides – add 50 percent of the area of the inner wall below the top of the lowest wall, plus an allowance for the area of the wall above the top of the lowest wall, in accordance with Section 1103.4(3) and Section 1103.4(5) above.
(7) Walls on four sides – no allowance for wall areas below the top of the lowest wall – add for areas above the top of the lowest wall in accordance with Section 1103.4(1), Section 1103.4(3), Section 1103.4(5), and Section 1103.4(6) above.

Secondary drainage systems for the adjacent roof area shall be sized based on double the rainfall rate for the local area.

Exception: Secondary drainage systems for the adjacent roof area shall be permitted to be sized for the normal rainfall rate where the structural design of the roof includes a ponding instability analysis in accordance with ASCE 7 for the additional ponding load resulting from twice the normal rainfall rate or a 15- minute duration/100-year return period storm. The analysis shall assume the primary drain system is blocked.

1104.0 Values for Continuous Flow.

1104.1 General. Where there is a continuous or semi-continuous discharge into the building storm drain or building storm sewer, as from a pump, ejector, air-conditioning plant, or similar device, 1 gpm (0.06 L/s) of such discharge shall be computed as being equivalent to 24 square feet ($2.2\ m^2$) of roof area, based upon a rate of rainfall of 4 inches per hour (in/h) (102 mm/h).

TABLE 1103.1
SIZING ROOF DRAINS, LEADERS, AND VERTICAL RAINWATER PIPING[2, 3]

SIZE OF DRAIN, LEADER, OR PIPE	FLOW	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)											
inches	gpm[1]	1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)	7 (in/h)	8 (in/h)	9 (in/h)	10 (in/h)	11 (in/h)	12 (in/h)
2	30	2880	1440	960	720	575	480	410	360	320	290	260	240
3	92	8800	4400	2930	2200	1760	1470	1260	1100	980	880	800	730
4	192	18 400	9200	6130	4600	3680	3070	2630	2300	2045	1840	1675	1530
5	360	34 600	17 300	11 530	8650	6920	5765	4945	4325	3845	3460	3145	2880
6	563	54 000	27 000	17 995	13 500	10 800	9000	7715	6750	6000	5400	4910	4500
8	1208	116 000	58 000	38 660	29 000	23 200	19 315	16 570	14 500	12 890	11 600	10 545	9600

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 inch per hour = 25.4 mm/h, 1 square foot = 0.0929 m^2

Notes:

1 Maximum discharge capacity, gpm (L/s) with approximately 1¾ inch (44 mm) head of water at the drain.

2 For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4 mm/h) column by the desired rainfall rate.

3 Vertical piping shall be round, square, or rectangular. Square pipe shall be sized to enclose its equivalent round pipe. Rectangular pipe shall have not less than the same cross-sectional area as its equivalent round pipe, except that the ratio of its side dimensions shall not exceed 3 to 1.

[W] 1105.0 Controlled-Flow Roof Drainage. This section is not adopted.

1106.0 Engineered Storm Drainage System.

1106.1 General. The design and sizing of a storm drainage system shall be permitted to be determined by accepted engineering practices. The system shall be designed by a registered design professional and approved in accordance with Section 301.5.

1106.2 Siphonic Roof Drainage Systems. The design of a siphonic roof drainage system shall comply with ASPE 45.

1106.3 Siphonic Roof Drains. Siphonic roof drains shall comply with ASME A112.6.9.

1107.0 Testing.

1107.1 Testing Required. New building storm drainage systems and parts of existing systems that have been altered, extended, or repaired shall be tested in accordance with Section 1107.2.1 or Section 1107.2.2 to disclose leaks and defects.

1107.2 Methods of Testing Storm Drainage Systems. Except for outside leaders and perforated or open-jointed drain tile, the piping of storm drain systems shall be tested upon completion of the rough piping installation by water or air, except that plastic pipe shall not be tested with air, and proved tight. The Authority Having Jurisdiction shall be permitted to require the removal of cleanout plugs to ascertain whether the pressure has reached parts of the system. One of the following test methods shall be used in accordance with Section 1107.2.1 through Section 1107.2.3.

1107.2.1 Water Test. After piping has been installed, the water test shall be applied to the drainage system, either to the entire system or sections. Where the test is applied to the entire system, all openings in the piping shall be tightly closed except for the highest opening, and the system shall be filled with water to the point of overflow. Where the system is tested in sections, each opening shall be tightly plugged except for the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10 foot (3048 mm) head of water. In testing successive sections, not less than the upper 10 feet (3048 mm) of the next preceding section shall be tested so that no joint of pipe in the building except the uppermost 10 feet (3048 mm) of a roof drainage system, which shall be filled with water to the flood level of the uppermost roof drain, shall have been submitted to a test of less than 10 foot (3048 mm) head of water. The water shall be kept in the system or the portion of the test for not less than 15 minutes before inspection starts; the system shall then be tight.

1107.2.2 Air Test. The air test shall be made by attaching an air compressor testing apparatus to a suitable opening after closing other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of 5 pounds-force per square inch (psi) (34 kPa) or sufficient pressure to balance a column of mercury 10 inches (34 kPa) in height. This pressure shall be held without the introduction of additional air for not less than 15 minutes.

1107.2.3 Exceptions. Where circumstances exist that make air and water tests described in Section 1107.2.1 and Section 1107.2.2 impractical, see Section 105.3.

TABLE 1103.2
SIZING OF HORIZONTAL RAINWATER PIPING[1, 2]

SIZE OF PIPE	FLOW (⅛ inch per foot slope)	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)					
inches	gpm	1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
3	34	3288	1644	1096	822	657	548
4	78	7520	3760	2506	1880	1504	1253
5	139	13 360	6680	4453	3340	2672	2227
6	222	21 400	10 700	7133	5350	4280	3566
8	478	46 000	23 000	15 330	11 500	9200	7670
10	860	82 800	41 400	27 600	20 700	16 580	13 800
12	1384	133 200	66 600	44 400	33 300	26 650	22 200
15	2473	238 000	119 000	79 333	59 500	47 600	39 650

SIZE OF PIPE	FLOW (¼ inch per foot slope)	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)					
inches	gpm	1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
3	48	4640	2320	1546	1160	928	773
4	110	10 600	5300	3533	2650	2120	1766
5	196	18 880	9440	6293	4720	3776	3146
6	314	30 200	15 100	10 066	7550	6040	5033
8	677	65 200	32 600	21 733	16 300	13 040	10 866
10	1214	116 800	58 400	38 950	29 200	23 350	19 450
12	1953	188 000	94 000	62 600	47 000	37 600	31 350
15	3491	336 000	168 000	112 000	84 000	67 250	56 000

SIZE OF PIPE	FLOW (½ inch per foot slope)	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)					
inches	gpm	1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
3	68	6576	3288	2192	1644	1310	1096
4	156	15 040	7520	5010	3760	3010	2500
5	278	26 720	13 360	8900	6680	5320	4450
6	445	42 800	21 400	14 267	10 700	8580	7140
8	956	92 000	46 000	30 650	23 000	18 400	15 320
10	1721	165 600	82 800	55 200	41 400	33 150	27 600
12	2768	266 400	133 200	88 800	66 600	53 200	44 400
15	4946	476 000	238 000	158 700	119 000	95 200	79 300

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, ⅛ inch per foot = 10.4 mm/m, 1 inch per hour = 25.4 mm/h, 1 square foot = 0.0929 m^2

Notes:

1 The sizing data for horizontal piping are based on the pipes flowing full.

2 For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4 mm/h) column by the desired rainfall rate.

TABLE 1103.3
SIZE OF GUTTERS

DIAMETER OF GUTTER (1/16 inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
inches	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
3	340	226	170	136	113
4	720	480	360	288	240
5	1250	834	625	500	416
6	1920	1280	960	768	640
7	2760	1840	1380	1100	918
8	3980	2655	1990	1590	1325
10	7200	4800	3600	2880	2400

DIAMETER OF GUTTER (1/8 inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
inches	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
3	480	320	240	192	160
4	1020	681	510	408	340
5	1760	1172	880	704	587
6	2720	1815	1360	1085	905
7	3900	2600	1950	1560	1300
8	5600	3740	2800	2240	1870
10	10 200	6800	5100	4080	3400

DIAMETER OF GUTTER (1/4 inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
inches	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
3	680	454	340	272	226
4	1440	960	720	576	480
5	2500	1668	1250	1000	834
6	3840	2560	1920	1536	1280
7	5520	3680	2760	2205	1840
8	7960	5310	3980	3180	2655
10	14 400	9600	7200	5750	4800

DIAMETER OF GUTTER (1/2 inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
inches	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
3	960	640	480	384	320
4	2040	1360	1020	816	680
5	3540	2360	1770	1415	1180
6	5540	3695	2770	2220	1850
7	7800	5200	3900	3120	2600
8	11 200	7460	5600	4480	3730
10	20 000	13 330	10 000	8000	6660

For SI units: 1 inch = 25 mm, 1/16 inch per foot = 5.2 mm/m, 1 inch per hour = 25.4 mm/h, 1 square foot = 0.0929 m^2

Chapter 12 is not adopted.

CHAPTER 12
FUEL GAS PIPING

CHAPTER 13

HEALTH CARE FACILITIES AND MEDICAL GAS AND MEDICAL VACUUM SYSTEMS

Part I – General Requirements.

1301.0 General Requirements.

1301.1 Applicability. This chapter applies to the special fixtures and systems in health care facilities; the special plumbing requirements for such facilities; and the installation, testing, and verification of Categories 1, 2, and 3 medical gas and medical vacuum piping systems, except as otherwise indicated in this chapter, from the central supply system to the station outlets or inlets in hospitals, clinics, and other health care facilities. Other plumbing in such facilities shall comply with other applicable sections of this code. For Category 3 medical gas systems, only oxygen and nitrous oxide shall be used.

1301.2 Where Not Applicable. This chapter does not apply to the following except as otherwise addressed in this chapter:

(1) Cylinder and container management, storage, and reserve requirements
(2) Bulk supply systems
(3) Electrical connections and requirements
(4) Motor requirements and controls
(5) Systems having nonstandard operating pressures
(6) Waste anesthetic gas disposal (WAGD) systems
(7) Surface-mounted medical gas rail systems
(8) Breathing air replenishment (BAR) systems
(9) Portable compressed gas systems
(10) Medical support gas systems
(11) Gas-powered device supply systems
(12) Scavenging systems

1301.3 Conflict of Requirements. The requirements of this chapter shall not be interpreted to conflict with the requirements of NFPA 99. For requirements of portions of medical gas and vacuum systems not addressed in this chapter or medical gas and vacuum systems beyond the scope of this chapter refer to NFPA 99.

1301.4 Where Required. Construction and equipment requirements shall be applied only to new construction and new equipment, except as modified in individual sections of this chapter. [NFPA 99:1.3.2]

1301.5 Existing Systems. Only the altered, renovated, or modernized portion of an existing system or individual component shall be required to meet the installation and equipment requirements stated in this code. If the alteration, renovation, or modernization adversely impacts the existing performance requirements of a system or component, additional upgrading shall be required. An existing system that is not in strict compliance with the provisions of this code shall be permitted to be continued in use, unless the Authority Having Jurisdiction has determined that such use constitutes a distinct hazard to life. [NFPA 99:1.3.2.1 – 1.3.2.3]

1302.0 Design Requirements.

1302.1 Risk Categories. Activities, systems, or equipment shall be designed to meet Category 1 through Category 4 requirements, as detailed in this chapter. [NFPA 99:4.1]

1302.1.1 Processes and Operations. The health care facility's governing body shall establish the processes and operations that are planned for the health care facility. [NFPA 99:4.2.1]

1302.1.1.1 Risk Categories. The governing body shall conduct risk assessments and shall determine risk categories based on the character of the processes and operations conducted in the health care facility. [NFPA 99:4.2.1.1]

1302.1.2 Risk Assessment. Risk categories shall be classified by the health care facility's governing body by following and documenting a defined risk assessment procedure. [NFPA 99:4.2.2]

1302.1.2.1 Documents to the Authority Having Jurisdiction. Where required by the Authority Having Jurisdiction (AHJ), the risk assessment shall be provided to the AHJ for review based on the character of the processes and operations conducted in the health care facility. [NFPA 99:4.2.2.1]

1302.1.3 Documented Risk Assessment. A documented risk assessment shall not be required where Category 1 is selected. [NFPA 99:4.2.3]

1302.2 Patient Care Spaces. The health care facility's governing body or its designee shall establish the following areas in accordance with the type of patient care anticipated (see definition of patient care space in Chapter 2):

(1) Category 1 spaces

(2) Category 2 spaces
(3) Category 3 spaces
(4) Category 4 spaces [NFPA 99:1.3.4.1]

1302.3 Anesthesia. It shall be the responsibility of the health care facility's governing body to designate anesthetizing locations. [NFPA 99:1.3.4.2]

1302.4 Wet Procedure Locations. It shall be the responsibility of the health care facility's governing body to designate wet procedure locations. [NFPA 99:1.3.4.3]

1303.0 Health Care Facilities.

1303.1 Drinking Fountain Control Valves. Drinking fountain control valves shall be flush-mounted or fully recessed where installed in corridors or other areas where patients are transported on a gurney, bed, or wheelchair.

1303.2 Psychiatric Patient Rooms. Piping and drain traps in psychiatric patient rooms shall be concealed. Fixtures and fittings shall be resistant to vandalism.

1303.3 Locations for Ice Storage. Ice makers or ice storage containers shall be located in nursing stations or similarly supervised areas to minimize potential contamination.

1303.4 Sterilizers and Bedpan Steamers. Sterilizers and bedpan steamers shall be installed in accordance with the manufacturer's installation instructions and comply with Section 1303.4.1 and Section 1303.4.2.

1303.4.1 Drainage Connections. Sterilizers and bedpan steamers shall be connected to the sanitary drainage system through an air gap in accordance with Section 801.2. The size of indirect waste piping shall be not less than the size of the drain connection on the fixture. Each such indirect waste pipe shall not exceed 15 feet (4572 mm) in length and shall be separately piped to a receptor. Such receptors shall be located in the same room as the equipment served. Except for bedpan steamers, such indirect waste pipes shall not require traps. A trap having a seal of not less than 3 inches (76 mm) shall be provided in the indirect waste pipe for a bedpan steamer.

1303.4.2 Vapor Vents and Stacks. Where a sterilizer or bedpan steamer has provision for a vapor vent and such a vent is required by the manufacturer, the vent shall be extended to the outdoors above the roof. Sterilizer and bedpan steamer vapor vents shall be installed in accordance with the manufacturer's installation instructions and shall not be connected to a drainage system vent.

1303.5 Aspirators. Provisions for aspirators or other water-supplied suction devices shall be installed with the specific approval of the Authority Having Jurisdiction. Where aspirators are used for removing body fluids, they shall include a collection container to collect liquids and solid particles. Aspirators shall indirectly discharge to the sanitary drainage system through an air gap in accordance with Section 806.1. The potable water supply to an aspirator shall be protected by a vacuum breaker or equivalent backflow protection device in accordance with Section 603.5.9.

1303.6 Drains. Drains shall be installed on dryers, aftercoolers, separators, and receivers.

1303.7 Clinical Sinks. Clinical sinks shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 1303.7.1.

1303.7.1 Drainage Connection. Clinical sinks shall be directly connected to the sanitary drainage system and shall be provided with approved flushing devices installed in accordance with Section 413.1.

[W] 1303.8 Water Mains for Hospitals. Hospitals shall be provided with not less than two approved potable water mains that are installed in such a manner as to prevent the interruption of water service.

1303.9 Work Performed in Occupied Healthcare Facilities. In existing, occupied, inpatient healthcare facilities, all plumbing systems installation and remodel work shall be performed by personnel certified in accordance with ASSE/IAPMO 12010, ASSE/IAPMO 12030 and ASSE/IAPMO 12040.

1304.0 Medical Gas and Medical Vacuum Piping Systems.

1304.1 General. The installation of medical gas and medical vacuum piping systems shall comply with the requirements of this chapter.

1304.2 Certification of Systems. Certification of medical gas and vacuum systems shall comply with the requirements of Section 1306.0.

1304.3 Construction Documents. Before a medical gas or medical vacuum system is installed or altered in a hospital, medical facility, or clinic, duplicate construction documents shall be filed with the Authority Having Jurisdiction. Approval of the plans shall be obtained before issuance of a permit by the Authority Having Jurisdiction.

1304.3.1 Requirements. Construction documents shall show the following:

(1) Plot plan of the site, drawn to scale, indicating the location of existing or new cylinder storage areas, property lines, driveways, and existing or proposed buildings.

(2) Piping layout of the proposed piping system or alteration, including alarms, valves, the origin of gases, user outlets, and user inlets. The demand and loading of piping, existing or future, shall also be indicated.

(3) Complete specification of materials.

1304.4 Extent of Work. Construction documents submitted to the Authority Having Jurisdiction shall clearly indicate the nature and extent of the work proposed and shall show in detail that such work will be in accordance with the provisions of this chapter.

1304.5 Record. A record of as-built plans and valve identification records shall remain on the site.

1305.0 System Performance.

1305.1 Required Operating Pressures. Medical gas and vacuum systems shall be capable of delivering service in the pressure ranges listed in Table 1305.1.

1305.2 Minimum Flow Rates. Medical gas and vacuum systems shall be capable of supplying the flow rates listed in Table 1305.2.

[W] 1305.3 Minimum Station Outlets/Inlets. Station outlets and inlets for medical gas and medical vacuum systems for facilities licensed or certified by the Washington State Department of Health (DOH) or Washington State Department of Social and Health Services (DSHS) shall be provided as listed in Chapters 246-320 and 246-330 WAC as required by the applicable licensing rules as applied by DOH Construction Review Services. All other medical gas and medical vacuum systems shall be provided as listed in Table 1305.3.

1306.0 System Certification.

1306.1 Certification. Prior to a medical gas or vacuum system being placed in service, such system shall be certified in accordance with Section 1306.2.

1306.2 Certification Tests. Certification tests, verified and attested to by the certification agency, shall include the following:

(1) Verifying in accordance with the installation requirements.

(2) Testing and checking for leakage, correct zoning, and identification of control valves.

(3) Checking for identification and labeling of pipelines, station outlets, and control valves.

(4) Testing for cross-connection, flow rate, system pressure drop, and system performance.

(5) Functional testing of pressure relief valves and safety valves.

(6) Functional testing of sources of supply.

(7) Functional testing of alarm systems, including accuracy of system components.

(8) Purge flushing of system and filling with specific source gases.

(9) Testing for purity and cleanliness of source gases.

(10) Testing for specific gas identity at each station outlet.

1306.3 Report Items. A report that includes the specific items addressed in Section 1306.2, and other information required by this chapter, shall be delivered to the Authority Having Jurisdiction prior to acceptance of the system.

1306.4 Components. Functioning of alarm components shall be verified in accordance with the testing and monitoring requirements of the manufacturer and the Authority Having Jurisdiction.

Part II – Category 1 Piped Gas and Vacuum Systems.

1307.0 Central Supply Systems.

1307.1 Terms. Where the terms medical gas or medical support gas occur, the provisions shall apply to all piped systems for oxygen, nitrous oxide, medical air, carbon dioxide, helium, nitrogen, instrument air, and mixtures thereof. Wherever the name of a specific gas service occurs, the provision shall apply only to that gas. [NFPA 99:5.1.1.3]

1307.2 Nature of Hazards of Gas and Vacuum Systems. Potential fire and explosion hazards associated with positive pressure gas central piping systems and medical–surgical vacuum systems shall be considered in the design, installation, testing, operation, and maintenance of these systems. [NFPA 99:5.1.2]

TABLE 1305.1
STANDARD DESIGNATION COLORS AND OPERATING PRESSURES FOR GAS AND VACUUM SYSTEMS
[NFPA 99: TABLE 5.1.11]

GAS SERVICE	ABBREVIATED NAME	COLORS (BACKGROUND/ TEXT)	STANDARD GAUGE PRESSURE
Medical air	Med Air	Yellow/black	50–55 psi
Carbon dioxide	CO_2	Gray/black or gray/white	50–55 psi
Helium	He	Brown/white	50–55 psi
Nitrogen	N_2	Black/white	160–185 psi
Nitrous oxide	N_2O	Blue/white	50–55 psi
Oxygen	O_2	Green/white or white/green	50–55 psi
Oxygen/carbon dioxide mixtures	O_2/CO_2 *n*% (*n* = % of CO_2)	Green/white	50–55 psi
Medical–surgical vacuum	Med Vac	White/black	15 inch to 30 inch HgV
Waste anesthetic gas disposal	WAGD	Violet/white	Varies with system type
Other mixtures	Gas A% / Gas B%	Colors as above; major gas for background/minor gas for text	None
Nonmedical air (Category 3 gas-powered device)	—	Yellow-and-white diagonal stripe/black	None
Nonmedical and Category 3 vacuum	—	White-and-black diagonal stripe/black boxed	None
Laboratory air	—	Yellow-and-white checker board/black	None
Laboratory vacuum	—	White-and-black checkerboard/black boxed	None
Instrument air	—	Red/white	160–185 psi

For SI units: 1 pound-force per square inch = 6.8947 kPa, 1 inch of mercury vacuum (HgV) = 3.386 kPa

TABLE 1305.2
MINIMUM FLOW RATES
(cubic feet per minute)

MEDICAL SYSTEM	FLOW RATE
Oxygen	0.71 CFM per outlet[1]
Nitrous Oxide	0.71 CFM per outlet[1]
Medical Compressed Air	0.71 CFM per outlet[1]
Nitrogen	15 CFM free air per outlet
Vacuum	1 SCFM per inlet[2]
Carbon Dioxide	0.71 CFM per outlet[1]
Helium	0.71 CFM per outlet

For SI units: 1 cubic foot per minute (CFM) = 0.47 L/s

Notes:

[1] A room designed for a permanently located respiratory ventilator or anesthesia machine shall have an outlet capable of a flow rate of 6.36 CFM (3.0 L/s) at the station outlet.

[2] For testing and certification purposes, individual station inlets shall be capable of a flow rate of 3 SCFM (1.4 L/s), while maintaining a system pressure of not less than 12 inches of mercury (41 kPa) at the nearest adjacent vacuum inlet.

1307.3 Permitted Locations for Medical Gases. Central supply systems for oxygen, medical air, nitrous oxide, carbon dioxide, and all other patient medical gases shall be piped only to medical gas outlets complying with Section 1315.0, into areas where the gases will be used under the direction of licensed medical professionals for purposes congruent with the following:

(1) Direct respiration by patients.

(2) Clinical application of the gas to a patient, such as the use of an insufflator to inject carbon dioxide into patient body cavities during laparoscopic surgery and carbon dioxide used to purge heart-lung machine blood flow ways.

(3) Medical device applications directly related to respiration.

(4) Power for medical devices used directly on patients.

(5) Calibration of medical devices intended for Section 1307.3(1) through Section 1307.3(4).

(6) Simulation centers for the education, training, and assessment of health care professionals. [NFPA 99:5.1.3.5.2]

TABLE 1305.3
MINIMUM OUTLETS AND INLETS PER STATION

LOCATION	OXYGEN	MEDICAL VACUUM	MEDICAL AIR	NITROUS OXIDE	NITROGEN	HELIUM	CARBON DIOXIDE
Patient rooms for medical/surgical, obstetrics, and pediatrics	1/bed	1/bed	1/bed	—	—	—	—
Examination/treatment for nursing units	1/bed	1/bed	—	—	—	—	—
Intensive care (all)	3/bed	3/bed	2/bed	—	—	—	—
Nursery[1]	2/bed	2/bed	1/bed	—	—	—	—
General operating rooms	2/room	3/room[4]	2/room	1/room	1/room	—	—
Cystoscopic and special invasive procedures	2/room	3/room[4]	2/room	—	—	—	—
Recovery delivery and labor/delivery/recovery rooms[2]	2/bed 2/room	2/bed 3/room[4]	1/bed 1/room	—	—	—	—
Labor rooms	1/bed	1/bed	1/bed	—	—	—	—
First aid and emergency treatment[3]	1/bed	1/bed[4]	1/bed	—	—	—	—
Autopsy	—	1/station	1/station	—	—	—	—
Anesthesia workroom	1/station	—	1/station	—	—	—	—

Notes:
[1] Includes pediatric nursery.
[2] Includes obstetric recovery.
[3] Emergency trauma rooms used for surgical procedures shall be classified as general operating rooms.
[4] Vacuum inlets required are in addition to inlets used as part of a scavenging system for removal of anesthetizing gases.

1307.4 Materials. Materials used in central supply systems shall meet the following requirements:

(1) In those portions of systems intended to handle oxygen at gauge pressures greater than 350 pounds-force per square inch (psi) (2413 kPa), interconnecting hose shall contain no polymeric materials.

(2) In those portions of systems intended to handle oxygen or nitrous oxide material, construction shall be compatible with oxygen under the temperatures and pressures to which the components can be exposed in the containment and use of oxygen, nitrous oxide, mixtures of these gases, or mixtures containing more than 23.5 percent oxygen.

(3) If potentially exposed to cryogenic temperatures, materials shall be designed for low temperature service.

(4) If intended for outdoor installation, materials shall be installed per the manufacturer's requirements. [NFPA 99:5.1.3.5.4]

1308.0 Pressure-Regulating Equipment.

1308.1 Where Required. Pressure-regulating equipment shall be installed in the supply main upstream of the final line-pressure valve. Where multiple piping systems for the same gas at different operating pressures are required, separate pressure-regulating equipment, relief valves, and source shutoff valves shall be provided for each pressure.

1308.2 Pressure Relief Valves. All pressure relief valves shall meet the following requirements:

(1) They shall be of brass, bronze, or stainless steel construction.

(2) They shall be designed for the specific gas service.

(3) They shall have a relief pressure setting not higher than the maximum allowable working pressure (MAWP) of the component with the lowest working pressure rating in the portion of the system being protected.

(4) They shall be vented to the outside of the building, except that relief valves for compressed air systems having less than 3000 cubic feet (84 950 L) at STP shall be permitted to be diffused locally by means that will not restrict the flow.

(5) They shall have a vent discharge line that is not smaller than the size of the relief valve outlet.

(6) Where two or more relief valves discharge into a common vent line, its internal cross-sectional area shall be not less than the aggregate cross-sectional area of all relief valve vent discharge lines served.

(7) They shall not discharge into locations creating potential hazards.

(8) They shall have the discharge terminal turned down and screened to prevent the entry of rain, snow, or vermin.

(9) They shall be designed in accordance with ASME B31.3. [NFPA 99:5.1.3.5.6.1]

1308.3 Pressure-Relief Valve Requirements. Central supply systems for positive pressure gases shall include one or more relief valves, all meeting the following requirements:

(1) They shall be located between each final line regulator and the source valve.

(2) They shall have a relief setting that is 50 percent above the normal system operating pressure, as indicated in Table 1305.1. [NFPA 99:5.1.3.5.6.3]

1309.0 Oxygen Concentrator Supply Units.

1309.1 Oxygen Requirements. Oxygen concentrator supply units for use with medical gas pipelines shall produce oxygen meeting the requirements of Oxygen 93 USP or Oxygen USP. [NFPA 99:5.1.3.5.11.1]

1309.2 Particulate Size. Output shall have less than or equal to 1.686×10^{-6} pounds per cubic yard (1 mg/m^3) of permanent particulates sized 1 micron or larger at normal atmospheric pressure. [NFPA 99:5.1.3.5.11.2]

1309.3 Suitability. Materials of construction on the air side of the oxygen concentrator unit shall be suitable for the service as determined by the manufacturer. [NFPA 99:5.1.3.5.11.3]

1309.4 Compatible Materials. Materials of construction on the oxygen side of the oxygen concentrator unit shall comply with Section 1307.4. [NFPA 99:5.1.3.5.11.4]

1309.5 Oxygen Concentrator Components. The components that make up the oxygen concentrator unit shall be as follows:

(1) The manufacturer of the concentrator unit shall be permitted to use such components and arrangement of such components as needed to produce oxygen complying with Section 1309.1 in the quantity as required by the facility, except where otherwise specifically defined in this code.

(2) Air receivers and oxygen accumulators, where used, shall comply with Section VIII, "Unfired Pressure Vessels," of the ASME Boiler and Pressure Vessels Code and be provided with overpressure relief valves. [NFPA 99:5.1.3.5.11.5]

1309.6 Supply Air Quality. The supply air to the concentrators shall be of a quality to ensure the oxygen concentrator unit can produce oxygen complying with Section 1309.1 and shall not be subject to normally anticipated contamination (e.g., vehicle or other exhausts, gas leakage, discharge from vents, flooding, and so forth). [NFPA 99:5.1.3.5.11.6]

1309.7 Electrical Components. The oxygen concentrator supply unit and any associated electrical equipment shall be provided, a minimum, with the following electrical components:

(1) Either a disconnect switch for each major electrical component or a single disconnect that deactivates all electrical components in the concentrator unit.

(2) Motor starting devices with overload protection for any component with an electrical motor over 2 hp (1.5 kW). [NFPA 99:5.1.3.5.11.7]

1309.8 Vent Valve. A vent valve shall be provided as follows:

(1) Located on the source side of the concentrator outlet isolation valve to permit the operation of the oxygen concentrator unit for validation, calibration, and testing while the unit is isolated from the pipeline system.

(2) Sized to allow for at least 25 percent of the oxygen concentrator unit flow.

(3) Vented to a location compliant with Section 1309.8.1. [NFPA 99:5.1.3.5.11.8]

1309.8.1 Venting of Relief Valves. Indoor supply systems shall have all relief valves vented per Section 1308.2(4) through Section 1308.2(9). [NFPA 99:5.1.3.3.3.2]

1309.9 Valved Sample Port. A DN8 (NPS 1/4) valved sample port shall be provided near the oxygen concentration monitor sensor connection for sampling of the gas from the oxygen concentrator unit. [NFPA 99:5.1.3.5.11.9]

1309.10 Suitable Filter. At least one 0.1 micron filter suitable for oxygen service shall be provided at the outlet of the oxygen concentrator supply unit. [NFPA 99:5.1.3.5.11.10]

1309.11 Check Valve. A check valve shall be provided at the outlet of the oxygen concentrator supply unit to prevent backflow into the oxygen concentrator supply unit and to allow service to the unit. [NFPA 99:5.1.3.5.11.11]

1309.12 Outlet Valve. An outlet valve shall be provided to isolate all components of the oxygen concentrator from the pipeline with the following characteristics:

(1) The valve shall have both manual and automatic actuation with visual indication of open or closed.

(2) The valve shall close automatically whenever the oxygen concentrator unit is not producing oxygen of a concentration equal to that in Section 1309.1.

(3) Continuing operation of the oxygen concentrator supply unit through the vent mode shall be permitted with the isolating valve closed.

(4) The isolating valve, when automatically closed due to low concentration, shall require manual reset to ensure the oxygen concentrator supply unit is examined prior to return to service.

(5) Closing the isolating valve, whether automatically or manually, shall activate an alarm signal at the master alarms (see Section 1317.1.1) indicating that the oxygen concentrator supply unit is disconnected. [NFPA 99:5.1.3.5.11.12]

1309.13 Oxygen Concentration Monitor. The oxygen concentrator supply unit shall be provided with an oxygen concentration monitor with the following characteristics:

(1) The monitor shall be capable of monitoring 99 percent oxygen concentration with 1 percent accuracy.

(2) The monitor shall continuously display the oxygen concentration and shall activate local alarm and master alarms per NFPA 99 when a concentration lower than 91 percent is observed.

(3) The monitor shall continuously display the oxygen concentration.

(4) It shall be permitted to insert the monitor into the pipeline without a demand check. [NFPA 99:5.1.3.5.11.13]

1310.0 Category 1 Medical Air Central Supply Systems.

1310.1 Quality of Medical Air. Medical air shall be required to have the following characteristics:

(1) It shall be supplied from cylinders, bulk containers, or medical air compressor sources, or it shall be reconstituted from oxygen USP and oil-free, dry nitrogen NF.

(2) It shall meet the requirements of medical air USP.

(3) It shall have no detectable liquid hydrocarbons.

(4) It shall have less than 25 ppm gaseous hydrocarbons.

(5) It shall have equal to or less than 1.686×10^{-6} pounds per cubic yard (1 mg/m^3) of permanent particulates sized 1 micron or larger in the air at normal atmospheric pressure. [NFPA 99:5.1.3.6.1]

1310.2 Uses of Medical Air. Medical air sources shall be connected to the medical air distribution system only and shall be used only for air in the application of human respiration and calibration of medical devices for respiratory application. [NFPA 99:5.1.3.6.2]

1310.3 Medical Air Compressors. Medical air compressors shall be installed in a well-lit, ventilated, and clean location and shall be accessible. The location shall be provided with drainage facilities in accordance with this code. The medical air compressor area shall be located separately from medical gas cylinder system sources, and shall be readily accessible for maintenance.

1310.3.1 Category 1 Medical Air Compressor. Medical air compressors shall be sufficient to serve the peak calculated demand with the largest single compressor out of service. In no case shall there be fewer than two compressors. [NFPA 99:5.1.3.6.3.9(B)]

1310.3.2 Required Components. Medical air compressor systems shall consist of the following:

(1) Components shall be arranged to allow service and a continuous supply of medical air in the event of a single fault failure.

Component arrangement shall be permitted to vary as required by the technology(ies) employed, provided that an equal level of operating redundancy and medical air quality is maintained. [NFPA 99:5.1.3.6.3.9(A)(1), 5.1.3.6.3.9(A)(2)]

(2) Automatic means to prevent backflow from all on-cycle compressors through all off-cycle compressors.

(3) Manual shutoff valve to isolate each compressor from the centrally piped system and from other compressors for maintenance or repair without loss of pressure in the system.

(4) Intake filter-muffler(s) of the dry type.

(5) Pressure relief valve(s) set at 50 percent above line pressure.

(6) Piping and components between the compressor and the source shutoff valve that do not contribute to contaminant levels.

(7) Except as defined in Section 1310.3.2(1) through Section 1310.3.2(6), materials and devices used between the medical air intake and the medical air source valve that are of any design or construction appropriate for the service as determined by the manufacturer. [NFPA 99:5.1.3.6.3.2 (2-7)]

1310.4 Medical Air Receivers. Receivers for medical air shall meet the following requirements:

(1) They shall be made of corrosion-resistant materials or otherwise be made corrosion resistant.

(2) They shall comply with Section VIII, "Unfired Pressure Vessels," of the ASME Boiler and Pressure Vessel Code.

(3) They shall be equipped with a pressure relief valve, automatic drain, manual drain, sight glass, and pressure indicator.

(4) They shall be of a capacity sufficient to prevent the compressors from short-cycling. [NFPA 99:5.1.3.6.3.6]

1310.5 Valves. A medical air receiver(s) shall be provided with proper valves to allow the flow of compressed air to enter and exit out of separate receiver ports during normal operation and allow the receiver to be bypassed during service without shutting down the supply of medical air. [NFPA 99:5.1.3.6.3.9(D)]

1311.0 Compressor Intake.

1311.1 Air Sources. Air sources for medical air compressors shall comply with Section 1311.2 through Section 1311.6.

1311.2 Medical Air Compressor Source. The medical air compressors shall draw their air from a source of clean air. [NFPA 99:5.1.3.6.3.11(A)]

If an air source equal to or better than outside air (e.g., air already filtered for use in operating room ventilating systems) is available, it shall be permitted to be used for the medical air compressors with the following provisions:

(1) This alternate source of supply air shall be available on a continuous 24 hours-per-day, 7 day-per-week basis.

(2) Ventilating systems having fans with motors or drive belts located in the airstream shall not be used as a source of medical air intake. [NFPA 99:5.1.3.6.3.11(E)]

1311.3 Air Intakes. Compressor intake piping shall be permitted to be made of materials and use a joining technique as permitted under Section 1319.0 and Section 1320.0. [NFPA 99:5.1.3.6.3.11(F)]

1311.4 Location. Medical air intakes shall be located as follows:

(1) The medical air intake shall be located a minimum of 25 feet (7620 mm) from ventilating system exhausts, fuel storage vents, combustion vents, plumbing vents, and vacuum discharges, or areas that can collect vehicular exhausts or other noxious fumes.

(2) The medical air intake shall be located a minimum of 20 feet (6096 mm) above ground level.

(3) The medical air intake shall be located a minimum of 10 feet (3048 mm) from any door, window, or other opening in the building. [NFPA 99:5.1.3.6.3.11(B-D)]

1311.5 Separate Compressors. Air intakes for separate compressors shall be permitted to be joined together to one common intake where the following conditions are met:

(1) The common intake is sized to minimize backpressure in accordance with the manufacturer's recommendations.

(2) Each compressor can be isolated by manual or check valve, blind flange, or tube cap to prevent open inlet piping when the compressor(s) is removed for service from the consequent backflow of room air into the other compressor(s). [NFPA 99:5.1.3.6.3.11(G)]

1311.6 Screening. The end of the intake shall be turned down and screened or otherwise be protected against the entry of vermin, debris, or precipitation by screening fabricated or composed of a noncorroding material. [NFPA 99:5.1.3.6.3.11(H)]

1312.0 Medical Surgical Vacuum Central Supply Systems.

1312.1 General. The vacuum plant shall be installed in a well-lit, ventilated, and clean location with accessibility. The location shall be provided with drainage facilities in accordance with this code. The vacuum plant, where installed as a source, shall be located separately from other medical vacuum system sources and shall be readily accessible for maintenance.

1312.2 Medical-Surgical Vacuum Sources. Medical-surgical vacuum central supply systems shall consist of the following:

(1) Two or more vacuum pumps sufficient to serve the peak calculated demand with the largest single vacuum pump out of service.

(2) Automatic means to prevent backflow from any on-cycle vacuum pumps through any off-cycle vacuum pumps.

(3) Shutoff valve or other isolation means to isolate each vacuum pump from the centrally piped system, and other vacuum pumps for maintenance or repair without loss of vacuum in the system.

(4) Vacuum receiver.

(5) Piping between the vacuum pump(s), discharge(s), receiver(s), and vacuum source shutoff valve in accordance with Section 1319.0, except brass, galvanized, or black steel pipe, which is permitted to be used as recommended by the manufacturer.

(6) Except as defined in Section 1312.2(1) through Section 1312.2(5), materials and devices used between the medical vacuum exhaust and the medical vacuum source that are permitted to be of any design or construction appropriate for the service as determined by the manufacturer.

(7) Vacuum filtration per Section 1312.4. [NFPA 99:5.1.3.7.1.1]

1312.3 Vacuum Receivers. Receivers for vacuum shall meet the following requirements:

(1) They shall be made of materials deemed suitable by the manufacturer.

(2) They shall comply with Section VIII, "Unfired Pressure Vessels," of the ASME Boiler and Pressure Vessel Code.

(3) They shall be capable of withstanding a gauge pressure of 60 psi (414 kPa) and 30 inch (762 mm) gauge HgV.

(4) They shall be equipped with a manual drain.

(5) They shall be of a capacity based on the technology of the pumps. [NFPA 99:5.1.3.7.3]

1312.4 Vacuum Filtration. Central supply systems for vacuum shall be provided with inlet filtration with the following characteristics:

(1) Filtration shall be at least duplex to allow one filter to be exchanged without impairing vacuum system.

(2) Filtration shall be located on the patient side of the vacuum producer.

(3) Filters shall be efficient to 0.03 μ and 99.97 percent HEPA or better, per DOE-STD-3020.

(4) Filtration shall be sized for 100 percent of the peak calculated demand while one filter or filter bundle is isolated.

(5) It shall be permitted to group multiple filters into bundles to achieve the required capacities.

(6) The system shall be provided with isolation valves on the source side of each filter or filter bundle and isolation valves on the patient side of each filter or filter bundle, permitting the filters to be isolated without shutting off flow to the central supply system.

(7) A means shall be available to allow the user to observe any accumulations of liquids.

(8) A vacuum relief petcock shall be provided to allow vacuum to be relieved in the filter canister during filter replacement.

(9) Filter elements and canisters shall be permitted to be constructed of materials as deemed suitable by the manufacturer.

(10) In normal operation, one filter or filter bundle shall be isolated from the system to be available for service should a blockage in the operating filter occur or rotation of the filters be desired after filter element exchange. [NFPA 99:5.1.3.7.4]

1312.5 Piping Arrangement and Redundancies. Piping arrangement shall be as follows:

(1) Piping shall be arranged to allow service and a continuous supply of medical-surgical vacuum in the event of a single fault failure.

(2) Piping arrangement shall be permitted to vary based on the technology(ies) employed, provided that an equal level of operating redundancy is maintained.

(3) Where only one set of vacuum pumps is available for a combined medical-surgical vacuum system and an analysis, a research, or a teaching laboratory vacuum system, such laboratories shall be connected separately from the medical-surgical system directly to the receiver tank through its own isolation valve and fluid trap located at the receiver, and between the isolation valve and fluid trap, a scrubber shall be permitted to be installed. [NFPA 99:5.1.3.7.5, 5.1.3.7.5.1]

1312.6 Piping Serviceability. The medical-surgical vacuum receiver(s) shall be serviceable without shutting down the medical-surgical vacuum system by any method to ensure continuation of service to the facility's medical-surgical pipeline distribution system. [NFPA 99:5.1.3.7.5.2]

1312.7 Shutoff Valve. Medical-surgical vacuum central supply systems shall be provided with a source shutoff valve per Section 1314.6. [NFPA 99:5.1.3.7.5.3]

1313.0 Medical-Surgical Vacuum Exhaust.

1313.1 Vacuum Source Exhausts. The medical-surgical vacuum pumps shall exhaust in a manner and location that minimizes the hazards of noise and contamination to the facility and its environment. [NFPA 99:5.1.3.7.7.1]

1313.2 Location. The exhaust shall be located as follows:

(1) Outdoors.

(2) At least 25 feet (7620 mm) from any door, window, air intake, or other openings in buildings or places of public assembly.

(3) At a level different from air intakes.

(4) Where prevailing winds, adjacent buildings, topography, or other influences will not divert the exhaust into occupied areas or prevent dispersion of the exhaust. [NFPA 99: 5.1.3.7.7.2]

1313.3 Screening. The end of the exhaust shall be turned down and screened or otherwise be protected against the entry of vermin, debris, or precipitation by screening fabricated or composed of a noncorroding material. [NFPA 99:5.1.3.7.7.3]

1313.4 Dips and Loops. The exhaust shall be free of dips and loops that might trap condensate or oil or provided with a drip leg and valved drain at the bottom of the low point. [NFPA 99:5.1.3.7.7.4]

1313.5 Multiple Pumps. Vacuum exhausts from multiple pumps shall be permitted to be joined together to one common exhaust where the following conditions are met:

(1) The common exhaust is sized to minimize backpressure in accordance with the pump manufacturer's recommendations.

(2) Each pump can be isolated by manual or check valve, blind flange, or tube cap to prevent open exhaust piping when the pump(s) is removed for service from consequent flow of exhaust air into the room. [NFPA 99:5.1.3.7.7.5]

1314.0 Valves.

1314.1 Gas and Vacuum Shutoff Valves. Shutoff valves shall be provided to isolate sections or portions of the piped distribution system for maintenance, repair, or planned future expansion need and to facilitate periodic testing. [NFPA 99:5.1.4.1.1]

1314.2 Security. All valves, except valves in zone valve box assemblies, shall be secured by any of the following means:

(1) Located in secured areas.

(2) Locked or latched in their operating position.

(3) Located above ceilings, but remaining accessible and not obstructed. [NFPA 99:5.1.4.1.2]

1314.3 Labeled. All valves shall be labeled as to gas supplied and the area(s) controlled, in accordance with Section 1323.14. [NFPA 99:5.1.4.1.3]

1314.4 Accessibility. Zone valves shall be installed in valve boxes with removable covers large enough to allow manual operation of valves.

Zone valves for use in certain areas, such as psychiatric or pediatric areas, shall be permitted to be secured with the approval of the Authority Having Jurisdiction to prevent inappropriate access. [NFPA 99:5.1.4.1.4]

1314.4.1 Flammable Gases. Valves for nonflammable medical gases shall not be installed with valves for flammable gases in the same zone valve box assembly with flammable gases. [NFPA 99:5.1.4.1.5]

1314.5 Valve Types. New or replacement valves shall be permitted to be of any type as long as they meet the following conditions:

(1) They have a minimum Cv factor in accordance with Table 1314.5.
(2) They use a quarter turn to off.
(3) They are constructed of materials suitable for the service.
(4) They are provided with copper tube extensions by the manufacturer for brazing or with corrugated medical tubing (CMT) fittings.
(5) They indicate to the operator if the valve is open or closed.
(6) They permit in-line serviceability.
(7) They are cleaned for oxygen service by the manufacturer if used for any positive-pressure service. [NFPA 99:5.1.4.1.6]

TABLE 1314.5
POSITIVE PRESSURE GASES
[NFPA 99: TABLE 5.1.4.1.6(a)]

VALVE SIZE (inch)	MINIMUM Cv (full open)
1/2	17
3/4	31
1	60
1 1/4	110
1 1/2	169
2	357
2 1/2	390
3	912
4	1837

For SI units: 1 inch = 25.4 mm

1314.6 Source Valves. A shutoff valve shall be placed at the immediate connection of each central supply system to the piped distribution system to allow the entire central supply system, including all accessory devices (e.g., air dryers, final line regulators), to be isolated from the facility. [NFPA 99:5.1.4.2.1]

1314.6.1 Location. The source valve shall be located in the immediate vicinity of the central supply system. [NFPA 99:5.1.4.2.2]

1314.7 Main Line Valve. A shutoff valve shall be provided in the main supply line inside of the buildings being served, except where one or more of the following conditions exist:

(1) The source and source valve are located inside the building served.
(2) The source system is physically mounted to the wall of the building served, and the pipeline enters the building in the immediate vicinity of the source valve. [NFPA 99:5.1.4.3.1]

1314.7.1 Location. The main line valve shall be located on the facility side of the source valve and outside of the source room, the enclosure, or where the main line first enters the building. [NFPA 99:5.1.4.3.2]

1314.8 Riser Valves. Each riser supplied from the main line shall be provided with a shutoff valve in the riser adjacent to the main line. [NFPA 99:5.1.4.4]

1314.9 Service Valves. Service valves shall be installed to allow servicing or modification of lateral branch piping from a main or riser without shutting down the entire main, riser, or facility. [NFPA 99:5.1.4.5.1]

1314.9.1 Branch Piping. Only one service valve shall be required for each branch off of a riser, regardless of how many zone valve boxes are installed on that lateral.

Service valves shall be placed in the branch piping prior to any zone valve box assembly on that branch. [NFPA 99:5.1.4.5.2, 5.1.4.5.3]

1314.10 Zone Valves. All station outlets/inlets shall be supplied through a zone valve, which shall be placed as follows:

(1) It is installed so that a wall intervenes between the valve and the outlets/inlets that it controls.
(2) It is readily operable from a standing position.
(3) It is installed where it is visible and accessible at all times.
(4) It is not installed where it can be hidden from plain view, such as behind normally open or normally closed doors.
(5) It is not installed in a room with the station outlets/inlets that it controls.
(6) It is not installed in rooms, areas, or closets that can be closed or locked. [NFPA 99:5.1.4.6.1]

1314.10.1 Readily Accessible. A zone valve in each medical gas or vacuum line shall be provided for each Category 1 space and anesthetizing location for moderate sedation, deep sedation, or general anesthesia specific for the occupancy. These zone valves shall be located as follows:

(1) They are installed immediately outside the area controlled.

(2) They are readily accessible in an emergency. [NFPA 99:5.1.4.6.2]

1314.10.2 Arrangement. Piping on the patient side of zone valves shall be arranged to provide the following:

(1) Shutting off the supply of medical gas or vacuum to one zone will not affect the supply of medical gas or vacuum to another zone or the rest of the system.

(2) Service will only be to outlets/inlets located on that same story.

