


Understanding the 2018 UPC Plumbing Requirements



Understanding the 2018 UPC Plumbing Requirements

Based on the 2018 Uniform Plumbing Code (UPC)

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Welcome!

- ▶ Reference
- ▶ Breaks-Lunch
- ▶ Questions



Welcome

Meet the instructor
Participant introductions




Know your 5 "Ps"

Prior
Preparation
Prevents
Poor
Performance


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Meet the Instructor

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- Jerry Flanik is a co-owner of F & B Engineering, Inc. and President of Associated Consulting Solutions, LLC (ACS) in Cleveland, Ohio. F & B Engineering provides mechanical, fuel gas, electrical, and structural engineering services. Additionally, ACS provides plan review services for building departments throughout the United States, pre and post design analysis services for architectural and engineering firms, and code consulting services. ACS is also an ICC Preferred Education Provider, providing education throughout the United States.
- Previously, Jerry served as the Chief Building Official for Lake County, Ohio for 16 years. Prior to working as a code official, he owned and operated a design build contracting company. Additionally, Jerry is a long-time UA member of Pipe Fitters Local Union #120 in Cleveland, Ohio.
- Mr. Flanik holds a Bachelor of Science Degree in Mechanical Engineering and a Bachelor of Science Degree in Electrical Engineering from Cleveland State University, as well as, a degree in Civil Engineering Technology. Holding over 40 various certifications and licenses, he is also an ICC-Certified Master Code Professional (MCP) and a LEED Accredited Professional BD+C. Jerry also gives back to the community as a 17-year adjunct faculty instructor at Lakeland College in the Civil and Electrical Engineering Departments.
- Jerry is a professional consultant for corporations and government agencies throughout the United States, and for the International Code Council throughout the world.




Associated Consulting Solutions, LLC
www.associatedconsultingsolutions.com

Description

This seminar will provide an overview of the key sections and basic principles of Design, Plan Review, and Inspection in accordance with the 2018 Uniform Plumbing Code. Instructor-led examples and applications will enable participants to better understand the various functions of plumbing systems correlated to the requirements of the 2018 Uniform Plumbing Code. This particular seminar will provide an overview of the following:

- Part I: Administration, Definitions and General Regulations
- Part II: Fixtures, Water Heaters, and Water Supply & Distribution
- Part III: Sanitary Drainage, Indirect Wastes, Traps, & Vents



Objectives

Upon completion, you will be better able to:

- Identify code issues acknowledged in key code sections in the 2018 UPC.
- Describe the application of the code to, design, plan review and inspection.
- Explain the basic principles of the UPC related to design, plan review and inspection.

Chapter One — Administration



Part I: Administration, Definitions and General Regulations

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Scope 101.2

Code applies to:

- Erection
 - Installation
 - Alterations
 - Repairs
 - Relocation
 - Replacement
 - Addition to
 - Use or maintenance
- 101.2 Scope.** The provisions of this code shall apply to the erection, installation, alteration, repair, relocation, replacement, addition to, use, or maintenance of plumbing systems within this jurisdiction.

Administration

Chapter One

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Existing installations 102.2

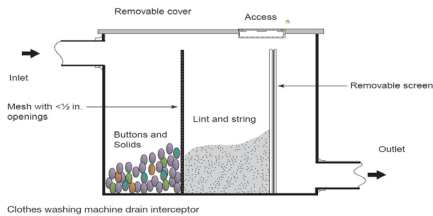
- ▶ Plumbing systems lawfully in existence at the time of the adoption of this code shall be permitted to have their use, maintenance, or repair continued where the use, maintenance, or repair is in accordance with the original design and location and no hazard to life, health, or property has been created by such plumbing system.



Maintenance 102.3

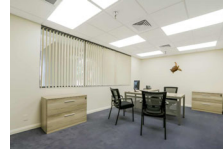
The owner or authorized agent shall maintain the system and all of its parts in a safe operating condition.

The owner or the owner's designated agent shall be responsible for maintenance of plumbing systems. To determine compliance with this subsection, the Authority Having Jurisdiction shall be permitted to cause a plumbing system to be re-inspected.



Section 102.6 – Changes in Building Occupancy

- ▶ Plumbing systems that are a part of a building or structure undergoing a change in use or occupancy, as defined in the building code, shall be in accordance with the requirements of this code that are applicable to the new use or occupancy.



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Additions, alterations or repairs 102.4

- ▶ The new work shall comply with the current code however existing plumbing systems may remain unchanged unless the addition, alteration or repair creates an unsafe, insanitary or overloaded.



Section 102.6 – Change of Occupancy

- ▶ If an office building is converted to a restaurant, the plumbing systems must be altered as necessary to comply with what the code prescribes for such assembly occupancies.
- ▶ Additional minimum required plumbing fixtures may be required dependent on the occupant load. Accessible plumbing facilities may also be required.
- ▶ Grease Interceptors or automatic grease removal devices may also be required to be installed to serve plumbing fixtures and equipment that would discharge grease laden waste.



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Existing Building Sewers & Drains 102.4.1

- ▶ Existing building sewers and building drains shall be permitted to be used in connection with new buildings or new plumbing and drainage work where they are found on examination and test to be in accordance with the requirements governing new work, and the proper Authority Having Jurisdiction shall notify the owner to make changes necessary to be in accordance with this code.



Duties and Powers of the Authority Having Jurisdiction Section 103.0



Section 103.0 – Duties and Powers of the Authority Having Jurisdiction

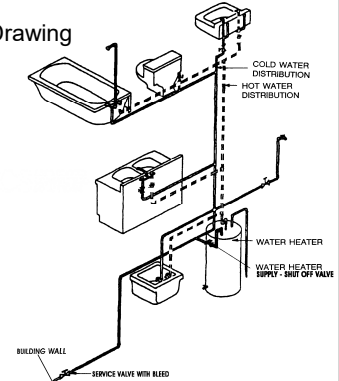
- ▶ Interpreting and enforcing code provisions
- ▶ Receiving applications and issuing permits
- ▶ Issuing notices and orders
- ▶ Making required inspections

103.3 Applications and Permits. The Authority Having Jurisdiction shall be permitted to require the submission of plans, specifications, drawings, and such other information in accordance with the Authority Having Jurisdiction, prior to the commencement of, and at a time during the progress of, work regulated by this code.

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Plumbing Diagrams

- ▶ Isometric Architectural Drawing



Section 104.0 – Permits

This section contains the rules governing the issuance, suspension, revocation or modification of plumbing permits.

104.1 Permits Required. It shall be unlawful for a person, firm, or corporation to make an installation, alteration, repair, replacement, or remodel a plumbing system regulated by this code except as permitted in Section 104.2, or to cause the same to be done without first obtaining a separate plumbing permit for each separate building or structure.

Permits are required for all plumbing work, except as follows:

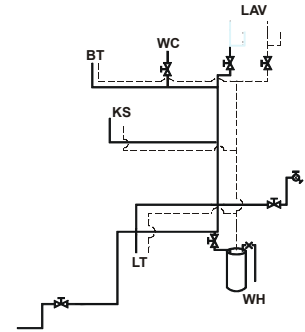
- Clearing stoppages.
- Repairing the working parts of faucets, fill valves, flushometers, valves and similar fixture trim.



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Plumbing Diagrams

- ▶ Riser plan for water system



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Section 104.3.1 – Construction Documents

Construction documents shall be drawn to scale with clarity to identify that the intended work to be performed is in accordance with the code.

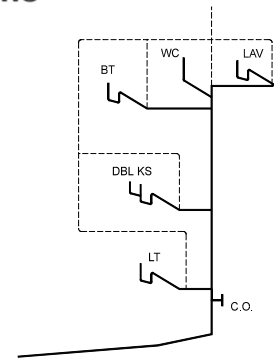
104.3.1 Construction Documents. Construction documents, engineering calculations, diagrams, and other data shall be submitted in two or more sets with each application for a permit. The construction documents, computations, and specifications shall be prepared by, and the plumbing designed by, a registered design professional. Construction documents shall be drawn to scale with clarity to identify that the intended work to be performed is in accordance with the code.



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Plumbing Diagrams

- ▶ Riser plan for DWV



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Section 105.0 – Inspections and Testing

105.2 Required Inspections. New plumbing work and such portions of existing systems as affected by new work, or changes, shall be inspected by the Authority Having Jurisdiction to ensure compliance with the requirements of this code and to ensure that the installation and construction of the plumbing system are in accordance with approved plans. The Authority Having Jurisdiction shall make the following inspections and other such inspections as necessary. The permittee or the permittee's authorized agent shall be responsible for the scheduling of such inspections as follows:

- (1) The underground inspection shall be made after trenches or ditches are excavated and bedded, piping installed, and before backfill is put in place.
- (2) Rough-in inspection shall be made prior to the installation of wall or ceiling membranes.
- (3) Final inspection shall be made upon completion of the installation.

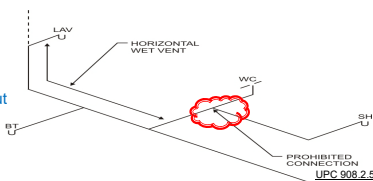
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Q&A Chapter One

Section 105.2.1 – Uncovering

Where a drainage or plumbing system, building sewer, private sewage disposal system, or part thereof, which is installed, altered, or repaired, is covered or concealed before being inspected, tested, and approved as prescribed in this code, it shall be uncovered for inspection after notice to uncover the work has been issued to the responsible person by the Authority Having Jurisdiction.