(3) All gas delivery columns, hose reels, ceiling tracks, control panels, pendants, booms, or other special installations are located on the patient side of the zone valve. [NFPA 99:5.1.4.6.3]

1314.10.3 Indicators. A pressure/vacuum indicator shall be provided on the station outlet/inlet side of each zone valve. [NFPA 99:5.1.4.6.4]

1314.11 In-Line Shutoff Valves. Optional in-line valves shall be permitted to be installed to isolate or shut off piping for servicing of individual rooms or areas. [NFPA 99:5.1.4.7]

1314.12 Valves for Future Connections. Future connection valves shall be labeled as to gas content. [NFPA 99:5.1.4.8.1]

1314.12.1 Downstream Piping. Downstream piping shall be closed with a brazed cap with tubing allowance for cutting and rebrazing. [NFPA 99:5.1.4.8.2]

1315.0 Station Outlets and Inlets.

1315.1 General. Each station outlet/inlet for medical gases or vacuums shall be gas-specific, whether the outlet/inlet is threaded or is a noninterchangeable quick coupler. [NFPA 99:5.1.5.1]

1315.2 Required Valves. Each station outlet shall consist of a primary and a secondary valve (or assembly).

Each station inlet shall consist of a primary valve (or assembly) and shall be permitted to include a secondary valve (or assembly). [NFPA 99:5.1.5.2, 5.1.5.3]

1315.3 Secondary Valve. The secondary valve (or assembly) shall close automatically to stop the flow of gas (or vacuum, if provided) when the primary valve (or assembly) is removed. [NFPA 99:5.1.5.4]

1315.4 Identification. Each outlet/inlet shall be legibly identified in accordance with Section 1323.15. [NFPA 99:5.1.5.5]

1315.5 Threaded Outlets/Fittings. Threaded outlets/inlets shall be noninterchangeable connections complying with the mandatory requirements of CGA V-5. [NFPA 99:5.1.5.6]

1315.6 Gas-Specific Station Outlet/Inlet. Each station outlet/inlet, including those mounted in columns, hose reels, ceiling tracks, or other special installations, shall be designed so that parts or components that are required to be gas-specific for compliance with Section 1315.1 and Section 1315.8 cannot be interchanged between the station outlet/inlet for different gases. [NFPA 99:5.1.5.7]

1315.7 Common Parts. The use of common parts in outlets/inlets, such as springs, O-rings, fasteners, seals, and shutoff poppets, shall be permitted. [NFPA 99:5.1.5.8]

1315.8 Marking of Components. Components of a vacuum station inlet necessary for the maintenance of vacuum specificity shall be legibly marked to identify them as components or parts of a vacuum or suction system. [NFPA 99:5.1.5.9]

1315.9 Components Not Specific to a Vacuum. Components of inlets not specific to a vacuum shall not be required to be marked. [NFPA 99:5.1.5.10]

1315.10 Factory-Installed Copper Inlet Tubes. Factory-installed copper inlet tubes on station outlets extending no further than 8 inches (203 mm) from the body of the terminal shall be not less than DN8 (NPS 1/4) (3/8 inch O.D.) size, with 0.3 inch (7.6 mm) minimum inside diameter. [NFPA 99:5.1.5.11]

1315.11 Factory-Installed Copper Outlet Tubes. Factory-installed copper outlet tubes on station inlets extending no further than 8 inches (203 mm) from the body of the terminal shall be not less than DN10 (NPS 3/8) (1/2 in. O.D.) size, with 0.4 inch (10.2 mm) minimum inside diameter. [NFPA 99:5.1.5.12]

1315.12 Protection from Damage. Station outlets/inlets shall be permitted to be recessed or otherwise protected from damage. [NFPA 99:5.1.5.13]

1315.13 Multiple Wall Outlets/Inlets. When multiple wall outlets/inlets are installed, they shall be spaced to allow the simultaneous use of adjacent outlets/inlets with any of the various types of therapy equipment. [NFPA 99:5.1.5.14]

1315.14 Nonstandard Operation Pressures. Station outlets in systems having nonstandard operating pressures shall meet the following additional requirements:

(1) They shall be gas-specific.

(2) They shall be pressure-specific where a single gas is piped at more than one operating pressure [e.g., a station outlet for oxygen at 80 psi (552 kPa) shall not accept an adapter for oxygen at 50 psi (345 kPa)].

(3) If operated at a pressure in excess of 80 psi (552 kPa), they shall be either D.I.S.S. connectors or comply with Section 1315.14(4).

(4) If operated at a gauge pressure between 200 psi and 300 psi (1379 kPa and 2068 kPa), the station outlet shall be designed so as to prevent the removal of the adapter until the pressure has been relieved to prevent the adapter injuring the user or others when removed from the outlet. [NFPA 99:5.1.5.15]

1315.15 Post Installation. After installation of the piping, but before installation of the station outlets and inlets and other medical gas and medical gas system components (e.g., pressure-actuating switches for alarms, manifolds, pressure gauges, or pressure relief valves), the line shall be blown clear using oil-free, dry nitrogen NF.

1316.0 Pressure and Vacuum Indicator Locations.

1316.1 Isolation. A pressure-relief valve shall not be isolated from its intended use by a valve.

1316.2 Pressure and Vacuum Indicator Locations. Pressure/vacuum indicators shall be readable from a standing position. Pressure/vacuum indicators shall be provided at the following locations, as a minimum:

(1) Adjacent to the alarm-initiating device for source main line pressure and vacuum alarms in the master alarm system.

(2) At or in area alarm panels to indicate the pressure/vacuum at the alarm activating device for each system that is monitored by the panel.

(3) On the station outlet/inlet side of zone valves. [NFPA 99:5.1.8.2.1, 5.1.8.2.2]

1317.0 Warning Systems.

1317.1 Category 1. All master, area, and local alarm systems used for medical gas and vacuum systems shall include the following:

(1) Separate visual indicators for each condition monitored, except as permitted in Section 1317.1.2 for local alarms that are displayed on master alarm panels.

(2) Visual indicators that remain in alarm until the situation that has caused the alarm is resolved.

(3) Cancelable audible indication of each alarm condition that produces a sound with a minimum level of 80 decibels at 3 feet (914 mm).

(4) Means to indicate a lamp or LED failure and audible failure.

(5) Visual and audible indication that the communication with an alarm-initiating device is disconnected.

(6) Labeling of each indicator, indicating the condition monitored.

(7) Labeling of each alarm panel for its area of surveillance.

(8) Reinitiation of the audible signal if another alarm condition occurs while the audible alarm is silenced.

(9) Power for master, area alarms, sensors, and switches from the life safety branch of the essential electrical system as described in NFPA 99.

(10) Power for local alarms, dew point sensors, and carbon monoxide sensors permitted to be from the same essential electrical branch as is used to power the air compressor system.

(11) Where used for communications, wiring from switches or sensors that is supervised or protected as required by NFPA 70 for life safety and critical branches circuits in which protection is any of the following types:

(a) Conduit

(b) Free air

(c) Wire

(d) Cable tray

(e) Raceways

(12) Communication devices that do not use electrical wiring for signal transmission will be supervised such that failure of communication shall initiate an alarm.

(13) Assurance by the responsible authority of the facility that the labeling of alarms, where room numbers or designations are used, is accurate and up-to-date.

(14) Provisions for automatic restart after a power loss of 10 seconds (e.g., during generator startup) without giving false signals or requiring manual reset.

(15) Alarm switches/sensors installed so as to be removable. [NFPA 99:5.1.9.1]

1317.1.1 Master Alarms. A master alarm system shall be provided to monitor the operation and condition of the source of supply, the reserve source (if any), and the pressure in the main lines of each medical gas and vacuum piping system. [NFPA 99:5.1.9.2]

1317.1.2 Master Alarm Signal. The master alarm shall include at least one signal from the source equipment to indicate a problem with the source equipment at this location. This master alarm signal shall activate when any of the required local alarm signals for this source equipment activates. [NFPA 99:5.1.9.5.2]

1318.0 Piping Materials for Field-Installed Positive Pressure Medical Gas Systems.

1318.1 General. The provisions of this section shall apply to field-installed piping for the distribution of medical gas systems.

1318.2 Cleaning. Tubes, valves, fittings, station outlets, and other piping components in medical gas systems shall have been cleaned for oxygen service by the manufacturer prior to installation in accordance with the mandatory requirements of CGA G-4.1, except that fittings shall be permitted to be cleaned by a supplier or agency other than the manufacturer. [NFPA 99:5.1.10.1.1]

Where tube ends, fittings or other components become contaminated before installation they shall be recleaned in accordance with Section 1321.8.7 and Section 1321.8.8.

1318.3 Delivery. Each length of tube shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation. Fittings, valves, and other components shall be delivered sealed and labeled and kept sealed until prepared for installation. [NFPA 99:5.1.10.1.2, 5.1.10.1.3]

1318.4 Tubes for Medical Gas Systems. Tubes shall be hard-drawn seamless copper in accordance with ASTM B819, medical gas tube, Type L, except Type K shall be used where operating pressures are above a gauge pressure of 185 psi (1276 kPa) and the pipe sizes are larger than DN80 [(NPS 3) ($3^{1}/_{8}$ inches O.D.)]. {NFPA 99:5.1.10.1.4}

1318.5 Manufacturer Markings. ASTM B819, medical gas tube shall be identified by the manufacturer's markings "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue (Type L) or green (Type K). [NFPA 99:5.1.10.1.7]

1318.6 Documentation. The installer shall furnish documentation certifying that all installed piping materials comply with the requirements of Section 1318.2. [NFPA 99:5.1.10.1.8]

1319.0 Piping Materials for Field-Installed Medical-Surgical Vacuum Systems.

1319.1 Tubes for Medical Vacuum Systems. Piping for vacuum systems shall be constructed of any of the following:

(1) Hard-drawn seamless copper tube in accordance with the following:
   (a) ASTM B88, copper tube (Type K, Type L, or Type M)
   (b) ASTM B280, copper ACR tube
   (c) ASTM B819, copper medical gas tubing (Type K or Type L)
(2) Stainless steel tube in accordance with the following:
   (a) ASTM A269 TP304L or 316L
   (b) ASTM A312 TP304L or 316L
   (c) ASTM A312 TP 304L/316L, Schedule 5S pipe, and ASTM A403 WP304L/316L, Schedule 5S fittings {NFPA 99:5.1.10.2.1}

1319.1.1 Where Not Required. If medical gas tube in accordance with ASTM B819, Standard Specification for Seamless Copper Tube for Medical Gas Systems, is used for vacuum piping, such special marking shall not be required. [NFPA 99:5.1.10.2.2.2]

1320.0 Joints and Connections.

1320.1 General. This section sets forth the requirements for pipe joint installations for a medical gas or vacuum system.

1320.2 Changes in Direction. Positive pressure patient gas systems, medical support gas systems, and vacuum systems constructed of hard-drawn seamless copper or stainless steel tubing shall have all turns, offsets, and other changes in direction made using fittings or techniques appropriate to any of the following acceptable joining methods:

(1) Brazing, as described in Section 1321.0.
(2) Welding, as described in Section 1322.1 through Section 1322.2.1.
(3) Memory metal fittings, as described in Section 1322.3.
(4) Axially swaged, elastic preload fittings, as described in Section 1322.4.
(5) Threaded, as described in Section 1322.5. [NFPA 99:5.1.10.3.1]

1320.2.1 Medical Vacuum Systems. Vacuum systems fabricated from copper tubing shall be permitted to have branch connections made using mechanically formed, drilled, and extruded tee-branch connections that are formed in accordance with the tool manufacturer's instructions. Such branch connections shall be joined by brazing, as described in Section 1321.0. [NFPA 99:5.1.10.3.3]

1321.0 Brazed Joints.

1321.1 Brazed Joints and Fittings. Fittings shall be wrought-copper capillary fittings complying with ASME B16.22, or brazed fittings complying with ASME B16.50. Cast copper alloy fittings shall not be permitted.

Brazed joints shall be made using a brazing alloy that exhibits a melting temperature in excess of 1000°F (538°C) to retain the integrity of the piping system in the event of fire exposure. [NFPA 99:5.1.10.4.1.1 – 5.1.10.4.1.3]

1321.2 Tube Joints. Brazed tube joints shall be the socket type. [NFPA 99:5.1.10.4.1.4]

1321.3 Filler Metals. Filler metals shall bond with and be metallurgically compatible with the base metals being joined.

Filler metals shall comply with AWS A5.8. [NFPA 99:5.1.10.4.1.5, 5.1.10.4.1.6]

1321.4 Copper-to-Copper Joints. Copper-to-copper joints shall be brazed using a copper–phosphorus or copper-phosphorus-silver brazing filler metal (BCuP series) without flux. [NFPA 99:5.1.10.4.1.7]

1321.5 Accessible. Joints to be brazed in place shall be accessible for necessary preparation, assembly, heating, filler application, cooling, cleaning, and inspection. [NFPA 99:5.1.10.4.1.9]

1321.6 Purging. Braze joints shall be continuously purged with nitrogen NF. [NFPA 99:5.1.10.4.1.10]

1321.7 Tube Ends. Tube ends shall be cut square using a sharp tubing cutter to avoid deforming the tube. [NFPA 99:5.1.10.4.2.1]

1321.7.1 Cutting Wheels. The cutting wheels on tubing cutters shall be free from grease, oil, or other lubricant not suitable for oxygen service. [NFPA 99:5.1.10.4.2.2]

1321.7.2 Cut Ends. The cut ends of the tube shall be permitted to be rolled smooth or deburred with a sharp, clean deburring tool, taking care to prevent chips from entering the tube. [NFPA 99:5.1.10.4.2.3]

1321.8 Cleaning Procedures. The interior surfaces of tubes, fittings, and other components that are cleaned for oxygen service shall be stored and handled to avoid contamination prior to assembly and brazing. [NFPA 99:5.1.10.4.3.1]

1321.8.1 Exterior Surfaces. The exterior surfaces of tube ends shall be cleaned prior to brazing to remove any surface oxides. When cleaning the exterior surfaces of tube ends, no matter shall be allowed to enter the tube. [NFPA 99:5.1.10.4.3.2, 5.1.10.4.3.3]

1321.8.2 Interior Surfaces. If the interior surfaces of fitting sockets become contaminated prior to brazing, they shall be recleaned for oxygen in accordance with Section 1321.8.7 and be cleaned for brazing with a clean, oil-free, stainless steel or brass wire brush. [NFPA 99:5.1.10.4.3.4]

1321.8.3 Abrasive Pads. Clean, nonshedding, abrasive pads shall be used to clean the exterior surfaces of the tube ends. [NFPA 99:5.1.10.4.3.5]

1321.8.4 Prohibited. The use of steel wool or sand cloth shall be prohibited. The cleaning process shall not result in grooving of the surfaces to be joined. [NFPA 99:5.1.10.4.3.6, 5.1.10.4.3.7]

1321.8.5 Wiped. After being abraded, the surfaces shall be wiped using a clean, lint-free white cloth. [NFPA 99:5.1.10.4.3.8]

1321.8.6 Examination. Tubes, fittings, valves, and other components shall be visually examined internally before being joined to verify that they have not become contaminated for oxygen service and that they are free of obstructions or debris. [NFPA 99:5.1.10.4.3.9]

1321.8.7 On-Site Recleaning. The interior surfaces of tube ends, fittings, and other components that were cleaned for oxygen service by the manufacturer, but that became contaminated prior to being installed, shall be permitted to be recleaned on-site by the installer by thoroughly scrubbing the interior surfaces with a clean, hot water–alkaline solution, such as sodium carbonate or trisodium phosphate, using a solution of 1 pound (0.5 kg) of sodium carbonate or trisodium phosphate to 3 gallons (11 L) of potable water, and thoroughly rinsing them with clean, hot, potable water.

Other aqueous cleaning solutions shall be permitted to be used for on-site recleaning provided that they are as recommended in the mandatory requirements of CGA G-4.1. [NFPA 99:5.1.10.4.3.10, 5.1.10.4.3.11]

1321.8.8 Contaminated Materials. Material that has become contaminated internally and is not clean for oxygen service shall not be installed. [NFPA 99:5.1.10.4.3.12]

1321.8.9 Timeframe for Brazing. Joints shall be brazed within 8 hours after the surfaces are cleaned for brazing. [NFPA 99:5.1.10.4.3.13]

1321.9 Brazing Dissimilar Metals. Flux shall only be used when brazing dissimilar metals, such as copper and bronze or brass, using a silver (BAg series) brazing filler metal. [NFPA 99:5.1.10.4.4.1]

1321.9.1 Surface Cleaning. Surfaces shall be cleaned for brazing in accordance with Section 1321.8. [NFPA 99:5.1.10.4.4.2]

1321.9.2 Flux. Flux shall be applied sparingly to minimize contamination of the inside of the tube with flux. The flux shall be applied and worked over the cleaned surfaces to be brazed using a stiff bristle brush to ensure complete coverage and wetting of the surfaces with flux. [NFPA 99:5.1.10.4.4.3, 5.1.10.4.4.4]

1321.9.3 Short Sections of Copper. Where possible, short sections of copper tube shall be brazed onto the non-copper component, and the interior of the subassembly shall be cleaned of flux prior to installation in the piping system. [NFPA 99:5.1.10.4.4.5]

1321.9.4 Flux-Coated Brazing Rods. On joints DN20 (NPS ¾) (⅞ inch O.D.) size and smaller, flux-coated brazing rods shall be permitted to be used in lieu of applying flux to the surfaces being joined. [NFPA 99:5.1.10.4.4.6]

1321.10 Nitrogen Purge. When brazing, joints shall be continuously purged with oil-free, dry nitrogen NF to prevent the formation of copper oxide on the inside surfaces of the joint. [NFPA 99:5.1.10.4.5.1]

1321.10.1 Source. The source of the purge gas shall be monitored, and the installer shall be audibly alerted when the source content is low. [NFPA 99:5.1.10.4.5.2]

1321.10.2 Flow Rate Control. The purge gas flow rate shall be controlled by the use of a pressure regulator and flowmeter, or combination thereof.

Pressure regulators alone shall not be used to control purge gas flow rates. [NFPA 99:5.1.10.4.5.3, 5.1.10.4.5.4]

1321.10.3 Oxygen Analyzer. In order to ensure that all ambient air has been removed from the pipeline prior to brazing, an oxygen analyzer shall be used to verify the effectiveness of the purge. The oxygen analyzer shall read below 1 percent oxygen concentration before brazing begins. [NFPA 99:5.1.10.4.5.5]

1321.10.4 During Installation. During and after installation, openings in the piping system shall be kept sealed to maintain a nitrogen atmosphere within the piping to prevent debris or other contaminants from entering the system. [NFPA 99:5.1.10.4.5.6]

1321.10.5 Discharge Opening. While a joint is being brazed, a discharge opening shall be provided on the opposite side of the joint from where the purge gas is being introduced. [NFPA 99:5.1.10.4.5.7]

1321.10.6 Temperature of Joint. The flow of purge gas shall be maintained until the joint is cool to the touch. [NFPA 99:5.1.10.4.5.8]

1321.10.7 Opening to Be Sealed. After the joint has cooled, the purge discharge opening shall be sealed to prevent contamination of the inside of the tube and maintain the nitrogen atmosphere within the piping system. [NFPA 99:5.1.10.4.5.9]

1321.10.8 Final Brazed Connection. The final brazed connection of new piping to an existing pipeline containing the system gas shall be permitted to be made without the use of a nitrogen purge. [NFPA 99:5.1.10.4.5.10]

1321.10.9 Final Tie-In Test. After a final brazed connection in a positive pressure medical gas pipeline is made without a nitrogen purge, an outlet in the immediate downstream zone of the affected portion(s) of both the new and existing piping shall be tested in accordance with the final tie-in test in Section 1324.5.9 through Section 1324.5.9.4. [NFPA 99:5.1.10.4.5.11]

1321.10.10 Autogenous Orbital Welding Process. When using the autogenous orbital welding process, joints shall be continuously purged inside and outside with inert gas(es) in accordance with the qualified welding procedure. [NFPA 99:5.1.10.4.5.12]

1321.11 Assembling and Heating Brazed Joints. Tube ends shall be inserted into the socket, either fully or to a mechanically limited depth that is not less than the minimum cup depth (overlap) specified by ASME B16.50. [NFPA 99:5.1.10.4.6.1]

1321.11.1 Heating of Joint. Where flux is permitted, the joint shall be heated slowly until the flux has liquefied. After flux is liquefied, or where flux is not permitted to be used, the joint shall be heated quickly to the brazing temperature, taking care not to overheat the joint. [NFPA 99:5.1.10.4.6.2, 5.1.10.4.6.3]

1321.12 Inspection of Brazed Joints. After brazing, the outside of all joints shall be cleaned by washing with water and a wire brush to remove any residue and allow clear visual inspection of the joint. [NFPA 99:5.1.10.4.7.1]

1321.12.1 Where Flux Is Used. Where flux has been used, the wash water shall be hot. [NFPA 99:5.1.10.4.7.2]

1321.12.2 Visually Inspected. Each brazed joint shall be visually inspected after cleaning the outside surfaces. [NFPA 99:5.1.10.4.7.3]

1321.12.3 Prohibited Brazed Joints. Joints exhibiting the following conditions shall not be permitted:

(1) Flux or flux residue (when flux or flux-coated BAg series rods are used with dissimilar metals).
(2) Base metal melting or erosion.
(3) Unmelted filler metal.
(4) Failure of the filler metal to be clearly visible all the way around the joint at the interface between the socket and the tube.
(5) Cracks in the tube or component.
(6) Cracks in the braze filler metal.
(7) Failure of the joint to hold the test pressure under the installer-performed initial pressure test (see Section 1324.5 through Section 1324.5.1.2) and standing pressure test (see Section 1324.5.4 or Section 1324.5.5). [NFPA 99:5.1.10.4.7.4]

1321.12.4 Defective Brazed Joints. Brazed joints that are identified as defective under the conditions of Section 1321.12.3(2) or Section 1321.12.3(5) shall be replaced. [NFPA 99:5.1.10.4.7.5]

Brazed joints that are identified as defective under the conditions of Section 1321.12.3(1), Section 1321.12.3(3), Section 1321.12.3(4), Section 1321.12.3(6) or Section 1321.12.3(7) shall be permitted to be repaired, except that no joint shall be reheated more than once before being replaced. [NFPA 99:5.1.10.4.7.6]

1322.0 Welded Joints.

1322.1 Welded Joints Procedure. Welded joints for medical gas and medical-surgical vacuum systems shall be permitted to be made using a gas tungsten arc welding (GTAW) autogenous orbital procedure. [NFPA 99:5.1.10.5.1.1]

1322.1.1 Welder Qualification Procedure. The GTAW autogenous orbital procedure and the welder qualification procedure shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Welder qualification procedures shall include a bend test and a tensile test in accordance with Section IX of the ASME Boiler and Pressure Vessel Code on each tube size diameter. [NFPA 99:5.1.10.5.1.2, 5.1.10.5.1.3]

1322.1.2 Welding Procedure Specification. Each welder shall qualify to a welding procedure specification (WPS) for each tube diameter. [NFPA 99:5.1.10.5.1.4]

1322.1.3 Purging of Joints. GTAW autogenous orbital welded joints shall be purged during welding with a commercially available mixture of 75 percent helium (+/- 5 percent) and 25 percent argon (+/- 5 percent). [NFPA 99:5.1.10.5.1.5]

1322.1.4 Shield Gas. The shield gas shall be as required in Section 1322.1.3. [NFPA 99:5.1.10.5.1.6]

1322.1.5 Test Coupons. Test coupons shall be welded and inspected, as a minimum, at the start of work and every 4 hours thereafter, or when the machine is idle for more than 30 minutes, and at the end of the work period. Test coupons shall be inspected on the I.D. and O.D. by a qualified quality control inspector. Test coupons shall also be welded at change of operator, weld head, welding power supply, or gas source. [NFPA 99:5.1.10.5.1.7 – 5.1.10.5.1.9]

1322.2 Welding for Stainless Tube. Stainless tube shall be welded using metal inert gas (MIG) welding, tungsten inert gas (TIG) welding, or other welding techniques suited to joining stainless tube. [NFPA 99:5.1.10.5.2.1]

1322.2.1 Qualifications. Welders shall be qualified to Section IX of the ASME Boiler and Pressure Vessel Code. [NFPA 99:5.1.10.5.2.2]

1322.3 Memory Metal Fittings. Memory metal fittings having a temperature rating not less than 1000°F (538°C) and a pressure rating not less than 300 psi (2068 kPa) shall be permitted to be used to join copper or stainless steel tube. Memory metal fittings shall be installed by qualified technicians in accordance with the manufacturer's instructions. [NFPA 99:5.1.10.6.1, 5.1.10.6.2]

1322.4 Axially Swaged Fittings. Axially swaged, elastic strain preload fittings providing metal-to-metal seals, having a temperature rating not less than 1000°F (538°C) and a pressure rating not less than 300 psi (2068 kPa), and that, when complete, are permanent and nonseparable shall be permitted to be used to join copper or stainless steel tube. Axially swaged, elastic strain preload fittings shall be installed by qualified technicians in accordance with the manufacturer's instructions. [NFPA 99:5.1.10.7.1, 5.1.10.7.2]

1322.5 Threaded Fittings. Threaded fittings shall meet the following criteria:

(1) They shall be limited to connections for pressure and vacuum indicators, alarm devices, gas-specific demand check fittings, and source equipment on the source side of the source valve.

(2) They shall be tapered pipe threads complying with ASME B1.20.1.

(3) They shall be made up with polytetrafluoroethylene (PTFE) tape or other thread sealant recommended for oxygen service, with sealant applied to the male threads only and care taken to ensure sealant does not enter the pipe. [NFPA 99:5.1.10.8]

1322.6 Other Types of Fittings. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint shall be permitted to be used. [NFPA 99:5.1.10.9.1]

1322.6.1 Dielectric Fittings. Dielectric fittings that comply with the following shall be permitted only where required by the manufacturer of special medical equipment to electrically isolate the equipment from the system distribution piping:

(1) They shall be of brass or copper construction with an approved dielectric.

(2) They shall be permitted to be a union.

(3) They shall be clean for oxygen where used for medical gases and medical support gases. [NFPA 99:5.1.10.9.2]

1322.7 Prohibited Joints. The following joints shall be prohibited throughout medical gas and vacuum distribution pipeline systems:

(1) Flared and compression-type connections, including connections to station outlets and inlets, alarm devices, and other components.

(2) Other straight-threaded connections, including unions.

(3) Pipe-crimping tools used to permanently stop the flow of medical gas and vacuum piping.

(4) Removable and nonremovable push-fit fittings that employ a quick assembly push fit connector. [NFPA 99:5.1.10.10]

1323.0 Installation of Piping and Equipment.

1323.1 Required Pipe Sizing. Piping systems shall be designed and sized to deliver the required flow rates at the utilization pressures. [NFPA 99:5.1.10.11.1.1]

1323.1.1 Mains and Branches. Mains and branches in medical gas piping systems shall be not less than DN15 (NPS ½) (⅝ inch O.D.) size. Mains and branches in medical-surgical vacuum systems shall be not less than DN20 (NPS ¾) (⅞ inch O.D.) size. [NFPA 99:5.1.10.11.1.2, 5.1.10.11.1.3]

1323.1.2 Drops to Individual Stations. Drops to individual station outlets and inlets shall be not less than DN15 (NPS ½) (⅝ inch O.D.) size. [NFPA 99:5.1.10.11.1.4]

1323.1.3 Runouts and Connecting Tubing. Runouts to alarm panels and connecting tubing for gauges and alarm devices shall be permitted to be DN8 (NPS ¼) (⅜ inch O.D.) size. [NFPA 99:5.1.10.11.1.5]

1323.1.4 Maximum Demand. Where the maximum demand for each medical gas or vacuum system does not exceed the values in Table 1323.1.4(1) through Table 1323.1.4(6), the size of pipe of each section of the system shall be determined in accordance with Section 1323.1.5. The size for systems beyond the range of Table 1323.1.4(1) through Table 1323.1.4(6) shall be determined in accordance with Section 1323.1.6.

1323.1.5 Sizing Procedures. The size of each section of pipe in a system within the range of Table 1323.1.4(1) through Table 1324.1.4(6) shall be determined in accordance with the following:

(1) Determine the total flow rate and number of outlets or inlets for each section of pipe in accordance with Table 1305.2 and Table 1305.3.

(2) Measure the length of the section of pipe to each station outlet or inlet on the system. Multiply the measured pipe length by 1.5 (150 percent), to account for the number of fittings in the system, to determine the pipe equivalent length.

(3) Beginning with the most remote outlet or inlet, multiply the total flow rate by the diversity factor specified in Table 1323.1.5(1) for each section of pipe to determine the sizing flow rate for the piping.

(4) Select Table 1323.1.4(1) through Table 1324.1.4(6) based on the medical gas or vacuum being transported through the piping.

(5) Select an estimated pipe size for determining the system pressure loss. Multiply the pipe equivalent length, for a given section of pipe, by the pressure loss for the sizing flow rate in the applicable table. Divide that number by 100 to determine the system pressure loss for the section of pipe.

(6) Add the pressure loss for each section of piping, from the source equipment location to the outlet or inlet, to determine the total system pressure loss to each outlet or inlet. The total system pressure loss in the piping to each outlet or inlet shall not exceed the values specified in Table 1323.1.5(2).

1323.1.6 Engineering Methods. For conditions other than those covered by Section 1323.1.4, such as longer runs of greater gas or vacuum demands, the size of each medical gas or vacuum piping system shall be determined by standard engineering methods acceptable to the Authority Having Jurisdiction, and each system shall be so designed that the total pressure drop or gain between the source equipment and an outlet or inlet shall not exceed the allowable pressures shown in Table 1305.1.

1323.2 Pipe Protection. Piping shall be protected against freezing, corrosion, and physical damage. [NFPA 99:5.1.10.11.2]

1323.2.1 Exposed Piping. Piping exposed in corridors and other areas where subject to physical damage from the movement of carts, stretchers, portable equipment, or vehicles shall be protected. [NFPA 99:5.1.10.11.2.1]

1323.2.2 Underground Piping. Piping underground within buildings or embedded in concrete floors or walls shall be installed in a continuous conduit. [NFPA 99:5.1.10.11.2.2]

1323.3 Location of Piping. Piping risers shall be permitted to be installed in pipe shafts if protected from physical damage, effects of excessive heat, corrosion, or contact with oil. [NFPA 99:5.1.10.11.3.1]

1323.3.1 Prohibited Locations. Piping shall not be installed in kitchens, stairwells, elevator shafts, elevator machine rooms, areas with open flames, electrical service equipment over 600 volts, and areas prohibited under NFPA 70 except for the following locations:

(1) Room locations for medical air compressor supply systems and medical-surgical vacuum pump supply systems

(2) Room locations for secondary distribution circuit panels and breakers having a maximum voltage rating of 600 volts [NFPA 99:5.1.10.11.3.2]

TABLE 1323.1.4(1)
PRESSURE LOSS FOR MEDICAL AIR

FLOW RATE (SCFM)[1]	PRESSURE DROP (psi) PER 100 FEET[2]		
	½ INCH PIPE	¾ INCH PIPE	1 INCH PIPE
0.35	0.004	0.001	–
0.71	0.012	0.003	–
1.06	0.023	0.005	–
1.41	0.037	0.007	–
1.77	0.055	0.011	–
2.12	0.075	0.015	–
2.47	0.097	0.019	–
2.82	0.123	0.024	–
3.18	0.151	0.029	–
3.53	0.181	0.035	–
4.24	0.249	0.048	–
4.94	0.326	0.063	–
5.65	0.413	0.080	–
6.36	0.507	0.098	–
7.06	0.611	0.118	0.030
7.77	0.723	0.139	0.035
8.47	0.843	0.162	0.041
9.18	0.969	0.187	0.047
9.89	1.108	0.212	0.053
10.59	1.252	0.240	0.060
12.36	1.647	0.315	0.079
14.12	2.090	0.398	0.100
15.89	2.580	0.490	0.123
17.66	3.116	0.591	0.148
19.42	–	0.701	0.176
21.19	–	0.818	0.205
22.95	–	0.944	0.236
24.72	–	1.078	0.268
28.25	–	1.369	0.341
31.78	–	1.690	0.421
35.31	–	2.043	0.509
38.84	–	2.425	0.603
42.37	–	2.838	0.705
45.90	–	3.280	0.814
49.43	–	3.751	0.929
52.97	–	4.249	1.052
56.50	–	–	1.181
60.03	–	–	1.318
63.56	–	–	1.461
67.09	–	–	1.611
70.62	–	–	1.768
81.21	–	–	2.276
88.28	–	–	2.647
95.34	–	–	3.044

For SI units: 1 standard cubic foot per minute = 28.32 SLPM, 1 inch = 25 mm, 1 foot = 304.8 mm, 1 pound-force per square inch = 6.8947 kPa

Notes:

[1] Based on the pressure of 14.7 psig (101 kPa) at 68°F (20°C).

[2] Based on the pressure of 55 psig (379 kPa) at 68°F (20°C).

TABLE 1323.1.4(2)
PRESSURE LOSS FOR NITROGEN

FLOW RATE (SCFM)[1]	PRESSURE DROP (psi) PER 100 FEET[2]		
	½ INCH PIPE	¾ INCH PIPE	1 INCH PIPE
5.30	0.126	0.024	–
10.59	0.430	0.082	–
15.89	0.886	0.168	–
21.19	1.485	0.281	–
26.48	2.220	0.419	–
31.78	3.089	0.581	–
37.08	4.087	0.766	–
42.37	–	0.975	–
47.67	–	1.206	–
52.97	–	1.460	0.361
58.26	–	1.736	0.429
63.56	–	2.033	0.502
68.85	–	2.352	0.580
74.15	–	2.692	0.663
79.45	–	3.054	0.752
84.74	–	3.436	0.845
90.04	–	3.840	0.943
95.34	–	4.264	1.046
100.63	–	4.709	1.154
105.93	–	–	1.267
116.52	–	–	1.508
127.12	–	–	1.768
137.71	–	–	2.046
148.30	–	–	2.344
158.90	–	–	2.660
169.49	–	–	2.994
180.08	–	–	3.347
190.67	–	–	3.719
201.27	–	–	4.108
211.86	–	–	4.516
222.45	–	–	4.942
233.05	–	–	–
243.64	–	–	–
254.23	–	–	–
264.83	–	–	–
275.42	–	–	–
286.01	–	–	–
296.60	–	–	–
307.20	–	–	–
317.79	–	–	–

For SI units: 1 standard cubic foot per minute = 28.32 SLPM, 1 inch = 25 mm, 1 foot = 304.8 mm, 1 pound-force per square inch = 6.8947 kPa

Notes:

[1] Based on the pressure of 14.7 psig (101 kPa) at 68°F (20°C).

[2] Based on the pressure of 55 psig (379 kPa) at 68°F (20°C).

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TABLE 1323.1.4(3)
PRESSURE LOSS FOR NITROUS OXIDE AND CARBON DIOXIDE

FLOW RATE (SCFM)[1]	PRESSURE DROP (psi) PER 100 FEET[2]		
	½ INCH PIPE	¾ INCH PIPE	1 INCH PIPE
0.35	0.004	–	–
0.71	0.014	–	–
1.06	0.029	–	–
1.41	0.047	–	–
1.77	0.070	–	–
2.12	0.096	–	–
2.47	0.125	–	–
2.82	0.159	–	–
3.18	0.195	–	–
3.53	0.235	0.045	–
4.24	0.324	0.062	–
4.94	0.425	0.081	–
5.65	0.539	0.103	–
6.36	0.664	0.127	–
7.06	0.802	0.153	0.038
7.77	0.950	0.181	0.045
8.47	1.110	0.211	0.053
9.18	1.281	0.243	0.061
9.89	1.463	0.278	0.070
10.59	1.656	0.314	0.079
12.36	2.186	0.413	0.103
14.12	2.752	0.525	0.131
15.89	3.442	0.648	0.162
17.66	4.166	0.783	0.195
19.42	–	0.929	0.231
21.19	–	0.744	0.270
22.95	–	0.858	0.312
24.72	–	0.980	0.356
28.25	–	1.244	0.453
31.78	–	1.537	0.560
35.31	–	1.858	0.677
38.84	–	2.205	0.804
42.37	–	2.581	0.941
45.90	–	2.982	1.088
49.43	–	3.411	1.245
52.97	–	4.249	1.411
56.50	–	–	1.587
60.03	–	–	1.772
63.56	–	–	1.967
67.09	–	–	2.174
70.62	–	–	2.385
79.45	–	–	2.959
88.28	–	–	3.589

For SI units: 1 standard cubic foot per minute = 28.32 SLPM, 1 inch = 25 mm, 1 foot = 304.8 mm, 1 pound-force per square inch = 6.8947 kPa

Notes:

[1] Based on the pressure of 14.7 psig (101 kPa) at 68°F (20°C).

[2] Based on the pressure of 55 psig (379 kPa) at 68°F (20°C).

TABLE 1323.1.4(4)
PRESSURE LOSS FOR OXYGEN

«

FLOW RATE (SCFM)[1]	PRESSURE DROP (psi) PER 100 FEET[2]		
	½ INCH PIPE	¾ INCH PIPE	1 INCH PIPE
0.35	0.004	–	–
0.71	0.013	0.003	–
1.06	0.025	0.005	–
1.41	0.041	0.008	–
1.77	0.060	0.012	–
2.12	0.082	0.016	–
2.47	0.107	0.021	–
2.82	0.135	0.026	–
3.18	0.166	0.032	–
3.53	0.199	0.038	–
4.24	0.274	0.053	–
4.94	0.359	0.069	–
5.65	0.454	0.087	–
6.36	0.558	0.107	–
7.06	0.672	0.129	0.033
7.77	0.795	0.153	0.039
8.47	0.927	0.179	0.045
9.18	1.066	0.205	0.052
9.89	1.218	0.233	0.059
10.59	1.377	0.263	0.066
12.36	1.811	0.346	0.087
14.12	2.298	0.438	0.110
15.89	2.837	0.539	0.135
17.66	3.456	0.650	0.163
19.42	–	0.771	0.193
21.19	–	0.900	0.225
22.95	–	1.038	0.260
24.72	–	1.185	0.295
28.25	–	1.505	0.375
31.78	–	1.859	0.463
35.31	–	2.247	0.559
38.84	–	2.667	0.663
42.37	–	3.121	0.775
45.90	–	3.607	0.895
49.43	–	4.125	1.022
52.97	–	–	1.157
56.50	–	–	1.299
60.03	–	–	1.449
63.56	–	–	1.607
67.09	–	–	1.772
70.62	–	–	1.944
81.21	–	–	2.503
91.81	–	–	3.127
102.40	–	–	3.813

For SI units: 1 standard cubic foot per minute = 28.32 SLPM, 1 inch = 25 mm, 1 foot = 304.8 mm, 1 pound-force per square inch = 6.8947 kPa

Notes:

[1] Based on pressure of 14.7 psig (101 kPa) at 68°F (20°C).

[2] Based on pressure of 55 psig (379 kPa) at 68°F (20 °C).

» TABLE 1323.1.4(5)
PRESSURE LOSS FOR VACUUM

FLOW RATE (SCFM)[1]	VACUUM LOSS (inch of mercury) PER 100 FEET FOR COPPER TUBE[2]				
	¾ INCH TUBE	1 INCH TUBE	1¼ INCH TUBE	1½ INCH TUBE	2 INCH TUBE
0.35	0.019	–	–	–	–
0.71	0.061	–	–	–	–
1.06	0.120	–	–	–	–
1.41	0.194	–	–	–	–
1.77	0.284	–	–	–	–
2.12	0.387	–	–	–	–
2.47	0.504 –	–	–	–	
2.82	0.634	–	–	–	–
3.18	0.777	–	–	–	–
3.53	0.932	0.238	–	–	–
4.24	1.277	0.325	–	–	–
4.94	1.669	0.424	–	–	–
5.65	2.106	0.534	–	–	–
6.36	2.586	0.655	–	–	–
7.06	3.110	0.787	0.272	–	–
7.77	3.674	0.929	0.321	–	–
8.47	4.280	1.081	0.373	–	–
9.18	4.927	1.243	0.429	–	–
9.89	–	1.416	0.488	–	–
10.59	–	1.597	0.551	0.242	–
11.30	–	1.789	0.616	0.270	–
12.01	–	1.990	0.685	0.300	–
12.71	–	2.200	0.757	0.332	–
13.42	–	2.419	0.832	0.365	–
14.12	–	2.648	0.911	0.399	–
14.83	–	2.886	0.992	0.435	–
15.54	–	3.132	1.077	0.471	–
16.24	–	3.388	1.164	0.510	–
16.95	–	3.652	1.254	0.549	–
17.66	–	3.925	1.348	0.590	–
18.36	–	4.207	1.444	0.632	0.167
19.07	–	4.498	1.543	0.675	0.179
19.77	–	4.797	1.646	0.720	0.190
20.48	–	–	1.751	0.766	0.202
21.19	–	–	1.859	0.813	0.214
24.72	–	–	2.441	1.066	0.281
28.25	–	–	3.092	1.350	0.356
31.78	–	–	3.811	1.662	0.438
35.31	–	–	4.596	2.004	0.527
38.84	–	–	–	2.373	0.624
42.37	–	–	–	2.770	0.728
45.90	–	–	–	3.194	0.838

« TABLE 1323.1.4(5)
PRESSURE LOSS FOR VACUUM (continued)

FLOW RATE (SCFM)[1]	VACUUM LOSS (inch of mercury) PER 100 FEET FOR COPPER TUBE[2]				
	¾ INCH TUBE	1 INCH TUBE	1¼ INCH TUBE	1½ INCH TUBE	2 INCH TUBE
49.43	–	–	–	3.645	0.956
52.97	–	–	–	4.122	1.081
56.50	–	–	–	4.626	1.212
63.56	–	–	–	–	1.495
70.62	–	–	–	–	1.803
77.68	–	–	–	–	2.138
84.74	–	–	–	–	2.497
91.81	–	–	–	–	2.882
98.87	–	–	–	–	3.291
105.93	–	–	–	–	3.724
112.99	–	–	–	–	4.181

For SI units: 1 standard cubic foot per minute = 28.32 SLPM, 1 inch = 25 mm, 1 foot = 304.8 mm, 1 inch of mercury = 3.386 kPa

Notes:

1 Based on the pressure of 14.7 psig (101 kPa) at 68°F (20°C).

2 Based on the pressure of 19 inches of mercury gauge vacuum (64 kPa) at 68°F (20°C).

« TABLE 1323.1.4(6)
PRESSURE LOSS FOR VACUUM (CATEGORY 3)

FLOW RATE (SCFM)[1]	VACUUM LOSS (inch of mercury) PER 100 FEET FOR PLASTIC TUBE[2]				
	¾ INCH TUBE	1 INCH TUBE	1¼ INCH TUBE	1½ INCH TUBE	2 INCH TUBE
0.35	0.005	–	–	–	–
0.71	0.010	–	–	–	–
1.06	0.015	–	–	–	–
1.41	0.021	–	–	–	–
1.77	0.026	–	–	–	–
2.12	0.060	0.010	–	–	–
2.47	0.077	0.020	–	–	–
2.82	0.096	0.025	–	–	–
3.18	0.118	0.031	0.011	–	–
3.53	0.141	0.036	0.013	–	–
4.24	0.192	0.050	0.017	–	–
4.94	0.249	0.064	0.023	0.010	–
5.65	0.313	0.081	0.028	0.012	–
6.36	0.383	0.099	0.035	0.015	–
7.06	0.459	0.118	0.041	0.018	–
7.77	0.541	0.139	0.049	0.021	–
8.47	0.628	0.161	0.056	0.024	–
9.18	0.722	0.185	0.065	0.027	–
9.89	0.821	0.210	0.073	0.031	–
10.59	0.925	0.237	0.083	0.035	–
11.30	1.035	0.265	0.092	0.039	0.010
12.01	1.151	0.294	0.102	0.043	0.011
12.71	1.270	0.324	0.113	0.048	0.012

TABLE 1323.1.4(6)
PRESSURE LOSS FOR VACUUM (CATEGORY 3) (continued)

FLOW RATE (SCFM)[1]	VACUUM LOSS (inch of mercury) PER 100 FEET FOR PLASTIC TUBE[2]				
	¾ INCH TUBE	1 INCH TUBE	1¼ INCH TUBE	1½ INCH TUBE	2 INCH TUBE
13.42	1.396	0.356	0.124	0.052	0.014
14.12	1.525	0.389	0.135	0.057	0.015
14.83	1.662	0.424	0.147	0.062	0.016
15.54	1.803	0.460	0.160	0.068	0.017
16.24	1.948	0.496	0.172	0.073	0.019
16.95	2.099	0.535	0.186	0.078	0.020
17.66	2.256	0.574	0.199	0.084	0.022
18.36	2.415	0.615	0.213	0.090	0.023
19.07	2.581	0.657	0.228	0.096	0.025
19.77	2.750	0.699	0.243	0.102	0.026
20.48	2.925	0.744	0.258	0.109	0.028
21.19	3.106	0.790	0.274	0.115	0.030
24.72	4.074	1.034	0.358	0.151	0.039
28.25	–	1.307	0.452	0.190	0.049
31.78	–	1.608	0.556	0.234	0.060
35.31	–	1.936	0.669	0.281	0.072
38.84	–	2.291	0.791	0.332	0.085
42.37	–	2.672	0.922	0.387	0.099
45.90	–	3.078	1.062	0.446	0.113
49.43	–	3.510	1.211	0.508	0.129
52.97	–	3.969	1.368	0.574	0.146
56.50	–	4.450	1.534	0.643	0.163
63.56	–	–	1.890	0.792	0.201
70.62	–	–	2.278	0.954	0.242
77.68	–	–	2.699	1.130	0.286
84.74	–	–	3.151	1.318	0.334
91.81	–	–	3.634	1.520	0.385
98.87	–	–	4.148	1.734	0.439
105.93	–	–	4.691	1.961	0.496
112.99	–	–	–	2.200	0.556

For SI units: 1 standard cubic foot per minute = 28.32 SLPM, 1 inch = 25 mm, 1 foot = 304.8 mm, 1 inch of mercury = 3.386 kPa

Notes:

1 Based on the pressure of 14.7 psig (101 kPa) at 68°F (20°C).

2 Based on the pressure of 19 inches of mercury gauge vacuum (64 kPa) at 68°F (20°C).

TABLE 1323.1.5(1)
SYSTEM SIZING – FLOW REQUIREMENTS FOR STATION OUTLETS AND INLETS[1]

NUMBER OF OUTLETS AND INLETS TERMINAL UNITS PER FACILITY	DIVERSITY PERCENTAGE OF AVERAGE FLOW PER OUTLETS AND INLETS TERMINAL UNITS	MINIMUM PERMISSIBLE SYSTEM FLOW OF ALL PRESSURIZED MEDICAL GAS SYSTEMS[2] (standard cubic feet per minute)
1–10	100%	Actual Demand
11–25	75%	7.0
26–50	50%	13.1
51–100	50%	17.5

Notes:

1 Flow rates of station outlets and inlets in accordance with Table 1305.2.

2 The minimum system flow is the average outlets and inlets flow times the number of station outlets and inlets times the diversity percentage.

TABLE 1323.1.5(2)
MAXIMUM PERMITTED PRESSURE LOSS IN MEDICAL GAS AND MEDICAL VACUUM SYSTEMS

TYPE OF SYSTEM	MAXIMUM ALLOWABLE SYSTEM PRESSURE LOSS (psi)
Medical Air	5
Nitrogen	15
Nitrous Oxide	5
Carbon Dioxide	5
Oxygen	5
Medical Vacuum	4 inches of mercury

For SI units: 1 pound-force per square inch = 6.8947 kPa, 1 inch of mercury = 3.386 kPa

1323.3.2 Approved Locations. Medical gas piping shall be permitted to be installed in the same service trench or tunnel with fuel gas lines, fuel oil lines, electrical lines, steam lines, and similar utilities, provided that the space is ventilated (naturally or mechanically) and the ambient temperature around the medical gas piping is limited to 130°F (54°C) maximum. [NFPA 99:5.1.10.11.3.3]

1323.3.3 Prohibited Contact with Oil. Medical gas piping shall not be located where subject to contact with oil, including a possible flooding area in the case of a major oil leak. [NFPA 99:5.1.10.11.3.4]

1323.4 Pipe Support. Piping shall be supported from the building structure. [NFPA 99:5.1.10.11.4.1]

1323.4.1 Hangers and Supports. Hangers and supports shall comply with and be installed in accordance with MSS SP-58. [NFPA 99:5.1.10.11.4.2]

1323.4.2 Copper Tube. Supports for copper tube shall be sized for copper tube. [NFPA 99:5.1.10.11.4.3]

1323.4.3 Damp Locations. In potentially damp locations, copper tube hangers or supports that are in contact with the tube shall be plastic-coated or otherwise be electrically insulated from the tube by a material that will not absorb moisture. [NFPA 99:5.1.10.11.4.5]

1323.4.4 Maximum Spacing. Maximum support spacing shall be in accordance with Table 1323.4.4. [NFPA 99:5.1.10.11.4.6]

TABLE 1323.4.4
MAXIMUM PIPE SUPPORT SPACING
[NFPA 99: TABLE 5.1.10.11.4.6]

PIPE SIZE			HANGER SPACING (feet)
DN8	(NPS ¼)	(⅜ of an inch O.D.)	5
DN10	(NPS ⅜)	(½ of an inch O.D.)	6
DN15	(NPS ½)	(⅝ of an inch O.D.)	6
DN20	(NPS ¾)	(⅞ of an inch O.D.)	7
DN25	(NPS 1)	(1⅛ of an inch O.D.)	8
DN32	(NPS 1¼)	(1⅜ of an inch O.D.)	9
DN40 and larger	(NPS 1½)	(1⅝ of an inch O.D.)	10
Vertical risers, all sizes, every floor, but not to exceed:			15

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

1323.4.5 Seismic Provisions. Where required, medical gas and vacuum piping shall be seismically restrained against earthquakes in accordance with the applicable building code. [NFPA 99:5.1.10.11.4.7]

1323.5 Frost Protection. Buried piping outside of buildings shall be installed below the local level of frost penetration. [NFPA 99:5.1.10.11.5.1]

1323.5.1 Backfilling and Trenching. The installation procedure for underground piping shall protect the piping from physical damage while being backfilled. [NFPA 99:5.1.10.11.5.2]

1323.5.2 Conduit, Cover, or Enclosure. If underground piping is protected by a conduit, cover, or other enclosure, the following requirements shall be met:

(1) Access shall be provided at the joints for visual inspection and leak testing.