Consider a slab-on-grade plumbing drainage system installed and covered without inspection?



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Questions and Answers

- ▶ **Question:** Changing a building's occupancy classification could result in a change to the plumbing systems?

True or False

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Section 105.2.2 – Inspection Requests

- ▶ It shall be the duty of the permit holder to provide access to and means for inspections of such work that are required by this code.



It shall be the duty of the holder of the permit or their duly authorized agent to notify the Authority Having Jurisdiction when work is ready for inspection.

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Questions and Answers

True
Section 102.6

Recall Previous Example: If an office building is converted to a restaurant, the plumbing systems must be altered as necessary to comply with what the code prescribes for such assembly occupancies.

102.6 Changes in Building Occupancy. Plumbing systems that are a part of a building or structure undergoing a change in use or occupancy, as defined in the building code, shall be in accordance with the requirements of this code that are applicable to the new use or occupancy.

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Definitions

Chapter Two

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Definitions

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 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.

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Definitions

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.

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).

Figure 202(4)
AIR GAP, AIR BREAK

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Combination Waste and Vent System

▶ A specially designed system of waste piping embodying the horizontal wet venting of one or more sinks, lavatories, drinking fountains or floor drains by means of a common waste and vent pipe adequately sized to provide free movement of air above the flow line of the drain.

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Definitions

- ▶ **Branch vent:** A vent connecting two or more individual vents with a vent stack or stack vent.
- ▶ **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.

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Definitions

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

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

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Definitions

- ▶ **Hot Water.** Water at a temperature exceeding or equal to 120°F (49°C).

Water Scalding Chart	
Set water heater to 120 degrees or less for safety!	
Temperature	Time to Produce Serious Burn
120 degrees (hot)	More than 5 minutes
130 degrees	About 30 seconds
140 degrees	About 5 seconds
150 degrees	About 1 1/2 seconds
160 degrees (very hot)	About 1/2 second



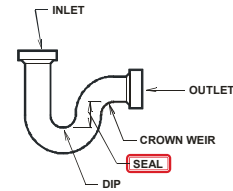
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Definitions

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.

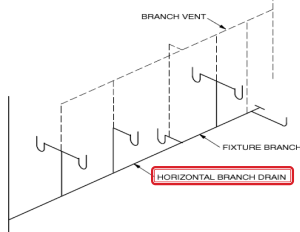
Top Dip (of the trap). The highest point in the internal cross-section of the trap at the lowest part of the bend (inverted siphon). By contrast, the bottom dip is the lowest point in the internal cross-section.



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Definitions

- ▶ **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.

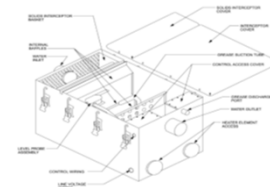


Horizontal Branch

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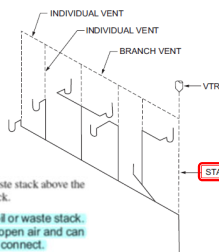
Grease Interceptor

- ▶ **Fats, oils and grease (FOG) disposal systems**
 - FOG Disposal System. A grease interceptor that reduces nonpetroleum fats, oils, and grease (FOG) in the effluent by separation, mass, and volume reduction.
 - FOG disposal systems use bioremediation process to convert Fats oils and greases into grey water.
- ▶ **Hydromechanical**
 - Hydromechanical grease interceptors are much smaller in size than the typical gravity grease interceptor. These units are more often located indoors and can be somewhat automated to draw off grease, making maintenance easier.



Definitions

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



STACK VENT: The extension of a soil or waste stack above the highest horizontal drain connected to the stack.

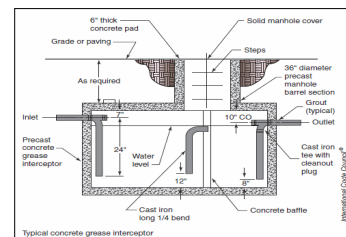
❖ A stack vent is the dry extension of a soil or waste stack. Generally, a stack vent extends to the open air and can serve as a vent to which branch vents connect.

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Grease Interceptor

- ▶ **Gravity**

Gravity grease interceptors are typically large tanks, usually buried below a parking lot or driveway, that provide for quiescent flow of grease-laden waste through the tank. Internal baffles and changes in flow direction cause solids to settle out and grease to float.



Plumbing Appliance

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.

There is difference between a plumbing appliance and a plumbing fixture.

- A dishwasher is a plumbing appliance as the operation or control is dependent on one or more energized components.
- Because a jetted whirlpool tub does not depend upon energized components to be a bathtub, it is a plumbing fixture.



Q&A

Chapter Two

Plumbing Fixture

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 connected. 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 fixture could have only a water supply connected to it, only a waste line connected to it, or both.



Questions and Answers

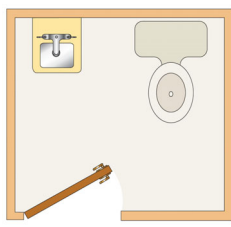
► **Question:** What is the pipe called that receives the discharge of the building drain and conveys it to a public sewer?

- A. Branch Interval
- B. Grease Interceptor
- C. Building Sewer
- D. Plumbing Fixture

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Toilet Facility

- A room or space that contains not less than one water closet and one lavatory.



Toilet facility

One might incorrectly interpret this to mean that only separate (male/female) water closet compartments are required. The intent of the code is that separate rooms or spaces that have not less than one water closet and one lavatory are required. The newer definition makes this clear.

Questions and Answers

C. Building Sewer

Recall Definition:

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.

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General Regulations

Chapter 3


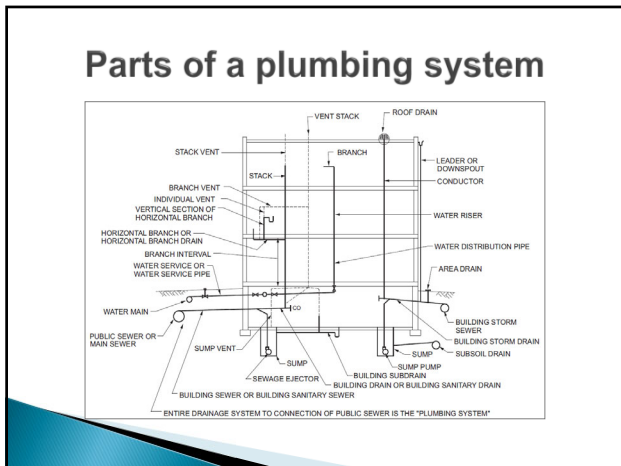
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Section 304.1 Connections to Plumbing System Required

Plumbing fixtures must connect directly to the drainage system, except as required by Chapter 8 for indirect wastes.

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.

Section 309.4 – Installation Practices

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.



Section 303.2.1 Marking

NOMINAL PIPE DIAMETER: 3/4"

MANUFACTURER (480 psi) NSF-pw D-1785 PVC 1120 Sch. 40 code no.

ASTM MATERIAL CLASSIFICATION: NSF-pw

ASTM SPECIFICATION: D-1785

ASTM MATERIAL CLASSIFICATION: PVC 1120

ASTM SPECIFICATION: Sch. 40

code no.

MANUFACTURER'S BRAND NAME

NSF-pw = NATIONAL SANITATION FOUNDATION - POTABLE WATER

PRESSURE RATING IN PSI FOR WATER AT 73° F

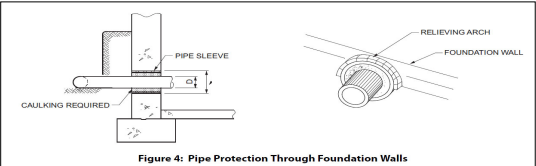
MANUFACTURER'S LOT NUMBER AND DATE CODE

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, °C = [(°F) - 32]/1.8.

SAMPLE MARKING OF PVC PIPE

Each length of pipe and each pipe fitting, trap, fixture, material and device utilized in a plumbing system shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.

Section 312.0-Protection of Piping, Materials, and Structures



Labels in diagram: PIPE SLEEVE, CAULKING REQUIRED, RELIEVING ARCH, FOUNDATION WALL.

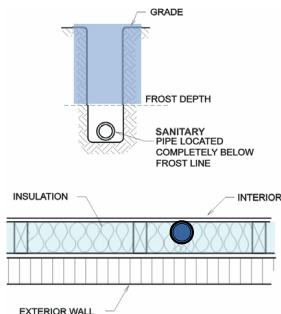
Figure 4: Pipe Protection Through Foundation Walls

Piping passing under or through walls shall be protected from breakage. Voids around piping passing through concrete floors on the ground shall be sealed.

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.

Section 312.6 - Freezing

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.



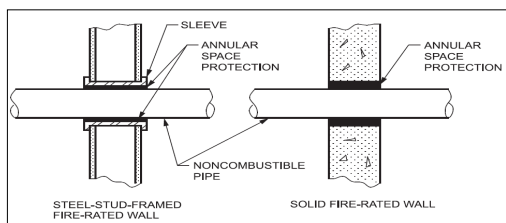
Section 313.0 – Hangars and Supports

The hangars and supports for plumbing system piping must be capable of supporting the load imposed by the piping system and not be detrimental to the pipe they support.