(2) The conduit, cover, or enclosure shall be self-draining and not retain groundwater in prolonged contact with the pipe. [NFPA 99:5.1.10.11.5.3]

1323.5.3 Excessive Stresses. Buried piping that will be subject to surface loads shall be buried at a depth that will protect the piping or its enclosure from excessive stresses. [NFPA 99:5.1.10.11.5.4]

1323.5.4 Minimum Backfill. The minimum backfilled cover above the top of the pipe or its enclosure for buried piping outside of buildings shall be 36 inches (914 mm), except that the minimum cover shall be permitted to be reduced to 18 inches (457 mm) where there is no potential for damage from surface loads or surface conditions. [NFPA 99:5.1.10.11.5.5]

1323.5.5 Trenches. Trenches shall be excavated so that the pipe or its enclosure has firm, substantially continuous bearing on the bottom of the trench. [NFPA 99:5.1.10.11.5.6]

1323.5.6 Composition of Backfill. Backfill shall be clean, free from material that can damage the pipe, and compacted. [NFPA 99:5.1.10.11.5.7]

1323.5.7 Marker. A continuous tape or marker placed immediately above the pipe or its enclosure shall clearly identify the pipeline by specific name. [NFPA 99:5.1.10.11.5.8]

1323.5.8 Warning. A continuous warning means shall also be provided above the pipeline at approximately one-half the depth of burial. [NFPA 99:5.1.10.11.5.9]

1323.5.9 Wall Sleeve. Where underground piping is installed through a wall sleeve, the outdoor end of the sleeve shall be sealed to prevent the entrance of groundwater into the building. [NFPA 99:5.1.10.11.5.10]

1323.6 Connectors. Hose and flexible connectors, both metallic and nonmetallic, shall be no longer than necessary and shall not penetrate or be concealed in walls, floors, ceilings, or partitions. [NFPA 99:5.1.10.11.6.1]

1323.6.1 Flexible Connectors. Flexible connectors, metallic or nonmetallic, shall have a minimum burst pressure, with a gauge pressure of 1000 psi (6895 kPa). [NFPA 99:5.1.10.11.6.2]

1323.6.2 Metallic Flexible Joints. Metallic flexible joints shall be permitted in the pipeline where required for expansion joints, seismic protection, thermal expansion, or vibration control and shall be as follows:

(1) For all wetted surfaces, made of bronze, copper, or stainless steel.

(2) Cleaned at the factory for oxygen service and received on the job site with certification of cleanliness.

(3) Suitable for service at 300 psig (2068 kPa) or above and able to withstand temperatures of 1000°F (538°C).

(4) Provided with brazing extensions to allow brazing into the pipeline per Section 1321.0.

(5) Supported with pipe hangers and supports as required for their additional weight. [NFPA 99:5.1.10.11.6.3]

1323.7 Prohibited System Interconnections. Two or more medical gas or vacuum piping systems shall not be interconnected for installation, testing, or any other reason except as permitted by Section 1323.7.1. [NFPA 99:5.1.10.11.7.1]

1323.7.1 Medical Gas and Medical Vacuum. Medical gas and vacuum systems with the same contents shall be permitted to be interconnected with an inline valve installed between the systems. [NFPA 99:5.1.10.11.7.2]

1323.7.2 Leak Testing. Leak testing shall be accomplished by separately charging and testing each individual piping system. [NFPA 99:5.1.10.11.7.3]

1323.8 Manufacturer's Instructions. The installation of individual components shall be made in accordance with the instructions of the manufacturer. Manufacturer's instructions shall include directions and information deemed by the manufacturer to be adequate for attaining proper operation, testing, and maintenance of the medical gas and vacuum systems. Copies of the manufacturer's instructions shall be left with the system owner. [NFPA 99:5.1.10.11.8.1 – 5.1.10.11.8.3]

1323.9 Changes in System Use. Where a positive-pressure medical gas piping distribution system originally used or constructed for use at one pressure and for one gas is converted for operation at another pressure or for another gas, all provisions of Section 1318.0 through Section 1323.12 shall apply as if the system were new. [NFPA 99:5.1.10.11.9.1]

1323.9.1 Medical Vacuum System. A vacuum system shall not be permitted to be converted for use as a gas system. [NFPA 99:5.1.10.11.9.2]

1323.10 Qualifications of Installers. The installation of medical gas and vacuum systems shall be made by qualified, competent technicians who are experienced in performing such installations, including all personnel who actually install the piping system. Installers of medical gas and vacuum piped distribution systems, all appurtenant piping supporting pump and compressor source systems, and appurtenant piping supporting source gas manifold systems not including permanently installed bulk source systems, shall be certified in accordance with ASSE 6010. [NFPA 99:5.1.10.11.10.1, 5.1.10.11.10.2]

1323.10.1 Brazing. Brazing shall be performed by individuals who are qualified in accordance with Section 1323.11. [NFPA 99:5.1.10.11.10.5]

1323.10.2 Documentation. Prior to any installation work, the installer of medical gas and vacuum piping shall provide and maintain documentation on the job site for the qualification of brazing procedures and individual brazers that is required under Section 1323.11. [NFPA 99:5.1.10.11.10.6]

1323.10.3 Health Care Organization Personnel. Health care organization personnel shall be permitted to install piping systems if all of the requirements of Section 1323.10 are met during the installation. [NFPA 99:5.1.10.11.10.7]

1323.11 Qualification of Brazing Procedures and Brazing. Brazing procedures and brazer performance for the installation of medical gas and vacuum piping shall be qualified in accordance with either Section IX, "Welding and Brazing Qualifications," of the ASME Boiler and Pressure Vessel Code, or AWS B2.2, both as modified by Section 1323.11.1 through Section 1323.11.4. [NFPA 99:5.1.10.11.11.1]

1323.11.1 Examination. Brazers shall be qualified by visual examination of the test coupon followed by sectioning. [NFPA 99:5.1.10.11.11.2]

1323.11.2 Brazing Procedure Specification. The brazing procedure specification shall address cleaning, joint clearance, overlap, internal purge gas, purge gas flow rate, and filler metal. [NFPA 99:5.1.10.11.11.3]

1323.11.3 Documentation. The brazing procedure qualification record and the record of brazer performance qualification shall document filler metal used, base metals, cleaning, joint clearance, overlap, internal purge gas and flow rate during brazing of coupon, and absence of internal oxidation in the completed coupon. [NFPA 99:5.1.10.11.11.4]

1323.11.4 Procedures. Brazing procedures qualified by a technically competent group or agency shall be permitted under the following conditions:

(1) The brazing procedure specification and the procedure qualification records meet the requirements of this code.

(2) The employer obtains a copy of both the brazing procedure specification and the supporting qualification records from the group or agency and signs and dates these records, thereby accepting responsibility for the qualifications that were performed by the group or agency.

(3) The employer qualifies at least one brazer following each brazing procedure specification used. [NFPA 99:5.1.10.11.11.5]

1323.11.5 Conditions of Acceptance. An employer shall be permitted to accept brazer qualification records of a previous employer under the following conditions:

(1) The brazer has been qualified following the same or an equivalent procedure that the new employer uses.

(2) The new employer obtains a copy of the record of brazer performance qualification tests from the previous employer and signs and dates these records, thereby accepting responsibility for the qualifications performed by the previous employer. [NFPA 99:5.1.10.11.11.6]

1323.11.6 Qualifications. Performance qualifications of brazers shall remain in effect indefinitely, unless the brazer does not braze with the qualified procedure for a period exceeding 6 months or there is a specific reason to question the ability of the brazer. [NFPA 99:5.1.10.11.11.7]

1323.12 Breaching or Penetrating Medical Gas Piping. Positive pressure patient medical gas piping and medical support gas piping shall not be breached or penetrated by any means or process that will result in residual copper particles or other debris remaining in the piping or affect the oxygen-clean interior of the piping. The breaching or penetrating process shall ensure that any debris created by the process remains contained within the work area. [NFPA 99:5.1.10.11.12.1, 5.1.10.11.12.2]

1323.13 Labeling, Identification and Operating Pressure. Color and pressure requirements shall be in accordance with Table 1305.1. [NFPA 99:5.1.11]

1323.13.1 Pipe Labeling. Piping shall be labeled by stenciling or adhesive markers that identify the patient medical gas, the support gas, or the vacuum system and include the following:

(1) Name of the gas or vacuum system or the chemical symbol per Table 1305.1.

(2) Gas or vacuum system color code per Table 1305.1.

(3) Where positive pressure gas piping systems operate at pressures other than the standard gauge pressure in Table 1305.1, the operating pressure in addition to the name of the gas. [NFPA 99:5.1.11.1.1]

1323.13.2 Location of Pipe Labeling. Pipe labels shall be located as follows:

(1) At intervals of not more than 20 feet (6096 mm).

(2) At least once in or above every room.

(3) On both sides of walls or partitions penetrated by the piping.

(4) At least once in every story height traversed by risers. [NFPA 99:5.1.11.1.2]

1323.13.3 Paint. Medical gas piping shall not be painted. [NFPA 99:5.1.11.1.3]

1323.14 Identification of Shutoff Valves. Shutoff valves shall be identified with the following:

(1) Name or chemical symbol for the specific medical gas or vacuum system.

(2) Room or areas served.

(3) Caution to not close or open valve except in emergency. [NFPA 99:5.1.11.2.1]

1323.14.1 Nonstandard Operating Pressures. Where positive pressure gas piping systems operate at pressures other than the standard gauge pressure of 50 psi (345 kPa) to 55 psi (379 kPa) or a gauge pressure of 160 psi (1103 kPa) to 185 psi (1276 kPa) for nitrogen or instrument air, the valve identification shall also include the nonstandard operating pressure. [NFPA 99:5.1.11.2.2]

1323.14.2 Source Valves. Source valves shall be labeled in substance as follows:

SOURCE VALVE
FOR THE (SOURCE NAME)

[NFPA 99:5.1.11.2.3]

1323.14.3 Main Line Valves. Main line valves shall be labeled in substance as follows:

MAIN LINE VALVE FOR THE
(GAS/VACUUM NAME)
SERVING (NAME OF BUILDING)

[NFPA 99:5.1.11.2.4]

1323.14.4 Riser Valves. The riser valve(s) shall be labeled in substance as follows:

RISER FOR THE (GAS/VACUUM NAME)
SERVING (NAME OF THE AREA/BUILDING SERVED BY THE PARTICULAR RISER)

[NFPA 99:5.1.11.2.5]

1323.14.5 Service Valves. The service valve(s) shall be labeled in substance as follows:

SERVICE VALVE FOR THE
(GAS/VACUUM NAME) SERVING
(NAME OF THE AREA/BUILDING
SERVED BY THE PARTICULAR VALVE)

[NFPA 99:5.1.11.2.6]

1323.14.6 Zone Valve Box. Zone valve box assemblies shall be labeled with the rooms, areas, or spaces that they control as follows:

ZONE VALVES FOR THE
(GAS/VACUUM NAME)
SERVING (NAME OF ROOMS OR SPACES SERVED BY THE PARTICULAR VALVE)

Labeling shall either be visible from outside the zone valve box assembly through the cover or be replicated on the outside, but not affixed to the removable cover. [NFPA 99:5.1.11.2.7]

1323.15 Identification. Station outlets and inlets shall be identified as to the name or chemical symbol for the specific medical gas or vacuum provided.

In sleep labs, where the outlet is downstream of a flow control device, the station outlet identification shall include a warning not to use the outlet for ventilating patients.

Where medical gas systems operate at pressures other than the standard gauge pressure of 50 psi to 55 psi (345 kPa to 380 kPa) or a gauge pressure of 160 psi to 185 psi (1103 kPa to 1275 kPa) for nitrogen, the station outlet identification shall include the nonstandard operating pressure in addition to the name of the gas. [NFPA 99:5.1.11.3.1 – 5.1.11.3.2]

1324.0 Performance Criteria and Testing Category 1 (Gases, Medical Surgical Vacuum).

1324.1 Where Required. Inspection and testing shall be performed on components, or portions thereof, of new, piped medical gas or vacuum systems, additions, renovations, temporary installations, or repaired systems in accordance with Section 1324.2 through Section 1324.5.11, and certified in accordance with Section 1306.0.

1324.2 Breached Systems. All systems that are breached and components that are subject to additions, renovations, or replacement (e.g., new gas sources: bulk, manifolds, compressors, dryers, alarms) shall be inspected and tested. Systems shall be deemed breached at the point of pipeline intrusion by physical separation or by system component removal, replacement, or addition. Breached portions of the systems subject to inspection and testing shall be confined to only the specific altered zone and components in the immediate zone or area that is located upstream for vacuum systems and downstream for pressure gases at the point or area of intrusion. [NFPA 99:5.1.12.1.3 – 5.1.12.1.5]

1324.2.1 Reports. The inspection and testing reports shall be submitted directly to the party that contracted for the testing, who shall submit the report through channels to the responsible facility authority and any others that are required. Reports shall contain detailed listings of all findings and results. [NFPA 99:5.1.12.1.6, 5.1.12.1.7]

1324.3 Test Gas. The test gas shall be oil-free, dry nitrogen NF. [NFPA 99:5.1.12.2.1.2]

1324.4 Initial Piping Blowdown. Piping in medical gas and vacuum distribution systems shall be blown clear by means of oil-free, dry nitrogen NF after installation of the distribution piping but before installation of station outlet/inlet rough-in assemblies and other system components (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, pressure relief valves, manifolds, source equipment). [NFPA 99:5.1.12.2.2]

1324.5 Initial Pressure Tests – Medical Gas and Vacuum Systems. Each section of the piping in medical gas and vacuum systems shall be pressure tested. Initial pressure tests shall be conducted as follows:

(1) After blowdown of the distribution piping.
(2) After installation of station outlet/inlet rough-in assemblies.
(3) Prior to the installation of components of the distribution piping system that would be damaged by the test pressure (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, line pressure relief valves). [NFPA 99:5.1.12.2.3.1, 5.1.12.2.3.2]

1324.5.1 Shutoff Valve. The source shutoff valve shall remain closed during tests specified in Section 1324.5 through Section 1324.5.1.2. [NFPA 99:5.1.12.2.3.3]

1324.5.1.1 Required Test Pressure. The test pressure for pressure gases and vacuum systems shall be 1.5 times the system operating pressure but not less than a gauge pressure of 150 psi (1034 kPa). The test pressure shall be maintained until each joint has been examined for leakage by means of a leak detectant that is safe for use with oxygen and does not contain ammonia. [NFPA 99:5.1.12.2.3.4, 5.1.12.2.3.5]

1324.5.1.2 Leaks. Leaks, if any, shall be located, repaired (if permitted), replaced (if required), and retested. [NFPA 99:5.1.12.2.3.6]

1324.5.2 Initial Cross-Connection Test. It shall be determined that no cross-connections exist between the various medical gas and vacuum piping systems. [NFPA 99:5.1.12.2.4]

1324.5.2.1 Atmospheric Pressure. All piping systems shall be reduced to atmospheric pressure. [NFPA 99:5.1.12.2.4.1]

1324.5.2.2 Sources of Test Gas. Sources of test gas shall be disconnected from all piping systems, except for the one system being tested. [NFPA 99:5.1.12.2.4.2]

1324.5.2.3 System to Be Charged. The system under test shall be charged with oil-free, dry nitrogen NF to a gauge pressure of 50 psi (345 kPa). [NFPA 99:5.1.12.2.4.3]

1324.5.2.4 Check Outlets and Inlets. After the installation of the individual faceplates with appropriate adapters matching outlet/inlet labels, each individual outlet/inlet in each installed medical gas and vacuum piping system shall be checked to determine that the test gas is being dispensed only from the piping system being tested. [NFPA 99:5.1.12.2.4.4]

1324.5.2.5 Repeat Test. The cross-connection test referenced in Section 1324.5.2 shall be repeated for each installed medical gas and vacuum piping system. [NFPA 99:5.1.12.2.4.5]

1324.5.2.6 Identification of System. The proper labeling and identification of system outlets/inlets shall be confirmed during these tests. [NFPA 99:5.1.12.2.4.6]

1324.5.3 Initial Piping Purge Tests. The outlets in each medical gas piping system shall be purged to remove any particulate matter from the distribution piping. [NFPA 99:5.1.12.2.5]

1324.5.3.1 Procedure. Using appropriate adapters, each outlet shall be purged with an intermittent high-volume flow of test gas until the purge produces no discoloration in a clean white cloth. [NFPA 99:5.1.12.2.5.1]

1324.5.3.2 Location. The purging required in Section 1324.5.3.1 shall be started at the closest outlet/inlet to the zone valve and continue to the furthest outlet/inlet within the zone. [NFPA 99:5.1.12.2.5.2]

1324.5.4 Standing Pressure Tests – for Positive Pressure Medical Gas Piping Systems. After successful completion of the initial pressure tests under Section 1324.5 through Section 1324.5.1.2, medical gas distribution piping shall be subjected to a standing pressure test. [NFPA 99:5.1.12.2.6]

1324.5.4.1 Time Frame for Testing. Tests shall be conducted after the final installation of station outlet valve bodies, faceplates, and other distribution system components (e.g. pressure alarm devices, pressure indicators, line pressure relief valves, manufactured assemblies, hose). [NFPA 99:5.1.12.2.6.1]

1324.5.4.2 Source Valve. The source valve shall be closed during this test. [NFPA 99:5.1.12.2.6.2]

1324.5.4.3 Length of Testing. The piping systems shall be subjected to a 24 hour standing pressure test using oil-free, dry nitrogen NF. [NFPA 99:5.1.12.2.6.3]

1324.5.4.4 Test Pressure. Test pressures shall be 20 percent above the normal system operating line pressure. [NFPA 99:5.1.12.2.6.4]

1324.5.4.5 Conclusion of Test. The leakage over the 24 hour test shall not exceed 0.5 percent of the starting pressure [e.g., 0.3 psi (2 kPa) starting at 60 psig (414 kPa), 0.125 inch (3.2 mm) HgV starting at 25 inches (635 mm) HgV] except that attributed to specific changes of ambient temperature. [NFPA 99:5.1.12.2.6.5]

1324.5.4.6 Leaks. Leaks, if any, shall be located, repaired (if permitted) or replaced (if required), and retested. [NFPA 99:5.1.12.2.6.6]

1324.5.4.7 Proof of Testing. The 24 hour standing pressure test of the positive pressure system shall be witnessed by an ASSE 6020 inspector, an ASSE 6030 verifier, or the Authority Having Jurisdiction or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of the tests required in Section 1324.5.7 through Section 1324.5.11. [NFPA 99:5.1.12.2.6.7]

1324.5.5 Standing Pressure Tests – Medical Vacuum Piping Systems. After successful completion of the initial pressure tests under Section 1324.5 through Section 1324.5.1.2, vacuum distribution piping shall be subjected to a standing vacuum test. [NFPA 99:5.1.12.2.7]

1324.5.5.1 Timeframe for Testing. Tests shall be conducted after installation of all components of the vacuum system. [NFPA 99:5.1.12.2.7.1]

1324.5.5.2 Length of Testing. The piping systems shall be subjected to a 24 hour standing vacuum test. [NFPA 99:5.1.12.2.7.2]

1324.5.5.3 Test Pressure. Test pressure shall be between 12 inches (305 mm) HgV and full vacuum. [NFPA 99:5.1.12.2.7.3]

1324.5.5.4 Disconnection of Testing Source. During the test, the source of test vacuum shall be disconnected from the piping system. [NFPA 99:5.1.12.2.7.4]

1324.5.5.5 Conclusion of Test. At the conclusion of the test, there shall be no change in the vacuum other than that attributed to changes of ambient temperature. [NFPA 99:5.1.12.2.7.5]

1324.5.5.6 Proof of Testing. The 24 hour standing pressure test of the vacuum system shall be witnessed by the Authority Having Jurisdiction or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of the tests required in Section 1324.5.7 through Section 1324.5.11. [NFPA 99:5.1.12.2.7.6]

1324.5.5.7 Leaks. Leaks, if any, shall be located, repaired (if permitted) or replaced (if required), and retested. [NFPA 99:5.1.12.2.7.7]

1324.5.6 System Inspection. System inspections shall be performed prior to concealing piping distribution systems in walls, ceilings, chases, trenches, underground, or otherwise hidden from view. [NFPA 99:5.1.12.3.1.1]

1324.5.6.1 Test Gas. The test gas shall be nitrogen NF. [NFPA 99:5.1.12.3.1.2]

1324.5.6.2 Inspection Qualification. Inspections shall be conducted by a party technically competent and experienced in the field of medical gas and vacuum pipeline inspections and testing and meeting the requirements of ASSE 6020, or ASSE 6030. [NFPA 99:5.1.12.3.1.3]

1324.5.6.3 Inspection Personnel. Inspections shall be performed by a party other than the installing contractor. [NFPA 99:5.1.12.3.1.4]

1324.5.6.4 Qualifications. Where systems have not been installed by inhouse personnel, inspections shall be permitted by personnel of the organization who meet the requirements of Section 1324.5.6.2. [NFPA 99:5.1.12.3.1.5]

1324.5.6.5 Inspections. The initial pressure tests performed by the installing contractor shall be witnessed by an ASSE 6020 inspector, an ASSE 6030 verifier, or the Authority Having Jurisdiction or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of the tests required in Section 1324.5.7 through Section 1324.5.11. The presence and correctness of labeling and valve tagging required by this code for all concealed components and piping distribution systems shall be inspected. [NFPA 99:5.1.12.3.2 – 5.1.12.3.2.2]

1324.5.7 System Verification. Verification tests shall be performed only after all tests required in Section 1324.3 through Section 1324.5.5.7, Installer Performed Tests, have been completed. [NFPA 99:5.1.12.4.1.1]

1324.5.7.1 Test Gas. The test gas shall be oil-free, dry nitrogen NF or the system gas where permitted. [NFPA 5.1.12.4.1.2]

1324.5.7.2 Approved Tester. Testing shall be conducted by a party technically competent and experienced in the field of medical gas and vacuum pipeline testing and meeting the requirements of ASSE 6030, except as required by Section 1324.5.7.3. [NFPA 99:5.1.12.4.1.3]

Testing shall be performed by a party other than the installing contractor. [NFPA 99:5.1.12.4.1.5]

Where systems have not been installed by in-house personnel, testing shall be permitted by personnel of that organization who meet the requirements of Section 1324.5.7.2. [NFPA 99:5.1.12.4.1.6]

1324.5.7.3 Cryogenic Fluid Testing. Testing of the cryogenic fluid central supply system shall be conducted by a party technically competent and experienced in the field of cryogenic fluid systems and meeting the requirements of ASSE 6035, in accordance with the mandatory requirements in CGA M-1. [NFPA 99:5.1.12.4.1.4]

1324.5.8 Particulate Matter. In order to remove any traces of particulate matter deposited in the pipelines as a result of construction, a heavy, intermittent purging of the pipeline shall be done. [NFPA 99:5.1.12.4.6]

1324.5.9 Final Tie-In Test. Each joint in the final connection between the new work and the existing system shall be leak-tested with the gas of system designation at the normal operating pressure by means of a leak detectant that is safe for use with oxygen and does not contain ammonia. [NFPA 99:5.1.12.4.9.2]

1324.5.9.1 Vacuum Joints. Vacuum joints shall be tested using an ultrasonic leak detector or other means that will allow detection of leaks in an active vacuum system. [NFPA 99:5.1.12.4.9.3]

1324.5.9.2 Pressure Gases. For pressure gases, immediately after the final brazed connection is made and leak-tested, an outlet in the new piping and an outlet in the existing piping that are immediately downstream from the point or area of intrusion shall be purged in accordance with the applicable requirements of Section 1324.5.8. [NFPA 99:5.1.12.4.9.4]

1324.5.9.3 Positive Pressure Gases. Before the new work is used for patient care, positive pressure gases shall be tested for operational pressure and gas concentration in accordance with Section 1324.5.10 and Section 1324.5.11. [NFPA 99:5.1.12.4.9.5]

1324.5.9.4 Permanent Records. Permanent records of these tests shall be maintained in accordance with NFPA 99. [NFPA 99:5.1.12.4.9.6]

1324.5.10 Operational Flow Pressure Drop Test. Operational flow pressure drop tests shall be performed at each station outlet/inlet or terminal where the user makes connections and disconnections. [NFPA 99: 5.1.12.4.10]

1324.5.10.1 Medical-Surgical Vacuum Inlets. Medical-surgical vacuum inlets shall draw 3 SCFM (85 Nl/min) without reducing the vacuum pressure below 12 inch (305 mm) gauge HgV at any adjacent station inlet. [NFPA 99:5.1.12.4.10.4]

1324.5.10.2 Oxygen and Medical Air Outlets. Oxygen and medical air outlets serving Category 1 space shall allow a transient flow rate of 6 SCFM (170 SLPM) for 3 seconds. [NFPA 99:5.1.12.4.10.5]

1324.5.11 Medical Gas Concentration Test. After purging each system with the gas of system designation, the following shall be performed:

(1) Each pressure gas source and outlet shall be analyzed for concentration of gas, by volume.

(2) Analysis shall be conducted with instruments designed to measure the specific gas dispensed.

(3) Allowable concentrations shall be as indicated in Table 1324.5.11. [NFPA 99:5.1.12.4.11]

TABLE 1324.5.11
GAS CONCENTRATIONS
[NFPA 99: TABLE 5.1.12.4.11]

MEDICAL GAS	CONCENTRATION
Oxygen USP	≥99% oxygen
Oxygen 93 USP	≥90% oxygen ≤96%
Nitrous oxide USP	≥99% nitrous oxide
Nitrogen NF	≤1% oxygen or ≥99% nitrogen
Medical air USP	19.5% - 23.5% oxygen
Other gases	Named gases by ±1%, or per specification

Part III – Category 2 Piped Gas and Vacuum Systems.

1325.0 Category 2 Piped Gas and Vacuum Systems.

1325.1 General. Category 2 piped gas or piped vacuum system requirements shall be permitted when all of the following criteria are met:

(1) Only moderate sedation; minimal sedation, as defined in Chapter 2; or no sedation is performed. Deep sedation and general anesthesia shall not be permitted.

(2) The loss of the piped gas or piped vacuum systems is likely to cause minor injury to patients, staff, or visitors.

(3) The facility piped gas or piped vacuum systems are intended for Category 2 patient care space as defined in Chapter 2. [NFPA 99:5.2.1.2]

1325.2 Nature of Hazards of Gas and Vacuum Systems. The requirement of Section 1307.2 shall apply to the nature of hazards of gas and vacuum systems. [NFPA 99:5.2.2]

1325.3 Central Supply Systems. Category 2 systems shall comply with Section 1307.3 through Section 1309.13. [NFPA 99:5.2.3.4]

1325.4 Category 2 Medical Air Supply Systems. Category 2 systems shall comply with Section 1310.0 through Section 1311.6, except as follows:

(1) Medical air compressors, dryers, aftercoolers, filters, and regulators shall be permitted to be simplex.

(2) The facility staff shall develop their emergency plan to deal with the loss of medical air. [NFPA 99:5.2.3.5]

1325.5 Oxygen Concentrators. Oxygen supply systems using concentrators shall be permitted to consist of two sources, one of which shall be a cylinder header with sufficient cylinder connections for one average day's supply. [NFPA 99:5.2.3.6]

1325.6 Category 2 Medical-Surgical Vacuum. Category 2 systems shall comply with Section 1312.0 through Section 1313.5, except as follows:

(1) Medical-surgical vacuum systems shall be permitted to be simplex.

(2) The facility staff shall develop their emergency plan to deal with the loss of medical-surgical vacuum. [NFPA 99:5.2.3.7]

1325.7 Valves. Category 2 systems shall comply with Section 1314.0 through Section 1314.12.1. [NFPA 99:5.2.4]

1325.8 Station Outlets and Inlets. Category 2 systems shall comply with Section 1315.0. [NFPA 99:5.2.5]

1325.9 Pressure and Vacuum Indicators. Category 2 systems shall comply with Section 1316.2. [NFPA 99:5.2.8]

1325.10 Warning Systems (Category 2). Warning systems associated with Category 2 systems shall provide the master, area, and local alarm functions of a Category 1 system as required in Section 1317.0, except as follows:

(1) Warning systems shall be permitted to be a single alarm panel.

(2) The alarm panel shall be located in an area of continuous surveillance while the facility is in operation.

(3) Pressure and vacuum switches/sensors shall be mounted at the source equipment with a pressure indicator at the master alarm panel. [NFPA 99:5.2.9]

1325.11 Category 2 Distribution. Level 2 systems shall comply with Section 1318.0 through Section 1323.12. [NFPA 99:5.2.10]

1325.12 Labeling and Identification. Category 2 systems shall comply with Section 1323.13 through Section 1323.15. [NFPA 99:5.2.11]

1325.13 Performance Criteria and Testing — Category 2 (Gas, Medical–Surgical and Vacuum). Category 2 systems shall comply with Section 1324.0. [NFPA 99:5.2.12]

Part IV – Category 3 Piped Gas and Vacuum Systems.

1326.0 Category 3 Piped Gas and Vacuum Systems.

1326.1 General. Category 3 piped gas and vacuum systems shall be permitted when all of the following criteria are met:

(1) Only moderate sedation; minimal sedation, as defined in Chapter 2; or no sedation is performed. Deep sedation and general anesthesia are not performed.

(2) The loss of the piped gas and vacuum systems is not likely to cause injury to patients, staff, or visitors, but can cause discomfort.

(3) The facility piped gas and vacuum systems are intended for Category 3 or Category 4 patient care rooms as defined in Chapter 2. [NFPA 99:5.3.1.2]

1326.2 Nature of Hazards of Gas and Vacuum Systems. The requirement of Section 1307.2 shall apply to the nature of hazards of gas and vacuum systems. [NFPA 99:5.3.2]

1326.3 Medical Air Supply Systems. Category 3 systems shall comply with Section 1310.0 through Section 1311.6, except as follows:

(1) Medical air compressors, dryers, after coolers, filters, and regulators shall be permitted to be simplex.

(2) The facility staff shall develop their emergency plan to deal with the loss of medical air. [NFPA 99:5.3.3.5]

1326.4 Oxygen Central Supply Systems Using Concentrators. Category 3 oxygen supply systems using concentrators shall be permitted to consist of two sources, one of which shall be a cylinder header with sufficient cylinder connections for one average day's supply. [NFPA 99:5.3.3.6]

1326.5 Medical–Surgical Vacuum. Category 3 systems shall comply with Section 1312.0 through Section 1313.5, except as follows:

(1) Medical–surgical vacuum systems shall be permitted to be simplex.

(2) The facility staff shall develop their emergency plan to deal with the loss of medical–surgical vacuum. [NFPA 99:5.3.3.7]

1326.6 Valves. Category 3 systems shall comply with Section 1314.0. [NFPA 99:5.3.4]

1326.7 Station Outlets and Inlets. Category 3 systems shall comply with Section 1315.0. [NFPA 99:5.3.5]

1326.8 Pressure and Vacuum Indicators. Category 3 systems shall comply with Section 1316.2. [NFPA 99:5.3.8]

1326.9 Warning Systems. Warning systems associated with Category 3 systems shall provide the master, area, and local alarm functions of a Category 1 system as required in Section 1317.0, except as follows:

(1) Warning systems shall be permitted to be a single alarm panel.

(2) The alarm panel shall be located in an area of continuous surveillance while the facility is in operation.

(3) Pressure and vacuum switches/sensors shall be mounted at the source equipment with a pressure indicator at the master alarm panel. [NFPA 99:5.3.9]

1326.10 Distribution. Category 3 systems shall comply with Section 1318.0 through Section 1323.12. [NFPA 99:5.3.10]

1326.11 Labeling and Identification. Category 3 systems shall comply with Section 1323.13 through Section 1323.15. [NFPA 99:5.3.11]

Part V – Dental Gas and Vacuum Systems.

1327.0 Dental Gas and Vacuum Systems.

1327.1 General. Dental gas and vacuum systems shall comply with this code and NFPA 99.

1327.2 Emergency Shutoff Valves (Oxygen and Nitrous Oxide). Emergency shutoff valves shall be provided in accordance with the following:

(1) Where a central medical gas supply is remote from a single treatment facility, the main supply line shall be provided with an emergency shutoff valve located in the single treatment facility so as to be accessible from all use-point locations in an emergency.

(2) Where a central medical gas supply system supplies two treatment facilities, each facility shall be provided with an emergency shutoff valve located in that treatment facility so as to be accessible from all use-point locations in an emergency.

(3) Emergency shutoff valves shall be labeled to indicate the gas controlled by the shutoff valve and shall shut off only the gas to the treatment facility that they serve.

(4) A remotely activated shutoff valve at a gas supply manifold shall not be used for emergency shutoff. For clinical purposes, such a remote valve actuator shall not fail-close in the event of loss of electric power. Where remote actuators are the type that fail-open, it shall be mandatory that cylinder shutoff valves be closed whenever the system is not in use. [NFPA 99:15.4.2.6.1 – 15.4.2.6.4.2]

1327.3 Warning Systems (Oxygen and Nitrous Oxide). Category 2 warning systems shall comply with Section 1325.10 except as follows:

(1) Warning systems shall be permitted to be a single alarm panel.

(2) The alarm panel shall be located in an area of continuous surveillance while the facility is in operation.

(3) Pressure and vacuum switches/sensors shall be mounted at the source equipment with a pressure indicator at the master alarm panel.

(4) Warning systems for medical gas systems shall provide the following alarms:

(a) Oxygen main line pressure low.

(b) Oxygen main line pressure high.

(c) Oxygen changeover to secondary bank or about to changeover (if automatic).

(d) Nitrous oxide main line pressure low.

(e) Nitrous oxide main line pressure high.

(f) Nitrous oxide changeover to secondary bank or about to changeover (if automatic).

(5) Audible and noncancelable alarm visual signals shall indicate if the pressure in the main line increases or decreases 20 percent from the normal operating pressure.

(6) Visual indications shall remain until the situation that caused the alarm is resolved.

(7) Pressure switches/sensors shall be installed downstream of any emergency shutoff valves and any other shutoff valves in the system and shall cause an alarm for the medical gas if the pressure decreases or increases 20 percent from the normal operating pressure.

(8) A cancelable audible indication of each alarm condition that produces a sound at the alarm panel shall reinitiate the audible signal if another alarm condition occurs while the audible signal is silenced. [NFPA 99:15.4.2.10]

1327.4 Initial Pressure Test. Each section of the piping in positive-pressure gas systems and copper vacuum systems shall be pressure tested. Plastic vacuum and plastic scavenging piping shall not be pressure tested. [NFPA 99:15.4.7.4.4.1]

1327.4.1 Pressure Test. Initial pressure tests shall be conducted as follows:

(1) After blowdown of the distribution piping

(2) After installation of station outlet/inlet rough-in assemblies

(3) Prior to the installation of components of the distribution piping system that would be damaged by the test pressure (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, and line pressure relief valves) [NFPA 99:15.4.7.4.4.2]

1327.4.2 Source Shutoff Valve. The source shutoff valve shall remain closed during the pressure tests. [NFPA 99:15.4.7.4.4.3]

1327.4.3 Test Pressure. The test pressure for oxygen and nitrous oxide piping shall be 1.5 times the system operating pressure but not less than a gauge pressure of 150 psi (1035 kPa). [NFPA 99:15.4.7.4.4.4]

1327.4.4 Examine for Leaks. The test pressure shall be maintained until each joint has been examined for leakage by means of a leak detectant that is safe for use with oxygen and does not contain ammonia. [NFPA 99:15.4.7.4.4.5]

1327.4.5 Leaks Located. Any leaks shall be located, repaired (if permitted), or replaced (if required) by the installer, and retested. [NFPA 99:15.4.7.4.4.6]

1327.5 Maximum Copper Tube Support Spacing. The maximum support spacing for copper tube shall be in accordance with Table 1327.5. [NFPA 99:15.4.5.6.5]

TABLE 1327.5
MAXIMUM COPPER TUBE SUPPORT SPACING
[NFPA 99: TABLE 15.4.5.6.5]

PIPE SIZE			HANGER SPACING (feet)
DN8	(NPS 1/4)	(3/8 of an inch O.D.)	5
DN10	(NPS 3/8)	(1/2 of an inch O.D.)	6
DN15	(NPS 1/2)	(5/8 of an inch O.D.)	6
DN20	(NPS 3/4)	(7/8 of an inch O.D.)	7
DN25	(NPS 1)	(1 1/8 of an inch O.D.)	8
DN32	(NPS 1 1/4)	(1 3/8 of an inch O.D.)	9
DN40 and larger	(NPS 1 1/2)	(1 5/8 of an inch O.D.)	10
Vertical risers, all sizes, every floor, but not to exceed:			15

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

1327.6 Maximum Plastic Pipe Support Spacing. The maximum support spacing for plastic pipe shall be in accordance with Table 1327.6. [NFPA 99:15.4.5.6.6]

TABLE 1327.6
MAXIMUM PLASTIC PIPE SUPPORT SPACING
[NFPA 99: TABLE 15.4.5.6.6]

PIPE SIZE			HANGER SPACING (feet)
DN15	(NPS 1/2)	(5/8 of an inch O.D.)	4
DN20	(NPS 3/4)	(7/8 of an inch O.D.)	4
DN25	(NPS 1)	(1 1/8 of an inch O.D.)	4.33
DN32	(NPS 1 1/4)	(1 3/8 of an inch O.D.)	4.33
DN40	(NPS 1 1/8)	(1 5/8 of an inch O.D.)	4.66
DN50	(NPS 2)	(2 3/8 of an inch O.D.)	4.66
DN65 and larger	(NPS 2 1/2)	(2 7/8 of an inch O.D.)	5
Vertical risers, all sizes, every floor, but not to exceed:			10

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

1327.7 Standing Pressure Tests for Oxygen and Nitrous Oxide Piping. After successful completion of the initial pressure tests in Section 1327.4, the gas distribution piping shall be subject to a standing pressure test. [NFPA 99:15.4.7.4.6.1]

1327.7.1 Tests Required. Tests shall be conducted after the final installation of station outlet valve bodies, faceplates, and other distribution system components (e.g., pressure alarm devices, pressure indicators, line pressure relief valves, manufactured assemblies, and hoses). [NFPA 99:15.4.7.4.6.2]

1327.7.2 Source Valve. The source valve shall be closed during this test. [NFPA 99:15.4.7.4.6.3]

1327.7.3 Piping Systems. The piping systems shall be subjected to 24-hour standing pressure tests using oil-free, dry nitrogen NF. [NFPA 99:15.4.7.4.6.4]

1327.7.4 Test Pressure. Test pressures shall be 20 percent above the normal system operating line pressure. [NFPA 99:15.4.7.4.6.5]

1327.7.5 Change in Test Pressure. At the conclusion of the tests, there shall be no change in the test pressure except that attributed to specific changes in ambient temperature. [NFPA 99:15.4.7.4.6.6]

1327.7.6 Leaks. Any leaks shall be located, repaired (if permitted), or replaced (if required) by the installer, and retested. [NFPA 99:15.4.7.4.6.7]

1327.8 Verifier Operational Pressure Test. Operational pressure tests shall be performed at each station outlet or terminal where the user makes connections and disconnections. [NFPA 99:15.4.7.5.8.1]

1327.8.1 Test Gas. Tests shall be performed with the gas of system designation. [NFPA 99:15.4.7.5.8.2]

1327.8.2 Medical Gas Outlets. All medical gas outlets with a gauge pressure of 50 psi (345 kPa), including oxygen and nitrous oxide, shall deliver 1.8 standard cubic feet per minute (SCFM) (50 SLPM) with a pressure drop of not more than 5 psi (34 kPa) and static pressure of 50 psi (345 kPa) to 55 psi (379 kPa). [NFPA 99:15.4.7.5.8.3]

Chapter 14 is not adopted.

CHAPTER 14
FIRESTOP PROTECTION

CHAPTER 15

ALTERNATE WATER SOURCES FOR NONPOTABLE APPLICATIONS

1501.0 General.

[W]1501.1 Applicability. The provisions of this chapter and the Washington State Department of Health shall apply to the construction, alteration, and repair of alternate water source systems for nonpotable applications.

1501.1.1 Allowable Use of Alternate Water. Where approved or required by the Authority Having Jurisdiction, alternate water sources [reclaimed (recycled) water, gray water, and on-site treated nonpotable water] shall be permitted to be used instead of potable water for the applications identified in this chapter.

1501.2 System Design. Alternate water source systems shall be designed in accordance with this chapter by a licensed plumbing contractor a registered design professional. Components, piping, and fittings used in any alternate water source system shall be listed.

Exceptions:

(1) A registered design professional is not required to design gray water systems having a maximum discharge capacity of 250 gallons per day (gal/d) (0.011 L/s) for single family and multi-family dwellings.

(2) A registered design professional is not required to design an on-site treated nonpotable water system for single-family dwellings having a maximum discharge capacity of 250 gal/d (0.011 L/s).

1501.3 Permit. It shall be unlawful for a person to construct, install, alter, or cause to be constructed, installed, or altered an alternate water source system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

1501.4 Component Identification. System components shall be properly identified as to the manufacturer.

1501.5 Maintenance and Inspection. Alternate water source systems and components shall be inspected and maintained in accordance with Section 1501.5.1 through Section 1501.5.3.

1501.5.1 Frequency. Alternate water source systems and components shall be inspected and maintained in accordance with Table 1501.5 unless more frequent inspection and maintenance are required by the manufacturer.

1501.5.2 Maintenance Log. A maintenance log for gray water and on-site treated nonpotable water systems is required to have a permit in accordance with Section 1501.3 and shall be maintained by the property owner and be available for inspection. The property owner or designated appointee shall ensure that a record of testing, inspection, and maintenance in accordance with Table 1501.5 is maintained in the log. The log will indicate the frequency of inspection and maintenance for each system.

1501.5.3 Maintenance Responsibility. The required maintenance and inspection of alternate water source systems shall be the responsibility of the property owner unless otherwise required by the Authority Having Jurisdiction.

1501.6 Operation and Maintenance Manual. An operation and maintenance manual for gray water and on-site treated water systems required to have a permit in accordance with Section 1501.3 shall be supplied to the building owner by the system designer. The operation and maintenance manual shall include the following:

(1) Detailed diagram of the entire system and the location of system components.

(2) Instructions for operating and maintaining the system.

(3) Details on maintaining the required water quality for onsite nonpotable water systems.

(4) Details on deactivating the system for maintenance, repair, or other purposes.

(5) Applicable testing, inspection, and maintenance frequencies in accordance with Table 1501.5.

(6) A method of contacting the manufacturer(s).

1501.7 Minimum Water Quality Requirements. The minimum water quality for alternate water source systems shall meet the applicable water quality requirements for the intended application as determined by the Authority Having Jurisdiction. In the absence of water quality requirements, for on-site treated nonpotable systems, the water quality requirements of NSF 350 shall apply. The EPA/625/R-04/108 contains recommended water reuse guidelines to assist regulatory agencies to develop, revise, or expand alternate water source water quality standards.

Exception: Water treatment is not required for gray water used for subsurface irrigation.

1501.8 Material Compatibility. Alternate water source systems shall be constructed of materials that are compatible with the type of pipe and fitting materials, water treatment, and water conditions in the system.

1501.9 Commercial, Industrial, and Institutional Restroom Signs. A sign shall be installed in restrooms in commercial, industrial, and institutional occupancies using reclaimed (recycled) water and on-site treated water, for water closets, urinals,

TABLE 1501.5
MINIMUM ALTERNATE WATER SOURCE TESTING, INSPECTION, AND MAINTENANCE FREQUENCY

DESCRIPTION	MINIMUM FREQUENCY
Inspect and clean filters and screens, and replace (where necessary).	Every 3 months
Inspect and verify that disinfection, filters, and water quality treatment devices and systems are operational and maintaining minimum water quality requirements as determined by the Authority Having Jurisdiction.	In accordance with manufacturer's instructions, and the Authority Having Jurisdiction.
Inspect pumps and verify operation.	After initial installation and every 12 months thereafter
Inspect valves and verify operation.	After initial installation and every 12 months thereafter
Inspect pressure tanks and verify operation.	After initial installation and every 12 months thereafter
Clear debris from and inspect storage tanks, locking devices, and verify operation.	After initial installation and every 12 months thereafter
Inspect caution labels and marking.	After initial installation and every 12 months thereafter
Inspect and maintain mulch basins for gray water irrigation systems.	As needed to maintain mulch depth and prevent ponding and runoff.
Cross-connection inspection and test*	After initial installation and every 12 months thereafter

* The cross-connection test shall be performed in the presence of the Authority Having Jurisdiction in accordance with the requirements of this chapter.

or both. Each sign shall contain ½ of an inch (12.7 mm) letters of a highly visible color on a contrasting background. The location of the sign(s) shall be such that the sign(s) are visible to users. The location of the sign(s) shall be approved by the Authority Having Jurisdiction and shall contain the following text:

TO CONSERVE WATER, THIS BUILDING USES *_____* TO FLUSH TOILETS AND URINALS.

1501.9.1 Equipment Room Signs. Each room containing reclaimed (recycled) water and on-site treated water equipment shall have a sign posted in a location that is visible to anyone working on or near nonpotable water equipment with the following wording in 1 inch (25.4 mm) letters:

CAUTION: NONPOTABLE *_____*, DO NOT DRINK. DO NOT CONNECT TO DRINKING WATER SYSTEM. NOTICE: CONTACT BUILDING MANAGEMENT BEFORE PERFORMING ANY WORK ON THIS WATER SYSTEM.

*_____*Shall indicate RECLAIMED (RECYCLED) WATER or ON-SITE TREATED WATER, accordingly.

1501.10 System Controls. Controls for pumps, valves, and other devices that contain mercury that come in contact with alternate water source water supply shall not be permitted.

1502.0. Inspection and Testing.

1502.1 General. Alternate water source systems shall be inspected and tested in accordance with Section 1502.2 through Section 1502.3.4.

1502.2 Supply System Inspection and Test. Alternate water source systems shall be inspected and tested in accordance with this code for testing of potable water piping.

1502.3 Annual Cross-Connection Inspection and Testing. An initial and subsequent annual inspection and test shall be performed on both the potable and alternate water source systems. The potable and alternate water source system shall be

isolated from each other and independently inspected and tested to ensure there is no cross-connection in accordance with Section 1502.3.1 through Section 1502.3.4.

1502.3.1 Visual System Inspection. Before commencing the cross-connection testing, a dual system inspection shall be conducted by the Authority Having Jurisdiction and other authorities having jurisdiction as follows:

(1) Meter locations of the alternate water source and potable water lines shall be checked to verify that no modifications were made and that no cross-connections are visible.

(2) Pumps and equipment, equipment room signs and exposed piping in equipment room shall be checked.

(3) Valves shall be checked to ensure that the valve lock seals are still in place and intact. Valve control door signs shall be checked to verify that no signs have been removed.

1502.3.2 Cross-Connection Test. The procedure for determining cross-connection shall be followed by the applicant in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction to determine whether a cross-connection has occurred as follows:

(1) The potable water system shall be activated and pressurized. The alternate water source system shall be shut down, depressurized, and drained.

(2) The potable water system shall remain pressurized for a minimum period specified by the Authority Having Jurisdiction while the alternate water source system is empty. The minimum period the alternate water source system is to remain depressurized shall be determined on a case-by-case basis, taking into account the size and complexity of the potable and the alternate water source distribution systems, but in no case shall that period be less than 1 hour.

(3) The drain on the alternate water source system shall be checked for flow during the test and fixtures, potable and alternate water source, shall be tested and inspected for flow. Flow from an alternate water source system outlet indicates a cross-connection. No flow from a potable water outlet shall indicate that it is connected to the alternate water source system.

(4) The potable water system shall then be depressurized and drained.

(5) The alternate water source system shall then be activated and pressurized.

(6) The alternate water source system shall remain pressurized for a minimum period specified by the Authority Having Jurisdiction while the potable water system is empty. The minimum period the potable water system is to remain depressurized shall be determined on a case-by-case basis, but in no case shall that period be less than 1 hour.

(7) Fixtures, potable, and alternate water source shall be tested and inspected for flow. Flow from a potable water system outlet indicates a cross-connection. No flow from an alternate water source outlet will indicate that it is connected to the potable water system.

(8) The drain on the potable water system shall be checked for flow during the test and at the end of the test.

(9) Where there is no flow detected in the fixtures which would indicate a cross-connection, the potable water system shall be repressurized.