When the hanger or strapping material is not compatible with the piping material it supports, corrosion caused by galvanic action can occur.



Section 312.7 - Fire-Resistant Construction



These penetrations must be protected in accordance with the building code and Chapter 14, "Firestop Protection."

Section 313.0 – Hangars and Supports

Types of piping hangars and supports



TYPE	Material	Notes
PIPE CLAMPS	Black Light Duty	Standard
	Black Heavy Duty	Standard
PIPE CLAMPS	Black Light Duty	Standard
	Black Heavy Duty	Standard
PIPE CLAMPS	Black Light Duty	Standard
	Black Heavy Duty	Standard
PIPE SUPPORTS	Black Light Duty	Standard
	Black Heavy Duty	Standard
UNDER-DECK ATTACHMENTS	Black Light Duty	Standard
	Black Heavy Duty	Standard
PIPE CLAMPS AND SUPPORTS	Black Light Duty	Standard
	Black Heavy Duty	Standard
PIPE CLAMPS AND SUPPORTS	Black Light Duty	Standard
	Black Heavy Duty	Standard

Section 312.9 - Steel Nail Plates

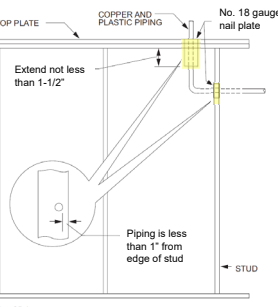
312.9 Steel Nail Plates. Plastic and copper or copper alloy piping penetrating framing members to within 1 inch (25.4 mm) of the exposed framing shall be protected by steel nail plates not less than No. 18 gauge (0.0478 inches) (1.2 mm) in thickness. The steel nail plate shall extend along the framing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

Exception: See Section 1210.3.3.

Fuel gas piping

1210.3.3 Tubing in Partitions. This provision shall not apply to tubing that passes walls, floors, or partitions. Tubing installed vertically and horizontally inside below walls or partitions without protection along its entire concealed length shall meet the following requirements:

- (1) A steel annular barrier not less than 0.0508 of an inch (1.3 mm) thick, or equivalent, is installed between the tubing and the finished wall and extends at least 4 inches (102 mm) beyond concealed penetrations of plates, firestops, wall studs, and similar construction features.
- (2) The tubing is installed in single runs and is rigidly secured. (NFPA 54-7.3.4)



Section 313.0 – Hangars and Supports

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



Table 313.3

**TABLE 313.3
HANGERS AND SUPPORTS**

MATERIALS	TYPES OF JOINTS	HORIZONTAL		VERTICAL
		Lead and Outlet	5 feet, except 10 feet where 10 foot lengths are installed ^{1,2,3}	Base and each floor, not to exceed 15 feet
Cast	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	Base and each floor, not to exceed 15 feet
	Shielded Coupling	Every other joint, unless over 4 feet then support each joint ^{1,2,3}	Base and each floor, not to exceed 15 feet	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}	Base and each floor, not to exceed 15 feet	Base and each floor, not to exceed 15 feet
Copper & Copper Alloys	Soldered, Braised, Threaded, or Mechanical	1½ inches and smaller, 6 feet; 2 inches and larger, 10 feet	Each floor, not to exceed 10 feet ²	Each floor, not to exceed 10 feet ²
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 ²	Every other floor, not to exceed 25 feet ²
Steel Pipe for Gas	Threaded or Welded	¾ inch, 6 feet; 1 inch and 1 inch, 8 feet; 1½ inches and larger, 10 feet	¾ inch, 6 feet; 1 inch and 1 inch, 8 feet; 1½ inches every floor level	¾ inch, 6 feet; 1 inch and 1 inch, 8 feet; 1½ inches every floor level
Schedule 40 PVC and ABS DWV	Solvent Cemented	All sizes, 4 feet, allow for expansion every 30 feet ²	Base and each floor, provide mid-story guides, provide for expansion every 30 feet	Base and each floor, provide mid-story guides, provide for expansion every 30 feet
CPVC	Solvent Cemented	1 inch and smaller, 3 feet; 1½ inches and larger, 4 feet	Base and each floor, provide mid-story guides	Base and each floor, provide mid-story guides
CPVC-AL-CPVC	Solvent Cemented	¾ inch, 3 feet; 1 inch, 6 feet	Base and each floor, provide mid-story guide	Base and each floor, provide mid-story guide
Lead	Wiped or Burned	Continuous Support	Not to exceed 4 feet	Not to exceed 4 feet
Steel	Mechanical	In accordance with standards acceptable to the Authority Having Jurisdiction	Not to exceed 4 feet	Not to exceed 4 feet
	Cold Expansion, Insert and Compression	1 inch and smaller, 32 inches; 1½ inches and larger, 4 feet	Base and each floor, provide mid-story guides	Base and each floor, provide mid-story guides
PEX		1 inch and smaller, 32 inches; 1½ inches and larger, 4 feet	Base and each floor, provide mid-story guides	Base and each floor, provide mid-story guides
PEX-AL-PEX	Metal Insert and Metal Compression	¾ inch } All sizes 98 inches ¾ inch } 1 inch }	Base and each floor, provide mid-story guides	Base and each floor, provide mid-story guides
PE-AL-PE	Metal Insert and Metal Compression	¾ inch } All sizes 98 inches ¾ inch } 1 inch }	Base and each floor, provide mid-story guides	Base and each floor, provide mid-story guides
PE-RT	Insert and Compression	1 inch and smaller, 32 inches; 1½ inches and larger, 4 feet	Base and each floor, provide mid-story guides	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; 1½ inches and larger, 4 feet	Base and each floor, provide mid-story guides	Base and each floor, provide mid-story guides




Table 313.3 Notes

- 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.

Notes to Table 313.3 are additional requirement that must be followed when indicated.

Section 313.7 – Gas Piping

313.7 Gas Piping. Gas piping shall be supported by metal straps or hooks at intervals not to exceed those shown in Table 1210.2.4.1.

**TABLE 1210.2.4.1
SUPPORT OF PIPING
(NFPA 54: TABLE 72.5.2)**

STEEL PIPE, NOMINAL SIZE OF PIPE (inches)	SPACING OF SUPPORTS (feet)	NOMINAL SIZE OF TUBING SMOOTH-WALL (inches O.D.)	SPACING OF SUPPORTS (feet)
¾	6	¾	4
¾ or 1	8	¾ or 1	6
1¼ or larger (horizontal)	10	¾ or 1 (horizontal)	8
1¼ or larger (vertical)	Every floor level	1 or larger (vertical)	Every floor level

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

Note: Spacing of supports for CSST shall be in accordance with the CSST manufacturer's instructions.

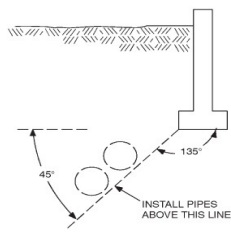


Section 314.1 - Trenches

Trenches installed parallel to footings must remain outside the bearing plane of the bottom of the footing.

Note that this is not just the pipe itself but the trench that the pipe is being installed in.

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.



Section 313.6 – Hanger Rod Sizes

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**

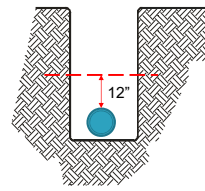
PIPE AND TUBE SIZE (inches)	ROD SIZE (inches)
½ – 4	¾
5 – 8	1
10 – 12	1½

For SI units: 1 inch = 25.4 mm



Section 314.4 - Excavations

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.




Section 318.0 – Test Gauges

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.




Fixtures and Fixture Fittings

Chapter 4

70

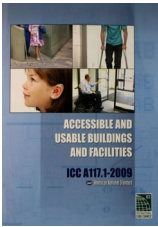
Section 319.0 – Medical Gas and Vacuum Systems

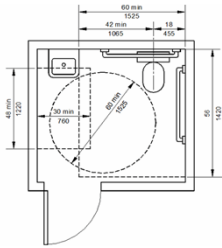
Piping shall be in accordance with the requirements of Chapter 13. The Authority Having Jurisdiction shall require evidence of the competency of the installers and verifiers.



Section 403.0 - Accessible Plumbing Facilities

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.





Part II: Fixtures, Water Heaters, and Water Supply & Distribution

69

Section 403.3 - Accessible Plumbing Facilities

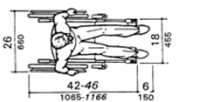
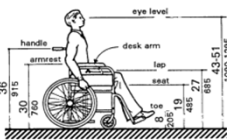
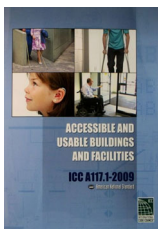
403.3 Exposed Pipes and Surfaces. Water supply and drain pipes under accessible lavatories and sinks shall be insulated or otherwise be configured to protect against contact. Protectors, insulators, or both shall comply with ASME A112.18.9 or ASTM C1822.