1502.3.3 Discovery of Cross-Connection. If a cross-connection is discovered, the following procedure, in the presence of the Authority Having Jurisdiction, shall be activated immediately:

(1) The alternate water source piping to the building shall be shutdown at the meter, and the alternate water source riser shall be drained.

(2) Potable water piping to the building shall be shutdown at the meter.

(3) The cross-connection shall be uncovered and disconnected.

(4) The building shall be retested in accordance with Section 1502.3.1 and Section 1502.3.2.

(5) The potable water system shall be chlorinated with 50 parts-per-million (ppm) chlorine for 24 hours.

(6) The potable water system shall be flushed after 24 hours, and a standard bacteriological test shall be performed. Where test results are acceptable, the potable water system shall be permitted to be recharged.

1502.3.4 Annual Inspection. An annual inspection of the alternate water source system, following the procedures listed in Section 1502.3.1 shall be required. Annual cross-connection testing, following the procedures listed in Section 1502.3.2 shall be required by the Authority Having Jurisdiction, unless site conditions do not require it. In no event shall the test occur less than once in 4 years. Alternate testing requirements shall be permitted by the Authority Having Jurisdiction.

1502.4 Separation Requirements. Underground alternate water source service piping other than gray water shall be separated from the building sewer in accordance with this code. Treated nonpotable water pipes shall be permitted to be run or laid in the same trench as potable water pipes with a 12 inch (305 mm) minimum vertical and horizontal separation where both pipe materials are approved for use within a building. Where horizontal piping materials do not comply with this requirement, the minimum separation shall be increased to 60 inches (1524 mm). The potable water piping shall be installed at an elevation above the treated nonpotable water piping.

1502.5 Abandonment. Alternate water source systems that are no longer in use or fail to be maintained in accordance with Section 1501.5 shall be abandoned. Abandonment shall comply with Section 1502.5.1 and Section 1502.5.2.

1502.5.1 General. An abandoned system or part thereof covered under the scope of this chapter shall be disconnected from remaining systems, drained, plugged, and capped in an approved manner.

1502.5.2 Underground Tank. An underground water storage tank that has been abandoned or otherwise discontinued from use in a system covered under the scope of this chapter shall be completely drained and filled with earth, sand, gravel, concrete, or other approved material or removed in a manner satisfactory to the Authority Having Jurisdiction.

1502.6 Sizing. Unless otherwise provided for in this chapter, alternate water source piping shall be sized in accordance with Chapter 6 for sizing potable water piping.

1503.0 Gray Water Systems.

1503.1 General. The provisions of this section shall apply to the construction, alteration, and repair of gray water systems.

1503.2 System Requirements. Gray water shall be permitted to be diverted away from a sewer or private sewage disposal system, and discharge to a subsurface irrigation or subsoil irrigation system. The gray water shall be permitted to discharge to a mulch basin for single-family and multi-family dwellings. Gray water shall not be used to irrigate root crops or food crops intended for human consumption that comes in contact with soil.

1503.2.1 Surge Capacity. Gray water systems shall be designed to have the capacity to accommodate peak flow rates and distribute the total amount of estimated gray water on a daily basis to a subsurface irrigation field, subsoil irrigation field, or mulch basin without surfacing, ponding, or runoff. A surge tank is required for systems that are unable to accommodate peak flow rates and distribute the total amount of gray water by gravity drainage. The water discharge for gray water systems shall be determined in accordance with Section 1503.8.1 or Section 1503.8.2.

1503.2.2 Diversion. The gray water system shall connect to the sanitary drainage system downstream of fixture traps and vent connections through a gray water diverter valve. The gray water diverter valve shall comply with IAPMO PS 59 and be installed in an accessible location and clearly indicate the direction of flow.

1503.2.3 Backwater Valves. Gray water drains subject to backflow shall be provided with a backwater valve so located as to be accessible for inspection and maintenance.

1503.2.4 Rainwater Diversion Valves. Rainwater diversion valves ranging from 6 inches (150 mm) to 12 inches (300 mm) in diameter shall comply with IAPMO IGC 352. Valves shall be accessible and include a filter located upstream of the valve when required.

1503.3 Connections to Potable and Reclaimed (Recycled) Water Systems. Gray water systems shall have no direct connection to a potable water supply, on-site treated nonpotable water supply, or reclaimed (recycled) water systems. Potable, on-site treated nonpotable, or reclaimed (recycled) water is permitted to be used as makeup water for a non-pressurized storage tank provided the connection is protected by an air gap in accordance with this code.

1503.4 Location. No gray water system or part thereof shall be located on a lot other than the lot that is the site of the building or structure that discharges the gray water, nor shall a gray water system or part thereof be located at a point having less than the minimum distances indicated in Table 1503.4.

1503.5 Plot Plan Submission. No permit for a gray water system shall be issued until a plot plan with data satisfactory to the Authority Having Jurisdiction has been submitted and approved.

1503.6 Prohibited Location. Where there is insufficient lot area or inappropriate soil conditions for adequate absorption to prevent the ponding, surfacing, or runoff of the gray water, as determined by the Authority Having Jurisdiction, no gray water system shall be permitted. A gray water system is not permitted on a property in a geologically sensitive area as determined by the Authority Having Jurisdiction.

1503.7 Drawings and Specifications. The Authority Having Jurisdiction shall require the following information to be included with or in the plot plan before a permit is issued for a gray water system, or at a time during the construction thereof:

(1) Plot plan drawn to scale and completely dimensioned, showing lot lines and structures, direction and approximate slope of surface, location of present or proposed retaining walls, drainage channels, water supply lines, wells, paved areas and structures on the plot, number of bedrooms and plumbing fixtures in each structure, location of private sewage disposal system and expansion area or building sewer connecting to the public sewer, and location of the proposed gray water system.

(2) Details of construction necessary to ensure compliance with the requirements of this chapter, together with a full description of the complete installation, including installation methods, construction, and materials in accordance with the Authority Having Jurisdiction.

(3) Details for holding tanks shall include dimensions, structural calculations, bracings, and such other pertinent data as required.

(4) A log of soil formations and groundwater level as determined by test holes dug in proximity to proposed irrigation area, together with a statement of water absorption characteristics of the soil at the proposed site as determined by approved percolation tests.

Exception: The Authority Having Jurisdiction shall permit the use of Table 1504.2 instead of percolation tests.

TABLE 1503.4
LOCATION OF GRAY WATER SYSTEM[7]

MINIMUM HORIZONTAL DISTANCE IN CLEAR REQUIRED FROM	SURGE TANK (feet)	SUBSURFACE AND SUBSOIL IRRIGATION FIELD AND MULCH BED (feet)
Building structures[1]	5[2, 9]	2[3, 8]
Property line adjoining private property	5	5[8]
Water supply wells[4]	50	100
Streams and lakes[4]	50	50[5]
Sewage pits or cesspools	5	5
Sewage disposal field[10]	5	4[6]
Septic tank	0	5
On-site domestic water service line	5	5
Pressurized public water main	10	10[7]

For SI units: 1 foot = 304.8 mm

Notes:

[1] Including porches and steps, whether covered or uncovered, breezeways, roofed carports, roofed patios, carports, covered walks, covered driveways, and similar structures or appurtenances.

[2] The distance shall be permitted to be reduced to 0 feet for aboveground tanks where first approved by the Authority Having Jurisdiction.

[3] Reference to a 45 degree (0.79 rad) angle from the foundation.

[4] Where special hazards are involved, the distance required shall be increased as directed by the Authority Having Jurisdiction.

[5] These minimum clear horizontal distances shall apply between the irrigation or disposal field and the ocean mean higher high tide line.

[6] Add 2 feet (610 mm) for each additional foot of depth more than 1 foot (305 mm) below the bottom of the drain line.

[7] For parallel construction or crossings, approval by the Authority Having Jurisdiction shall be required.

[8] The distance shall be permitted to be reduced to 1½ feet (457 mm) for drip and mulch basin irrigation systems.

[9] The distance shall be permitted to be reduced to 0 feet for surge tanks of 75 gallons (284 L) or less.

[10] Where irrigation or disposal fields are installed in the sloping ground, the minimum horizontal distance between a part of the distribution system and the ground surface shall be 15 feet (4572 mm).

(5) Distance between the plot and surface waters such as lakes, ponds, rivers or streams, and the slope of the plot and the surface water, wherein close proximity.

1503.8 Procedure for Estimating Gray Water Discharge. Gray water systems shall be designed to distribute the total amount of estimated gray water on a daily basis. The water discharge for gray water systems shall be determined in accordance with Section 1503.8.1 or Section 1503.8.2.

1503.8.1 Single Family Dwellings and Multi-Family Dwellings. The gray water discharge for single family and multi-family dwellings shall be calculated by water use records, calculations of local daily per person interior water use, or the following procedure:

(1) The number of occupants of each dwelling unit shall be calculated as follows:

First Bedroom 2 occupants

Each additional bedroom 1 occupant

(2) The estimated gray water flows of each occupant shall be calculated as follows:

Showers, bathtubs, and lavatories	25 gallons (95 L) per day/occupant
Laundry	15 gallons (57 L) per day/occupant

(3) The total number of occupants shall be multiplied by the applicable estimated gray water discharge as provided above and the type of fixtures connected to the gray water system.

1503.8.2 Commercial, Industrial, and Institutional Occupancies. The gray water discharge for commercial, industrial, and institutional occupancies shall be calculated by utilizing the procedure in Section 1503.8.1, water use records or other documentation to estimate gray water discharge.

1503.9 Gray Water System Components. Gray water system components shall comply with Section 1503.9.1 through Section 1503.9.7.

1503.9.1 Surge Tanks. Where installed, surge tanks shall be in accordance with the following:

(1) Surge tanks shall be constructed of solid, durable materials not subject to excessive corrosion or decay and shall be watertight. Surge tanks constructed of steel shall be approved by the Authority Having Jurisdiction, provided such tanks are in accordance with approved applicable standards.

(2) Each surge tank shall be vented in accordance with this code. The vent size shall be determined based on the total gray water fixture units as outlined in this code.

(3) Each surge tank shall have an access opening with lockable gasketed covers or approved equivalent to allow for inspection and cleaning.

(4) Each surge tank shall have its rated capacity permanently marked on the unit. Also, a sign stating GRAY WATER, DANGER — UNSAFE WATER shall be permanently marked on the holding tank.

(5) Each surge tank shall have an overflow drain. The overflow drains shall have permanent connections to the building drain or building sewer, upstream of septic tanks. The overflow drain shall not be equipped with a shutoff valve.

(6) The overflow drain pipes shall not be less in size than the inlet pipe. Unions or equally effective fittings shall be provided for piping connected to the surge tank.

(7) Surge tank shall be structurally designed to withstand anticipated earth or other loads. Surge tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft^2) (1465 kg/m^2) where the tank is designed for underground installation.

(8) Where a surge tank is installed underground, the system shall be designed so that the tank overflow will gravity drain to the existing sewer line or septic tank. The tank shall be protected against sewer line backflow by a backwater valve installed in accordance with this code.

(9) Surge tanks shall be installed on dry, level, well-compacted soil where underground or on a level 3 inch (76 mm) thick concrete slab where aboveground.

(10) Surge tanks shall be anchored to prevent against overturning where installed aboveground. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground where empty. The combined weight of the tank and hold down system shall meet or exceed the buoyancy forces of the tank.

1503.9.2 Gray Water Pipe and Fitting Materials. Aboveground and underground building drainage and vent pipe and fittings for gray water systems shall comply with the requirements for aboveground and underground sanitary building drainage and vent pipe and fittings in this code. These materials shall extend not less than 2 feet (610 mm) outside the building.

1503.9.3 Subsoil Irrigation Field Materials. Subsoil irrigation field piping shall be constructed of perforated high-density polyethylene pipe, perforated ABS pipe, perforated PVC pipe, or other approved materials, provided that sufficient openings are available for distribution of the gray water into the trench area. Material, construction, and perforation of the pipe shall be in accordance with the appropriate absorption field drainage piping standards and shall be approved by the Authority Having Jurisdiction.

1503.9.4 Subsurface Irrigation Field and Mulch Basin Supply Line Materials. Materials for gray water piping outside the building shall be polyethylene or PVC. Drip feeder lines shall be PVC or polyethylene tubing.

1503.9.5 Valves. Valves shall be accessible.

1503.9.6 Trap. Gray water piping discharging into the surge tank or having a direct connection to the sanitary drain or sewer piping shall be downstream of an approved water seal type trap(s). Where no such trap(s) exists, an approved vented running trap shall be installed upstream of the connection to protect the building from possible waste or sewer gases.

1503.9.7 Backwater Valve. A backwater valve shall be installed on gray water drain connections to the sanitary drain or sewer.

1504.0 Subsurface Irrigation System Zones.

1504.1 General. Irrigation or disposal fields shall be permitted to have one or more valved zones. Each zone shall be of a size to receive the gray water anticipated in that zone.

1504.2 Required Area of Subsurface Irrigation Fields, Subsoil Irrigation Fields, and Mulch Basins. The minimum effective irrigation area of subsurface irrigation fields, subsoil irrigation fields, and mulch basins shall be determined by Table 1504.2 for the type of soil found in the excavation, based upon a calculation of estimated gray water discharge under Section 1503.8. For a subsoil irrigation field, the area shall be equal to the aggregate length of the perforated pipe sections within the valved zone multiplied by the width of the proposed subsoil irrigation field.

TABLE 1504.2
DESIGN OF SIX TYPICAL SOILS

TYPE OF SOIL	MINIMUM SQUARE FEET OF IRRIGATION AREA PER 100 GALLONS OF ESTIMATED GRAY WATER DISCHARGE PER DAY	MAXIMUM ABSORPTION CAPACITY IN GALLONS PER SQUARE FOOT OF IRRIGATION/ LEACHING AREA FOR A 24-HOUR PERIOD
Coarse sand or gravel	20	5.0
Fine sand	25	4.0
Sandy loam	40	2.5
Sandy clay	60	1.7
Clay with considerable sand or gravel	90	1.1
Clay with small amounts of sand or gravel	120	0.8

For SI units: 1 square foot = 0.0929 m^2, 1 gallon per day = 0.000043 L/s

1504.3 Determination of Maximum Absorption Capacity. The irrigation field and mulch basin size shall be based on the maximum absorption capacity of the soil and determined using Table 1504.2. For soils not listed in Table 1504.2, the maximum absorption capacity for the proposed site shall be determined by percolation tests or another method acceptable to the Authority Having Jurisdiction. A gray water system shall not be permitted, where the percolation test shows the absorption capacity of the soil is unable to accommodate the maximum discharge of the proposed gray water irrigation system.

1504.4 Groundwater Level. No excavation for an irrigation field, disposal field, or mulch basin shall extend within 3 feet (914 mm) vertical of the highest known seasonal groundwater level, nor to a depth where gray water contaminates the groundwater or surface water. The applicant shall supply evidence of groundwater depth to the satisfaction of the Authority Having Jurisdiction.

1504.5 Subsurface and Subsoil Irrigation Field Design and Construction. Subsurface and subsoil irrigation field design and construction shall be in accordance with Section 1504.5.1 through Section 1504.7.3. Where a gray water irrigation system design is predicated on soil tests, the subsurface or subsoil irrigation field or mulch basin shall be installed at the same location and depth as the tested area.

1504.5.1 Subsurface Irrigation Field. A subsurface irrigation field shall comply with Section 1504.5.2 through Section 1504.5.7.

1504.5.2 Minimum Depth. Supply piping, including drip feeders, shall be not less than 2 inches (51 mm) below finished grade and covered with mulch or soil.

1504.5.3 Filter. Not less than 140 mesh (105 microns) filter with a capacity of 25 gallons per minute (gpm) (1.58 L/s), or equivalent shall be installed. Where a filter backwash is installed, the backwash and flush discharge shall discharge into the building sewer or private sewage disposal system. Filter backwash and flush water shall not be used.

1504.5.4 Emitter Size. Emitters shall be installed in accordance with the manufacturer's installation instructions. Emitters shall have a flow path of not less than 1200 microns (μ) (1200 μm) and shall not have a coefficient of manufacturing variation (Cv) exceeding 7 percent. Irrigation system design shall be such that emitter flow variation shall not exceed 10 percent.

1504.5.5 Number of Emitters. The minimum number of emitters and the maximum discharge of each emitter in an irrigation field shall be in accordance with Table 1504.5.5.

TABLE 1504.5.5
SUBSURFACE IRRIGATION DESIGN CRITERIA FOR SIX TYPICAL SOILS

TYPE OF SOIL	MAXIMUM EMITTER DISCHARGE (gallons per day)	MINIMUM NUMBER OF EMITTERS PER GALLON OF ESTIMATED GRAY WATER DISCHARGE PER DAY* (gallons per day)
Sand	1.8	0.6
Sandy loam	1.4	0.7
Loam	1.2	0.9
Clay loam	0.9	1.1
Silty clay	0.6	1.6
Clay	0.5	2.0

For SI units: 1 gallon per day = 0.000043 L/s

* The estimated gray water discharge per day shall be determined in accordance with Section 1503.8 of this code.

1504.5.6 Controls. The system design shall provide user controls, such as valves, switches, timers, and other controllers, to rotate the distribution of gray water between irrigation zones.

1504.5.7 Maximum Pressure. Where pressure at the discharge side of the pump exceeds 20 pounds-force per square inch (psi) (138 kPa), a pressure-reducing valve able to maintain downstream pressure not exceeding 20 psi (138 kPa) shall be installed downstream from the pump and before an emission device.

1504.6 Mulch Basin Design and Construction. A mulch basin shall comply with Section 1504.6.1 through Section 1504.6.4.

1504.6.1 Single Family and Multi-Family Dwellings. The gray water discharge to a mulch basin is limited to single family and multi-family dwellings.

1504.6.2 Size. Mulch basins shall be of sufficient size to accommodate peak flow rates and distribute the total amount of estimated gray water on a daily basis without surfacing, ponding or runoff. Mulch basins shall have a depth of not less than 10 inches (254 mm) below finished grade. The mulch basin size shall be based on the maximum absorption capacity of the soil and determined using Table 1504.2.

1504.6.3 Minimum Depth. Gray water supply piping, including drip feeders, shall be not less than 2 inches (51 mm) below finished grade and covered with mulch.

1504.6.4 Maintenance. The mulch basin shall be maintained periodically to retain the required depth and area, and to replenish the required mulch cover.

1504.7 Subsoil Irrigation Field. Subsoil irrigation fields shall comply with Section 1504.7.1 through Section 1504.7.3.

1504.7.1 Minimum Pipe Size. Subsoil irrigation field distribution piping shall be not less than 3 inches (80 mm) diameter.

1504.7.2 Filter Material and Backfill. Filter material, clean stone, gravel, slag, or similar material acceptable to the Authority Having Jurisdiction, varying in size from ¾ of an inch (19.1 mm) to 2½ inches (64 mm) shall be placed in the trench to the depth and grade in accordance with Table 1504.7.3. The perforated section of subsoil irrigation field distribution piping shall be laid on the filter material in an approved manner. The perforated section shall then be covered with filter material to the minimum depth in accordance with Table 1504.7.3. The filter material shall then be covered with porous material to prevent the closure of voids with earth backfill. No earth backfill shall be placed over the filter material cover until after inspection and acceptance.

1504.7.3 Subsoil Irrigation Field Construction. Subsoil irrigation fields shall be constructed in accordance with Table 1504.7.3. Where necessary on sloping ground to prevent excessive line slopes, irrigation lines shall be stepped. The lines between each horizontal leaching section shall be made with approved watertight joints and installed on the natural or unfilled ground.

1504.8 Gray Water System Color and Marking Information. Pressurized gray water distribution systems shall be identified as containing nonpotable water in accordance with Section 601.3 of this code.

1504.9 Other Collection and Distribution Systems. Other collection and distribution systems shall be approved by the local Authority Having Jurisdiction, as allowed by Section 301.3 of this code.

1504.9.1 Higher Requirements. Nothing contained in this chapter shall be construed to prevent the Authority Having Jurisdiction from requiring compliance with higher requirements than those contained herein, where such higher requirements are essential to maintaining a safe and sanitary condition.

TABLE 1504.7.3
SUBSOIL IRRIGATION FIELD CONSTRUCTION

DESCRIPTION	MINIMUM	MAXIMUM
Number of drain lines per valved zone	1	–
Length of each perforated line	–	100 feet
Bottom width of trench	12 inches	18 inches
Spacing of lines, center to center	4 feet	–
Depth of earth covers of lines	10 inches	–
Depth of filter material cover of lines	2 inches	–
Depth of filter material beneath lines	3 inches	–
Grade of perforated lines level	level	3 inches per 100 feet

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 inch per foot = 83.3 mm/m

1504.10 Testing. Building drains and vents for gray water systems shall be tested in accordance with this code. Surge tanks shall be filled with water to the overflow line prior to and during the inspection. Seams and joints shall be left exposed, and the tank shall remain watertight. A flow test shall be performed through the system to the point of gray water discharge. Lines and components shall be watertight up to the point of the irrigation perforated and drip lines.

1504.11 Maintenance. Gray water systems and components shall be maintained in accordance with Table 1501.5.

1505.0 Reclaimed (Recycled) Water Systems.

1505.1 General. The provisions of this section shall apply to the installation, construction, alteration, and repair of reclaimed (recycled) water systems intended to supply uses such as water closets, urinals, trap primers for floor drains and floor sinks, aboveground and subsurface irrigation, industrial or commercial cooling or air conditioning and other uses approved by the Authority Having Jurisdiction.

1505.2 Permit. It shall be unlawful for a person to construct, install, alter, or cause to be constructed, installed, or altered a reclaimed (recycled) water system within a building or on premises without first obtaining a permit to do such work from the Authority Having Jurisdiction.

1505.2.1 Plumbing Plan Submission. No permit for a reclaimed (recycled) water system shall be issued until complete plumbing plans, with data satisfactory to the Authority Having Jurisdiction, have been submitted and approved.

1505.3 System Changes. No changes or connections shall be made to either the reclaimed (recycled) water system or the potable water system within site containing a reclaimed (recycled) water system without approval by the Authority Having Jurisdiction.

1505.4 Connections to Potable or Reclaimed (Recycled) Water Systems. Reclaimed (recycled) water systems shall have no connection to a potable water supply or alternate water source system. Potable water is permitted to be used as makeup water for a reclaimed (recycled) water storage tank provided the water supply inlet is protected by an air gap or reduced-pressure principle backflow preventer in accordance with this code.

1505.5 Initial Cross-Connection Test. A cross-connection test is required in accordance with Section 1502.3. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.

1505.6 Reclaimed (Recycled) Water System Materials. Reclaimed (recycled) water supply and distribution system materials shall comply with the requirements of this code for potable water supply and distribution systems unless otherwise provided for in this section.

1505.7 Reclaimed (Recycled) Water System Color and Marking Information. Reclaimed (recycled) water systems shall have a colored background and marking information in accordance with Section 601.3 of this code.

1505.8 Valves. Valves, except fixture supply control valves, shall be equipped with a locking feature.

1505.9 Hose Bibbs. Hose bibbs shall not be allowed on reclaimed (recycled) water piping systems located in areas accessible to the public. Access to reclaimed (recycled) water at points in the system accessible to the public shall be through a quick-disconnect device that differs from those installed on the potable water system. Hose bibbs supplying reclaimed (recycled) water shall be marked with the words: “CAUTION: NONPOTABLE RECLAIMED WATER, DO NOT DRINK,” and the symbol in Figure 1505.9.

FIGURE 1505.9

1505.10 Required Appurtenances. The reclaimed (recycled) water system and the potable water system within the building shall be provided with the required appurtenances (e.g., valves, air/vacuum relief valves, etc.) to allow for deactivation or drainage as required for a cross-connection test in accordance with Section 1502.3.

1505.11 Same Trench as Potable Water Pipes. Reclaimed (recycled) water pipes shall be permitted to be run or laid in the same trench as potable water pipes with 12 inches (305 mm) minimum vertical and horizontal separation where both pipe materials are approved for use within a building. Where piping materials do not meet this requirement, the minimum horizontal separation shall be increased to 60 inches (1524 mm). The potable water piping shall be installed at an elevation above the reclaimed (recycled) water piping. Reclaimed (recycled) water pipes laid in the same trench or crossing building sewer or drainage piping shall be installed in accordance with this code for potable water piping.

1505.12 Signs. Signs in rooms and water closet tanks in buildings using reclaimed (recycled) water shall be in accordance with Section 1501.9 and Section 1501.9.1.

1505.13 Inspection and Testing. Reclaimed (recycled) water systems shall be inspected and tested in accordance with Section 1502.1.

1506.0 On-Site Treated Nonpotable Water Systems.

1506.1 General. The provisions of this section shall apply to the installation, construction, alteration, and repair of on-site treated nonpotable water systems intended to supply uses such as water closets, urinals, trap primers for floor drains and floor sinks, above and belowground irrigation, and other uses approved by the Authority Having Jurisdiction.

1506.2 Plumbing Plan Submission. No permit for an on-site treated nonpotable water system shall be issued until complete plumbing plans, with data satisfactory to the Authority Having Jurisdiction, have been submitted and approved.

1506.3 System Changes. No changes or connections shall be made to either the on-site treated nonpotable water system or the potable water system within a site containing an on-site treated nonpotable water system without approval by the Authority Having Jurisdiction.

1506.4 Connections to Potable or Reclaimed (Recycled) Water Systems. On-site treated nonpotable water systems shall have no connection to a potable water supply or reclaimed (recycled) water source system. Potable or reclaimed (recycled) water is permitted to be used as makeup water for a non-pressurized storage tank provided the makeup water supply is protected by an air gap in accordance with this code.

1506.5 Initial Cross-Connection Test. A cross-connection test is required in accordance with Section 1502.3. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.

1506.6 On-Site Treated Nonpotable Water System Materials. On-site treated nonpotable water supply, and distribution system materials shall comply with the requirements of this code for potable water supply and distribution systems unless otherwise provided for in this section.

1506.7 On-Site Treated Nonpotable Water Devices and Systems. Devices or equipment used to treat on-site treated nonpotable water to maintain the minimum water quality requirements determined by the Authority Having Jurisdiction shall be listed or labeled (third-party certified) by a listing agency (accredited conformity assessment body) or approved for the intended application. Devices or equipment used to treat on-site treated nonpotable water for use in the water closet and urinal flushing, surface irrigation, and similar applications shall comply with NSF 350 or approved by the Authority Having Jurisdiction.

1506.8 On-Site Treated Nonpotable Water System Color and Marking Information. On-site treated water systems shall have a colored background and marking information in accordance with Section 601.3 of this code.

1506.9 Design and Installation. The design and installation of on-site treated nonpotable systems shall be in accordance with Section 1506.9.1 through Section 1506.9.5.

1506.9.1 Listing Terms and Installation Instructions. On-site treated nonpotable water systems shall be installed in accordance with the terms of its listing and the manufacturer's installation instructions.

1506.9.2 Minimum Water Quality. On-site treated nonpotable water supplied to toilets or urinals or for other uses in which it is sprayed or exposed shall be disinfected. Acceptable disinfection methods shall include chlorination, ultraviolet sterilization, ozone, or other methods as approved by the Authority Having Jurisdiction. The minimum water quality for on-site treated nonpotable water systems shall meet the applicable water quality requirements for the intended applications as determined by the public health Authority Having Jurisdiction.

1506.9.3 Deactivation and Drainage. The on-site treated nonpotable water system and the potable water system within the building shall be provided with the required appurtenances (e.g., valves, air/vacuum relief valves, etc.) to allow for deactivation or drainage as required for a cross-connection test in accordance with Section 1502.3.

1506.9.4 Near Underground Potable Water Pipe. On-site treated nonpotable water pipes shall be permitted to be run or laid in the same trench as potable water pipes with a 12 inch (305 mm) minimum vertical and horizontal separation where both pipe materials are approved for use within a building. Where piping materials do not meet this requirement the minimum separation shall be increased to 60 inches (1524 mm). The potable water piping shall be installed at an elevation above the on-site treated nonpotable water piping.

1506.9.5 Required Filters. A filter permitting the passage of particulates no larger than 100 microns (100 μm) shall be provided for on-site treated nonpotable water supplied to water closets, urinals, trap primers, and drip irrigation system.

1506.10 Valves. Valves, except fixture supply control valves, shall be equipped with a locking feature.

1506.11 Signs. Signs in buildings using on-site treated nonpotable water shall comply with Section 1501.9 and Section 1501.9.1.

1506.12 Inspection and Testing. On-site treated nonpotable water systems shall be inspected and tested in accordance with Section 1502.1.

CHAPTER 16

NONPOTABLE RAINWATER CATCHMENT SYSTEMS

1601.0 General.

[W] 1601.1 Applicability. The provisions of this chapter and the Washington state department of health shall apply to the construction, alteration , and repair of nonpotable rainwater catch systems.

1601.1.1 Allowable Use of Alternate Water. Where approved or required by the Authority Having Jurisdiction, rainwater shall be permitted to be used instead of potable water for the applications identified in this chapter.

1601.2 System Design. Rainwater catchment systems shall be designed in accordance with this chapter by a licensed plumbing contractor or registered design professional. Components, piping, and fittings used in a rainwater catchment system shall be listed.

Exceptions:

(1) A person registered or licensed to perform plumbing design work is not required to design rainwater catchment systems used for irrigation with a maximum storage capacity of 360 gallons (1363 L).

(2) A person registered or licensed to perform plumbing design work is not required to design rainwater catchment systems for single family dwellings where outlets, piping, and system components are located on the exterior of the building.

1601.3 Permit. It shall be unlawful for a person to construct, install, alter, or cause to be constructed, installed, or altered a rainwater catchment system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

Exceptions:

(1) A permit is not required for exterior rainwater catchment systems used for outdoor drip and subsurface irrigation with a maximum storage capacity of 360 gallons (1363 L).

(2) A plumbing permit is not required for rainwater catchment systems for single family dwellings where outlets, piping, and system components are located on the exterior of the building. This does not exempt the need for permits where required for electrical connections, tank supports, or enclosures.

1601.4 Component Identification. System components shall be properly identified as to the manufacturer.

1601.5 Maintenance and Inspection. Rainwater catchment systems and components shall be inspected and maintained in accordance with Section 1601.5.1 through Section 1601.5.3.

1601.5.1 Frequency. Rainwater catchment systems and components shall be inspected and maintained in accordance with Table 1601.5 unless more frequent inspection and maintenance are required by the manufacturer.

1601.5.2 Maintenance Log. A maintenance log for rainwater catchment systems is required to have a permit in accordance with Section 1601.3 and shall be maintained by the property owner and be available for inspection. The property owner or designated appointee shall ensure that a record of testing, inspection, and maintenance in accordance with Table 1601.5 is maintained in the log. The log will indicate the frequency of inspection and maintenance for each system.

1601.5.3 Maintenance Responsibility. The required maintenance and inspection of rainwater catchment systems shall be the responsibility of the property owner unless otherwise required by the Authority Having Jurisdiction.

1601.6 Operation and Maintenance Manual. An operation and maintenance manual for rainwater catchment systems required to have a permit in accordance with Section 1601.3, shall be supplied to the building owner by the system designer. The operating and maintenance manual shall include the following:

(1) Detailed diagram of the entire system and the location of system components.

(2) Instructions for operating and maintaining the system.

(3) Details on maintaining the required water quality as determined by the Authority Having Jurisdiction.

(4) Details on deactivating the system for maintenance, repair, or other purposes.

(5) Applicable testing, inspection, and maintenance frequencies in accordance with Table 1601.5.

(6) A method of contacting the manufacturer(s).

1601.7 Minimum Water Quality Requirements. The minimum water quality for rainwater catchment systems shall comply with the applicable water quality requirements for the intended application as determined by the Authority Having Jurisdiction. Water quality for nonpotable rainwater catchment systems shall comply with Section 1602.9.6.

TABLE 1601.5
MINIMUM ALTERNATE WATER SOURCE TESTING, INSPECTION, AND MAINTENANCE FREQUENCY

DESCRIPTION	MINIMUM FREQUENCY
Inspect and clean filters and screens, and replace (where necessary).	Every 3 months
Inspect and verify that disinfection, filters, and water quality treatment devices and systems are operational and maintaining minimum water quality requirements as determined by the Authority Having Jurisdiction.	In accordance with manufacturer's instructions and the Authority Having Jurisdiction.
Inspect and clear debris from rainwater gutters, downspouts, and roof washers.	Every 6 months
Inspect and clear debris from the roof or another aboveground rainwater collection surfaces.	Every 6 months
Remove tree branches and vegetation overhanging a roof or other aboveground rainwater collection surfaces.	As needed
Inspect pumps and verify operation.	After initial installation and every 12 months thereafter
Inspect valves and verify operation.	After initial installation and every 12 months thereafter
Inspect pressure tanks and verify operation.	After initial installation and every 12 months thereafter
Clear debris from and inspect storage tanks, locking devices, and verify operation.	After initial installation and every 12 months thereafter
Inspect caution labels and marking.	After initial installation and every 12 months thereafter
Cross-connection inspection and test*	After initial installation and every 12 months thereafter
Test water quality of rainwater catchment systems required by Section 1602.9.6 to maintain a minimum water quality	Every 12 months. After system renovation or repair.

* The cross-connection test shall be performed in the presence of the Authority Having Jurisdiction in accordance with the requirements of this chapter.

Exceptions:

(1) Water treatment is not required for rainwater catchment systems used for aboveground irrigation with a maximum storage capacity of 360 gallons (1363 L).

(2) Water treatment is not required for rainwater catchment systems used for subsurface or drip irrigation.

1601.8 Material Compatibility. Rainwater catchment systems shall be constructed of materials that are compatible with the type of pipe and fitting materials, water treatment, and water conditions in the system.

1601.9 System Controls. Controls for pumps, valves, and other devices that contain mercury that come in contact with rainwater supply shall not be permitted.

1601.10 Separation Requirements. Underground rainwater catchment service piping shall be separated from the building sewer in accordance with Section 609.2. Treated nonpotable water pipes shall be permitted to be run or laid in the same trench as potable water pipes with a 12 inch (305 mm) minimum vertical and horizontal separation where both pipe materials are approved for use within a building. Where horizontal piping materials do not meet this requirement, the minimum separation shall be increased to 60 inches (1524 mm). The potable water piping shall be installed at an elevation above the treated nonpotable water piping.

1601.11 Abandonment. Rainwater catchment systems that are no longer in use, or fail to be maintained in accordance with Section 1601.5, shall be abandoned. Abandonment shall comply with Section 1601.11.1 and Section 1601.11.2.

1601.11.1 General. An abandoned system or part thereof covered under the scope of this chapter shall be disconnected from remaining systems, drained, plugged, and capped in an approved manner.

1601.11.2 Underground Tank. An underground water storage tank that has been abandoned or otherwise discontinued from use in a system covered under the scope of this chapter shall be completely drained and filled with earth, sand, gravel, concrete, or other approved material or removed in a manner satisfactory to the Authority Having Jurisdiction.

1601.12 Sizing. Unless otherwise provided for in this chapter, rainwater catchment piping shall be sized in accordance with Chapter 6 for sizing potable water piping.

1602.0 Nonpotable Rainwater Catchment Systems.

1602.1 General. The installation, construction, alteration, and repair of rainwater catchments systems intended to supply uses such as water closets, urinals, trap primers for floor drains and floor sinks, irrigation, industrial processes, water features, cooling tower makeup and other uses shall be approved by the Authority Having Jurisdiction. Rainwater catchment systems for collecting precipitation from rooftops shall comply with ARCSA/ASPE 63.

1602.2 Plumbing Plan Submission. No permit for a rainwater catchment system shall be issued until complete plumbing plans, with data satisfactory to the Authority Having Jurisdiction, have been submitted and approved.

1602.3 System Changes. No changes or connections shall be made to either the rainwater catchment system or the potable water system within a site containing a rainwater catchment system requiring a permit without approval by the Authority Having Jurisdiction.

1602.4 Connections to Potable or Reclaimed (Recycled) Water Systems. Rainwater catchment systems shall have no direct connection to a potable water supply or alternate water source system. Potable or reclaimed (recycled) water is permitted to be used as makeup water for a rainwater catchment system provided the potable or reclaimed (recycled) water supply connection is protected by an air gap or reduced-pressure principle backflow preventer in accordance with this code.

1602.5 Initial Cross-Connection Test. Where a portion of a rainwater catchment system is installed within a building, a cross-connection test is required in accordance with Section 1605.3. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.

1602.6 Sizing. The design and size of rainwater drains, gutters, conductors, and leaders shall comply with Chapter 11 of this code.

1602.7 Rainwater Catchment System Materials. Rainwater catchment system materials shall comply with Section 1602.7.1 through Section 1602.7.4.

1602.7.1 Water Supply and Distribution Materials. Rainwater catchment water supply and distribution materials shall comply with the requirements of this code for potable water supply and distribution systems unless otherwise provided for in this section.

1602.7.2 Rainwater Catchment System Drainage Materials. Materials used in rainwater catchment drainage systems, including gutters, downspouts, conductors, and leaders shall be in accordance with the requirements of this code for storm drainage.

1602.7.3 Storage Tanks. Rainwater storage tanks shall comply with Section 1603.1.

1602.7.4 Collections Surfaces. The collection surface shall be constructed of a hard, impervious material.

1602.8 Rainwater Catchment System Color and Marking Information. Rainwater catchment systems shall have a colored background in accordance with Section 601.3. Rainwater catchment systems shall be marked, in lettering in accordance with Section 601.3.3, with the words: “CAUTION: NONPOTABLE RAINWATER, DO NOT DRINK.”

1602.9 Deactivation and Drainage for Cross-Connection Test. The rainwater catchment system and the potable water system within the building shall be provided with the required appurtenances (e.g., valves, air or vacuum relief valves, etc.) to allow for deactivation or drainage as required for a cross-connection test in accordance with Section 1605.3.

1603.0 Design and Installation.

1603.1 Rainwater Catchment Systems. The design and installation of nonpotable rainwater catchment systems shall be in accordance with Section 1603.2 through Section 1603.20.

1603.2 Outside Hose Bibbs. Outside hose bibbs shall be allowed on rainwater piping systems. Hose bibbs supplying rainwater shall be marked with the words: "CAUTION: NONPOTABLE RAINWATER, DO NOT DRINK" and in Figure 1603.2.

FIGURE 1603.2

1603.3 Construction. Rainwater storage tanks shall be constructed of solid, durable materials not subject to excessive corrosion or decay and shall be watertight.

1603.4 Rainwater Catchment Collection Surfaces. Rainwater shall be collected from roof surfaces or other manmade, aboveground collection surfaces.

1603.4.1 Other Surfaces. Natural precipitation collected from surface water runoff, vehicular parking surfaces, or manmade surfaces at or below grade shall be in accordance with the stormwater requirements for on-site treated nonpotable water systems in Section 1506.0.

1603.4.2 Prohibited Discharges. Overflows and bleed-off pipes from roof-mounted equipment and appliances shall not discharge onto roof surfaces that are intended to collect rainwater without prior approval from the Authority Having Jurisdiction.

1603.5 Minimum Water Quality. The minimum water quality for harvested rainwater shall meet the applicable water quality requirements for the intended applications as determined by the Authority Having Jurisdiction. In the absence of water quality requirements determined by the Authority Having Jurisdiction, the minimum treatment and water quality shall be in accordance with Table 1603.5.

Exception: No treatment is required for rainwater used for subsurface or nonsprinkled surface irrigation where the maximum storage volume is less than 360 gallons (1363 L).

1603.5.1 Treatment. If the quality of the tested water cannot consistently be maintained at the minimum levels specified in Table 1603.5, then the system shall be equipped with an appropriate treatment device meeting applicable NSF standards referenced in Chapter 17.

1603.6 Rainwater Storage Tanks. Rainwater storage tanks shall be constructed and installed in accordance with Section 1603.3 and Section 1603.7 through Section 1603.13.

1603.7 Location. Rainwater storage tanks shall be permitted to be installed above or below grade.

1603.8 Above Grade. Above grade, storage tanks shall be of an opaque material, approved for aboveground use in direct sunlight or shall be shielded from direct sunlight. Tanks shall be installed in an accessible location to allow for inspection and cleaning. The tank shall be installed on a foundation or platform that is constructed to accommodate loads in accordance with the building code.

1603.9 Below Grade. Rainwater storage tanks installed below grade shall be structurally designed to withstand anticipated earth or other loads. Holding tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft^2) (1465 kg/m^2) where the tank is designed for underground installation. Below grade rainwater tanks installed underground shall be provided with manholes. The manhole opening shall be not less than 20 inches (508 mm) in diameter and located not less than 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground where empty. The combined weight of the tank and hold down system shall meet or exceed the buoyancy force of the tank.

TABLE 1603.5
MINIMUM WATER QUALITY

APPLICATION	MINIMUM TREATMENT	MINIMUM WATER QUALITY
Car washing	Debris excluder or other approved means in accordance with Section 1603.14, and 100 microns in accordance with Section 1603.15 for drip irrigation.	N/A
Subsurface and drip irrigation	Debris excluder or other approved means in accordance with Section 1603.14, and 100 microns in accordance with Section 1603.15 for drip irrigation.	N/A
Spray irrigation where the maximum storage volume is less than 360 gallons	Debris excluder or other approved means in accordance with Section 1603.14, and disinfection in accordance with Section 1603.12.	N/A
Spray irrigation where the maximum storage volume is equal to or more than 360 gallons	Debris excluder or other approved means in accordance with Section 1603.14.	Escherichia coli: < 100 CFU/100 mL, and Turbidity: < 10 NTU
Urinal and water closet flushing, clothes washing, and trap priming	Debris excluder or other approved means in accordance with Section 1603.14, and 100 microns in accordance with Section 1603.15.	Escherichia coli: < 100 CFU/100 mL, and Turbidity: < 10 NTU
Ornamental fountains and other water features	Debris excluder or other approved means in accordance with Section 1603.14.	Escherichia coli: < 100 CFU/100 mL, and Turbidity: < 10 NTU
Cooling tower make-up water	Debris excluder or other approved means in accordance with Section 1603.14, and 100 microns in accordance with Section 1603.15.	Escherichia coli: < 100 CFU/100 mL, and Turbidity: < 10 NTU

For SI units: 1 micron = 1 μm, 1 gallon = 3.785 L

1603.10 Drainage and Overflow. Rainwater storage tanks shall be provided with a means of draining and cleaning. The overflow drain shall not be equipped with a shutoff valve. The overflow outlet shall discharge in accordance with this code for storm drainage systems. Where discharging to the storm drainage system, the overflow drain shall be protected from backflow of the storm drainage system by a backwater valve or other approved method.

1603.10.1 Overflow Outlet Size. The overflow outlet shall be sized to accommodate the flow of the rainwater entering the tank and not less than the aggregate cross-sectional area of inflow pipes.

›› **1603.11 Opening and Access Protection.** Rainwater tank openings shall be protected to prevent the entrance of insects, birds, or rodents into the tank.

Rainwater tank access openings exceeding 12 inches (305 mm) in diameter shall be secured to prevent tampering and unintended entry by either a lockable device or other approved method.

›› **1603.12 Marking.** Rainwater tanks shall be permanently marked with the capacity and the language: "NONPOTABLE RAINWATER." Where openings are provided to allow a person to enter the tank, the opening shall be marked with the following language: "DANGER-CONFINED SPACE."

›› **1603.13 Storage Tank Venting.** Where venting using drainage or overflow piping is not provided or is considered insufficient, a vent shall be installed on each tank. The vent shall extend from the top of the tank and terminate not less than 6 inches (152 mm) above grade and shall be not less than 1½ inches (40 mm) in diameter. The vent terminal shall be directed downward and covered with a 3⁄32 of an inch (2.4 mm) mesh screen to prevent the entry of vermin and insects.

›› **1603.14 Pumps.** Pumps serving rainwater catchment systems shall be listed. Pumps supplying water to water closets, urinals, and trap primers shall be capable of delivering not less than 15 pounds-force per square inch (psi) (103 kPa) residual pressure at the highest and most remote outlet served. Where the water pressure in the rainwater supply system within the building exceeds 80 psi (552 kPa), a pressure reducing valve reducing the pressure to 80 psi (552 kPa) or less to water outlets in the building shall be installed in accordance with this code.

›› **1603.15 Roof Drains.** Primary and secondary roof drains, conductors, leaders, and gutters shall be designed and installed in accordance with this code.

›› **1603.16 Water Quality Devices and Equipment.** Devices and equipment used to treat rainwater to maintain the minimum water quality requirements determined by the Authority Having Jurisdiction shall be listed or labeled (third-party certified) by a listing agency (accredited conformity assessment body) and approved for the intended application.

›› **1603.17 Freeze Protection.** Tanks and piping installed in locations subject to freezing shall be provided with an approved means of freeze protection.

›› **1603.18 Debris Removal.** The rainwater catchment conveyance system shall be equipped with a debris excluder or other approved means to prevent the accumulation of leaves, needles, other debris and sediment from entering the storage tank. Devices or methods used to remove debris or sediment shall be accessible and sized and installed in accordance with manufacturer's installation instructions.

›› **1603.19 Required Filters.** A filter permitting the passage of particulates not larger than 100 microns (100 μm) shall be provided for rainwater supplied to water closets, urinals, trap primers, and drip irrigation system.

›› **1603.20 Roof Gutters.** Gutters shall maintain a minimum slope and be sized in accordance with Section 1103.3.

1604.0 Signs.

1604.1 General. Signs in buildings using rainwater shall be in accordance with Section 1604.2 and Section 1604.3.

1604.2 Commercial, Industrial, and Institutional Restroom Signs. A sign shall be installed in restrooms in commercial, industrial, and institutional occupancies using nonpotable rainwater for water closets, urinals, or both. Each sign shall contain ½ of an inch (12.7 mm) letters of a highly visible color on a contrasting background. The location of the sign(s) shall be such that the sign(s) shall be visible to users. The number and location of the signs shall be approved by the Authority Having Jurisdiction and shall contain the following text:

TO CONSERVE WATER, THIS BUILDING USES RAINWATER TO FLUSH TOILETS AND URINALS.

1604.3 Equipment Room Signs. Each equipment room containing nonpotable rainwater equipment shall have a sign posted with the following wording in 1 inch (25.4 mm) letters:

CAUTION NONPOTABLE RAINWATER, DO NOT DRINK. DO NOT CONNECT TO DRINKING WATER SYSTEM. NOTICE: CONTACT BUILDING MANAGEMENT BEFORE PERFORMING ANY WORK ON THIS WATER SYSTEM.

This sign shall be posted in a location that is visible to anyone working on or near rainwater equipment.

1605.0 Inspection and Testing.

1605.1 General. Rainwater catchment systems shall be inspected and tested in accordance with Section 1605.2 and Section 1605.3

1605.2 Supply System Inspection and Test. Rainwater catchment systems shall be inspected and tested in accordance with the applicable provisions of this code for testing of potable water and storm drainage systems. Storage tanks shall be filled with water to the overflow opening for a period of 24 hours, and during the inspection, or by other means as approved by the Authority Having Jurisdiction. Seams and joints shall be exposed during the inspection and checked for watertightness.

1605.3 Annual Cross-Connection Inspection and Testing. An initial and subsequent annual inspection and test in accordance with Section 1602.5 shall be performed on both the potable and rainwater catchment water systems. The potable and

rainwater catchment water systems shall be isolated from each other and independently inspected and tested to ensure there is no cross-connection in accordance with Section 1605.3.1 through Section 1605.3.4.

1605.3.1 Visual System Inspection. Prior to commencing the cross-connection testing, a dual system inspection shall be conducted by the Authority Having Jurisdiction and other authorities having jurisdiction as follows:

(1) Pumps, equipment, equipment room signs, and exposed piping in an equipment room shall be checked.

1605.3.2 Cross-Connection Test. The procedure for determining cross-connection shall be followed by the applicant in the presence of the Authority Having Jurisdiction and other authorities having jurisdiction to determine whether a cross-connection has occurred as follows:

(1) The potable water system shall be activated and pressurized. The rainwater catchment water system shall be shut down and completely drained.

(2) The potable water system shall remain pressurized for a minimum period of time specified by the Authority Having Jurisdiction while the rainwater catchment water system is empty. The minimum period the rainwater catchment water system is to remain depressurized shall be determined on a case-by-case basis, taking into account the size and complexity of the potable and rainwater catchment water distribution systems, but in no case shall that period be less than 1 hour.

(3) Fixtures, potable, and rainwater shall be tested and inspected for flow. Flow from a rainwater catchment water system outlet shall indicate a cross-connection. No flow from a potable water outlet shall indicate that it is connected to the rainwater system.

(4) The drain on the rainwater catchment water system shall be checked for flow during the test and at the end of the period.

(5) The potable water system shall then be completely drained.

(6) The rainwater catchment water system shall then be activated and pressurized.

(7) The rainwater catchment water system shall remain pressurized for a minimum period of time specified by the Authority Having Jurisdiction while the potable water system is empty. The minimum period the potable water system is to remain depressurized shall be determined on a case-by-case basis, but in no case shall that period be less than 1 hour.