Understanding some basics and key areas of ICC A117.1

Standard wheelchair dimensions



NOTE: Footrest may extend further for tall people

ICC A117.1 - Chapter 3 – Building Blocks

306.2 Toe Clearance.

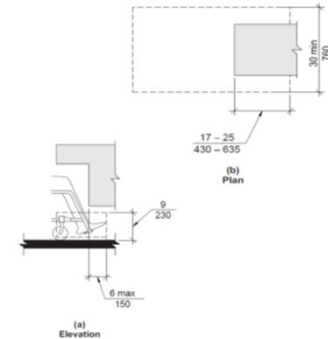
306.2.1 General. Space beneath an element between the floor and 9 inches (230 mm) above the floor shall be considered toe clearance, and shall comply with Section 306.2.

306.2.2 Maximum Depth. Toe clearance shall be permitted to extend 25 inches (635 mm) maximum under an element.

306.2.3 Minimum Depth. Where toe clearance is required at an element as part of a clear floor space complying with Section 305, the toe clearance shall extend 17 inches (430 mm) minimum beneath the element.

306.2.4 Additional Clearance. Space extending greater than 6 inches (150 mm) beyond the available knee clearance at 9 inches (230 mm) above the floor shall not be considered toe clearance.

306.2.5 Width. Toe clearance shall be 30 inches (760 mm) minimum in width.



ICC A117.1 - Chapter 3 – Building Blocks

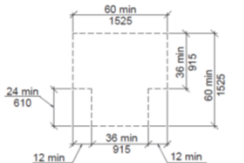
304.3 Size. Turning spaces shall comply with Section 304.3.1 or 304.3.2.

304.3.1 Circular Space. The turning space shall be a circular space with a 60-inch (1525 mm) minimum diameter. The turning space shall be permitted to include knee and toe clearance complying with Section 306.

304.3.2 T-Shaped Space. The turning space shall be a T-shaped space within a 60-inch (1525 mm) minimum square, with arms and base 36 inches (915 mm) minimum in width. Each arm of the T shall be clear of obstructions 12 inches (305 mm) minimum in each direction, and the base shall be clear of obstructions 24 inches (610 mm) minimum. The turning space shall be permitted to include knee and toe clearance complying with Section 306 only at the end of either the base or one arm.



(a) Circular



(b) T-shaped

ICC A117.1 - Chapter 3 – Building Blocks

306.3 Knee Clearance.

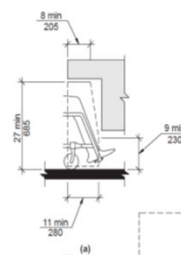
306.3.1 General. Space beneath an element between 9 inches (230 mm) and 27 inches (685 mm) above the floor shall be considered knee clearance and shall comply with Section 306.3.

306.3.2 Maximum Depth. Knee clearance shall be permitted to extend 25 inches (635 mm) maximum under an element at 9 inches (230 mm) above the floor.

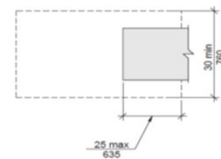
306.3.3 Minimum Depth. Where knee clearance is required beneath an element as part of a clear floor space complying with Section 305, the knee clearance shall be 11 inches (280 mm) minimum in depth at 9 inches (230 mm) above the floor, and 8 inches (205 mm) minimum in depth at 27 inches (685 mm) above the floor.

306.3.4 Clearance Reduction. Between 9 inches (230 mm) and 27 inches (685 mm) above the floor, the knee clearance shall be permitted to be reduced at a rate of 1 inch (25 mm) in depth for each 6 inches (150 mm) in height.

306.3.5 Width. Knee clearance shall be 30 inches (760 mm) minimum in width.



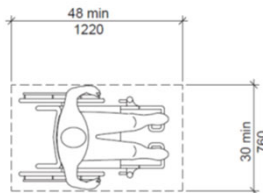
(a) Elevation



(b) Plan

ICC A117.1 - Chapter 3 – Building Blocks

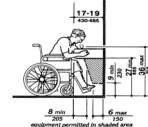
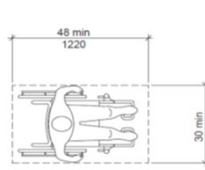
305.3 Size. The clear floor space shall be 48 inches (1220 mm) minimum in length and 30 inches (760 mm) minimum in width.



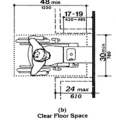
ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

602 Drinking Fountains.

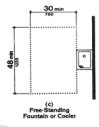
602.2 Clear Floor Space. A clear floor space complying with Section 305, positioned for a forward approach to the drinking fountain, shall be provided. Knee and toe space complying with Section 306 shall be provided. The clear floor space shall be centered on the drinking fountain.