(8) Fixtures, potable and rainwater catchment, shall be tested and inspected for flow. Flow from a potable water system outlet shall indicate a cross-connection. No flow from a rainwater catchment water outlet shall indicate that it is connected to the potable water system.

(9) The drain on the potable water system shall be checked for flow during the test and at the end of the period.

(10) Where there is no flow detected in the fixtures which would indicate a cross-connection, the potable water system shall be repressurized.

1605.3.3 Discovery of Cross-Connection. In the event that a cross-connection is discovered, the following procedure, in the presence of the Authority Having Jurisdiction, shall be activated immediately:

(1) Rainwater catchment piping to the building shall be shutdown at the meter, and the rainwater riser shall be drained.

(2) Potable water piping to the building shall be shutdown at the meter.

(3) The cross-connection shall be uncovered and disconnected.

(4) The building shall be retested following procedures listed in Section 1605.3.1 and Section 1605.3.2.

(5) The potable water system shall be chlorinated with 50 ppm chlorine for 24 hours.

(6) The potable water system shall be flushed after 24 hours, and a standard bacteriological test shall be performed. Where test results are acceptable, the potable water system shall be permitted to be recharged.

1605.3.4 Annual Inspection. An annual inspection of the rainwater catchment water system, following the procedures listed in Section 1605.3.1 shall be required. Annual cross-connection testing, following the procedures listed in Section 1605.3.2 shall be required by the Authority Having Jurisdiction, unless site conditions do not require it. In no event shall the test occur less than once in 4 years.

Alternate testing requirements shall be permitted by the Authority Having Jurisdiction.

CHAPTER 17
REFERENCED STANDARDS

1701.0 General.

1701.1 Standards. The standards listed in Table 1701.1 are referenced in various sections of this code and shall be considered part of the requirements of this document. The standards are listed herein by the standard number and effective date, the title, application and the section(s) of this code that references the standard. The application of the referenced standard(s) shall be as specified in Section 301.2.2. The promulgating agency acronyms referred to in Table 1701.1 are defined in a list found at the end of the tables.

[W] TABLE 1701.1
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
Where more than one standard has been listed for the same material or method, the relevant portions of all such standards shall apply.

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
49 CFR 192.281	Plastic Pipe	Plastic, Pipe	1208.6.7.2
49 CFR 192.283	Plastic Pipe: Qualifying Joining Procedures	Plastic, Pipe	1208.6.7.2
ARCSA/ASPE 63-2013	Rainwater Catchment Systems	Miscellaneous	1602.1
ASME A112.1.2-2012 (R2017)	Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)	Fittings	Table 603.2
ASME A112.1.3-2000 (R2015)	Air Gap Fittings for Use with Plumbing Fixtures, Appliances, and Appurtenances	Fittings	Table 603.2
ASME A112.3.1-2007 (R2017)	Stainless Steel Drainage Systems for Sanitary DWV, Storm, and Vacuum Applications, Above- and Below-Ground	Piping	418.1, Table 701.2, 705.7.2, 1102.1
ASME A112.3.4-2018/CSA B45.9-2018	Macerating Toilet Systems and Waste-Pumping Systems for Plumbing Fixtures	Fixtures	710.13
ASME A112.4.1-2009 (R2014)	Water Heater Relief Valve Drain Tubes	Appliances	608.5
ASME A112.4.2-2015/CSA B45.16-2015	Personal Hygiene Devices for Water Closets	Fixtures	411.4
ASME A112.4.4-2017	Plastic Push-Fit Drain, Waste, and Vent (DWV) Fittings	Fittings	Table 701.2
ASME A112.4.14-2017/CSA B125.14-2017	Manually Operated Valves for Use in Plumbing Systems	Valves	606.1
ASME A112.6.1M-1997 (R2017)	Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use	Fixtures	402.4
ASME A112.6.2-2017	Framing-Affixed Supports (Carriers) for Off-the-Floor Plumbing Fixtures	Fixtures	402.4
ASME A112.6.3-2016	Floor and Trench Drains	Fixtures	418.1
ASME A112.6.4-2003 (R2012)	Roof, Deck, and Balcony Drains	Fixtures	1102.1
ASME A112.6.7-2010 (R2015)	Sanitary Floor Sinks	Fixtures	421.1
ASME A112.6.9-2005 (R2015)	Siphonic Roof Drains	DWV Components	1106.3
ASME A112.14.1-2003 (R2017)	Backwater Valves	Valves	710.6
ASME A112.14.3-2018	Hydromechanical Grease Interceptors	Fixtures	1014.1
ASME A112.14.4-2001 (R2017)	Grease Removal Devices	Fixtures	1014.1
ASME A112.14.6-2010 (R2015)	FOG (Fats, Oils, and Greases) Disposal Systems	Fixtures	1015.2
ASME A112.18.1-2018/CSA B125.1-2018	Plumbing Supply Fittings	Fittings	408.3, 417.1, 417.2, 417.3, 417.4, 417.6, 603.5.19

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
Where more than one standard has been listed for the same material or method, the relevant portions of all such standards shall apply.

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
ASME A112.18.2-2015/CSA B125.2-2015	Plumbing Waste Fittings	Fittings	404.1
ASME A112.18.3-2002 (R2017)	Backflow Protection Devices and Systems in Plumbing Fixture Fittings	Backflow Protection	417.3, 417.4
ASME A112.18.6-2017/CSA B125.6-2017	Flexible Water Connectors	Piping	604.5, 604.13
ASME A112.18.9-2011 (R2017)	Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures	Miscellaneous	403.3
ASME A112.19.1-2018/CSA B45.2-2018	Enameled Cast Iron and Enameled Steel Plumbing Fixtures	Fixtures	407.1, 408.1, 409.1, 415.1, 420.1
ASME A112.19.2-2018/CSA B45.1-2018	Ceramic Plumbing Fixtures	Fixtures	407.1, 408.1, 409.1, 410.1, 411.1, 412.1, 415.1, 420.1
ASME A112.19.3-2017/CSA B45.4-2017	Stainless Steel Plumbing Fixtures	Fixtures	407.1, 408.1, 409.1, 410.1, 411.1, 415.1, 420.1
ASME A112.19.5-2017/CSA B45.15-2017	Flush Valves and Spuds for Water Closets, Urinals, and Tanks	Fixtures	413.3
ASME A112.19.7-2012/CSA B45.10-2012 (R2017)	Hydromassage Bathtub Systems	Fixtures	409.1, 409.6
ASME A112.19.12-2014	Wall Mounted, Pedestal Mounted, Adjustable, Elevating, Tilting, and Pivoting Lavatory, Sink, and Shampoo Bowl Carrier Systems and Drain Waste Systems	Fixtures	407.1, 420.1
ASME A112.19.14-2013 (R2018)	Six-Liter Water Closets Equipped with a Dual Flushing Device	Fixtures	411.2.1
ASME A112.19.15-2012 (R2017)	Bathtubs/Whirlpool Bathtubs with Pressure Sealed Doors	Fixtures	409.1
ASME A112.19.19-2016	Vitreous China Nonwater Urinals	Fixtures	412.1, 412.1.2
ASME A112.36.2M-1991 (R2017)	Cleanouts	DWV Components	Table 707.2
ASME B1.20.1-2013	Pipe Threads, General Purpose, Inch	Joints	605.1.5, 605.2.3, 605.5.2, 605.12.3, 705.1.3, 705.3.4, 705.4.2, 705.6.3, 1208.6.9, 1322.5(2)
ASME B16.1-2015	Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250	Fittings	1208.6.12.1
ASME B16.3-2016	Malleable Iron Threaded Fittings: Classes 150 and 300	Fittings	Table 604.1, Table 701.2
ASME B16.4-2016	Gray Iron Threaded Fittings: Classes 125 and 250	Fittings	Table 604.1
ASME B16.5-2017	Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch	Fittings	1208.6.12.2(1)
ASME B16.12-2009 (R2014)	Cast Iron Threaded Drainage Fittings	Fittings	Table 701.2
ASME B16.15-2018	Cast Copper Alloy Threaded Fittings: Classes 125 and 250	Fittings	Table 604.1
ASME B16.18-2018	Cast Copper Alloy Solder Joint Pressure Fittings	Fittings	Table 604.1
ASME B16.20-2017	Metallic Gaskets for Pipe Flanges	Joints	1208.6.13.2
ASME B16.21-2016	Nonmetallic Flat Gaskets for Pipe Flanges	Joints	1208.6.13.3
ASME B16.22-2018	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings	Fittings	Table 604.1, 1321.1
ASME B16.23-2016	Cast Copper Alloy Solder Joint Drainage Fittings: DWV	Fittings	Table 701.2

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
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STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
ASME B16.24-2016	Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500	Fittings	1208.6.12.3
ASME B16.26-2018	Cast Copper Alloy Fittings for Flared Copper Tubes	Fittings	Table 604.1
ASME B16.29-2017	Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings – DWV	Fittings	Table 701.2
ASME B16.34-2017	Valves-Flanged, Threaded, and Welding End	Valves	606.1
ASME B16.42-2016	Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300	Fuel Gas Piping	1208.6.12.4
ASME B16.47-2017	Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric/Inch	Fittings	1208.6.12.2(2)
ASME B16.50-2018	Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings	Fittings	Table 604.1, 1321.1, 1321.11
ASME B16.51-2018	Copper and Copper Alloy Press-Connect Pressure Fittings	Fittings	Table 604.1
ASME B31.3-2016	Process Piping	Piping	1308.2(9)
ASME B36.10M-2018	Welded and Seamless Wrought Steel Pipe	Fuel Gas, Piping	1208.6.3.1
ASME BPVC Section VIII.1-2017	Rules for Construction of Pressure Vessels - Division 1	Miscellaneous	505.4, 1309.5(2), 1310.4(2), 1312.3(2)
ASME BPVC Section IX-2017	Welding, Brazing, and Fusing Qualifications - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators	Miscellaneous	1322.1.1, 1322.2.1, 1323.11
ASPE 45-2019	Siphonic Roof Drainage	Storm Drainage	1106.2
ASSE 1001-2017	Atmospheric Type Vacuum Breakers	Backflow Protection	Table 603.2
ASSE 1002/ASME A112.1002/CSA B125.12-2015	Anti-Siphon Fill Valves for Water Closet Tanks	Backflow Protection	413.3, Table 603.2
ASSE 1003-2009	Water Pressure Reducing Valves for Domestic Water Distribution Systems	Valves	608.2
ASSE 1004-2017	Commercial Dishwashing Machines	Backflow Protection	414.2
ASSE 1008-2006	Plumbing Aspects of Residential Food Waste Disposer Units	Appliances	419.1
ASSE 1010-2004	Water Hammer Arresters	Appliances	609.11
ASSE 1011-2017	Hose Connection Vacuum Breakers	Backflow Protection	Table 603.2
ASSE 1012-2009	Backflow Preventers with an Intermediate Atmospheric Vent	Backflow Protection	Table 603.2
ASSE 1013-2011	Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers	Backflow Protection	Table 603.2
ASSE 1014-2005	Backflow Prevention Devices for Hand-Held Shower	Backflow Protection	417.3
ASSE 1015-2011	Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies	Backflow Protection	Table 603.2
ASSE 1016-2017/ASME A112.1016-2017/CSA B125.16-2017	Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations	Valves	408.3, 408.3.2(1)
ASSE 1018-2001	Trap Seal Primer Valves - Potable Water Supplied	Valves	1007.2
ASSE 1019-2011 (R2016)	Wall Hydrant with Backflow Protection and Freeze Resistance	Backflow Protection	Table 603.2
ASSE 1020-2004	Pressure Vacuum Breaker Assembly	Backflow Protection	Table 603.2
ASSE 1022-2017	Backflow Preventer for Beverage Dispensing Equipment	Backflow Protection	Table 603.2, 603.5.12
ASSE 1023-1979	Hot Water Dispensers Household Storage Type - Electrical	Appliances	417.6
ASSE 1024-2017	Dual Check Backflow Preventers	Backflow Protection	Table 603.2

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
Where more than one standard has been listed for the same material or method, the relevant portions of all such standards shall apply.

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
ASSE 1035-2008	Laboratory Faucet Backflow Preventers	Backflow Protection	Table 603.2, 603.3.11
ASSE 1037-2015/ASME A112.1037-2015/CSA B125.37-2015	Pressurized Flushing Devices for Plumbing Fixtures	Backflow Protection	413.2
ASSE 1044-2015	Trap Seal Primer - Drainage Types and Electric Design Types	DWV Components	1007.2
ASSE 1047-2011	Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies	Backflow Protection	Table 603.2
ASSE 1048-2011	Double Check Detector Fire Protection Backflow Prevention Assemblies	Backflow Protection	Table 603.2
ASSE 1052-2016	Hose Connection Backflow Preventers	Backflow Protection	Table 603.2
ASSE 1053-2004	Dual Check Backflow Preventer Wall Hydrants – Freeze Resistant Type	Backflow Protection	Table 603.2
ASSE/IAPMO 1055-2020	Chemical Dispensers with Integral Backflow Protection	Backflow Protection	603.5.21
ASSE 1056-2013	Spill Resistant Vacuum Breaker Assemblies	Backflow Protection	Table 603.2
ASSE 1057-2012	Freeze Resistant Sanitary Yard Hydrants with Backflow Protection	Backflow Protection	Table 603.2
ASSE 1060-2017	Outdoor Enclosures for Fluid Conveying Components	Miscellaneous	603.4.7
ASSE 1061-2015	Push-Fit Fittings	Fittings	Table 604.1, 605.1.3.3, 605.2.1.1, 605.3.2.1, 605.9.3
ASSE 1062-2017	Temperature Actuated, Flow Reduction (TAFR) Valves for Individual Supply Fittings	Valves	408.3.2(5)
ASSE 1064-2006 (R2011)	Performance Requirements for Backflow Prevention Assembly Field Test Kits	Backflow Protection	603.4.2
ASSE 1069-2005	Automatic Temperature Control Mixing Valves	Valves	408.3.1, 408.3.2(2)
ASSE 1070-2015/ASME A112.1070-2015/CSA B125.70-2015	Water Temperature Limiting Devices	Valves	407.3(1), 408.3.2(3), 409.4(1), 410.3(1)
ASSE 1071-2012	Temperature Actuated Mixing Valves for Plumbed Emergency Equipment	Valves	416.2
ASSE 1079-2012	Dielectric Pipe Unions	Fittings	605.15, 605.16.1, 605.16.3
ASSE 1081-2014	Backflow Preventers with Integral Pressure Reducing Boiler Feed Valve and Intermediate Atmospheric Vent Style for Domestic and Light Commercial Water Distribution Systems	Backflow Protection	Table 603.2
ASSE 1084-2018	Water Heaters with Temperature Limiting Capacity	Appliances	407.3(2), 408.3.2(4), 409.4(2), 410.3(2)
ASSE 1085-2018	Water Heaters for Emergency Equipment	Appliances	416.2
ASSE 1087-2018	Commercial and Food Service Water Treatment Equipment Utilizing Drinking Water	Water Conditioning, Water Treatment	Table 611.1
ASSE Series 5000-2015	Cross-Connection Control Professional Qualifications Standard	Certification	603.2, 603.4.2
ASSE Series 6000-2015	Professional Qualifications Standard for Medical Gas Systems Personnel	Certification	1323.10
ASSE 6020-2015	Medical Gas Systems Inspectors	Miscellaneous	1324.5.4.7, 1324.5.6.2, 1324.5.6.5

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
Where more than one standard has been listed for the same material or method, the relevant portions of all such standards shall apply.

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
ASSE 6030-2015	Medical Gas Systems Verifiers	Miscellaneous	1324.5.4.7, 1324.5.6.2, 1324.5.6.5, 1324.5.7.2
ASSE 6035-2015	Bulk Medical Gas Systems Verifiers	Miscellaneous	1324.5.7.3
ASSE Series 7000-2013	Residential Potable Water Fire Protection System Installers & Inspectors for One and Two Family Dwellings	Miscellaneous	612.1
ASSE/IAPMO 12010-2018	Biological Pathogens Professional Qualifications Standard for Construction and Maintenance Personnel	Professional Qualifications	1303.9
ASSE/IAPMO 12030-2018	Waterborne Pathogens Professional Qualifications Standard for Construction and Maintenance Personnel	Professional Qualifications	1303.9
ASSE/IAPMO 12040-2018	Professional Qualifications Standard for Construction and Maintenance Personnel for Contamination/Infection Prevention Procedures to Protect Facility Occupants and Operations	Professional Qualifications	1303.9
ASSE Z359.1-2016	The Fall Protection Code	Miscellaneous	508.2.1.1
ASTM A53/A53M-2018	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless	Piping	Table 604.1, Table 701.2, 1208.6.3.1(1)
ASTM A74-2017	Cast Iron Soil Pipe and Fittings	Piping	301.2.4, Table 701.2
ASTM A106/A106M-2018	Seamless Carbon Steel Pipe for High-Temperature Service	Piping	1208.6.3.1(2)
ASTM A254/A254M-2012	Copper-Brazed Steel Tubing	Piping	1208.6.4.2
ASTM A268/A268M-2010 (R2016)	Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service	Piping	1208.6.4.1(1)
ASTM A269/A269M-2015a	Seamless and Welded Austenitic Stainless Steel Tubing for General Service	Piping	Table 604.1, 1208.6.4.1(2), 1319.1(2)(a)
ASTM A312/A312M-2018a	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes	Piping	Table 604.1, 1208.6.3.1(3), 1319.1(2)(b), 1319.1(2)(c)
ASTM A403/A403M-2018a	Wrought Austenitic Stainless Steel Piping Fittings	Fittings	1319.1(2)(c)
ASTM A554-2016	Welded Stainless Steel Mechanical Tubing	Piping	Table 604.1
ASTM A778-2016	Welded, Unannealed Austenitic Stainless Steel Tubular Products	Piping	Table 604.1
ASTM A861-2004 (R2017)	High-Silicon Iron Pipe and Fittings	Piping	811.2
ASTM A888-2018a	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications	Piping	301.2.4, Table 701.2, Table 707.2
ASTM A1056-2012 (R2017)	Cast Iron Couplings used for Joining Hubless Cast Iron Soil Pipe and Fittings	Fittings	705.2.2
ASTM B32-2008 (R2014)	Solder Metal	Joints	605.1.4, 705.3.3
ASTM B42-2015a	Seamless Copper Pipe, Standard Sizes	Piping	Table 604.1
ASTM B43-2015	Seamless Red Brass Pipe, Standard Sizes	Piping	Table 604.1, Table 701.2
ASTM B75/B75M-2011	Seamless Copper Tube	Piping	Table 604.1, Table 701.2
ASTM B88-2016	Seamless Copper Water Tube	Piping	Table 604.1, 604.4, 903.2.3, 1208.6.4.3, 1319.1(1)(a)
ASTM B135/B135M-2017	Seamless Brass Tube	Piping	Table 604.1
ASTM B152/B152M-2013	Copper Sheet, Strip, Plate, and Rolled Bar	Miscellaneous	408.7.4

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
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STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
ASTM B210-2012	Aluminum and Aluminum-Alloy Drawn Seamless Tubes	Piping	1208.6.4.4
ASTM B241/B241M-2016	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube	Piping	1208.6.3.3, 1208.6.4.4
ASTM B251/B251M-2017	General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	Piping	Table 604.1, Table 701.2
ASTM B280-2018	Seamless Copper Tube for Air Conditioning and Refrigeration Field Service	Piping	1208.6.4.3, 1319.1(1)(b)
ASTM B302-2017	Threadless Copper Pipe, Standard Sizes	Piping	Table 604.1, Table 701.2
ASTM B306-2013	Copper Drainage Tube (DWV)	Piping	Table 701.2, 903.2.3
ASTM B447-2012a	Welded Copper Tube	Piping	Table 604.1
ASTM B813-2016	Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube	Joints	605.1.4, 705.3.3
ASTM B819-2018	Seamless Copper Tube for Medical Gas Systems	Piping	1318.4, 1318.5, 1319.1(1)(c), 1319.1.1
ASTM B828-2016	Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings	Joints	605.1.4, 705.3.3
ASTM C4-2004 (R2018)	Clay Drain Tile and Perforated Clay Drain Tile	Piping	Table 1101.4.6
ASTM C425-2004 (R2018)	Compression Joints for Vitrified Clay Pipe and Fittings	Joints	705.8.1
ASTM C564-2014	Rubber Gaskets for Cast Iron Soil Pipe and Fittings	Joints	705.2.2
ASTM C700-2018	Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated	Piping	Table 701.2, Table 1101.4.6
ASTM C1053-2000 (R2015)	Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications	Piping	811.2
ASTM C1173-2018	Flexible Transition Couplings for Underground Piping Systems	Fittings	705.10
ASTM C1277-2018	Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings	Fixtures	301.2.4, 705.2.2
ASTM C1460-2017	Shielded Transition Couplings for Use With Dissimilar DWV Pipe and Fittings Above Ground	Joints	705.10
ASTM C1461-2008 (R2017)	Mechanical Couplings Using Thermoplastic Elastomeric (TPE) Gaskets for Joining Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems for Above and Below Ground Use	Joints	705.10
ASTM C1540-2018	Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings	Joints	705.2.2
ASTM C1563-2008 (R2017)	Gaskets for Use in Connection with Hub and Spigot Cast Iron Soil Pipe and Fittings for Sanitary Drain, Waste, Vent, and Storm Piping Applications	Joints	705.2.2
ASTM C1822-2015	Insulating Covers on Accessible Lavatory Piping	Miscellaneous	403.3
ASTM D1785-2015[e1]	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120	Piping	Table 604.1, Table 701.2
ASTM D2235-2004(R2016)	Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings	Joints	705.1.2
ASTM D2239-2012a	Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter	Piping	Table 604.1
ASTM D2241-2015	Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)	Piping	Table 604.1
ASTM D2464-2015	Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80	Fittings	Table 604.1

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
Where more than one standard has been listed for the same material or method, the relevant portions of all such standards shall apply.

STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
ASTM D2466-2017	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40	Fittings	Table 604.1
ASTM D2467-2015	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80	Fittings	Table 604.1
ASTM D2513-2018a	Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings	Piping	1208.6.5, 1208.6.7.2, 1208.6.11.2, 1210.1.7.1(1)
ASTM D2564-2012 (R2018)	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems	Joints	605.12.2, 705.6.2
ASTM D2609-2015	Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe	Fittings	Table 604.1
ASTM D2661-2014[e1]	Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings	Piping	Table 701.2, Table 707.2
ASTM D2665-2014	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings	Piping	Table 701.2, Table 707.2
ASTM D2680-2001 (R2014)	Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping	Piping	Table 701.2
ASTM D2683-2014	Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing	Fittings	Table 604.1
ASTM D2729-2017	Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	Piping	Table 701.2, Table 1101.4.6
ASTM D2737-2012a	Polyethylene (PE) Plastic Tubing	Piping, Plastic	Table 604.1
ASTM D2846/D2846M-2019	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems	Piping	Table 604.1, 605.2.2, 605.3.1
ASTM D3034-2016	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	Piping, Plastic	Table 701.2
ASTM D3035-2015	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	Piping	Table 604.1
ASTM D3138-2004 (R2016)	Solvent Cement for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Non-Pressure Piping Components	Joints	705.9.4
ASTM D3139-1998 (R2011)	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals	Joints	605.12.1
ASTM D3212-2007 (R2013)	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals	Joints	705.1.1, 705.6.1
ASTM D3261-2016	Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing	Fittings	Table 604.1
ASTM D4068-2017	Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane	Miscellaneous	408.7.2
ASTM D4551-2017	Poly (Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane	Miscellaneous	408.7.1
ASTM E84-2018b	Surface Burning Characteristics of Building Materials	Miscellaneous	701.2(2), 903.1(2), 1101.4
ASTM E119-2018c[e1]	Fire Tests of Building Construction and Materials	Miscellaneous	1404.3, 1405.3
ASTM E814-2013a (R2017)	Fire Tests of Penetration Firestop Systems	Miscellaneous	1404.3, 1405.3
ASTM F409-2017	Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings	Piping, Plastic	404.1
ASTM F437-2015	Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	Fittings	Table 604.1
ASTM F438-2017	Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40	Fittings	Table 604.1
ASTM F439-2013	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	Fittings	Table 604.1

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
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STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
ASTM F441/F441M-2015	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80	Piping	Table 604.1
ASTM F442/F442M-2013[e1]	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)	Piping	Table 604.1, 605.2.2
ASTM F493-2014	Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings	Joints	605.2.2, 605.3.1
ASTM F628-2012[e3]	Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core	Piping	Table 701.2
ASTM F656-2015	Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings	Joints	605.2.2, 605.3.1, 605.12.2, 705.6.2
ASTM F667/F667M-2016	3 through 24 in. Corrugated Polyethylene Pipe and Fittings	Piping, Plastic	Table 1101.4.6
ASTM F714-2013	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter	Piping	Table 701.2
ASTM F794-2003 (R2014)	Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter	Piping	Table 701.2
ASTM F876-2017	Crosslinked Polyethylene (PEX) Tubing	Piping	Table 604.1, 605.9.1
ASTM F877-2018a	Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems	Piping	Table 604.1
ASTM F891-2016	Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core	Piping	Table 701.2
ASTM F894-2013	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe	Piping, Plastic	Table 701.2
ASTM F1055-2016a	Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing	Fittings	Table 604.1, 705.5.1.2
ASTM F1216-2016	Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube	Piping	715.3
ASTM F1281-2017	Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe	Piping	Table 604.1
ASTM F1282-2017	Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe	Piping	Table 604.1
ASTM F1336-2015	Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings	Fittings	Table 701.2
ASTM F1412-2016	Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems	Piping	811.2
ASTM F1488-2014 (R2019)	Coextruded Composite Pipe	Piping	Table 701.2
ASTM F1673-2010 (R2016)	Polyvinylidene Fluoride (PVDF) Corrosive Waste Drainage Systems	Piping	811.2
ASTM F1760-2016	Coextruded Poly(Vinyl Chloride) PVC Non-Pressure Plastic Pipe Having Reprocessed Recycled Content	Piping	Table 701.2
ASTM F1807-2018a	Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing	Fittings	Table 604.1
ASTM F1866-2018	Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings	Fittings	Table 701.2
ASTM F1960-2018a	Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing	Fittings	Table 604.1
ASTM F1970-2012[e1]	Special Engineered Fittings, Appurtenances or Valves for Use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems	Piping	Table 604.1, 606.1

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
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STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
ASTM F1973-2013 (R2018)	Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems	Fuel Gas	1210.1.7.1(2)
ASTM F1974-2009 (R2015)	Metal Insert Fittings for Polyethylene/ Aluminum/Polyethylene and Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene Composite Pressure Pipe	Fittings	Table 604.1, 605.7.1, 605.10.1
ASTM F1986-2001 (R2011)	Multilayer Pipe Type 2, Compression Fittings, and Compression Joints for Hot and Cold Drinking-Water Systems	Fittings	Table 604.1
ASTM F2080-2018	Cold-Expansion Fittings with Metal Compression-Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR9 Polyethylene of Raised Temperature (PE-RT) Pipe	Fittings	Table 604.1
ASTM F2098-2015	Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing to Metal Insert and Plastic Insert Fittings	Fittings	Table 604.1
ASTM F2159-2018a	Plastic Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing	Fittings	Table 604.1
ASTM F2389-2017a	Pressure-Rated Polypropylene (PP) Piping Systems	Piping	Table 604.1, 605.11.1, 606.1
ASTM F2434-2018	Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Tubing	Fittings	Table 604.1, 605.10.1
ASTM F2509-2015	Field-Assembled Anodeless Riser Kits for Use on Outside Diameter Controlled Polyethylene and Polyamide-11 (PA11) Gas Distribution Pipe and Tubing	Fuel Gas	1210.1.7.1(3)
ASTM F2561-2017	Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner	Piping	715.3
ASTM F2599-2016	The Sectional Repair of Damaged Pipe by Means of an Inverted Cured-In-Place Liner	Piping	715.3
ASTM F2618-2015	Chlorinated Poly(Vinyl Chloride) CPVC Pipe and Fittings for Chemical Waste Drainage Systems	Piping	811.2
ASTM F2620-2013	Heat Fusion Joining of Polyethylene Pipe and Fittings	Joints	605.6.1.1, 605.6.1.3, 705.5.1.1, 705.5.1.3
ASTM F2735-2018	Plastic Insert Fittings for SDR9 Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing	Fittings	Table 604.1
ASTM F2769-2018	Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems	Piping, Fittings	Table 604.1
ASTM F2831-2012 (R2017)	Internal Non-Structural Epoxy Barrier Coating Material Used in Rehabilitation of Metallic Pressurized Piping Systems	Miscellaneous	320.1
ASTM F2855-2012	Chlorinated Poly (Vinyl Chloride)/Aluminum/Chlorinated Poly (Vinyl Chloride) (CPVC/AL/CPVC) Composite Pressure Tubing	Piping	Table 604.1, 605.3.1
ASTM F2945-2018	Polyamide 11 Gas Pressure Pipe, Tubing, and Fittings	Piping	1208.6.5
ASTM F3226/F3226M-2016[e1]	Metallic Press-Connect Fittings for Piping and Tubing Systems	Fittings	Table 604.1
ASTM F3240-2017	Installation of Seamless Molded Hydrophilic Gaskets (SMHG) for Long-Term Watertightness of Cured-in-Place Rehabilitation of Main and Lateral Pipelines	Piping	715.3
AWS A5.8M/A5.8-2011-AMD 1	Filler Metals for Brazing and Braze Welding	Joints	605.1.1, 705.3.1, 1321.3

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
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STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
AWS A5.9/A5.9M-2017 (ISO 14343:2009 MOD)	Welding Consumables—Wire Electrodes, Strip Electrodes, Wires, and Rods for Arc Welding of Stainless and Heat Resisting Steels—Classification	Joints	605.13.2
AWS B2.2/B2.2M-2016	Brazing Procedure and Performance Qualification	Certification	1323.11
AWWA C110-2012	Ductile-Iron and Gray-Iron Fittings	Fittings	Table 604.1
AWWA C111-2017	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings	Joints	605.4.1, 605.4.2
AWWA C151-2017	Ductile-Iron Pipe, Centrifugally Cast	Piping	Table 604.1
AWWA C153-2011	Ductile-Iron Compact Fittings	Fittings	Table 604.1
AWWA C210-2015	Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings	Miscellaneous	604.9
AWWA C500-2009	Metal-Seated Gate Valves for Water Supply Service	Valves	606.1
AWWA C504-2015	Rubber-Seated Butterfly Valves	Valves	606.1
AWWA C507-2015	Ball Valves, 6 in. through 60 in. (150 mm through 1,500 mm)	Valves	606.1
AWWA C510-2017	Double Check-Valve Backflow Prevention Assembly	Backflow Protection	Table 603.2
AWWA C511-2017	Reduced-Pressure Principle Backflow Prevention Assembly	Backflow Protection	Table 603.2
AWWA C900-2016	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100 mm through 300 mm)	Piping	Table 604.1
AWWA C901-2017	Polyethylene (PE) Pressure Pipe and Tubing, ¾ in. (19 mm) through 3 in. (76 mm), for Water Service	Piping	Table 604.1
AWWA C904-2016	Crosslinked Polyethylene (PEX) Pressure Tubing, ½ in. through 3 in. (13 mm through 76 mm), for Water Service	Piping	Table 604.1
AWWA C907-2017	Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in. through 12 in. (100 mm through 300 mm), for Water, Wastewater, and Reclaimed Water Service	Fittings	Table 604.1
CGA G-4.1-2009	Cleaning Equipment for Oxygen Service	Miscellaneous	1318.2, 1321.8.7
CGA M-1-2018	Medical Gas Supply Systems at Health Care Facilities	Miscellaneous	1324.5.7.3
CGA V-5-2008 (R2013)	Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)	Connections	1315.5
CISPI 301-2017	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications	Piping, Ferrous	301.2.4, Table 701.2, Table 707.2
CISPI 310-2017	Couplings for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications	Joints	301.2.4, 705.2.2
CSA B45.5-2017/IAPMO Z124-2017	Plastic Plumbing Fixtures (with Errata dated August 2017)	Fixtures	407.1, 408.1, 409.1, 411.1, 412.1, 420.1
CSA B45.8-2018/IAPMO Z403-2018	Terrazzo, Concrete, Composite Stone, and Natural Stone Plumbing Fixtures	Fixtures	407.1, 420.1
CSA B45.11-2017/IAPMO Z401-2017	Glass Plumbing Fixtures	Fixtures	407.1
CSA B45.12-2013/IAPMO Z402-2013	Aluminum and Copper Plumbing Fixtures	Fixtures	407.1, 408.1, 409.1, 420.1
CSA B64.1.1-2011 (R2016)	Atmospheric Vacuum Breakers (AVB)	Backflow Protection	Table 603.2
CSA B64.1.2-2011 (R2016)	Pressure Vacuum Breakers (PVB)	Backflow Protection	Table 603.2
CSA B64.2.1.1-2011 (R2016)	Hose Connection Dual Check Vacuum Breakers (HCDVB)	Backflow Protection	Table 603.2
CSA B64.4-2011 (R2016)	Reduced Pressure Principle (RP) Backflow Preventers	Backflow Protection	Table 603.2

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
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STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
CSA B64.4.1-2011 (R2016)	Reduced Pressure Principle Backflow Preventers for Fire Protection Systems (RPF)	Backflow Protection	Table 603.2
CSA B64.5-2011 (R2016)	Double Check Valve (DCVA) Backflow Preventers	Backflow Protection	Table 603.2
CSA B64.5.1-2011 (R2016)	Double Check Valve Backflow Preventers for Fire Protection Systems (DCVAF)	Backflow Protection	Table 603.2
CSA B79-2008 (R2018)	Commercial and Residential Drains and Cleanouts	Fixtures	418.1,Table 707.2
CSA B125.3-2018	Plumbing Fittings	Fittings	408.3.2(3), 409.4(1), 410.3(1)
CSA B125.5/IAPMO Z600-2011 (R2016)	Flexible Water Connectors with Excess Flow Shut-off Device	Miscellaneous	604.5
CSA B137.1-2017	Polyethylene (PE) Pipe, Tubing, and Fittings for Cold-Water Pressure Services	Piping	Table 604.1
CSA B137.5-2017	Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications	Piping	Table 604.1
CSA B137.6-2017	Chlorinated Polyvinylchloride (CPVC) Pipe, Tubing, and Fittings for Hot- and Cold-Water Distribution Systems	Piping, Fittings	Table 604.1
CSA B137.9-2017	Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure-Pipe Systems	Piping	Table 604.1
CSA B137.10-2017	Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Composite Pressure-Pipe Systems	Piping	Table 604.1
CSA B137.11-2017	Polypropylene (PP-R) Pipe and Fittings for Pressure Applications	Piping	Table 604.1, 605.11.1
CSA B137.18-2017	Polyethylene of Raised Temperature Resistance (PE-RT) Tubing Systems for Pressure Applications	Piping, Fittings	Table 604.1
CSA B181.3-2018	Polyolefin and Polyvinylidene Fluoride (PVDF) Laboratory Drainage Systems	Piping	811.2
CSA B481-2012 (R2017)	Grease Interceptors	Fixtures	1014.1
CSA LC 1-2018	Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (same as CSA 6.26)	Fuel Gas	1208.6.4.5, 1210.4.1(4), 1211.3
CSA LC 4a-2013 (R2017)	Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems (same as CSA 6.32a)	Fuel Gas	1208.6.10.1, 1208.6.10.2, 1208.6.10.3, 1210.4.1(3)
CSA Z21.10.1-2017	Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less (same as CSA 4.1)	Fuel Gas, Appliances	Table 501.1(1)
CSA Z21.10.3-2017	Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous (same as CSA 4.3)	Fuel Gas, Appliances	Table 501.1(1)
CSA Z21.22-2015	Relief Valves for Hot Water Supply Systems (same as CSA 4.4)	Valves	607.5, 608.7
CSA Z21.24-2015	Connectors for Gas Appliances (same as CSA 6.10)	Fuel Gas	1212.1(3), 1212.2
CSA Z21.41-2014	Quick-Disconnect Devices for Use with Gas Fuel Appliances (same as CSA 6.9)	Fuel Gas	1212.7
CSA Z21.54-2014	Gas Hose Connectors for Portable Outdoor Gas-Fired Appliances (same as CSA 8.4)	Fuel Gas	1212.3.2
CSA Z21.69-2015	Connectors for Moveable Gas Appliances (same as CSA 6.16)	Fuel Gas	1212.1.1
CSA Z21.75-2016	Connectors for Outdoor Gas Appliances and Manufactured Homes (same as CSA 6.27)	Fuel Gas	1212.1(4)
CSA Z21.80a-2012	Line Pressure Regulators (same as CSA 6.22a)	Fuel Gas	1208.8.1, 1208.8.4(1)

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
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STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
CSA Z21.90-2015	Gas Convenience Outlets and Optional Enclosures (same as CSA 6.24)	Fuel Gas	1212.8
CSA Z21.93-2017	Excess Flow Valves for Natural Gas and Propane Gas with Pressures up to 5 psig (same as CSA 6.30)	Fuel Gas	1209.1
DOE-STD-3020-2015	HEPA Filters Used by DOE Contractors	Miscellaneous	1312.4(3)
EPA/625/R-04/108-2004	Guidelines for Water Reuse	Miscellaneous	1501.7
IAPMO IGC 78-2018	Drain, Waste and Vent (DWV) Internal Cleanout Fittings	DWV Components	Table 707.2
IAPMO IGC 115-2013[e1]	Automatic Water Leak Detection Devices	Miscellaneous	606.9
IAPMO IGC 127-2018	Combined Hand-Washing Systems	Fixtures	407.1, 420.1
IAPMO IGC 154-2019	Shower and Tub/Shower Enclosures, Bathtubs with Glass Pressure-Sealed Doors, and Shower/Steam Panels	Fixtures	408.1
IAPMO IGC 224-2018	ABS, PVC and Cast Iron DWV Test Fitting with Integral Cleanout	DWV Components	Table 707.2
IAPMO IGC 322-2018	Alkaline Water – Drinking Water Treatment Units	Miscellaneous	611.1.1
IAPMO IGC 349-2018	Electronic Plumbing Supply System Integrity Protection Devices	Miscellaneous	606.9
IAPMO IGC 352-2018	Diverter Valves for Diversion of Rainwater or Storm Water for Use in Alternate Nonpotable Water Source Systems	Valves	1503.2.4
IAPMO PS 59-2016a[e1]	Wastewater Diverter Valves and Diversion Systems	Fittings	1503.2.2
IAPMO PS 65-2002	Airgap Units for Water Conditioning Equipment Installation	Backflow Protection	611.2
IAPMO PS 90-2014	Elastomeric Test Caps, Cleanout Caps, and Combination Test Caps/Shielded Couplings	DWV Components	Table 707.2
IAPMO PS 117-2017	Press and Nail Connections	Fittings	Table 604.1
IAPMO Z124.5-2013[e1]	Plastic Toilet Seats	Appurtenance	411.3
IAPMO Z601-2018	Scale Reduction Devices	Water Conditioning, Water Treatment	611.1.2
IAPMO Z1001-2016	Prefabricated Gravity Grease Interceptors	Fixtures	1014.3.4
IAPMO Z1033-2015	Flexible PVC Hoses and Tubing for Pools, Hot Tubs, Spas, and Jetted Bathtubs	Tubing	409.6.1
IAPMO Z1088-2013	Pre-Pressurized Water Expansion Tanks	Miscellaneous	608.3
IAPMO Z1157-2014e1	Ball Valves	Valves	606.1
ICC A117.1-2017	Accessible and Usable Buildings and Facilities	Miscellaneous	403.2, 408.6
ISEA Z358.1-2014	Emergency Eyewash and Shower Equipment	Miscellaneous	416.1, 416.2
MSS SP-58-2018	Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation	Miscellaneous	1210.3.5, 1323.4.1
MSS SP-67-2017	Butterfly Valves	Valves	606.1
MSS SP-70-2011	Gray Iron Gate Valves, Flanged and Threaded Ends	Valves	606.1
MSS SP-71-2018	Gray Iron Swing Check Valves, Flanged and Threaded Ends	Valves	606.1
MSS SP-72-2010a	Ball Valves with Flanged or Butt-Welding Ends for General Service	Valves	606.1
MSS SP-78-2011	Gray Iron Plug Valves, Flanged and Threaded Ends	Valves	606.1
MSS SP-80-2013	Bronze Gate, Globe, Angle, and Check Valves	Valves	606.1
MSS SP-110-2010	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	Valves	606.1
MSS SP-122-2017	Plastic Industrial Ball Valves	Valves	606.1
NFPA 13D-2019	Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes	Miscellaneous	612.1, 612.5.3.1

TABLE 1701.1 (continued)
STANDARDS FOR MATERIALS, EQUIPMENT, JOINTS AND CONNECTIONS
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STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
NFPA 30A-2018	Motor Fuel Dispensing Facilities and Repair Garages	Miscellaneous	507.14.2
NFPA 31-2016	Installation of Oil-Burning Equipment	Fuel Gas, Appliances	505.3, 1201.1
NFPA 51-2018	Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes	Fuel Gas	507.9
NFPA 54/Z223.1-2018	National Fuel Gas Code	Fuel Gas	Chapter 5, Chapter 12
NFPA 58-2017	Liquefied Petroleum Gas Code	Fuel Gas	1208.5(7), 1208.6.7.3, 1208.6.11.4, 1212.11
NFPA 70-2017	National Electrical Code	Miscellaneous	1210.12.5(2), 1211.2.4, 1211.7, 1317.1(11), 1323.3.1
NFPA 88A-2019	Parking Structures	Miscellaneous	507.14.1
NFPA 99-2018	Health Care Facilities Code	Miscellaneous	1301.3, 1309.13(2), 1317.1(9), 1324.5.9.4, 1327.1
NFPA 211-2019	Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances	Fuel Gas, Appliances	509.5.2, 509.5.3, 509.5.6.1, 509.5.6.3
NFPA 409-2016	Aircraft Hangars	Miscellaneous	507.15
NFPA 780-2017	Installation of Lightning Protection Systems	Fuel Gas	1211.5
NFPA 1192-2018	Recreational Vehicles	Fuel Gas	1202.3(18)
NSF 3-2017	Commercial Warewashing Equipment	Appliances	414.1
NSF 14-2018	Plastics Piping System Components and Related Materials	Miscellaneous	301.2.3, 604.1
NSF 42-2018	Drinking Water Treatment Units – Aesthetic Effects	Appliances	Table 611.1
NSF 44-2018	Residential Cation Exchange Water Softeners	Appliances	Table 611.1
NSF 53-2017	Drinking Water Treatment Units-Health Effects	Appliances	Table 611.1
NSF 55-2018	Ultraviolet Microbiological Water Treatment Systems	Appliances	Table 611.1
NSF 58-2017	Reverse Osmosis Drinking Water Treatment Systems	Appliances	611.2, Table 611.1
NSF 61-2018	Drinking Water System Components – Health Effects	Miscellaneous	415.1, 417.1, 604.1, 604.9, 606.1, 607.2, 608.2, 609.8.2, Table 611.1
NSF 62-2018	Drinking Water Distillation Systems	Appliances	Table 611.1
NSF 350-2017a	Onsite Residential and Commercial Water Reuse Treatment Systems	Miscellaneous	1501.7, 1506.7
NSF 359-2018	Valves for Crosslinked Polyethylene (PEX) Water Distribution Tubing Systems	Valves	606.1
PDI G-101-2017	Testing and Rating Procedure for Hydro Mechanical Grease Interceptors with Appendix of Installation and Maintenance	DWV Components	1014.1
PDI G-102-2010	Testing and Certification for Grease Interceptors with FOG Sensing and Alarm Devices	Certification	1014.1
PDI-WH 201-2017	Water Hammer Arresters	Water Supply Components	609.11
UL 17-2008	Vent or Chimney Connector Dampers for Oil-Fired Appliances (with revisions through September 25, 2013)	Fuel Gas, Vent Dampers	509.14.1
UL 103-2010	Factory-Built Chimneys for Residential Type and Building Heating Appliances (with revisions through March 15, 2017)	Fuel Gas, Appliances	509.5.1, 509.5.1.1
UL 174-2004	Household Electric Storage Tank Water Heaters (with revisions through December 15, 2016)	Appliances	Table 501.1(1)

[W] TABLE 1701.1 (continued)
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STANDARD NUMBER	STANDARD TITLE	APPLICATION	REFERENCED SECTION
UL 263-2011	Fire Tests of Building Construction and Materials (with revisions through March 2, 2018)	Miscellaneous	1404.3, 1405.3
UL 378-2006	Draft Equipment (with revisions through September 17, 2013)	Fuel Gas, Appliances	509.3.3, 509.14.1
UL 399-2017	Drinking Water Coolers (with revisions through August 29, 2018)	Fixtures	415.1
UL 430-2015	Waste Disposers (with revisions through February 23, 2018)	Appliances	419.1
UL 441-2016	Gas Vents (with revisions through July 27, 2016)	Fuel Gas, Vents	509.1
UL 467-2013	Grounding and Bonding Equipment	Miscellaneous	1211.2.5
UL 499-2014	Electric Heating Appliances (with revisions through February 23, 2017)	Appliances	417.6, Table 501.1(1)
UL 641-2010	Type L Low-Temperature Venting Systems (with revisions through April 23, 2018)	Fuel Gas	509.1
UL 651-2011	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings (with revisions through June 15, 2016)	Piping	1208.6.6
UL 723-2018	Test for Surface Burning Characteristics of Building Materials	Miscellaneous	701.2(2), 903.1(2), 1101.4
UL 732-2018	Oil-Fired Storage Tank Water Heaters (with revisions through August 9, 2018)	Fuel Gas, Appliances	Table 501.1(1)
UL 749-2018	Household Dishwashers	Appliances	414.1
UL 778-2016	Motor-Operated Water Pumps (with revisions through January 17, 2019)	Appliances	1101.14
UL 921-2016	Commercial Dishwashers (with revisions through September 20, 2017)	Appliances	414.1
UL 959-2010	Medium Heat Appliance Factory-Built Chimneys (with revisions through June 12, 2014)	Fuel Gas, Appliances	509.5.1
UL 1453-2016	Electric Booster and Commercial Storage Tank Water Heaters (with revisions through May 18, 2018)	Appliances	Table 501.1(1)
UL 1479-2015	Fire Tests of Penetration Firestops	Miscellaneous	1404.3, 1405.3
UL 1738-2010	Venting Systems for Gas-Burning Appliances, Categories II, III, and IV (with revisions through November 7, 2014)	Fuel Gas, Appliances	509.4.1, 509.4.2, 509.4.3
UL 1777-2015	Chimney Liners	Chimney Liners	509.5.3(2)
UL 2523-2009	Solid Fuel-Fired Hydronic Heating Appliances, Water Heaters, and Boilers (with revisions through March 16, 2018)	Fuel Gas, Appliances	Table 501.1(1)
UL 2561-2016	1400 Degree Fahrenheit Factory-Built Chimneys (with revisions through April 19, 2018)	Fuel Gas, Appliances	509.5.1
WAC 246-290-490	Washington State Department of Health Cross-Connection Control Requirements	Backflow Protection	603.1, 602

1701.2 Standards, Publications, Practices, and Guides. The standards, publications, practices, and guides listed in Table 1701.2 are not referenced in other sections of this code. The application of the referenced standards, publications, practices, and guides shall be as specified in Section 301.2.2. The promulgating agency acronyms are found at the end of the tables.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
AHAM FWD-1-2016	Food Waste Disposers	Appliances
ASCE 25-2016	Earthquake-Actuated Automatic Gas Shutoff Devices	Fuel Gas
ASHRAE/IES 90.1-2016	Energy Standard for Buildings Except Low-Rise Residential Buildings	Miscellaneous
ASHRAE/IES 90.2-2018	Energy-Efficient Design of Low-Rise Residential Buildings	Miscellaneous
ASHRAE 188-2018	Legionellosis: Risk Management for Building Water Systems	Risk Management
ASHRAE Guideline 12-2000	Minimizing the Risk of Legionellosis Associated with Building Water Systems	Risk Management
ASME A13.1-2015	Scheme for the Identification of Piping Systems	Piping
ASME A112.4.3-1999 (R2015)	Plastic Fittings for Connecting Water Closets to the Sanitary Drainage System	Fittings
ASME A112.19.10-2017	Retrofit Dual Flush Devices for Water Closets	Fixtures
ASME A112.21.3M-1985 (R2017)	Hydrants for Utility and Maintenance Use	Valves
ASME B1.20.3-1976 (R2018)	Dryseal Pipe Threads (Inch)	Joints
ASME B16.33-2012 (R2017)	Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 175 psi (Sizes NPS ½ through NPS 2)	Valves
ASME B16.39-2014	Malleable Iron Threaded Pipe Unions: Classes 150, 250 and 300	Fittings
ASME B16.40-2013	Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems	Valves
ASME B31.1-2018	Power Piping	Piping
ASME B36.19M-2018	Stainless Steel Pipe	Piping, Ferrous
ASME BPVC Section IV-2015	Rules for Construction of Heating Boilers	Miscellaneous
ASSE 1017-2009	Temperature Actuated Mixing Valves for Hot Water Distribution Systems	Valves
ASSE 1032-2004 (R2011)	Dual Check Valve Type Backflow Preventers for Carbonated Beverage Dispensers, Post Mix Type	Backflow Protection
ASSE 1066-1997	Individual Pressure Balancing In-Line Valves for Individual Fixture Fittings	Valves
ASSE 1082-2018	Water Heaters with Integral Temperature Control Devices for Hot Water Distribution Systems	Appliances
ASTM A48/A48M-2003 (R2016)	Gray Iron Castings	Piping, Ferrous
ASTM A126-2004 (R2014)	Gray Iron Castings for Valves, Flanges, and Pipe Fittings	Piping, Ferrous
ASTM A377-2018	Ductile Iron Pressure Pipe	Piping, Ferrous
ASTM A479/A479M-2018	Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels	Piping, Ferrous
ASTM A536-1984 (R2014)	Ductile Iron Castings	Piping, Ferrous
ASTM A733-2016	Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples	Piping, Ferrous
ASTM A1045-2010 (R2017)	Flexible Poly (Vinyl Chloride) (PVC) Gaskets used in Connection of Vitreous China Plumbing Fixtures to Sanitary Drainage Systems	Piping, Plastic
ASTM B29-2014	Refined Lead	Joints
ASTM B370-2012	Copper Sheet and Strip for Building Construction	Miscellaneous
ASTM B687-1999 (R2016)	Brass, Copper, and Chromium-Plated Pipe Nipples	Piping, Copper Alloy
ASTM C14-2015a	Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe	Piping, Non-Metallic

TABLE 1701.2 (continued)
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
ASTM C412-2015	Concrete Drain Tile	Piping, Non-Metallic
ASTM C443-2012 (R2017)	Joints for Concrete Pipe and Manholes, Using Rubber Gaskets	Joints
ASTM C444-2017	Perforated Concrete Pipe	Piping, Non-Metallic
ASTM C478-2018	Circular Precast Reinforced Concrete Manhole Sections	Miscellaneous
ASTM C1227-2013	Precast Concrete Septic Tanks	DWV Components
ASTM C1440-2017	Thermoplastic Elastomeric (TPE) Gasket Materials for Drain, Waste, and Vent (DWV), Sewer, Sanitary and Storm Plumbing Systems	Joints
ASTM D1784-2011	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds	Piping, Plastic
ASTM D2321-2018	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications	Piping, Plastic
ASTM D2517-2018	Reinforced Epoxy Resin Gas Pressure Pipe and Fittings	Piping, Plastic
ASTM D2657-2007 (R2015)	Heat Fusion Joining of Polyolefin Pipe and Fittings	Joints
ASTM D2774-2012	Underground Installation of Thermoplastic Pressure Piping	Piping, Plastic
ASTM D2855-2015	Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets	Joints
ASTM D3122-2015	Solvent Cement for Styrene-Rubber (SR) Plastic Pipe and Fittings	Joints
ASTM D3311-2017	Drain, Waste, and Vent (DWV) Plastic Fittings Patterns	Fittings
ASTM F402-2018	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings	Joints
ASTM F480-2014	Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80	Piping, Plastic
ASTM F810-2012 (R2018)	Smoothwall Polyethylene (PE) Pipe for Use in Drainage and Waste Disposal Absorption Fields	Piping, Plastic
ASTM F949-2015	Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings	Piping, Plastic
ASTM F1476-2007 (R2013)	Performance of Gasketed Mechanical Couplings for Use in Piping Applications	Joints
ASTM F1499-2017	Coextruded Composite Drain, Waste, and Vent Pipe (DWV)	Piping, Plastic
ASTM F1743-2017	Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)	Piping, Plastic
ASTM F1924-2012	Plastic Mechanical Fittings for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing	Fittings
ASTM F1948-2015	Metallic Mechanical Fittings for Use on Outside Diameter Controlled Thermoplastic Gas Distribution Pipe and Tubing	Fittings
ASTM F2165-2013	Flexible Pre-Insulated Piping	Piping, Plastic
ASTM F2206-2014	Fabricated Fittings of Butt-Fused Polyethylene (PE)	DWV Components
ASTM F2306/F2306M-2018	12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications	Piping, Plastic
AWS B2.4-2012	Welding Procedure and Performance Qualification for Thermoplastics	Joints, Certification
AWWA C203-2015	Coal-Tar Protective Coatings and Linings for Steel Water Pipe	Miscellaneous
AWWA C213-2015	Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings	Miscellaneous
AWWA C215-2016	Extruded Polyolefin Coatings for Steel Water Pipe	Miscellaneous
AWWA C606-2015	Grooved and Shouldered Joints	Joints
CGA C-9-2013	Standard Color Marking of Compressed Gas Containers for Medical Use	Miscellaneous
CGA S-1.3-2008	Pressure Relief Device Standards-Part 3-Stationary Storage Containers for Compressed Gases	Fuel Gas
CGA V-1-2013	Compressed Gas Cylinder Valve Outlet and Inlet Connections	Valves
CSA A257-2014	Concrete Pipe and Manhole Sections	Piping

TABLE 1701.2 (continued)
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
CSA B55.2-2015	Drain Water Heat Recovery Units	Miscellaneous
CSA B64.7-2011 (R2016)	Laboratory Faucet Vacuum Breakers (LFVB)	Backflow Protection
CSA B66-2016	Design, Material, and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks	DWV Components
CSA B128.1-2006/B128.2-2006 (R2016)	Design and Installation of Non-Potable Water Systems/Maintenance and Field Testing of Non-Potable Water Systems	Miscellaneous
CSA B242-2005 (R2016)	Groove- and Shoulder-Type Mechanical Pipe Couplings	Fittings
CSA B356-2010 (R2015)	Water Pressure Reducing Valves for Domestic Water Supply Systems	Valves
CSA G401-2014	Corrugated Steel Pipe Products	Piping, Ferrous
CSA Z21.12b-1994 (R2015)	Draft Hoods	Fuel Gas, Appliances
CSA Z21.13-2017	Gas-Fired Low-Pressure Steam and Hot Water Boilers (same as CSA 4.9)	Fuel Gas, Appliances
CSA Z21.15b-2013 (R2014)	Manually Operated Gas Valves for Appliances, Appliance Connector Valves, and Hose End Valves (same as CSA 9.1b)	Fuel Gas
CSA Z21.81a-2007 (R2015)	Cylinder Connection Devices (same as CSA 6.25a)	Fuel Gas
CSA Z21.86-2016	Vented Gas-Fired Space Heating Appliances (same as CSA 2.32)	Fuel Gas, Appliances
CSA Z83.11-2016	Gas Food Service Equipment (same as CSA 1.8)	Fuel Gas, Appliances
CSA Z317.1-2016	Special Requirements for Plumbing Installations in Health Care Facilities	Miscellaneous
Energy Star-2012 (version 2.0)	Program Requirements Product Specification for Commercial Dishwashers	Appliances
Energy Star-2018 (version 8.0)	Program Requirements Product specification for Clothes Washers (effective February 5, 2018)	Appliances
Energy Star-2016 (version 6.0)	Program Requirements for Residential Dishwashers	Appliances
EPA/600/R-12/618-2012	Guidelines for Water Reuse	Miscellaneous
EPA WaterSense-2007	High-Efficiency Lavatory Faucet Specification	Fixtures
EPA WaterSense-2009	Specification for Flushing Urinals	Fixtures
EPA WaterSense-2014	Specification for Tank-Type Toilets	Fixtures
IAPMO IGC 67-2014[e1]	Specialized ABS and PVC DWV Fittings	DWV Components
IAPMO IGC 109-2017	Water Distribution Manifolds	Valves
IAPMO IGC 183-2016	Oil/Water Separators and Coalescing Plate Separators	DWV Components
IAPMO IGC 193-2010	Safety Plates, Plate Straps, Notched Plates and Safety Collars	Miscellaneous
IAPMO IGC 226-2006a	Drinking Water Fountains With or Without Chiller or Heater	Fixtures
IAPMO IGC 244-2015a	Tub and Shower Flow-Reduction Systems	Valves
IAPMO IGC 267-2015[e1]	Hydrants Without Integral Backflow Preventers	Valves
IAPMO IGC 276-2011	Bundled Expanded Polystyrene Synthetic Aggregate Units	DWV Components
IAPMO IGC 315-2016	Water Manifold Systems	Fittings
IAPMO IGC 327-2016	Flexible Metallic Expansion Joints for Pressure Systems	Joints
IAPMO IGC 330-2017	Recirculating Shower Systems	Fixtures
IAPMO IGC 332-2017a	Hydronic Radiators	Miscellaneous
IAPMO PS 1-2007	Tank Risers	DWV Components
IAPMO PS 23-2006a	Dishwasher Drain Airgaps	Backflow Protection
IAPMO PS 25-2002	Metallic Fittings for Joining Polyethylene Pipe for Water Service and Yard Piping	Joints
IAPMO PS 34-2003	Encasement Sleeve for Potable Water Pipe and Tubing	Piping

TABLE 1701.2 (continued)
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
IAPMO PS 36-2014el	Lead-Free Sealing Compounds for Threaded Joints	Joints
IAPMO PS 37-1990	Black Plastic PVC or PE Pressure-Sensitive Corrosion Preventive Tape	Miscellaneous
IAPMO PS 42-2013e1	Pipe Alignment and Secondary Support Systems	Miscellaneous
IAPMO PS 50-2010	Flush Valves with Dual Flush Device for Water Closets or Water Closet Tank with an Integral Flush Valves with a Dual Flush Device	Fixtures
IAPMO PS 51-2016	Expansion Joints and Flexible Expansion Joints for DWV Piping Systems	Joints
IAPMO PS 52-2009e1	Pump/Dose, Sumps and Sewage Ejector Tanks with or without a Pump	DWV Components
IAPMO PS 53-2016a	Grooved Mechanical Pipe Couplings and Grooved Fittings	Joints
IAPMO PS 54-2015	Metallic and Plastic Utility Boxes	Miscellaneous
IAPMO PS 57-2002	PVC Hydraulically Actuated Diaphragm Type Water Control Valves	Valves
IAPMO PS 63-2014	Plastic Leaching Chambers	DWV Components
IAPMO PS 64-2012ae1	Roof Pipe Flashings	Miscellaneous
IAPMO PS 66-2015	Dielectric Fittings	Fittings
IAPMO PS 67-2010	Early-Closure Replacement Flappers or Early-Closure Replacement Flapper with Mechanical Assemblies	Fixtures
IAPMO PS 69-2006	Bathwaste and Overflow Assemblies with Tub Filler Spout	DWV Components
IAPMO PS 72-2007e1	Valves with Atmospheric Vacuum Breakers	Valves
IAPMO PS 73-2015	Dental Liquid-Ring Vacuum Pumps	Miscellaneous
IAPMO PS 76-2012a	Trap Primers for Fill Valves and Flushometer Valves	DWV Components
IAPMO PS 79-2005	Multiport Electronic Trap Primer	DWV Components
IAPMO PS 80-2008	Clarifiers	DWV Components
IAPMO PS 81-2006	Precast Concrete Seepage Pit Liners and Covers	DWV Components
IAPMO PS 82-1995	Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Fittings	Fittings
IAPMO PS 85-1995	Tools for Mechanically Formed Tee Connections in Copper Tubing	Miscellaneous
IAPMO PS 86-1995	Rainwater Diverter Valve for Non-Roofed Area Slabs	DWV Components
IAPMO PS 89-1995	Soaking and Hydrotherapy (Whirlpool) Bathtubs with Hydraulic Seatlift	Fixtures
IAPMO PS 90-2014	Elastomeric Test Caps, Cleanout Caps, and Combination Test Caps/Shielded Couplings	DWV Components
IAPMO PS 91-2005a	Plastic Stabilizers for Use with Plastic Closet Bends	DWV Components
IAPMO PS 92-2013e1	Heat Exchangers and Indirect Water Heaters	Miscellaneous
IAPMO PS 94-2012e1	Insulated Protectors for P-Traps, Supply Stops and Risers	Miscellaneous
IAPMO PS 95-2018e1	Pipe Support Hangers and Hooks	DWV Components
IAPMO PS 98-1996	Prefabricated Fiberglass Church Baptisteries	Fixtures
IAPMO PS 100-1996	Porous Filter Protector for Sub-Drain Weep Holes	DWV Components
IAPMO PS 101-1997	Suction Relief Valves	Valves
IAPMO PS 104-1997	Pressure Relief Connection for Dispensing Equipment	Valves
IAPMO PS 105-1997	Polyethylene Distribution Boxes	DWV Components
IAPMO PS 106-2015el	Tileable Shower Receptors and Shower Kits	Fixtures
IAPMO PS 110-2006a	PVC Cold Water Compression Fittings	Fittings
IAPMO PS 111-1999	PVC Cold Water Gripper Fittings	Fittings
IAPMO PS 112-1999	PVC Plastic Valves for Cold Water Distribution Systems Outside a Building and CPVC Plastic Valves for Hot and Cold Water Distribution Systems	Valves
IAPMO PS 113-2010	Hydraulically Powered Household Food Waste Disposers	Appliances
IAPMO PS 114-1999e1	Remote Floor Box Industrial Water Supply, Air Supply, Drainage	Miscellaneous

TABLE 1701.2 (continued)
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DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
IAPMO PS 115-2007	Hot Water On-Demand or Automatic Activated Hot Water Pumping Systems	Miscellaneous
IAPMO PS 116-1999	Hot Water Circulating Devices Which Do Not Use a Pump	Miscellaneous
IAPMO PS 119-2012a[e3]	Water-Powered Sump Pumps	Miscellaneous
IAPMO Z124.7-2013	Prefabricated Plastic Spa Shells	Fixtures, Swimming Pools, Spas, and Hot Tubs
IAPMO Z124.8-2013[e2]	Plastic Liners for Bathtubs and Shower Receptors	Fixtures
IAPMO Z1000-2013	Prefabricated Septic Tanks	DWV Components
MSS SP-25-2018	Standard Marking System for Valves, Fittings, Flanges, and Unions	Miscellaneous
MSS SP-42-2013	Corrosion-Resistant Gate, Globe, Angle, and Check Valves with Flanged and Butt Weld Ends (Classes 150, 300, & 600)	Piping, Ferrous
MSS SP-44-2016 (R2017)	Steel Pipeline Flanges	Fittings
MSS SP-83-2018	Class 3000 and 6000 Pipe Unions, Socket Welding and Threaded (Carbon Steel, Alloy Steel, Stainless Steels, and Nickel Alloys)	Joints
MSS SP-104-2018	Wrought Copper, Solder-Joint Pressure Fittings	Fittings
MSS SP-106-2012	Cast Copper Alloy Flanges and Flanged Fittings: Class 125, 150, and 300	Fittings
MSS SP-109-2018	Weld-Fabricated, Copper Solder-Joint Pressure Fittings	Fittings
MSS SP-123-2013	Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube	Joints
NFPA 13R-2019	Installation of Sprinkler Systems in Low-Rise Residential Occupancies	Miscellaneous
NFPA 80-2019	Fire Doors and Other Opening Protectives	Miscellaneous
NFPA 501A-2017	Fire Safety Criteria for Manufactured Home Installations, Sites, and Communities	Miscellaneous
NFPA 1981-2013	Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services	Miscellaneous
NFPA 1989-2019	Breathing Air Quality for Emergency Services Respiratory Protection	Miscellaneous
NFPA 5000-2018	Building Construction and Safety Code	Miscellaneous
NSF 2-2018	Food Equipment	Appliances
NSF 4-2016	Commercial Cooking, Rethermalization, and Powered Hot Food Holding and Transportation Equipment	Appliances
NSF 5-2016	Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment	Appliances
NSF 12-2018	Automatic Ice Making Equipment	Appliances
NSF 18-2016	Manual Food and Beverage Dispensing Equipment	Appliances
NSF 29-2017	Detergent and Chemical Feeders for Commercial Spray-Type Dishwashing Machines	Appliances
NSF 40-2018	Residential Wastewater Treatment Systems	DWV Components
NSF 41-2018	Non-Liquid Saturated Treatment Systems	DWV Components
NSF 46-2018	Evaluation of Components and Devices Used in Wastewater Treatment Systems	DWV Components
NSF 169-2016	Special Purpose Food Equipment and Devices	Appliances
PSAI Z4.1-2016	For Sanitation – In Places of Employment: Minimum Requirements	Miscellaneous
SAE J512-1997	Automotive Tube Fittings	Fittings
SAE J1670-2008	Type “F” Clamps for Plumbing Applications	Joints
TCNA A118.10-2014	Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation	Miscellaneous
Title 49, Code of Federal Regulations, Part 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Standards	Miscellaneous
UL 70-2001	Septic Tanks, Bituminous-Coated Metal	DWV Components
UL 80-2007	Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids (with revisions through January 16, 2014)	Fuel Gas
UL 144-2012	LP-Gas Regulators (with revisions through November 5, 2014)	Fuel Gas

TABLE 1701.2 (continued)
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

DOCUMENT NUMBER	DOCUMENT TITLE	APPLICATION
UL 252-2017	Compressed Gas Regulators (with revisions through August 10, 2018)	Fuel Gas
UL 296-2017	Oil Burners (with revisions through November 29,2017)	Fuel Gas, Appliances
UL 404-2010	Gauges, Indicating Pressure, for Compressed Gas Service (with revisions through February 11, 2015)	Fuel Gas
UL 429-2013	Electrically Operated Valves	Valves
UL 536-2014	Flexible Metallic Hose	Fuel Gas
UL 563-2009	Ice Makers (with revisions through August 30, 2018)	Appliances
UL 569-2013	Pigtails and Flexible Hose Connectors for LP-Gas (with revisions through July 28, 2017)	Fuel Gas
UL 726-1995	Oil-Fired Boiler Assemblies (with revisions through October 9, 2013)	Fuel Gas, Appliances
UL 1206-2003	Electric Commercial Clothes-Washing Equipment (with revisions through January 7, 2019)	Appliances
UL 1331-2005	Station Inlets and Outlets (with revisions through May 12, 2017)	Medical Gas
UL 1795-2016	Hydromassage Bathtubs (with revisions through December 8, 2017)	Fixtures
UL 1951-2011	Electric Plumbing Accessories (with revisions through August 25, 2017)	Miscellaneous
UL 2157-2018	Electric Clothes Washing Machines and Extractors	Appliances
WQA S-300-2000	Point-of-Use Low-Pressure Reverse Osmosis Drinking Water Systems	Appliances

ABBREVIATIONS IN TABLE 1701.1 AND TABLE 1701.2

AHAM	Association of Home Appliance Manufacturers, 1111 19th Street, NW, Suite 402, Washington, DC 20036.
ANSI	American National Standards Institute, Inc., 25 W. 43rd Street, 4th Floor, New York, NY 10036.
ARCSA	American Rainwater Catchment Systems Association, 6101 Long Prairie Road, Suite 744, PMB 251, Flower Mound, TX 75028.
ASCE	American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191-4400.
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, GA 30329-2305.
ASME	American Society of Mechanical Engineering, Two Park Avenue, New York, NY 10016-5990.
ASPE	American Society of Plumbing Engineers, 6400 Shafer Court, Suite 350, Rosemont, IL 60018.
ASSE	American Society of Sanitary Engineering, 18927 Hickory Creek Drive, Suite 220, Mokena, IL 60448.
ASTM	ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.
AWS	American Welding Society, 8669 NW 36 Street, #130 Miami, FL 33166-6672.
AWWA	American Water Works Association, 6666 W. Quincy Avenue, Denver, CO 80235.
CFR	Code of Federal Regulations, U.S Government Publishing Office, 723 North Capitol Street, N.W. Washington, DC 20401-001
CGA	Compressed Gas Association, 14501 George Carter Way, Suite 103, Chantilly, VA 20151.
CISPI	Cast-Iron Soil Pipe Institute, 2401 Fieldcrest Drive, Mundelein, IL 60060.
CSA	Canadian Standards Association, 178 Rexdale Boulevard, Toronto, Ontario, Canada, M9W 1R3.
DOE	U.S. Department of Energy, Forrestal Building, 1000 Independence Avenue, SW, Washington, DC 20585.
e1	An editorial change since the last revision or reapproval.
ENERGY STAR	1200 Pennsylvania Avenue, N.W., Washington, D.C. 20460.
EPA WATERSENSE	U.S. Environmental Protection Agency, Office of Wastewater Management (4204M), 1200 Pennsylvania Avenue, N.W., Washington, D.C. 20460.
IAPMO	International Association of Plumbing and Mechanical Officials, 4755 E. Philadelphia Street, Ontario, CA 91761.
ICC	International Code Council, 500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001.
ISEA	International Safety Equipment Association, 1901 N. Moore Street, Suite 808, Arlington, VA 22209-1762.
ISO	International Organization for Standardization, 1 ch. de la Voie-Creuse, Casa Postale 56, CH-1211 Geneva 20, Switzerland.
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, NE, Vienna, VA 22180.
NFPA	National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.
NSF	NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.
PDI	Plumbing and Drainage Institute, 800 Turnpike Street, Suite 300, North Andover, MA 01845.
PSAI	Portable Sanitation Association International, 2626 E. 82nd Street, Suite 175, Bloomington, MN 55425.
SAE	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.
TCNA	Tile Council of North America, Inc. 100 Clemson Research Blvd., Anderson, SC 29625.
UL	Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062.
WQA	Water Quality Association, 4151 Naperville Road, Lisle, IL 60532-3696.

APPENDICES

The appendices are intended to supplement the provisions of the installation requirements of this code. The definitions in Chapter 2 are also applicable to the appendices.

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Appendix M
Peak Water Demand Calculator 223

APPENDIX A

RECOMMENDED RULES FOR SIZING THE WATER SUPPLY SYSTEM

A 101.0 General.

A 101.1 Applicability. This appendix provides a general procedure for sizing a water supply system. Because of the variable conditions encountered, it is impractical to lay down definite detailed rules of procedure for determining the sizes of water supply pipes in an appendix, which shall necessarily be limited in length. For an adequate understanding of the problems involved, refer to Water-Distributing Systems for Buildings, Report BMS 79 of the National Bureau of Standards; and Plumbing Manual, Report BMS 66, also published by the National Bureau of Standards.

A 102.0 Preliminary Information.

A 102.1 Daily Service Pressure. Obtain the necessary information regarding the minimum daily service pressure in the area where the building is to be located.

A 102.2 Water Meter. Where the building supply is to be metered, obtain information regarding friction loss relative to the rate of flow of meters in the range of sizes likely to be used. Friction-loss data is capable of being obtained from most manufacturers of water meters. Friction losses for disk-type meters shall be permitted to be obtained from Chart A 102.2.

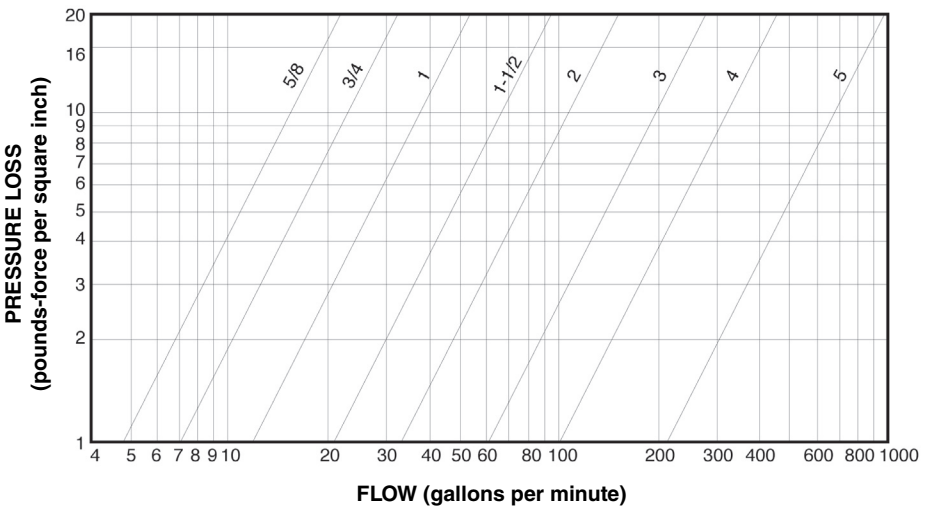
A 102.3 Local Information. Obtain available local information regarding the use of different kinds of pipe with respect both to durability and to decrease in capacity with the length of service in the particular water supply.

A 103.0 Demand Load.

A 103.1 Supply Demand. Estimate the supply demand for the building main, the principal branches and risers of the system by totaling the fixture units on each, Table A 103.1, and then by reading the corresponding ordinate from Chart A 103.1(1) or Chart A 103.1(2), whichever is applicable.

A 103.2 Continuous Supply Demand. Estimate continuous supply demands in gallons per minute (gpm) (L/s) for lawn sprinklers, air conditioners, etc., and add the sum to the total demand for fixtures. The result is the estimated supply demand of the building supply.

CHART A 102.2
FRICTION LOSSES FOR DISK-TYPE WATER METERS



For SI units: 1 inch = 25 mm, 1 pound-force per square inch = 6.8947 kPa, 1 gallon per minute = 0.06 L/s

A 104.0 Permissible Friction Loss.

A 104.1 Residual Pressure. Decide what is the desirable minimum residual pressure that shall be maintained at the highest fixture in the supply system. Where the highest group of fixtures contains flushometer valves, the residual pressure for the group shall be not less than 15 pounds-force per square inch (psi) (103 kPa). For flush tank supplies, the available residual pressure shall be not less than 8 psi (55 kPa).

A 104.2 Elevation. Determine the elevation of the highest fixture or group of fixtures above the water (street) main. Multiply this difference in elevation by 0.43. The result is the loss of static pressure in psi (kPa).

A 104.3 Available Pressure. Subtract the sum of loss in static pressure and the residual pressure to be maintained at the highest fixture from the average minimum daily service pressure. The result will be the pressure available for friction loss in the supply pipes, where no water meter is used. Where a meter is to be installed, the friction loss in the meter for the estimated maximum demand should also be subtracted from the service pressure to determine the pressure loss available for friction loss in the supply pipes.

A 104.4 Developed Length. Determine the developed length of pipe from the water (street) main to the highest fixture. Where close estimates are desired, compute with the aid of Table A 104.4(1), Table A 104.4(2), or Table A 104.4(3), whichever is applicable, the equivalent length of pipe for fittings in the line from the water (street) main to the highest fixture and add the sum to the developed length. The pressure available for friction loss in psi (kPa), divided by the developed lengths of pipe from the water (street) main to the highest fixture, times 100, will be the average permissible friction loss per 100 feet (30 480 mm) length of pipe.

A 105.0 Size of Building Supply.

A 105.1 Diameter. Knowing the permissible friction loss per 100 feet (30 480 mm) of pipe and the total demand, the diameter of the building supply pipe shall be permitted to be obtained from Chart A 105.1(1), Chart A 105.1(2), Chart A 105.1(3), Chart A 105.1(4) Chart A 105.1(5), Chart A 105.1(6), or Chart A 105.1(7), whichever is applicable. The diameter of pipe on or next above the coordinate point corresponding to the estimated total demand and the permissible friction loss will be the size needed up to the first branch from the building supply pipe.

A 105.2 Copper and Copper Alloy Piping. Where copper tubing or copper alloy pipe is to be used for the supply piping and where the character of the water is such that slight changes in the hydraulic characteristics are expected, Chart A 105.1(1) shall be permitted to be used.

A 105.3 Hard Water. Chart A 105.1(2) shall be used for ferrous pipe with the most favorable water supply in regards to corrosion and caking. Where the water is hard or corrosive, Chart A 105.1(3) or Chart A 105.1(4) will be applicable. For extremely hard water, it will be advisable to make additional allowances for the reduction of the capacity of hot-water lines in service.

A 106.0 Size of Principal Branches and Risers.

A 106.1 Size. The required size of branches and risers shall be permitted to be obtained in the same manner as the building supply, by obtaining the demand load on each branch or riser and using the permissible friction loss computed in Section A 104.0.

A 106.2 Branches. Where fixture branches to the building supply are sized for the same permissible friction loss per 100 feet (30 480 mm) of pipe as the branches and risers to the highest level in the building and lead to the inadequate water supply to the upper floor of a building, one of the following shall be provided:

(1) Selecting the sizes of pipe for the different branches so that the total friction loss in each lower branch is approximately equal to the total loss in the riser, including both friction loss and loss in static pressure.

(2) Throttling each such branch using a valve until the preceding balance is obtained.

(3) Increasing the size of the building supply and risers above the minimum required to meet the maximum permissible friction loss.

A 106.3 Water Closets. The size of branches and mains serving flushometer tanks shall be consistent with sizing procedures for flush tank water closets.

A 107.0 General.

A 107.1 Velocities. Velocities shall not exceed 10 feet per second (ft/s) (3 m/s), except as otherwise approved by the Authority Having Jurisdiction.

A 107.2 Pressure-Reducing Valves. Where a pressure-reducing valve is used in the building supply, the developed length of supply piping and the permissible friction loss shall be computed from the building side of the valve.

A 107.3 Fittings. The allowances in Table A 104.4(1) for fittings are based on non-recessed threaded fittings. For recessed threaded fittings and streamlined soldered fittings, one-half of the allowances given in the table will be ample.

TABLE A 103.1
WATER SUPPLY FIXTURE UNITS (WSFU) AND MINIMUM FIXTURE BRANCH PIPE SIZES[3]

APPLIANCES, APPURTENANCES, OR FIXTURES[2]	MINIMUM FIXTURE BRANCH PIPE SIZE[1,4] (inches)	PRIVATE	PUBLIC	ASSEMBLY[6]
Bathtub or Combination Bath/Shower (fill)	½	4.0	4.0	–
¾ inch Bathtub Fill Valve	¾	10.0	10.0	–
Bidet	½	1.0	–	–
Clothes Washer	½	4.0	4.0	–
Dental Unit, cuspidor	½	–	1.0	–
Dishwasher, domestic	½	1.5	1.5	–
Drinking Fountain or Water Cooler	½	0.5	0.5	0.75
Hose Bibb	½	2.5	2.5	–
Hose Bibb, each additional[7]	½	1.0	1.0	–
Lavatory	½	1.0	1.0	1.0
Lawn Sprinkler, each head[5]	–	1.0	1.0	–
Mobile Home, each (minimum)	–	12.0	–	–
Sinks	–	–	–	–
Bar	½	1.0	2.0	–
Clinical Faucet	½	–	3.0	–
Clinical Flushometer Valve with or without faucet	1	–	8.0	–
Kitchen, domestic	½	1.5	1.5	–
Laundry	½	1.5	1.5	–
Service or Mop Basin	½	1.5	3.0	–
Washup, each set of faucets	½	–	2.0	–
Shower per head	½	2.0	2.0	–
Urinal, 1.0 GPF Flushometer Valve	¾	3.0	4.0	5.0
Urinal, greater than 1.0 GPF Flushometer Valve	¾	4.0	5.0	6.0
Urinal, flush tank	½	2.0	2.0	3.0
Wash Fountain, circular spray	¾	–	4.0	–
Water Closet, 1.6 GPF Gravity Tank	½	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Tank	½	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Valve	1	5.0	5.0	8.0
Water Closet, greater than 1.6 GPF Gravity Tank	½	3.0	5.5	7.0
Water Closet, greater than 1.6 GPF Flushometer Valve	1	7.0	8.0	10.0

For SI units: 1 inch = 25 mm

Notes:

1 Size of the cold branch pipe, or both the hot and cold branch pipes.

2 Appliances, appurtenances, or fixtures not included in this table shall be permitted to be sized by reference to fixtures having a similar flow rate and frequency of use.

3 The listed fixture unit values represent their total load on the cold water building supply. The separate cold water and hot water fixture unit value for fixtures having both cold and hot water connections shall be permitted to be three-quarters of the listed total value of the fixture.

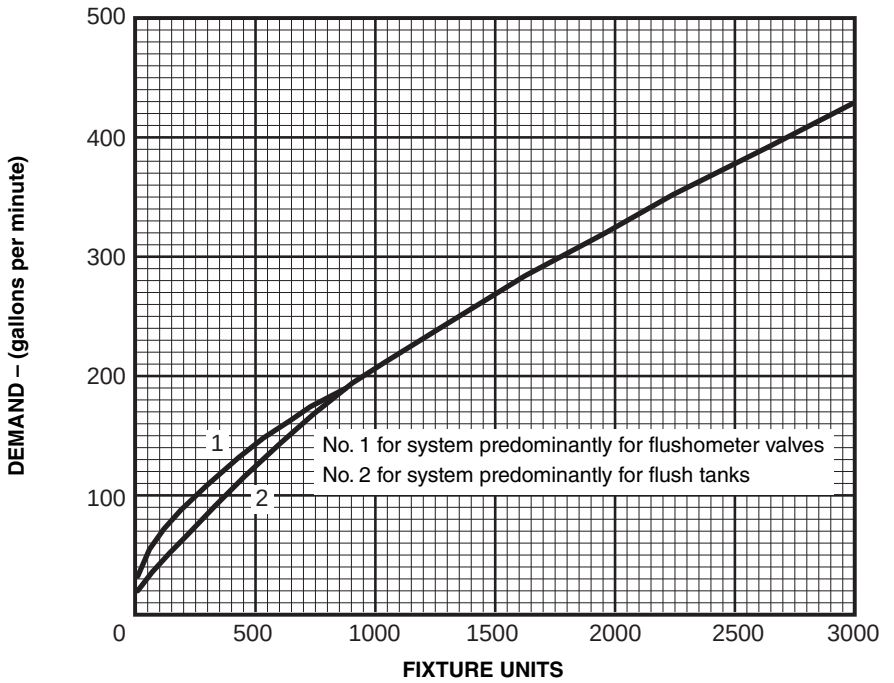
4 The listed minimum supply branch pipe sizes for individual fixtures are the nominal (I.D.) pipe size.

5 For fixtures or supply connections likely to impose continuous flow demands, determine the required flow in gallons per minute (gpm) (L/s) and add it separately to the demand in gpm (L/s) for the distribution system or portions thereof.

6 Assembly [Public Use (see Table 422.1)].

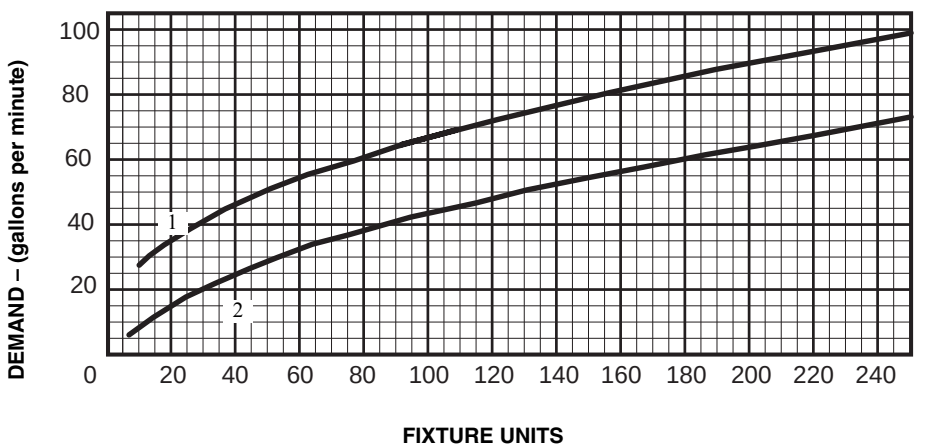
7 Reduced fixture unit loading for additional hose bibbs is to be used where sizing total building demand and for pipe sizing where more than one hose bibb is supplied by a segment of water distribution pipe. The fixture branch to each hose bibb shall be sized by 2.5 fixture units.

CHART A 103.1(1)
ESTIMATE CURVES FOR DEMAND LOAD



For SI units: 1 gallon per minute = 0.06 L/s

CHART A 103.1(2)
ENLARGED SCALE DEMAND LOAD



For SI units: 1 gallon per minute = 0.06 L/s

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TABLE A 104.4(1)
ALLOWANCE IN EQUIVALENT LENGTH OF PIPE FOR FRICTION LOSS IN VALVES AND THREADED FITTINGS*
EQUIVALENT LENGTH OF PIPE FOR VARIOUS FITTINGS

DIAMETER OF FITTING (inches)	90° STANDARD ELBOW (feet)	45° STANDARD ELBOW (feet)	90° STANDARD TEE (feet)	COUPLING OR STRAIGHT RUN OF TEE (feet)	GATE VALVE (feet)	GLOBE VALVE (feet)	ANGLE VALVE (feet)
⅜	1.0	0.6	1.5	0.3	0.2	8	4
½	2.0	1.2	3.0	0.6	0.4	15	8
¾	2.5	1.5	4.0	0.8	0.5	20	12
1	3.0	1.8	5.0	0.9	0.6	25	15
1¼	4.0	2.4	6.0	1.2	0.8	35	18
1½	5.0	3.0	7.0	1.5	1.0	45	22
2	7.0	4.0	10.0	2.0	1.3	55	28
2½	8.0	5.0	12.0	2.5	1.6	65	34
3	10.0	6.0	15.0	3.0	2.0	80	40
4	14.0	8.0	21.0	4.0	2.7	125	55
5	17.0	10.0	25.0	5.0	3.3	140	70
6	20.0	12.0	30.0	6.0	4.0	165	80

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm, 1 degree = 0.017 rad

* Allowances are based on nonrecessed threaded fittings. Use one-half the allowances for recessed threaded fittings or streamlined solder fittings.

TABLE A 104.4(2)
EQUIVALENT LENGTH OF COPPER TUBE SIZE CPVC PIPE FOR VARIOUS FITTINGS

DIAMETER OF FITTING (inches)	90 DEGREE ELBOW (feet)	45 DEGREE ELBOW (feet)	COUPLING OR STRAIGHT RUN OF TEE (feet)	90 DEGREE STANDARD TEE (feet)
½	1.6	0.8	1.0	3.1
¾	2.1	1.1	1.4	4.1
1	2.6	1.4	1.7	5.3
1¼	3.5	1.8	2.3	6.9
1½	4.0	2.1	2.7	8.1
2	5.2	2.8	3.5	10.3

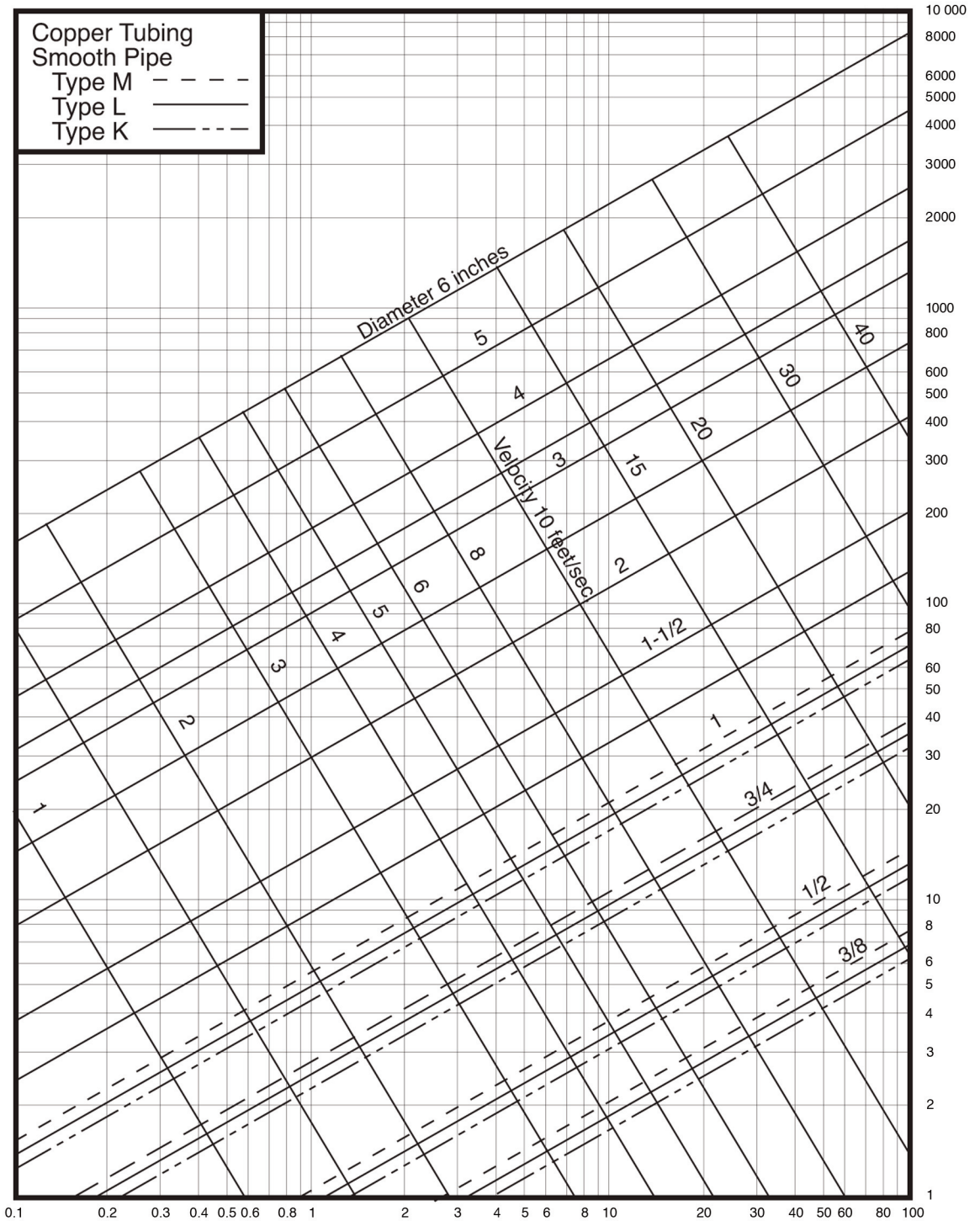
For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

TABLE A 104.4(3)
EQUIVALENT LENGTH OF SCHEDULE 40 AND 80 CPVC PIPE FOR VARIOUS FITTINGS

DIAMETER OF FITTING (inches)	90 DEGREE ELBOW (feet)	45 DEGREE ELBOW (feet)	COUPLING OR STRAIGHT RUN OF TEE (feet)	90 DEGREE STANDARD TEE (feet)
½	1.5	0.8	1.0	4.0
¾	2.0	1.1	1.4	5.0
1	2.5	1.4	1.7	6.0
1¼	3.8	1.8	2.3	7.0
1½	4.0	2.1	2.7	8.0
2	5.7	2.6	4.3	12.0

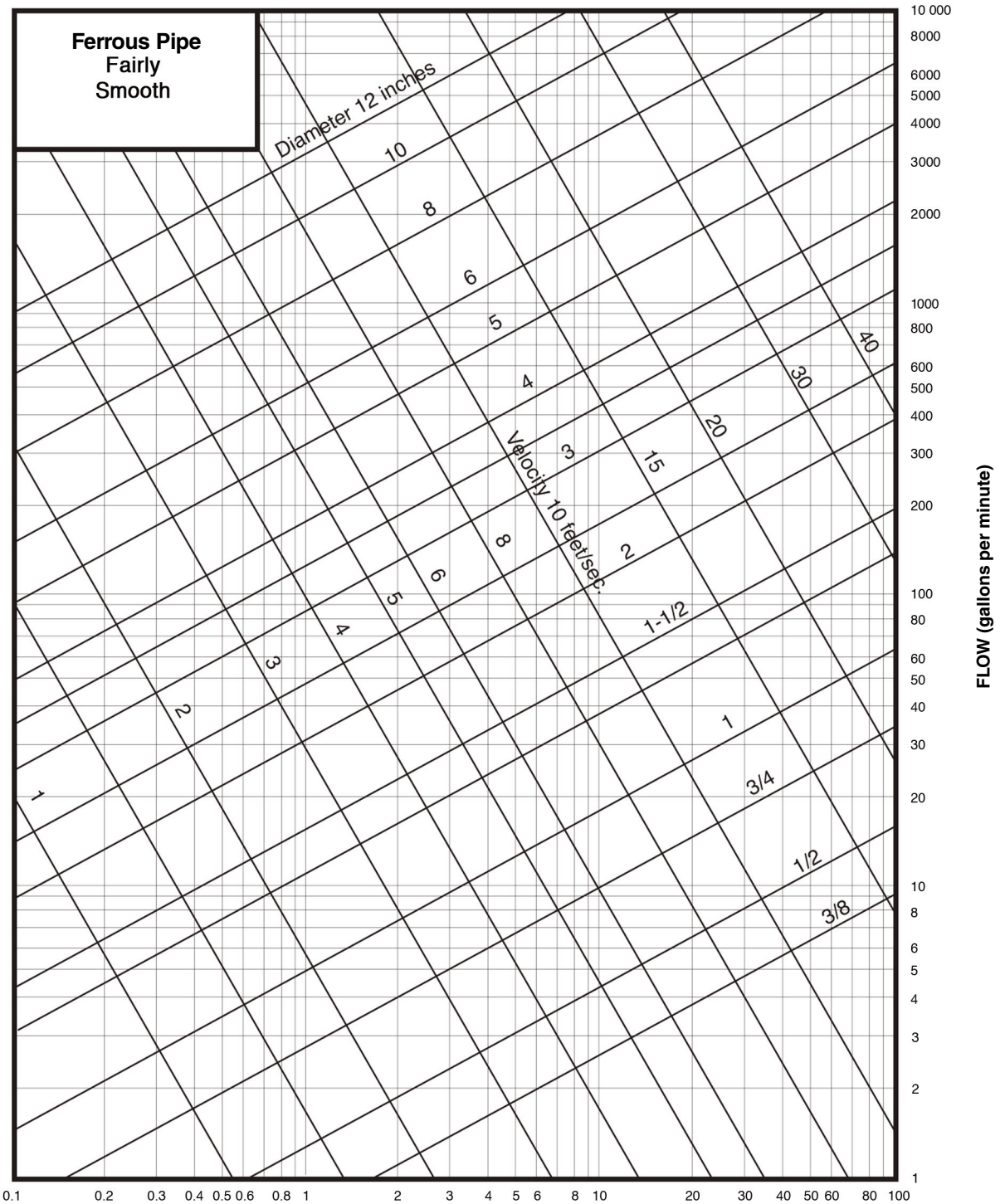
For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

CHART A 105.1(1)



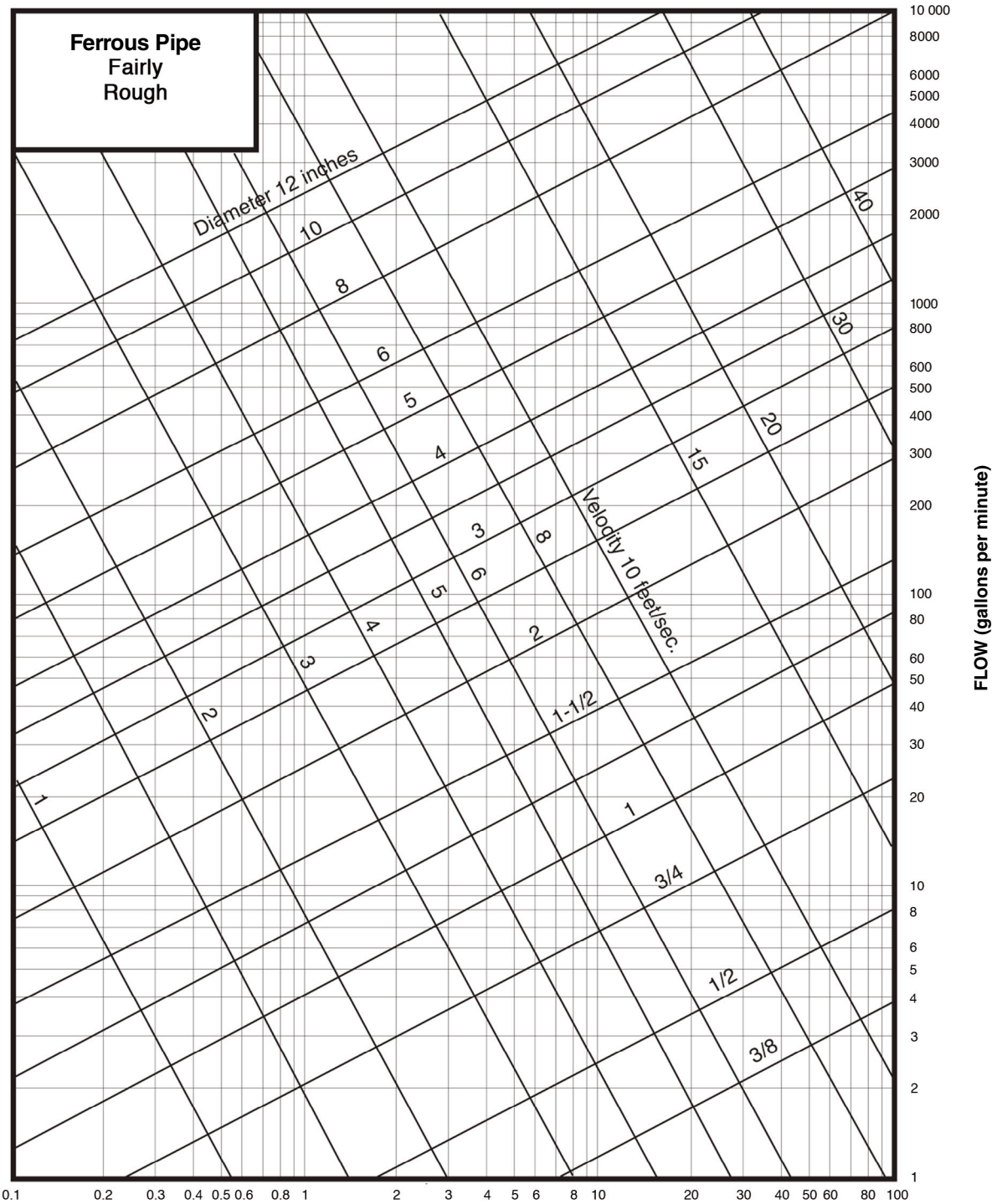
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART A 105.1(2)



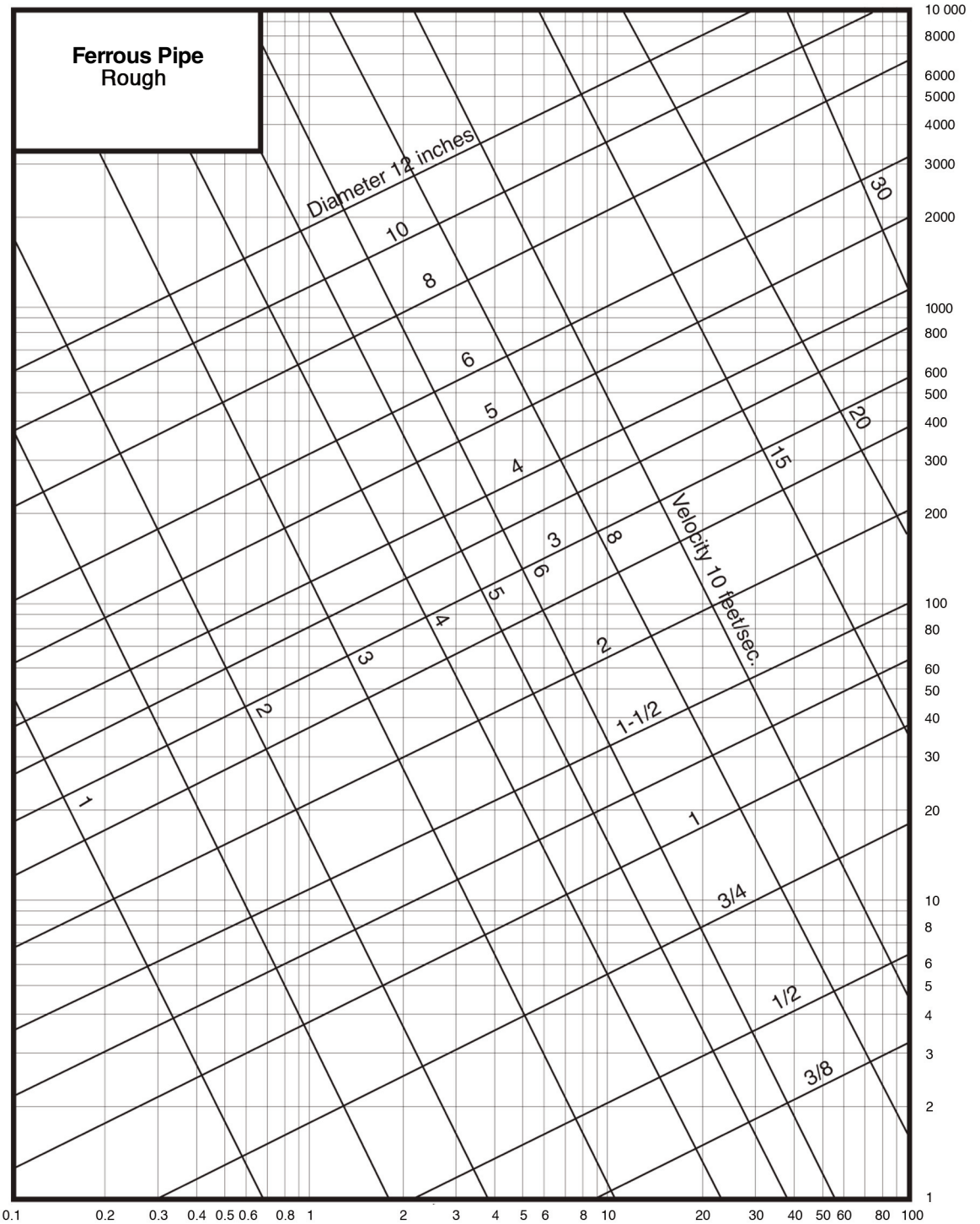
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART A 105.1(3)



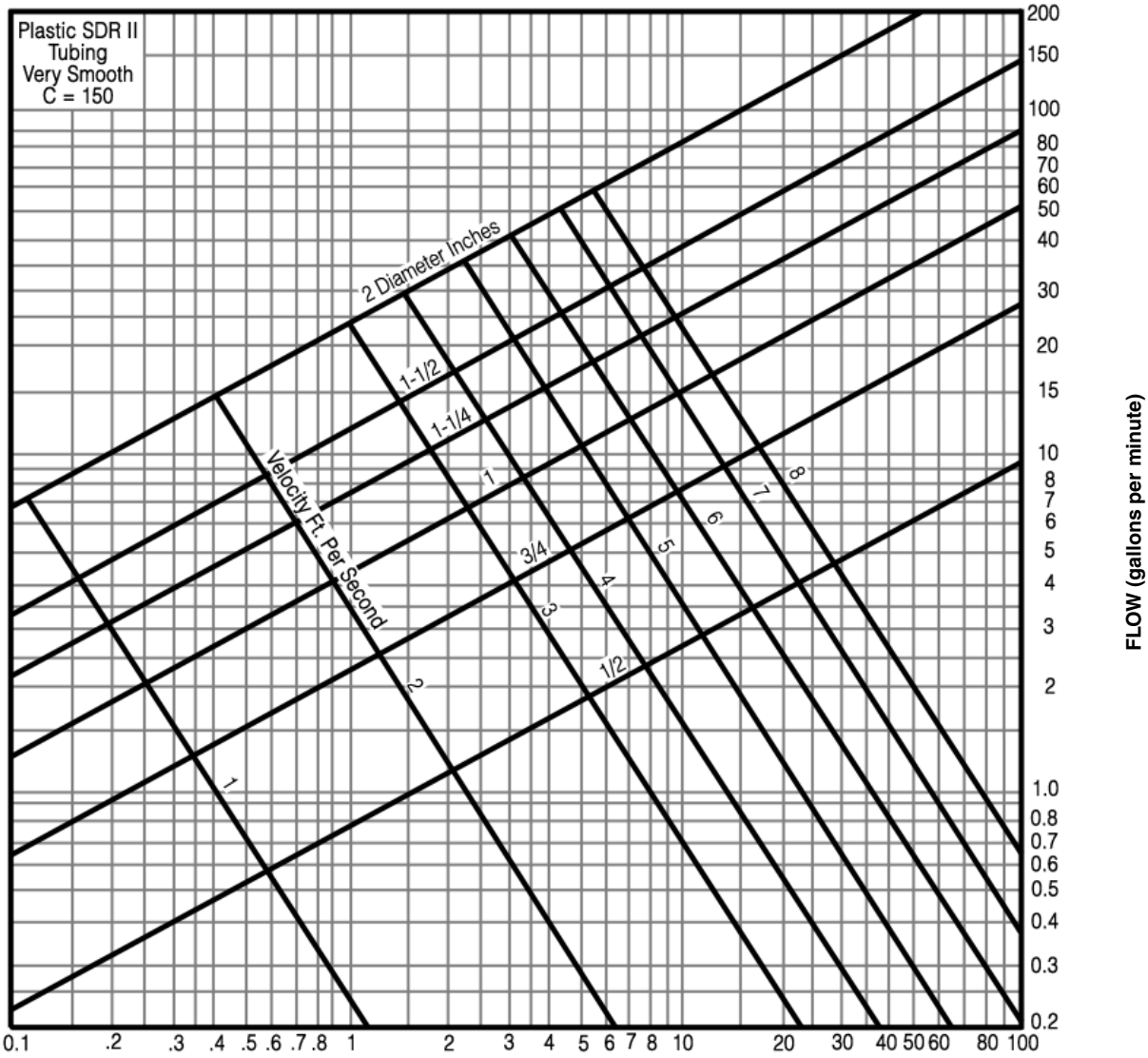
For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART A 105.1(4)



For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

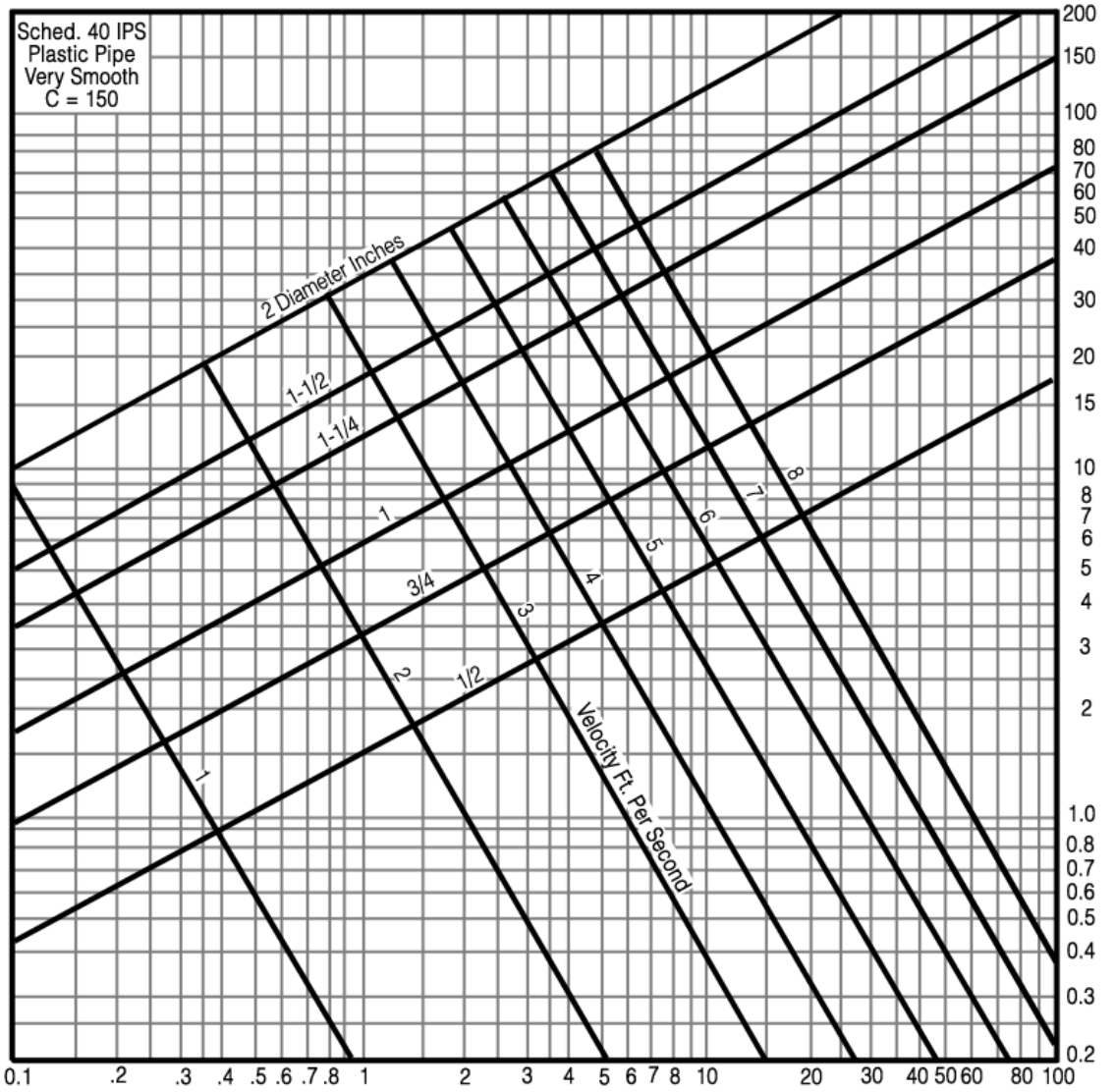
CHART A 105.1(5)



FRICTION LOSS IN HEAD (pounds-force per square inch) PER 100-FOOT LENGTH

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

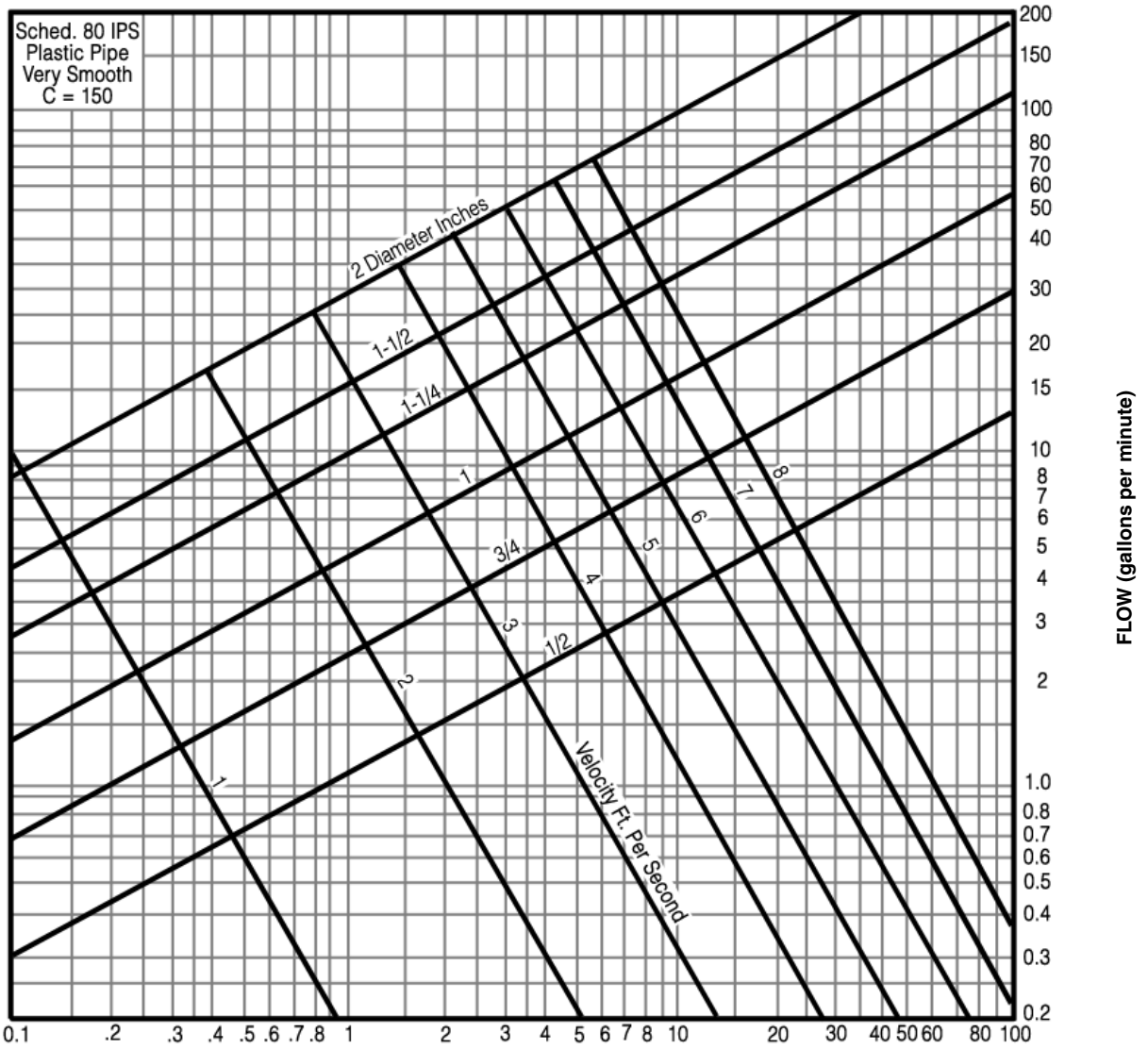
CHART A 105.1(6)



FRICTION LOSS IN HEAD (pounds-force per square inch) PER 100-FOOT LENGTH

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

CHART A 105.1(7)



FRICTION LOSS IN HEAD (pounds-force per square inch) PER 100-FOOT LENGTH

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 pound-force per square inch = 6.8947 kPa, 1 foot = 304.8 mm, 1 foot per second = 0.3048 m/s

A 108.0 Sizing.

A 108.1 Example. Assume an office building of four stories and basement; pressure on the building side of the pressure-reducing valve of 55 psi (379 kPa) (after an allowance for reduced pressure falloff at peak demand); an elevation of highest fixture above the pressure-reducing valve of 45 feet (13 716 mm); a developed length of pipe from the pressure-reducing valve to the most distant fixture of 200 feet (60 960 mm); and fixtures to be installed with flush valves for water closets and stall urinals as follows:

Where the pipe material and water supply are such that Chart A 105.1(2) applies, the required diameter of the building supply is 3½ inches (90 mm), and the required diameter of the branch to the hot-water heater is 1½ inches (40 mm).

The sizes of the various branches and risers shall be permitted to be determined in the same manner as the size of the building supply or the branch to the hot-water system, by estimating the demand for the riser or branch from Chart A 103.1(1) or Chart A 103.1(2) and applying the total demand estimate from the branch, riser, or section thereof to the appropriate flowchart.

A 108.1 EXAMPLE

FIXTURE UNITS AND ESTIMATED DEMANDS							
BUILDING SUPPLY DEMAND					BRANCH TO HOT WATER SYSTEM		
KIND OF FIXTURES	NUMBER OF FIXTURES	FIXTURE UNIT DEMAND	TOTAL UNITS	BUILDING SUPPLY DEMAND (gallons per minute)	NUMBER OF FIXTURES	FIXTURE UNIT DEMAND CALCULATION	DEMAND (gallons per minute)
Water Closets	130	8.0	1040	–	–	–	–
Urinals	30	4.0	120	–	–	–	–
Showerheads	12	2.0	24	–	12	12 x 2 x ¾ = 18	–
Lavatories	100	1.0	100	–	100	100 x 1 x ¾ = 75	–
Service Sinks	27	3.0	81	–	27	27 x 3 x ¾ = 61	–
Total	–	–	1365	252	–	154	55

For SI units: 1 gallon per minute = 0.06 L/s, 1 pound-force per square foot = 6.8947 kPa

Allowing for 15 psi (103 kPa) at the highest fixture under the maximum demand of 252 gallons per minute (15.90 L/s), the pressure available for friction loss is found by the following:

$$55 – [15 + (45 \times 0.43)] = 20.65 \text{ psi } (142.38 \text{ kPa})$$

The allowable friction loss per 100 feet (30 480 mm) of the pipe is, therefore:

$$100 \times 20.65 \div 200 = 10.32 \text{ psi } (71.15 \text{ kPa})$$

APPENDIX B

EXPLANATORY NOTES ON COMBINATION WASTE AND VENT SYSTEMS

(See Section 910.0 for specific limitations)

B 101.0 General.

B 101.1 Applicability. This appendix provides general guidelines for the design and installation of a combination waste and vent system.

B 101.2 General Requirements. Combination waste and vent systems, as outlined in Section 910.0 of this code, cover the horizontal wet venting of a series of traps using a common waste and vent pipe. Pipe sizes not less than two pipe sizes larger than those required for a conventional system are designed to maintain a wetted perimeter or flow line low enough in the waste pipe to allow adequate air movement in the upper portion, thus balancing the system. Sinks, lavatories, and other fixtures that rough in above the floor, shall not be permitted on a combination waste and vent system, which, at best, is merely an expedient designed to be used in locations where it would be structurally impractical to provide venting in a conventional manner.

Combination waste and vent systems are intended primarily for extensive floor or shower drain installations where separate venting is not practical, for floor sinks in markets, demonstration or work tables in school buildings, or for similar applications where the fixtures are not adjacent to walls or partitions. Due to its oversize characteristics, such a waste system is not self-scouring and, consequently, care shall be exercised as to the type of fixtures connected to it and the location of cleanouts. Given its grease-producing potential, restaurant kitchen equipment shall not be connected to a combination waste and vent system.

B 101.3 Caution. Caution shall be exercised to exclude appurtenances delivering large quantities or surges of water (such as pumps, sand interceptors, etc.) from combination waste and vent systems so that adequate venting will be maintained. Small fixtures with a waste-producing potential of less than 7½ gallons per minute (gpm) (0.47 L/s) shall be permitted to be safely assigned a loading value of one unit. Long runs shall be laid at the minimum permissible slope to keep tailpieces as short as possible. Tailpieces shall not exceed 2 feet (610 mm) in length, which shall necessitate slopes up to 45 degrees (0.79 rad) (see definition of horizontal pipe) on some branches.

B 101.4 Pneumatics. It is essential that the pneumatics of such a system be properly engineered, as the air pressure within the line shall at all times balance that of outside atmosphere to prevent either trap seal loss or air locking between traps. Long mains shall be provided with additional relief vents located at intervals not exceeding 100 feet (30 480 mm). Each such relief vent shall equal not less than one-half of the inside cross-sectional area of the drain pipe served.

B 101.5 Trap Sizes. Trap sizes are required to be equivalent to the branches they serve (two pipe sizes larger than normal), and tailpieces between fixtures or floor drains and such traps shall be reduced to normal size.

B 101.6 Layout Drawings. Duplicate layout drawings of each such proposed piping system shall be presented to the Authority Having Jurisdiction and approval obtained before an installation is made. Complicated layouts shall be checked by qualified personnel.

B 101.6.1 Example of Sizing. A floor drain normally requires a 2 inch (50 mm) trap and waste. On a combination waste and vent system, both trap and waste shall be increased two pipe sizes (through 2½ inches and 3 inches) (65 mm and 80 mm), which would make the trap 3 inches (80 mm). Pipe sizes recognized for this purpose are 2 inches, 2½ inches, 3 inches, 3½ inches, 4 inches, 4½ inches, 5 inches, 6 inches, etc. (50 mm, 65 mm, 80 mm, 90 mm, 100 mm, 115 mm, 125 mm, 150 mm, etc.). The tailpiece between the floor drain and its trap shall be 2 inches (50 mm) (or normal size) to ensure that the amount of wastewater entering the trap partially fills the waste branch. A 3 inch (80 mm) floor drain would thus require a 4 inch (100 mm) trap, and a 4 inch (100 mm) floor drain would require a 5 inch (125 mm) trap for the reasons previously stated.

WHERE IN DOUBT, CHECK WITH YOUR LOCAL Authority Having Jurisdiction.

"The information contained in this appendix is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this appendix may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the standard."

The following IAPMO Installation Standard is included here for the convenience of the users of the Uniform Plumbing Code. It is not considered as a part of the Uniform Plumbing Code unless formally adopted as such. This Installation Standard is an independent, stand-alone document published by the International Association of Plumbing and Mechanical Officials and is printed herein by the expressed written permission of IAPMO.

APPENDIX I

INSTALLATION STANDARD FOR PEX TUBING SYSTEMS FOR HOT- AND COLD-WATER DISTRIBUTION

IAPMO IS 31-2014

1.0 Scope.

1.1 General.

1.1.1 This Standard specifies requirements for the installation of SDR 9 CTS crosslinked polyethylene (PEX) tubing and fittings, including cold-expansion, crimp, press, and mechanical compression fittings, intended for hot- and cold-water distribution systems within buildings.

1.1.2 This Standards applies to

(a) SDR 9 CTS PEX tubing complying with ASTM F876 and pressure-rated in accordance with PPI TR-3; and

(b) PEX fitting systems complying with

(i) ASTM F877, for mechanical compression fittings and metal or plastic insert fittings with stainless steel press sleeves;

(ii) ASTM F1807 or ASTM F2159, for metal or plastic insert fittings with copper crimp rings;

(iii) ASTM F1960, for cold expansion fittings with PEX reinforced rings; or

(iv) ASTM F2080, for cold expansion fittings with metal compression sleeves.

1.2 Terminology. In this Standard,

(a) “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy to comply with the Standard;

(b) “should” is used to express a recommendation, but not a requirement;

(c) “may” is used to express an option or something permissible within the scope of the Standard; and

(d) “can” is used to express a possibility or a capability.

Notes accompanying sections of the Standard do not specify requirements or alternative requirements; their purpose is to separate explanatory or informative material from the text. Notes to tables and figures are considered part of the table or figure and can be written as requirements.

1.3 Amendments. Proposals for amendments to this Standard will be processed in accordance with the standards-writing procedures of IAPMO.

2.0 Reference Publications. This Standard refers to the following publications, and where such reference is made, it shall be to the current edition of those publications, including all amendments published thereto.

ASTM F876	Standard Specification for Crosslinked Polyethylene (PEX) Tubing
ASTM F877	Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems
ASTM F1807	Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
ASTM F1960	Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing

ASTM F2080	Standard Specification for Cold-Expansion Fittings With Metal Compression-Sleeves for Cross-Linked Polyethylene (PEX) Pipe
ASTM F2159	Standard Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
ASTM F2657	Standard Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene (PEX) Tubing
AWWA C904	Cross-Linked Polyethylene (PEX) Pressure Tubing, ½ In. (12 mm) Through 3 In. (76 mm) for Water Service
IAPMO/ANSI UPC-1	Uniform Plumbing Code
PPI TR-3	Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Tubing Materials or Tubing

3.0 Abbreviations. The following abbreviations apply in this Standard:

CTS — copper tube size
HDPE — high density polyethylene
IC — insulation contact
NTS — nominal tubing size
PEX — crosslinked polyethylene
SDR — standard dimension ratio
UV — ultraviolet light

4.0 General.

4.1 Tubing.

4.1.1 PEX tubing can be

(a) pigmented throughout (i.e., with color);
(b) non-pigmented (e.g., translucent or natural); or
(c) coated with a pigmented layer.

4.1.2 PEX tubing is typically available in NTS-1/4 to NTS-3.

4.1.3 Before installation, the installer shall review the tubing markings and verify that

(a) the standard designation(s) of the fittings to which the tube can be joined to is included in the markings;
(b) it bears a certification mark from an accredited certification organization; and
(c) pressure and temperature ratings meet or exceed that of the intended end-use.

4.2 Fittings.

4.2.1 Cold-Expansion Fittings.

Cold-expansion fittings typically

(a) are made of brass, stainless steel, or sulfone;
(b) consist of an insert and a PEX reinforcing ring; and
(c) are available in NTS-3/8 to NTS-3.

4.2.2 Crimp or Press Insert Fittings.

Crimp or press insert fittings typically

(a) are made of brass, stainless steel, or sulfone;
(b) consist of an insert and a copper crimp ring or a stainless steel press ring
(c) are available in NTS-3/8 to NTS-2.

4.2.3 Compression Fittings.

Compression (i.e., transition) fittings typically

(a) are made of brass; and
(b) consist of

(i) a nut, a compression ring, and an insert; or

(ii) an O-ring brass insert with a compression sleeve

(c) are available in NTS-¼ to NTS-3.

4.3 Installation. Only fittings systems marked on the tubing shall be used for installation with that particular tubing.

4.4 Tools. Tools and tool accessories (e.g., tool heads) used for the installation of PEX tubing systems shall be in accordance with the manufacturer's specifications and written instructions.

4.5 Tubing Protection.

4.5.1 Abrasion. PEX tubing passing through drilled or notched metal studs or metal joists, or hollow-shell masonry walls shall be protected from abrasion by elastomeric or plastic sleeves or grommets.

4.5.2 Puncture. Steel-plate protection shall be installed in accordance with the local plumbing code.

5.0 Handling.

5.1 Receiving. When receiving PEX tubing shipments, the receiver shall inspect and inventory each shipment, ensuring that there has been no loss or damage. In addition:

(a) At the time of unloading, the markings of all tubing, fittings, and accessories shall be verified to ensure that all items have been manufactured in accordance with the applicable product Standard and appropriately certified.

(b) An overall examination of the shipment shall be made. If the shipment is intact, ordinary inspection while unloading shall be sufficient to ensure that the items have arrived in good condition.

(c) If the load has shifted, has broken packaging, or shows evidence of rough treatment, each item shall be carefully inspected for damage.

(d) The total quantities of each shipment (e.g., tubing, gaskets, fittings, and accessories) shall be checked against shipping records.

(e) Any damaged or missing items shall be noted on the delivery slip. The carrier shall be notified immediately and a claim made in accordance with its instructions.

(f) No damaged material shall be disposed of. The carrier shall recommend the procedure to follow.

(g) Shortages and damaged materials are normally not reshipped without request. If replacement material is needed, it shall be reordered from the manufacturer, the distributor, or a manufacturer's representative.

5.2 Storage and UV Exposure.

5.2.1 PEX tubing and fittings shall be stored indoors and in its original packaging until the time of installation. Appropriate precautions to protect the tubing from damage, impact, and punctures shall be taken.

5.2.2 Accumulative exposure time to UV radiation during storage and installation shall not exceed the UV exposure limits recommended by the manufacturer or specified in ASTM F876.

Note: *ASTM F876 has four categories for UV-resistance, ranging from untested to 6 months of continuous exposure, as listed in the material designation code.*

5.3 Exposure to Heat.

5.3.1 PEX tubing and fittings shall not be exposed to open flames.

5.3.2 PEX tubing shall not be exposed to temperatures exceeding 93ºC (200ºF).

5.4 Exposure to Chemicals.

5.4.1 Chemical compatibility (e.g., with common construction materials) shall be verified with the manufacturer prior to direct contact.

5.4.2 In general, petroleum- or solvent-based chemicals (e.g., paints, greases, pesticides, or sealants) shall not be allowed to come in direct contact with PEX tubing or fittings.

6.0 Thermal Expansion and Contraction.

6.1 Horizontal Tubing Runs. Thermal expansion and contraction forces on suspended horizontal runs of PEX tubing that can experience a 22ºC (40ºF) or greater change in temperature (operating temperature compared to ambient temperature) shall be controlled by a means of mitigating temperature-induced stresses to other parts of the water distribution system. Means for controlling thermal expansion and contraction include

(a) loops;

(b) offsets;

(c) arms with rigid anchor points; and

(d) supporting the tubing with continuous runs of CTS support channels with

(i) rigid anchor points installed every 20 m (65 ft); and

(ii) proper strapping (e.g., 27 kg (60 lb) straps or equivalent) spaced 1 m (3 ft) and rated for the maximum temperature and UV exposure of the PEX tubing application.

6.2 Vertical Tubing Runs. Thermal expansion and contraction forces on vertical runs of PEX tubing that pass through more than one floor and can experience a 22ºC (40ºF) or greater change in temperature (operating temperature compared to ambient temperature) shall be controlled by installing

(a) a riser clamp at the top of every other floor; and

(b) mid-story guides to maintain the alignment of the vertical tubing.

Note: *Installing riser clamps isolates expansion and contraction to two-floor intervals allowing the PEX tubing to naturally compensate for the expansion and contraction.*

6.3 Clearance. Adequate clearance shall be provided between PEX tubing and the building structure (e.g., using bored holes and sleeves) to allow for free longitudinal movement of the tubing.

6.4 Expansion Arms and Expansion Loops.

6.4.1 Expansion Arms (See Figure 1).

6.4.1.1 Expansion arms shall be installed as illustrated in Figure 1.

6.4.1.2 The minimum length of expansion arms shall be calculated using the following equation:

$LB = C \times \sqrt{(D \times \Delta L)}$

where

LB = length of flexible arm

C = material constant (12 for PEX)

D = nominal outside diameter of tubing

ΔL = thermal expansion length

6.4.2 Expansion Loops (See Figure 2).

6.4.2.1 Expansion loops shall be installed at the mid-point between anchors, as illustrated in Figure 2.

6.4.2.2 The minimum length of expansion loops shall be calculated using the equation in Section 6.4.1.2; however, the distance LB shall be divided into three sections, as illustrated in Figure 2, where

$L1 = LB \div 5$; and

$L2 = L1 \times 2$

7.0 Hangers and Supports.

7.1 Vertical Tubing. Vertical PEX tubing shall

(a) be supported at each floor or as specified by the water-distribution system designer to allow for expansion and contraction; and

(b) have mid-story guides.

7.2 Horizontal Tubing. Unless otherwise authorized by the authority having jurisdiction, suspended horizontal runs of PEX tubing

(a) NTS-1 and smaller shall be supported every 0.8 m (32 in), unless continuously supported by metallic CTS or V channels that

(i) are supported at intervals not exceeding 1.8 m (6 ft);

(ii) have a maximum cantilever, measured from the support to the end of the CTS support channel, of 0.5 m (1.5 ft); and

(b) NTS-1¼ and larger shall be supported every 1.2 m (4 ft), unless continuously supported by metallic CTS or V channels that

(i) are supported at intervals not exceeding 2.4 m (8 ft); and

(ii) have a maximum cantilever, measured from the support to the end of the CTS support channel, of 0.5 m (1.5 ft).

7.3 Anchors. Anchors shall be

(a) used to restrict PEX tubing movement;

(b) made of materials that provide rigidity to the support system and utilize pipe clamps designed for plastic tubing capable of restraining the tubing; and

(c) installed in accordance with Figures 1 or 2, as applicable (i.e., anchor distances and size of arms and offsets).

Note: *Anchors are typically installed every 20 m (65 ft). See Section 6.*

8.0 Joints and Connections.

8.1 Assembly Procedure. The procedure for making joints shall be as specified by the manufacturer.

8.2 Concealed Joints. PEX tubing systems manufactured in accordance with the applicable standards referenced in Section 2 are deemed manufactured joints and may be installed in concealed spaces without the need for access panels.

9.0 Clearances.

9.1 Gas Vents. Except for double-wall B-vents, which require a 25 mm (1 in) clearance, the clearance between gas appliance vents and PEX tubing shall be at least 150 mm (6 in).

9.2 Recessed Light Fixtures. Except when the PEX tubing is protected with fiberglass or closed-cell insulation or the recessed light is IC-rated, the clearance between recessed light fixtures and PEX tubing shall be at least 300 mm (12 in).

9.3 Fluorescent Lighting. When in direct view of the light source, the clearance between fluorescent lighting and PEX tubing shall be at least 1.5 m (5 ft). If the minimum clearance cannot be achieved, the PEX tubing shall be protected with a UV-blocking sleeve.

10.0 Other Considerations.

10.1 Hot-Work Joints. Hot-work joints (e.g., soldering, brazing, welding, and fusion-welding) shall be

(a) made at least 500 mm (18 in) from PEX tubing in the same water line; and

(b) performed prior to completing the PEX joints.

10.2 Bending Radius.

10.2.1 The free (unsupported) bending radius for PEX tubing, measured at the outside of the bend, shall be not less than six times the actual outside diameter of the tubing, unless otherwise specified by the PEX manufacturer. Supports should be used to facilitate rigid bends and to alleviate stress on PEX joints when bends are needed in close proximity to such joints.

10.2.2 Tighter bends may be used when the PEX tubing is uniformly bent (supported) around a curved bracket or other rigid fixture. In this case, the minimum outside radius of the supported bend shall be as specified by the PEX manufacturer.

10.3 Directional Fittings. Directional fittings (e.g., 90º and 45º elbows) should only be installed where necessary.

Note: *The flexible nature of PEX tubing allows for sweeping bends resulting in less fittings and joints.*

10.4 Direct Burial. PEX tubing and fittings may be used in direct burial applications when allowed in the manufacturer's written installation instructions.

Note: *AWWA C904 should be consulted for water service applications.*

10.5 Fire-Resistive Construction. Manufacturer's installation instructions shall be consulted prior to installation of PEX tubing in fire resistive constructions. PEX tubing penetrating a wall or floor-and-ceiling fire-rated assembly shall include a means of passive fire protection in accordance with the local codes.

10.6 Sizing and Flow Velocities.

10.6.1 PEX tubing shall be sized in accordance with IAPMO/ANSI UPC 1.

Note: *Potable water piping sizing is addressed in Section 610.0 and Appendix A of IAPMO/ANSI UPC 1-2012.*

10.6.2 The tubing manufacturer's pressure-loss data should be referenced when using Appendix A of IAPMO/ANSI UPC 1. In absence of such data, Figures 3 and 4 shall be used.

10.6.3 Flow velocities through the water distribution system, used for calculating flush tank and flush valve fixture units depending on the tubing sizes (see Table 1), shall not exceed

(a) 3.0 m/s (10 ft/s) for cold-water distribution systems; and

(b) 2.4 m/s (8 ft/s) for hot-water distribution systems.

Note: *The flow velocities in Items (a) and (b) account for the increased velocities through the fittings.*

10.6.4 Hot-water recirculation systems shall

(a) be balanced to maintain adequate system temperatures; and

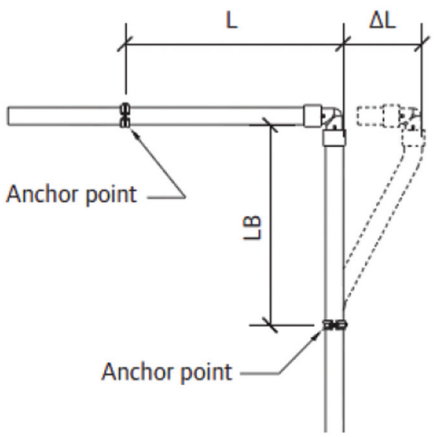
(b) have flow velocities that do not exceed 0.6 m/s (2 ft/s) (see Table 2); and

(c) use only PEX tubing designated for hot, chlorinated water recirculation systems and rated for the maximum percentage of time during which the system is intended to be operated at elevated temperatures, in accordance with ASTM F876.

10.7 Installation Testing. Installation of PEX water distribution systems may be tested with air when

(a) expressly allowed in the written instructions of the manufacturers of all plastic pipe and fittings installed at the time the PEX piping system is being tested; and

(b) compressed air or other gas testing is not prohibited by the authority having jurisdiction.



Note:

$LB = C \times \sqrt{(D \times \Delta L)}$

where

LB = *length of flexible arm*

C = *material constant (12 for PEX)*

D = *nominal outside diameter of tubing*

ΔL = *thermal expansion length*

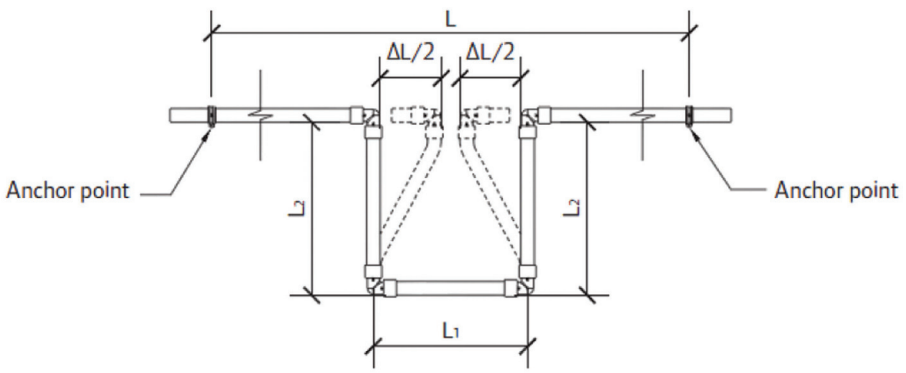
FIGURE 1
EXPANSION ARMS
(See Sections 6.4.1 and 7.3)

TABLE 1
CALCULATION OF FLUSH TANK AND FLUSH VALVE FIXTURE UNITS
(See Section 10.6.3)

NOMINAL TUBING SIZE	FLOW VELOCITY: 3.0 m/s (10 ft/s)			FLOW VELOCITY: 2.4 m/s (8 ft/s)		
	FLOW VOLUME, L/min (gpm)	FLUSH TANK FIXTURE UNITS	FLUSH VALVE FIXTURE UNITS	FLOW, L/min (gpm)	FLUSH TANK FIXTURE UNITS	FLUSH VALVE FIXTURE UNITS
½	20.8 (5.5)	6	—	16.7 (4.4)	4	—
¾	41.6 (11.0)	15	—	33.3 (8.8)	11	—
1	68.9 (18.2)	26	—	55.3 (14.6)	20	—
1¼	103.0 (27.2)	46	10	82.5 (21.8)	33	5
1½	143.5 (37.9)	77	24	114.7 (30.3)	54	13
2	246.1 (65.0)	200	91	196.8 (52.0)	135	52
3	533.0 (140.8)	590	495	426.2 (112.6)	443	310

TABLE 2
TUBING SIZES, FLOWS, AND FRICTION LOSSES FOR HOT-WATER RECIRCULATION SYSTEMS
(See Section 10.6.4)

NOMINAL TUBING SIZE	FLOW VELOCITY m/s (ft/s)	FLOW VOLUME L/min (gpm)	FRICTION LOSSES AT 49 °C (120°F) kPa/m (psi/ft)
½	0.6 (2)	4.2 (1.1)	0.4411 (0.0195)
¾	0.6 (2)	8.3 (2.2)	0.2850 (0.0126)
1	0.6 (2)	13.6 (3.6)	0.2081 (0.0092)
1¼	0.6 (2)	20.4 (5.4)	0.1629 (0.0072)
1½	0.6 (2)	28.4 (7.5)	0.1335 (0.0059)
2	0.6 (2)	48.8 (12.9)	0.0950 (0.0042)



Note:
LB shall be calculated as specified in Figure 2 and divided into three sections, as follows:
LB = L1 + (2 × L2)
where
L1 = LB ÷ 5; and
L2 = L1 × 2.

FIGURE 2
EXPANSION LOOPS
(See Sections 6.4.2 and 7.3)

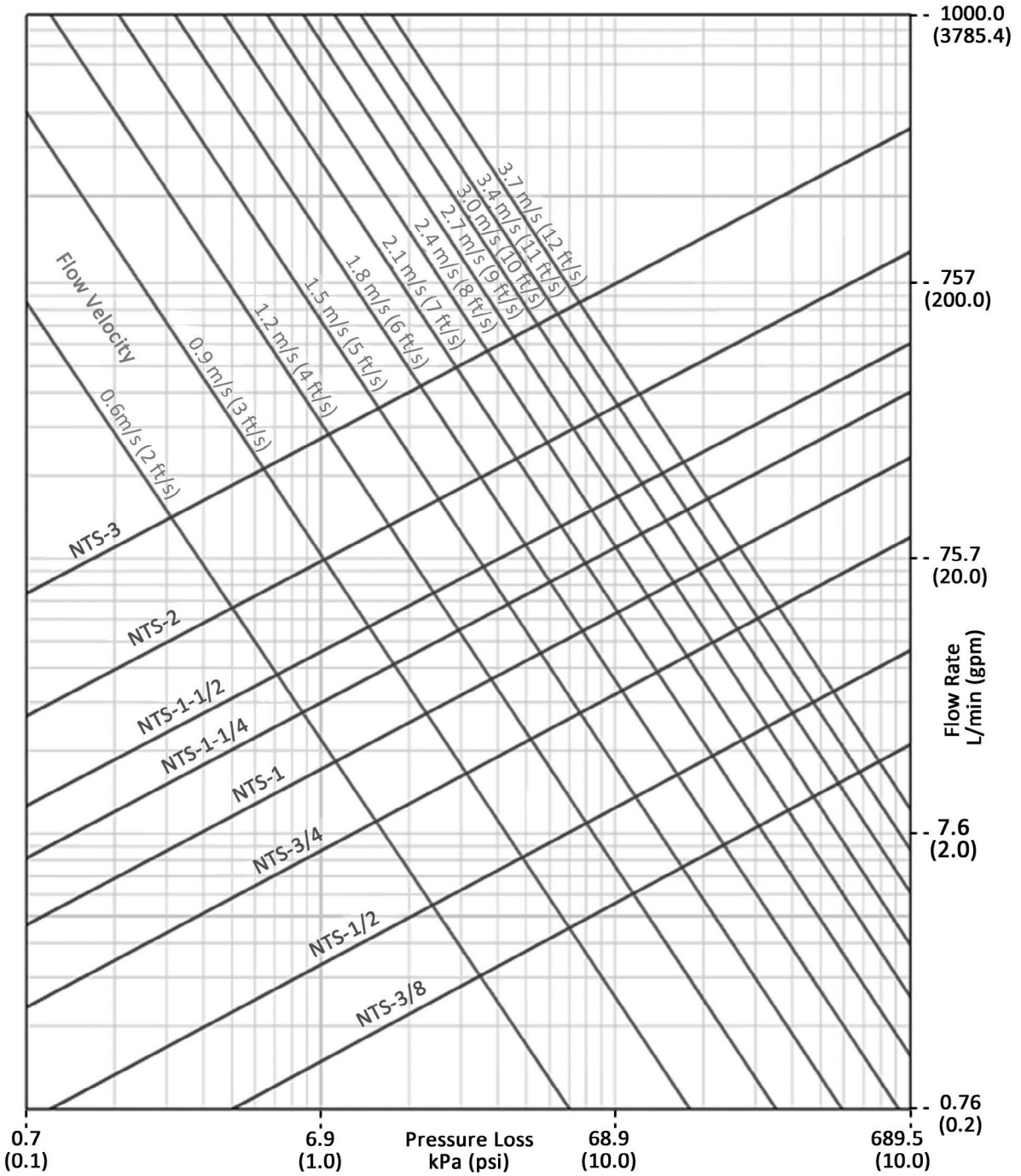


FIGURE 3
PRESSURE LOSS OF PEX TUBING AT 16 °C (60°F)
(See Section 10.6.2)

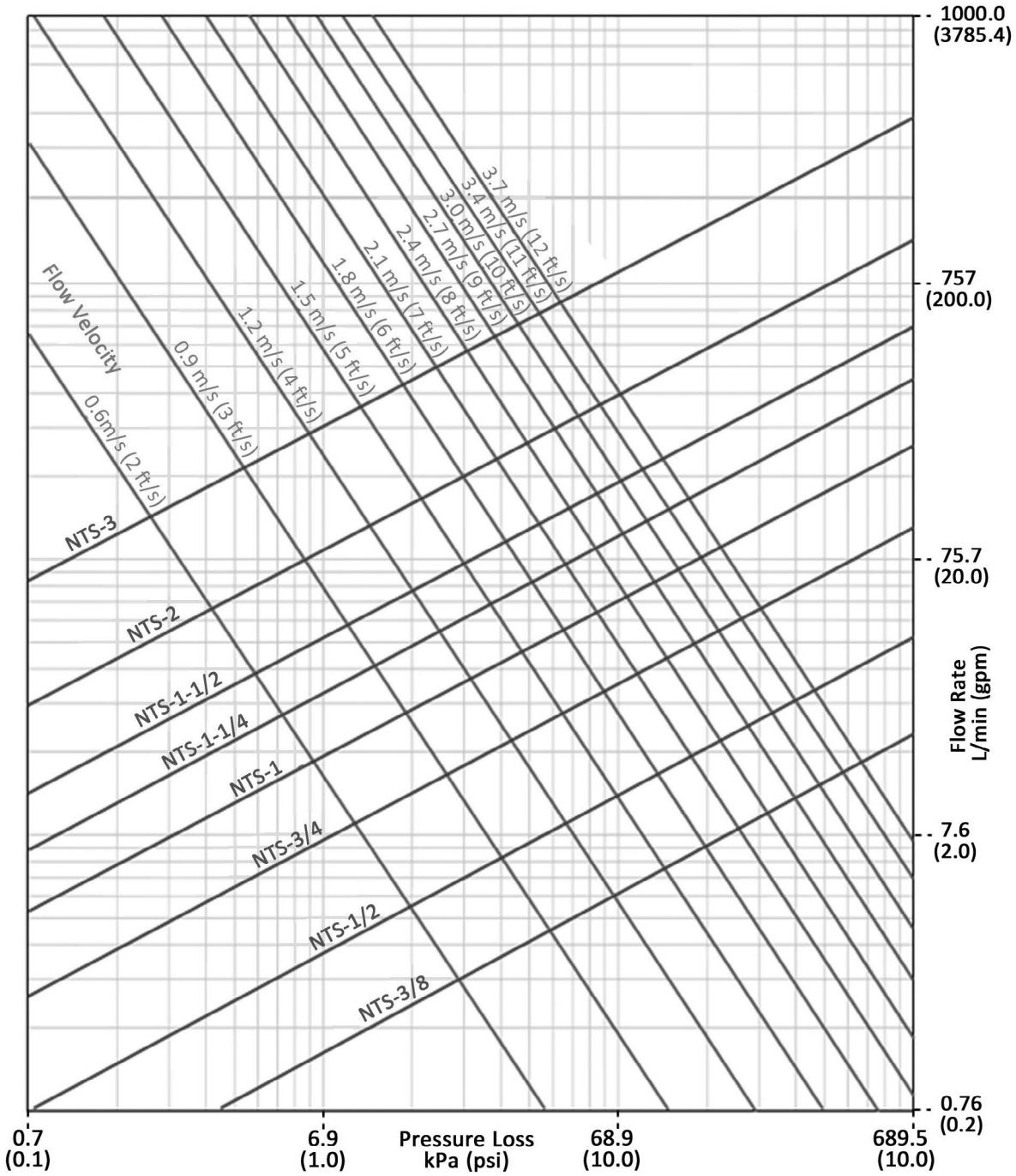


FIGURE 4
PRESSURE LOSS OF PEX TUBING AT 49 °C (120°F)
(See Section 10.6.2)

APPENDIX M
PEAK WATER DEMAND CALCULATOR

M 101.0 General.

M 101.1 Applicability. This appendix provides a method for estimating the demand load for the building water supply and principal branches for single- and multi-family dwellings with water-conserving plumbing fixtures, fixture fittings, and appliances.

M 102.0 Demand Load.

M 102.1 Water-Conserving Fixtures. Plumbing fixtures, fixture fittings, and appliances shall not exceed the design flow rate in Table M 102.1.

TABLE M 102.1
DESIGN FLOW RATE FOR WATER-CONSERVING PLUMBING FIXTURES AND APPLIANCES IN RESIDENTIAL OCCUPANCIES

FIXTURE AND APPLIANCE	MAXIMUM DESIGN FLOW RATE (gallons per minute)
Bar Sink	1.5
Bathtub	5.5
Bidet	2.0
Clothes Washer*	3.5
Combination Bath/Shower	5.5
Dishwasher*	1.3
Kitchen Faucet	2.2
Laundry Faucet (with aerator)	2.0
Lavatory Faucet	1.5
Shower, per head	2.0
Water Closet, 1.28 GPF Gravity Tank	3.0

For SI units: 1 gallon per minute = 0.06 L/s
* Clothes washers and dishwashers shall have an energy star label.

M 102.2 Water Demand Calculator. The estimated design flow rate for the building supply and principal branches and risers shall be determined by the IAPMO Water Demand Calculator available for download at http://www.iapmo.org/WE•Stand/Pages/WaterDemandCalculator.aspx

M 102.3 Meter and Building Supply. To determine the design flow rate for the water meter and building supply, enter the total number of indoor plumbing fixtures and appliances for the building in Column [B] of the Water Demand Calculator and run Calculator. See Table M 102.3 for an example.

M 102.4 Fixture Branches and Fixture Supplies. To determine the design flow rate for fixture branches and risers, enter the total number of plumbing fixtures and appliances for the fixture branch or riser in Column [B] of the Water Demand Calculator and run Calculator. The flow rate for one fixture branch and one fixture supply shall be the design flow rate of the fixture according to Table M 102.1.

M 102.5 Continuous Supply Demand. Continuous supply demands in gallons per minute (gpm) for lawn sprinklers, air conditioners, hose bibbs, etc., shall be added to the total estimated demand for the building supply as determined by Section M 102.3. Where there is more than one hose bibb installed on the plumbing system, the demand for only one hose bibb shall be added to the total estimated demand for the building supply. Where a hose bibb is installed on a fixture branch, the demand of the hose bibb shall be added to the design flow rate for the fixture branch as determined by Section M 102.4.

M 102.6 Other Fixtures. Fixtures not included in Table M 102.1 shall be added in Rows 12 through 14 in the Water Demand Calculator as Other Fixture. The probability of use and flow rate for Other Fixtures shall be added by selecting the comparable probability of use and flow rate from Columns [C] and [E].

TABLE M 102.3
WATER DEMAND CALCULATOR EXAMPLE

	[A] FIXTURE	[B] ENTER NUMBER OF FIXTURES	[C] PROBABILITY OF USE (%)	[D] ENTER FIXTURE FLOW RATE (GPM)	[E] MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)
1	Bar Sink	0	2.0	1.5	1.5
2	Bathtub	0	1.0	5.5	5.5
3	Bidet	0	1.0	2.0	2.0
4	Clothes Washer	1	5.5	3.5	3.5
5	Combination Bath/Shower	1	5.5	5.5	5.5
6	Dishwasher	1	0.5	1.3	1.3
7	Kitchen Faucet	1	2.0	2.2	2.2
8	Laundry Faucet	0	2.0	2.0	2.0
9	Lavatory Faucet	1	2.0	1.5	1.5
10	Shower, per head	0	4.5	2.0	2.0
11	Water Closet, 1.28 GPF Gravity Tank	1	1.0	3.0	3.0
12	Other Fixture 1	0	0.0	0.0	6.0
13	Other Fixture 2	0	0.0	0.0	6.0
14	Other Fixture 3	0	0.0	0.0	6.0
Total Number of Fixtures		6		RESET	RUN WATER DEMAND CALCULATOR
99th Percentile Demand Flow =		8.5 GPM			

For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L

M 102.7 Size of Water Piping per Appendix A. Except as provided in Section M 102.0 for estimating the demand load for single- and multi-family dwellings, the size of each water piping system shall be determined in accordance with the procedure set forth in Appendix A. After determining the permissible friction loss per 100 feet (30 480 mm) of pipe in accordance with Section A 104.0 and the demand flow in accordance with the Water Demand Calculator, the diameter of the building supply pipe, branches and risers shall be obtained from Chart A 105.1(1) through Chart A 105.1(7), whichever is applicable, in accordance with Section A 105.0 and Section A 106.0. Velocities shall be in accordance with Section A 107.0. Appendix I (IS 31), Figure 3 and Figure 4 shall be permitted when sizing PEX systems.

M 102.7.1 Minimum Fixture Branch Size. The minimum fixture branch size shall be ½ inch (15 mm) in diameter.

M 102.8 Examples Illustrating Use of Water Demand Calculator with Appendix A.

Example 1: Indoor Water Use Only – Use the information given below to find the pipe size for the building supply to a residential building with six indoor fixtures as shown in Figure 1 [Pipe Section 4].

Given Information:

Type of construction:	Residential, one-bathroom	Friction loss per 100 ft (30 480 mm):	15 psi (103 kPa)
Type of pipe material:	L-copper	Maximum velocity:	10 ft/s (3.05 m/s)
Fixture number/type:	1 combination bath/shower 1 dishwasher	1 kitchen faucet 1 WC	1 lavatory faucet 1 clothes washer

Solution: Step 1 of 2 – Find Demand Load for the Building Supply.

The Water Demand Calculator [WDC] in Figure 2 is used to determine the demand load expected from indoor water use. The WDC has white-shaded cells and light gray-shaded cells. The values in the light gray cells are derived from a national survey of indoor water use at homes with efficient fixtures and cannot be changed.

The white-shaded cells accept input from the designer. For instance, fixture counts from the given information are entered in Column [B]; the corresponding recommended fixture flow rates are already provided in Column [D]. The flow rates in Column [D] may be reduced only if the manufacturer specifies a lower flow rate for the fixture. Column [E] establishes the upper limits for the flow rates entered into Column [D]. Clicking the Run Water Demand Calculator button gives 8.5 gpm (0.54 L/s) as the estimated indoor water demand for the whole building. This result appears in the dark gray box of the WDC in Figure 2.

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.

Chart A 105.1(1) for copper piping systems (from Appendix A of the UPC, shown in Figure 3) is used to determine the pipe size, based on given friction loss, given maximum allowable pipe velocity, given pipe material and the demand load computed in Step 1. In Figure 3, the intersection of the given friction loss (15 psi) (103 kPa) and the maximum allowable pipe velocity (10 ft/s) (3.05 m/s) is labeled point A**.** The vertical line that descends from point A to the base of the chart intersects four nominal sizes for L-copper pipe. These intersection points are labeled B, C, D, E and correspond to pipe sizes of 1 inch (25 mm), ¾ inch (20 mm), ½ inch (15 mm) and ⅜ inch (10 mm), respectively. A horizontal line from points B, C, D, E to the right-hand side of the chart gives maximum flow rates of 24 gpm (1.5 L/s), 12 gpm (0.757 L/s), 4.5 gpm (0.28 L/s), and 2.3 gpm (0.145 L/s), respectively. These results are summarized in Table 1 which shows that a ¾ inch (20 mm) type L copper line is the minimum size that can convey the peak water demand of 8.5 gpm (0.54 L/s).

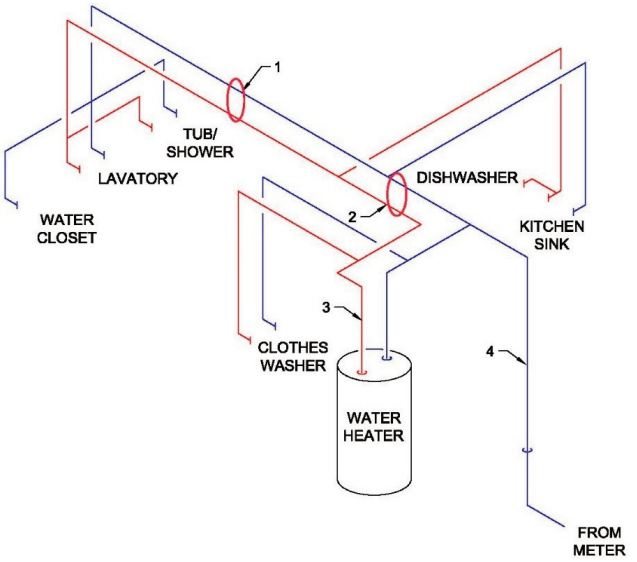


FIGURE 1
RESIDENTIAL BUILDING WITH SIX INDOOR FIXTURES

[A] FIXTURE		[B] ENTER NUMBER OF FIXTURES	[C] PROBABILITY OF USE (%)	[D] ENTER FIXTURE FLOW RATE (GPM)	[E] MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)
1	Bar Sink	0	2.0	1.5	1.5
2	Bathtub	0	1.0	5.5	5.5
3	Bidet	0	1.0	2.0	2.0
4	Clothes Washer	1	5.5	3.5	3.5
5	Combination Bath/Shower	1	5.5	5.5	5.5
6	Dishwasher	1	0.5	1.3	1.3
7	Kitchen Faucet	1	2.0	2.2	2.2
8	Laundry Faucet	0	2.0	2.0	2.0
9	Lavatory Faucet	1	2.0	1.5	1.5
10	Shower, per head	0	4.5	2.0	2.0
11	Water Closet, 1.28 GPF Gravity Tank	1	1.0	3.0	3.0
12	Other Fixture 1	0	0.0	0.0	6.0
13	Other Fixture 2	0	0.0	0.0	6.0
14	Other Fixture 3	0	0.0	0.0	6.0
Total Number of Fixtures		6		RESET	RUN WATER DEMAND CALCULATOR
99th Percentile Demand Flow =		8.5 GPM			

For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L

FIGURE 2
WATER DEMAND CALCULATOR FOR INDOOR USE AT HOME WITH SIX EFFICIENT FIXTURES (EXAMPLE 1).

Example 2: Indoor and Outdoor Water Use – Find the pipe size for the building supply [Figure 1, Pipe Section 4] if the building in Example 1 adds two outdoor fixtures (hose bibb, each with a fixture flow of 2.0 gpm) (0.13 L/s).

Solution: Step 1 of 2 – Find Demand Load for the Building Supply.

The WDC has been developed exclusively for peak indoor water use which can be viewed as a high-frequency short duration process. Because fixtures for outdoor water use may operate continuously for very long periods, they are not included in the WDC. To account for water use from one or more outdoor fixtures, add the demand of the single outdoor fixture with the highest flowrate to the calculated demand for indoor water use. With two hose bibbs, the demand of only one hose bibb is included. Hence, in this example, the total demand for the whole house is 8.5 gpm (0.54 L/s) + 2.0 gpm (0.13 L/s) = 10.5 gpm (0.662 L/s).

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.

Table 1 shows that at 10.5 gpm (0.662 L/s) the building supply shall be ¾ inch (20 mm) in diameter.

TABLE 1
PIPE SIZE OPTIONS FOR BUILDING SUPPLY

POINT IN FIGURE 3	PIPE DIAMETER (INCH)	MAXIMUM FLOW (GPM)	OK FOR BUILDING SUPPLY*
E	⅜	2.3	No
D	½	4.5	No
C	¾	12	Yes
B	1	24	Yes

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s
* For Building in Examples 1, 2, 3, and 4.

Example 3: Indoor, Outdoor and Other Fixture Water Use – Find the pipe size for the water supply [Figure 1, Pipe Section 4] if the building in Example 2 adds a kitchen pot filler and a dog bath each with a faucet flow rate of 5.5 gpm (0.35 L/s).

Solution: Step 1 of 2 – Find Demand Load for the Building Supply.

The kitchen pot filler and dog bath are not listed in Column [A] of the WDC. To accommodate cases such as this, the WDC provides up to three additional rows for "Other Fixtures". Enter the kitchen pot filler and dog bath in Column [A] of the WDC and enter the fixture count for each in Column [B]. Find an indoor fixture that has a similar probability of use in Column [C] and add that to the column. Finally, enter the flow rate of the kitchen pot filler and dog bath in Column [D]. The estimated indoor water demand for the whole building is 11 gpm, as shown in the WDC in Figure 4. As illustrated in Example 2, the hose bibb will increase the total demand for the whole house to 13 gpm (0.820 L/s).

Note that a reset button is provided to clear any numbers in Column [B] from a previous calculation.

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply.

Table 1 shows that at 13 gpm (0.820 L/s) the building supply shall be 1 inch (25 mm) in diameter.

Example 4: Sizing Branches and Risers – For individual hot and cold branches, repeat Steps 1 and 2. For example, for the hot water branch at the water heater [Figure 1, Pipe Section 3], enter all the fixtures and appliances that use hot water into the Water Demand Calculator (toilets will be excluded) as seen in Figure 5. Use the calculated demand load to find the pipe size in Step 2. Table 1 shows that at 7.7 gpm (0.49 L/s), the hot water branch shall be ¾ inch (20 mm) in diameter.

For each additional hot and cold branch [Figure 1, Pipe Sections 1 and 2], enter the number of fixtures and appliances served by that branch into the WDC and use that demand in Step 2 to determine the branch size. If the branch serves a hose bibb, add the demand of the hose bibb to the calculated demand flow for the branch. As discussed in Example 2, the hose bibb is not to be entered into WDC, since the Calculator is for indoor uses only.

When there is only one fixture or appliance served by a fixture branch, the demand flow shall not exceed the fixture flow rate in Column [E] of the Water Demand Calculator. The fixture flow rate would be used in Step 2 to determine the size of the fixture branch and supply.

CHART A 105.1(1)

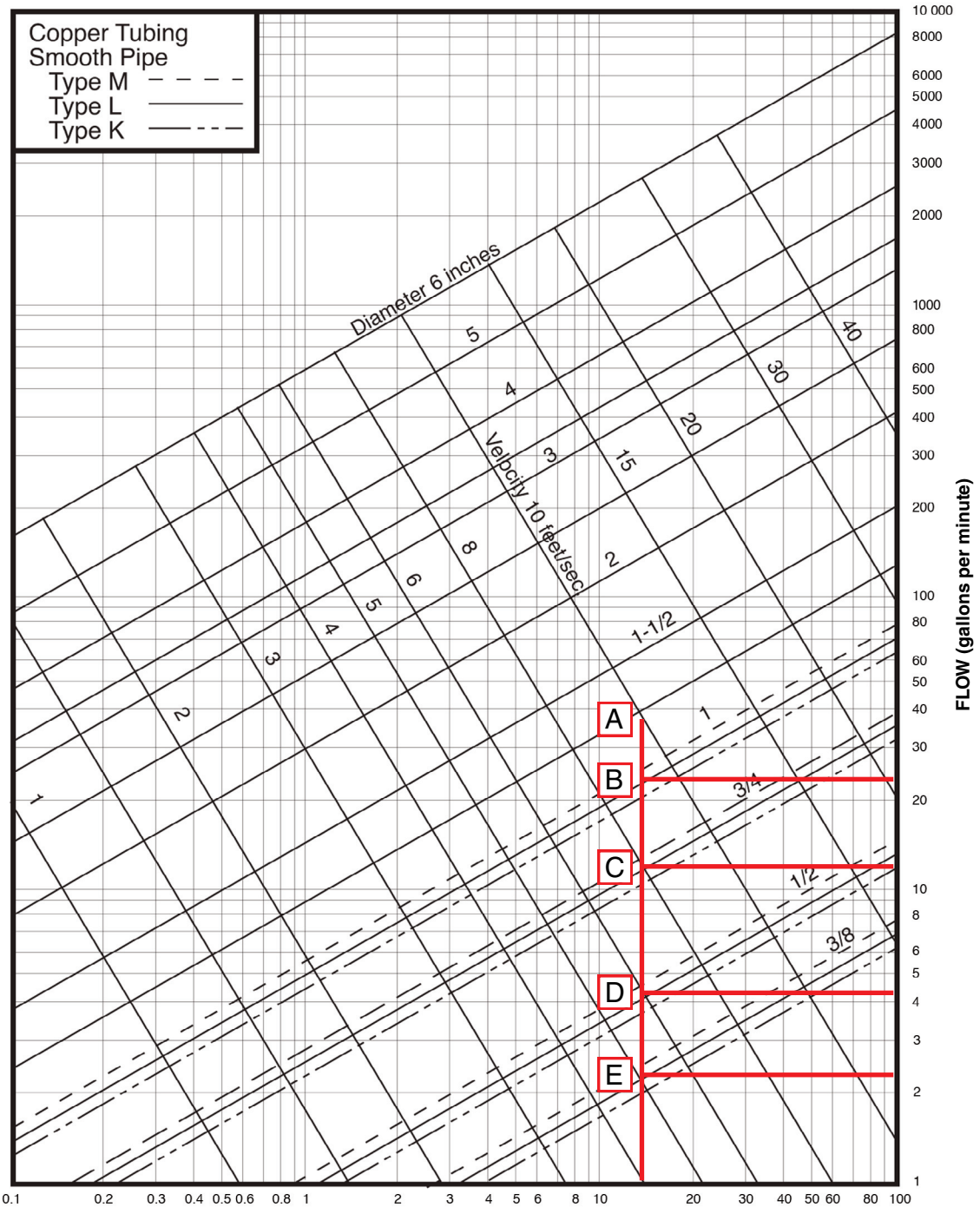


FIGURE 3
CHART A 105.1(1) FOR FINDING PIPE SIZE

For SI units: 1 foot = 304.8 mm, 1 gallon per minute = 0.06 L/s), 1 pound-force per square inch = 6.8947 kPa

[A] FIXTURE		[B] ENTER NUMBER OF FIXTURES	[C] PROBABILITY OF USE (%)	[D] ENTER FIXTURE FLOW RATE (GPM)	[E] MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)
1	Bar Sink	0	2.0	1.5	1.5
2	Bathtub	0	1.0	5.5	5.5
3	Bidet	0	1.0	2.0	2.0
4	Clothes Washer	1	5.5	3.5	3.5
5	Combination Bath/Shower	1	5.5	5.5	5.5
6	Dishwasher	1	0.5	1.3	1.3
7	Kitchen Faucet	1	2.0	2.2	2.2
8	Laundry Faucet	0	2.0	2.0	2.0
9	Lavatory Faucet	1	2.0	1.5	1.5
10	Shower, per head	0	4.5	2.0	2.0
11	Water Closet, 1.28 GPF Gravity Tank	1	1.0	3.0	3.0
12	Pot Filler	1	2.0	5.5	6.0
13	Dog Bath	1	1.0	5.5	6.0
14	Other Fixture 3	0	0.0	0.0	6.0
Total Number of Fixtures		8		RESET	RUN WATER DEMAND CALCULATOR
99th Percentile Demand Flow =		11.0 GPM			

For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L

FIGURE 4
WATER DEMAND CALCULATOR TO ACCOMMODATE OTHER FIXTURES (EXAMPLE 3).

[A] FIXTURE		[B] ENTER NUMBER OF FIXTURES	[C] PROBABILITY OF USE (%)	[D] ENTER FIXTURE FLOW RATE (GPM)	[E] MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)
1	Bar Sink	0	2.0	1.5	1.5
2	Bathtub	0	1.0	5.5	5.5
3	Bidet	0	1.0	2.0	2.0
4	Clothes Washer	1	5.5	3.5	3.5
5	Combination Bath/Shower	1	5.5	5.5	5.5
6	Dishwasher	1	0.5	1.3	1.3
7	Kitchen Faucet	1	2.0	2.2	2.2
8	Laundry Faucet	0	2.0	2.0	2.0
9	Lavatory Faucet	1	2.0	1.5	1.5
10	Shower, per head	0	4.5	2.0	2.0
11	Water Closet, 1.28 GPF Gravity Tank	0	1.0	3.0	3.0
12	Other Fixture 1	0	0.0	0.0	6.0
13	Other Fixture 2	0	0.0	0.0	6.0
14	Other Fixture 3	0	0.0	0.0	6.0

For SI units: 1 gallon per minute = 0.66 L/s, 1 gallon = 3.785 L

FIGURE 5
WATER DEMAND CALCULATOR FOR THE HOT WATER BRANCH (EXAMPLE 4).

USEFUL TABLES

CONVERSION TABLES

Note: The information contained in these tables are not part of this American National Standard (ANS) and have not been processed in accordance with ANSI's requirements for an ANS. As such, these tables may contain material that has not been subjected to public review or a consensus process. In addition, they do not contain requirements necessary for conformance to the standard.

UNIT CONVERSIONS

MULTIPLY	BY	TO OBTAIN
Acres	43 560	Square feet (ft^2)
Acre-feet	43 560	Cubic feet (ft^3)
Acre-feet	325 851	Gallons (U. S. liquid)
Atmosphere (atm)	76.0	Centimeters of mercury (0°C)
Atmosphere (standard) (atm)	76.0	Centimeters of mercury (0°C)
Atmosphere (standard) (atm)	33.90	Feet of water (4°C)
Atmosphere (standard) (atm)	29.92	Inches of mercury
Atmosphere (standard) (atm)	101.32501	Kilopascals (kPa)
Atmosphere (standard) (atm)	14.70	Pounds-force/square inch (lbf/in^2)
Barrels	42	Gallons (gal)
Barrels	158.9873	Liters (L)
British thermal units (Btu)	1055.055	Joules (J)
British thermal units/hour (Btu/h)	0.000293	Kilowatts (kW)
British thermal units/hour (Btu/h)	0.293	Watts (W)
British thermal unit hour (Btu/h)	1.055056	Kilojoules (kJ)
British thermal unit hour (Btu/h)	1055.056	Joule (J)
British thermal units/minute (Btu/min)	12.97	Foot pounds-force/second (ft•lbf/s)
British thermal units/minute (Btu/min)	0.02358	Horsepower (hp) (international)
British thermal unit per hour square foot degree Fahrenheit [Btu/(h•ft^2•°F)]	5.678263	Watt per square meter kelvin [W/(m^2•K)]
British thermal unit inch per hour foot degree Fahrenheit [Btu•in/(h•ft•°F)]	0.14442279	Watt per meter kelvin [W/(m•K)]
Candelas per square inch (cd/in^2)	1.550003×10^3	Candela per square meters (cd/m^2)
Celsius (°C)	°C + 273.15	Kelvin (k)
Celsius (°C)	1.8 x °C + 32	Fahrenheit (°F)
Centimeters (cm)	0.3937	Inches (in)
Centimeters of mercury (0°C)	0.01316	Atmosphere (standard)
Centimeters of mercury (0°C)	0.446	Feet of water (4°C)
Centimeters of mercury (0°C)	27.84	Pounds-force/square feet (lbf/ft^2)
Centimeters of mercury (0°C)	0.1934	Pounds-force/square inch (lbf/in^2)
Circumference	6.283	Radians (rad)
Cubic feet (ft^3)	1728	Cubic inches (in^3)
Cubic feet (ft^3)	0.0283	Cubic meters (m^3)
Cubic feet (ft^3)	0.03704	Cubic yards (yd^3)
Cubic feet (ft^3)	7.48052	Gallons (U.S. liquid) (gal)
Cubic feet (ft^3)	28.32	Liters (L)
Cubic feet (ft^3)	29.92	Quarts (U.S. liquid)
Cubic feet/hour (ft^3/h)	0.0283	Cubic meters/hour (m^3/h)

UNIT CONVERSIONS (continued)

MULTIPLY	BY	TO OBTAIN
Cubic feet/minute (ft^3/min)	0.000472	Cubic meters/second (m^3/s)
Cubic feet/minute (ft^3/min)	0.1247	Gallons/second
Cubic feet/minute (ft^3/min)	0.47194	Liters/second (L/s)
Cubic feet/second (ft^3/s)	646 316.89	Gallons/day
Cubic feet/second (ft^3/s)	448.831	Gallons/minute (gpm)
Cubic inches (in^3)	1.64×10^{-5}	Cubic meters (m^3)
Cubic inches (in^3)	0.01639	Liters (L)
Cubic meters (m^3)	264.17	Gallons (U.S. liquid)
Cubic yards (yd^3)	27	Cubic feet (ft^3)
Cubic yards (yd^3)	0.76455	Cubic meters (m^3)
Cubic yards (yd^3)	201.97	Gallons (U.S. liquid)
Degrees (deg)	0.0174	Radians (rad)
Fahrenheit (°F)	(°F-32)/1.8	Celsius (°C)
Feet (ft)	0.3048	Meters (m)
Feet (ft)	304.8	Millimeters (mm)
Feet of water (4°C)	0.0295	Atmosphere (standard) (atm)
Feet of water (4°C)	0.8827	Inches of mercury (0°C)
Feet of water (4°C)	62.43	Pounds-force/square feet
Feet of water (4°C)	0.4335	Pounds-force/square inch
Feet/minute (ft/min)	0.01667	Feet/second (ft/s)
Feet/minute (ft/min)	0.01136	Miles/hour (mi/h)
Feet/second (ft/s)	0.3048	Meters/second (m/s)
Feet/second (ft/s)	0.6818	Miles/hour (mi/h)
Feet/second (ft/s)	0.01136	Miles/minute (mi/min)
Foot lambert (fL)	3.426259	Candela per square meter (cd/m^2)
Foot pounds-force (ft•lbf)	1.355	Joules (J)
Foot pounds-force/minute (ft•lbf/min)	2.260×10^{-5}	Kilowatts (kW)
Foot pounds-force/second (ft•lbf/s)	1.356×10^{-3}	Kilowatts (kW)
Gallons (U.S. liquid) (gal)	231	Cubic inches (in^3)
Gallons (U.S. liquid) (gal)	0.003785	Cubic meters (m^3)
Gallons (U.S. liquid) (gal)	0.1337	Cubic feet (ft^3)
Gallons (U.S. liquid) (gal)	3.785	Liters (L)
Gallons (U.S. liquid) (gal)	4	Quarts (U.S. liquid)
Gallons/day	4.3×10^{-5}	Liters/second
Gallons/minute (gal/min) (gpm)	8.0208	Cubic feet/hour (ft^3/h)
Gallons/minute (gal/min) (gpm)	0.003785412	Cubic meters/minute (m^3/min)
Gallons/minute (gal/min) (gpm)	0.00223	Cubic feet/second (ft^3/s)
Gallons/minute (gal/min) (gpm)	6.309020×10^{-5}	Cubic meters/second (m^3/s)
Gallons/minute (gal/min) (gpm)	0.06309	Liters/second (L/s)
Grains (gr)	0.00006479	Kilograms (kg)
Horsepower (hp)	0.7457	Kilowatts (kW)
Horsepower-hours	$2.684 \times 10^{+6}$	Joules (J)
Horsepower-hours	0.7457	Kilowatt-hours (kW•h)
Inch (water column at 60°F)	0.24884	Kilopascals (kPa)
Inches (in)	2.54	Centimeters (cm)

UNIT CONVERSIONS (continued)

MULTIPLY	BY	TO OBTAIN
Inches (in)	25.4	Millimeters (mm)
Inches/hour	25.4	Millimeters/hour (mm/h)
Inches of mercury (0°C)	0.03342	Atmosphere (standard) (atm)
Inches of mercury (0°C)	1.133	Feet of water (4°C)
Inches mercury (0°C)	3.3863	Kilopascals (kPa)
Inches of mercury (0°C)	0.4912	Pounds-force/square inch
Inches of water (4°C)	0.002458	Atmosphere (standard) (atm)
Inches of water (4°C)	0.07356	Inches of mercury (0°C)
Inches of water (4°C)	5.202	Pounds-force/square feet
Inches of water (4°C)	0.03613	Pounds-force/square inch
Joules (J)	9.480×10^{-4}	British thermal units (Btus)
Joules (J)	0.7376	Foot-pounds
Joules (J)	2.778×10^{-4}	Watt-hours
Kelvin (K)	°K - 273.15	Celsius (°C)
Kilograms (kg)	2.2046	Pounds (lbs)
Kilograms (kg)	1.102×10^{-3}	Tons (short)
Kilopascals (kPa)	0.145038	Pounds-force/square inch
Kilometers (km)	0.6214	Miles (statute)
Kilometers/hour (km/h)	0.6214	Miles/hour (mi/h)
Kilowatts (kW)	3412.14	British thermal units/hour (Btus/hour)
Kilowatts (kW)	1.341	Horsepower (hp)
Kilowatt-hours	3413	British thermal units (Btus)
Kilowatt-hours	$2.655 \times 10^{+6}$	Foot-pounds (ft•lbs)
Kilowatt-hours	$3.6 \times 10^{+6}$	Joules (J)
Kip (1000 lbf)	4.448222	Kilonewtons (kN)
Kip-foot	1.35671	Kilonewton meters (kN•m)
Kips per square inch (kip/in^2)	6.8947	Megapascals (MPa)
Lambert (la)	3.183099×10^{3}	Candela per square meter (cd/m^2)
Liters (L)	0.03531	Cubic feet (ft^3)
Liters (L)	61.02	Cubic inches (in^3)
Liters (L)	0.001	Cubic meters (m^3)
Liters (L)	0.2642	Gallons (U.S. liquid)
Lumens per square foot (lm/ft^2) (footcandle)	10.76391	Lux (lx)
Meters (m)	3.281	Feet (ft)
Meters (m)	39.37	Inches (in)
Meters (m)	1.094	Yards
Meters/second (m/s)	3.281	Feet/second (ft/s)
Meters/second (m/s)	2.237	Miles/hour (mi/h)
Miles (mi)	5280	Feet (ft)
Miles (statute)	1.609	Kilometers (km)
Miles/hour (mi/h)	88	Feet/minute (ft/min)
Miles/hour (mi/h)	1.467	Feet/second (ft/s)
Miles/hour (mi/h)	1.609344	Kilometers/hour (km/h)
Miles/hour (mi/h)	26.82	Meters/minute (m/min)
Miles/hour (mi/h)	0.44704	Meters/second (m/s)

UNIT CONVERSIONS (continued)

MULTIPLY	BY	TO OBTAIN
Millimeters (mm)	0.1	Centimeters (cm)
Millimeters (mm)	0.03937	Inches (in)
Millimeters (mm)	0.001	Meters (m)
Minutes (min)	2.908882×10^{-4}	Radians (rads)
Ounces/square inch (oz/in^2)	43.94185	Kilograms/square meter (kg/m^2)
Ounces/square feet (oz/ft^2)	0.03051517	Kilograms/square meter (kg/m^2)
Ounces (oz)	0.02834	Kilograms (kg)
Ounces (oz)	29.57353	Millimeters (mL)
Pints	0.4731765	Liters (L)
Pound-force feet (lbf•ft)	1.355818	Newton meters (N•m)
Pound-force inch (lbf•in)	0.1129848	Newton meters (N•m)
Pound-force per foot (lbf/ft)	14.5939	Newton meters (N•m)
Pound-force per square foot (lbf/ft^2)	47.88026	Pascal (Pa)
Pound-force per square inch (lbf/in^2)	6.89476	Kilopascals (kPa)
Pound-force per inch (lbf/in)	175.1268	Newton meters (N•m)
Pounds/cubic inch (lb/in^3)	2.767990×10^4	Kilograms/cubic meter (kg/m^3)
Pounds/cubic yard (lb/yd^3)	0.5932764	Kilograms/cubic meter (kg/m^3)
Pounds (lb)	0.45359	Kilograms (kg)
Pounds/cubic foot (lb/ft^3)	16.0184	Kilograms/cubic meter (kg/m^3)
Pounds/foot (lb/ft)	1.4881	Kilograms/meters (kg/m)
Pounds/square inch (lb/in^2)	703.1	Kilograms-force/square meter (kg/m^2)
Pounds/square foot (lb/ft^2)	4.882427	Kilograms-force/square meter (kg/m^2)
Pounds-force (lbf)	4.4482	Newtons (N)
Pounds-force/square inch (psi)	0.06805	Atmosphere (standard) (atm)
Pounds-force/square inch (psi)	2.307	Feet of water (4°C)
Pounds-force/square inch (psi)	2.036	Inches of mercury (0°C)
Pounds-force/square inch (psi)	6.89476	Kilopascals (kPa)
Quarts (U.S. dry) (dry qt)	67.20	Cubic inches (in^3)
Quarts (U.S. liquid) (liq qt)	57.75	Cubic inches (in^3)
Quarts (liquid)	0.9463529	Liters (L)
Radians (rads)	57.30	Degrees (deg)
Seconds (s)	4.848137×10^{-6}	Radians (rads)
Square acre	0.404687	Square kilometers (km^2)
Square feet (ft^2)	144	Square inches (in^2)
Square feet (ft^2)	0.0929	Square meters (m^2)
Square inches (in^2)	645.16	Square millimeters (mm^2)
Square inches (in^2)	0.000645	Square meters (m^2)
Square meters (m^2)	1550	Square inches (in^2)
Square miles (mi^2)	640	Acres
Square miles (mi^2)	2.589988	Square kilometers (km^2)
Square millimeters (mm^2)	1.550×10^{-3}	Square inches (in^2)
Square yards (yd^2)	9	Square feet (ft^2)
Square yards (yd^2)	0.8361274	Square meters (m^3)
Temperature (°C) + 17.28	1.8	Temperature (°F)
Temperature (°F) – 32	5⁄9	Temperature (°C)

UNIT CONVERSIONS (continued)

MULTIPLY	BY	TO OBTAIN
Ton-force (tonf) (2000 lbf)	8.896443	Kilonewtons (kN)
Ton-force foot (tonf•f/ft)	2.71342	Kilonewton meters (kN•m)
Ton-force per square foot (tonf/ft^2)	95.7605	Kilopascals (kPa)
Ton-force per square inch (tonf/in^2)	13.7895	Megapascals (MPa)
Ton (metric)	1000	Kilograms (kg)
Tons (long) (2240 lbs)	1016.047	Kilograms (kg)
Tons (short)	2000	Pounds (lbs)
Watts	3.4121	British thermal units per hour (Btus/hour)
Watts	1.341 x 10^{-3}	Horsepower (hp)
Yards (y)	0.9144	Meters (m)

SI SYMBOLS AND PREFIXES

SI PREFIXES				
MULTIPLICATION FACTOR			PREFIX	SYMBOL
1 000 000 000 000 000 000	=	E+18	exa	E
1 000 000 000 000 000	=	E+15	peta	P
1 000 000 000 000	=	E+12	tera	T
1 000 000 000	=	E+09	giga	G
1 000 000	=	E+06	mega	M
1 000	=	E+03	kilo	k
100	=	E+02	hecto	h
10	=	E+01	deka	da
0.1	=	E-01	deci	d
0.01	=	E-02	centi	c
0.001	=	E-03	milli	m
0.000 001	=	E-06	micro	μ
0.000 000 001	=	E-09	nano	n
0.000 000 000 001	=	E-12	pico	p
0.000 000 000 000 001	=	E-15	femto	f
0.000 000 000 000 000 001	=	E-18	atto	a

FLOW IN GALLONS PER MINUTE CONVERTED TO FIXTURE UNITS FOR GRAVITY FLUSH TANKS AND FLUSHOMETERS

These tables may be interpolated

FLOW GPM	FIXTURE UNITS	
	FLUSH VALVE TANKS	FLUSHOMETER VALVES
1	0	—
2	1	—
3	3	—
4	4	—
5	6	—
6	7	—
7	8	—
8	10	—
9	12	—
10	13	—
11	15	—
12	16	—
13	18	—
14	20	—
15	21	—
16	23	—
17	24	—
18	26	—
19	28	—
20	30	—
21	32	—
22	34	5
23	36	6
24	39	7
25	42	8
26	44	9
27	46	10
28	49	11
29	51	12
30	54	13
31	56	14
32	58	15
33	60	16
34	63	18
35	66	20
36	69	21
37	74	23
38	78	25
39	83	26
40	86	28
41	90	30
42	95	31

FLOW GPM	FIXTURE UNITS	
	FLUSH VALVE TANKS	FLUSHOMETER VALVES
43	99	33
44	103	35
45	107	37
46	111	39
47	115	42
48	119	44
49	123	46
50	127	48
51	130	50
52	135	52
53	141	54
54	146	57
55	151	60
56	155	63
57	160	66
58	165	69
59	170	73
60	175	76
62	185	82
64	195	88
66	205	95
68	215	102
70	225	108
72	236	116
74	245	124
76	254	132
78	264	140
80	275	148
82	284	158
84	294	168
86	305	176
88	315	186
90	325	195
92	337	205
94	348	214
96	359	223
98	370	234
100	380	245
105	406	270
110	431	295
115	455	329
120	479	365

FLOW GPM	FIXTURE UNITS	
	FLUSH VALVE TANKS	FLUSHOMETER VALVES
125	506	396
130	533	430
135	559	460
140	585	490
145	611	521
150	638	559
155	665	596
160	692	631
165	719	666
170	748	700
175	778	739
180	809	775
185	840	811
190	874	850
200	945	931
210	1018	1009
220	1091	1091
230	1173	1173
240	1254	1254
250	1335	1335
260	1418	1418
270	1500	1500
280	1598	1598
290	1668	1668
300	1755	1755
310	1845	1845
320	1926	1926
330	2018	2018
340	2110	2110
350	2204	2204
360	2298	2298
370	2388	2388
380	2480	2480
390	2575	2575
400	2670	2670
410	2765	2765
420	2862	2862
430	2960	2960
440	3060	3060
450	3150	3150
500	3620	3620

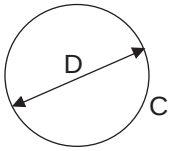
AREAS AND CIRCUMFERENCES OF CIRCLES

DIAMETER		CIRCUMFERENCE		AREA	
Inches	mm	Inches	mm	Inches²	mm²
⅛	6	0.40	10	0.01227	8.0
¼	8	0.79	20	0.04909	31.7
⅜	10	1.18	30	0.11045	71.3
½	15	1.57	40	0.19635	126.7
¾	20	2.36	60	0.44179	285.0
1	25	3.14	80	0.7854	506.7
1¼	32	3.93	100	1.2272	791.7
1½	40	4.71	120	1.7671	1140.1
2	50	6.28	160	3.1416	2026.8
2½	65	7.85	200	4.9087	3166.9
3	80	9.43	240	7.0686	4560.4
4	100	12.55	320	12.566	8107.1
5	125	15.71	400	19.635	12 667.7
6	150	18.85	480	28.274	18 241.3
7	175	21.99	560	38.485	24 828.9
8	200	25.13	640	50.265	32 428.9
9	225	28.27	720	63.617	41 043.1
10	250	31.42	800	78.540	50 670.9

EQUAL PERIPHERIES

S = 0.7854 D

D = 1.2732 S



S = 0.8862 D

D = 1.1284 S

S = 0.2821 C

EQUAL AREAS

Area of square (S') =
1.2732 x area of circle

Area of square (S) =
0.6366 x area of circle

C = πD = 2πR

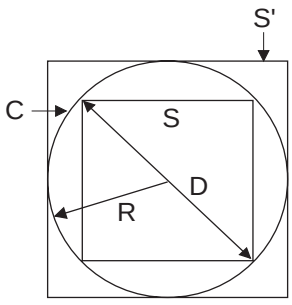
C = 3.5446 $\sqrt{\text{area}}$

D = 0.3183 C = 2R

D = 1.1283 $\sqrt{\text{area}}$

Area = πR^2 = 0.7854 D^2

Area = 0.07958 $C^2 = \frac{\pi D^2}{4}$



π = 3.1416

FRICTION LOSS PER FOOT LENGTH
[SCHEDULE 80 PVC EXCEEDING CHART A105.1(7)]

The following formula should be used for where Schedule 80 IPS CPVC sizes 2½" through 10" exceed Chart A 105.1(7):

Head loss formula: $H_L = 0.2083\ (100/C)\ 1.852 \times Q\ 1.852 / d_I\ 4.8655$

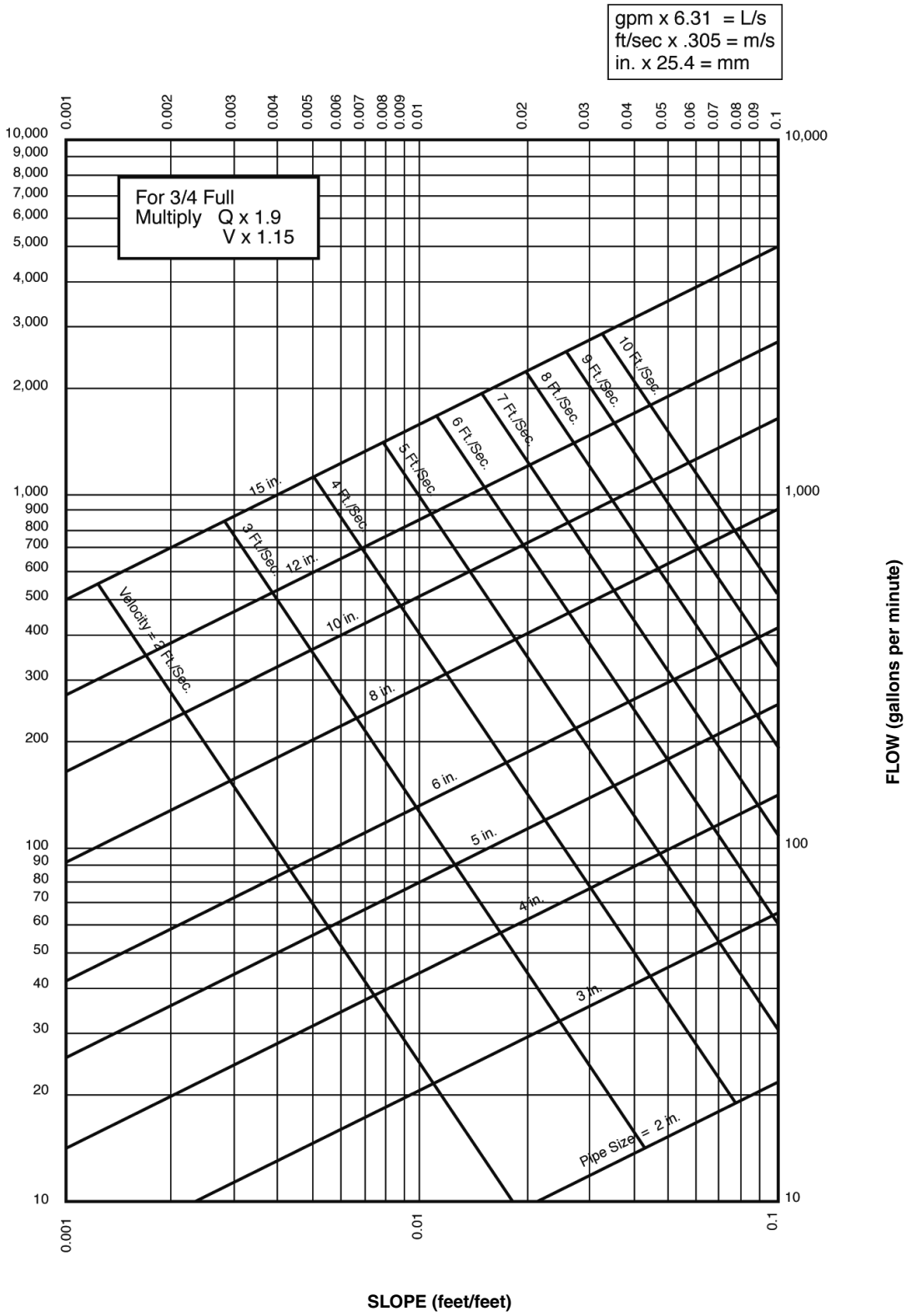
Where:
H_L = frictional head loss (feet of water per 100 feet)
C = Hazen-Williams factor (150 for CPVC)
Q = flow rate (gal/min)
d_I = inside diameter of pipe (inches)

Note: head loss in feet of water per 100 feet can be multiplied by 0.4335 to obtain pressure drop in psi

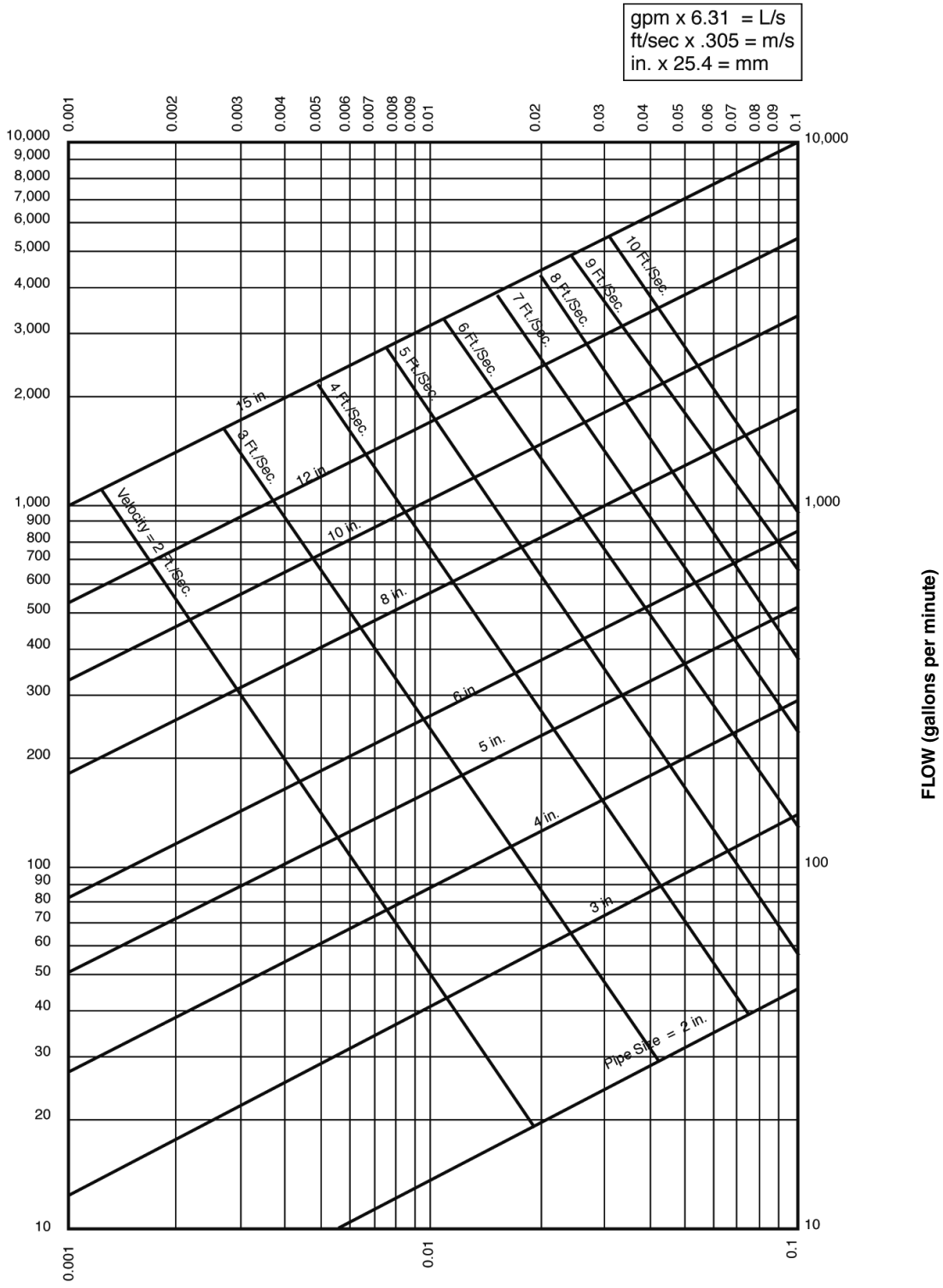
Velocity formula: $V_W = 0.4085\ Q / d_I^2$

Where: V_W = velocity of water (feet per second)

FLOW IN PARTLY FILLED (ONE-HALF FULL) PIPES
(BASED ON MANNING'S FORMULA WITH n = .012)



FLOW IN PARTLY FILLED (FULL) PIPES
(BASED ON MANNING'S FORMULA WITH n = .012)



INDEX

Amended sections of the Seattle Plumbing Code are not reflected in the Index.

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