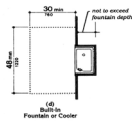
(a) Space Height and Knee Clearance



(b) Clear Floor Space



(c) Free-standing Fountain or Cooler



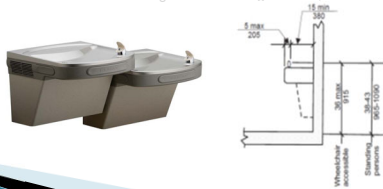
(d) Wall-mounted Fountain or Cooler

ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

602 Drinking Fountains

602.4 Spout Outlet Height. Spout outlets of wheelchair accessible drinking fountains shall be 36 inches (915 mm) maximum above the floor. Spout outlets of drinking fountains for standing persons shall be 38 inches (965 mm) minimum and 43 inches (1090 mm) maximum above the floor.

602.5 Spout Location. The spout shall be located 15 inches (380 mm) minimum from the vertical support and 5 inches (125mm) maximum from the front edge of the drinking fountain, including bumpers. Where only a parallel approach is provided, the spout shall be located 3-1/2 inches (90 mm) maximum from the front edge of the drinking fountain, including bumpers.



ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

604 Water Closets and Toilet Compartments

604.2 Location. The water closet shall be located with a wall or partition to the rear and to one side. The centerline of the water closet shall be 16 inches (405 mm) minimum and 18 inches (455 mm) maximum from the side wall or partition. Water closets located in ambulatory accessible compartments specified in Section 604.10 shall have the centerline of the water closet 17 inches (430 mm) minimum and 19 inches (485 mm) maximum from the side wall or partition.

1109.2.2 Water closet compartment. Where water closet compartments are provided in a toilet room or bathing room, at least 5 percent of the total number of compartments shall be wheelchair accessible. Where the combined total water closet compartments and urinals provided in a toilet room or bathing room is six or more, at least 5 percent of the total number of compartments shall be ambulatory accessible, provided in addition to the wheelchair accessible compartment.

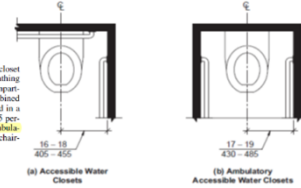


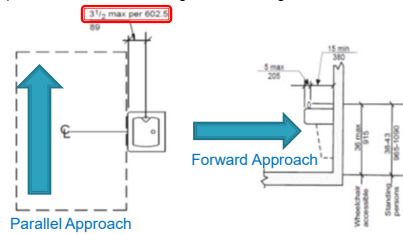
FIG. 604.2 WATER CLOSET LOCATION



ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

602 Drinking Fountains

602.5 Spout Location. The spout shall be located 15 inches (380 mm) minimum from the vertical support and 5 inches (125mm) maximum from the front edge of the drinking fountain, including bumpers. Where only a parallel approach is provided, the spout shall be located 3-1/2 inches (90 mm) maximum from the front edge of the drinking fountain, including bumpers.



ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

604 Water Closets and Toilet Compartments

604.3.1 Clearance width. Clearance around a water closet shall be 60 inches (1525 mm) minimum in width, measured perpendicular from the sidewall.
604.3.2 Clearance Depth. Clearance around the water closet shall be 56 inches (1420 mm) minimum in depth, measured perpendicular from the rear wall.

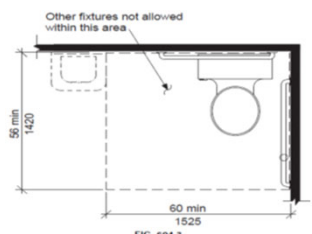


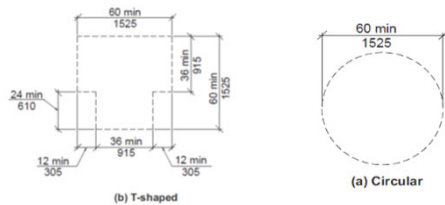
FIG. 604.3 SIZE OF CLEARANCE FOR WATER CLOSET



ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

603 Toilet and Bathing Rooms

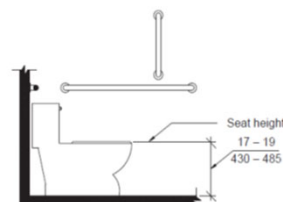
603.2.1 Turning Space. A turning space complying with Section 304 shall be provided within the room. The required turning space shall not be provided within a toilet compartment.



ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

604 Water Closets and Toilet Compartments

604.4 Height. The height of water closet seats shall be 17 inches (430 mm) minimum and 19 inches (485 mm) maximum above the floor, measured to the top of the seat. Seats shall not be sprung to return to a lifted position.

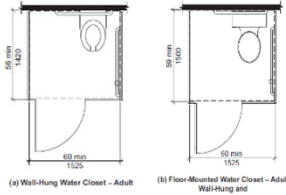


ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

604 Water Closets and Toilet Compartments

604.9.2 Size. Toilet compartments shall comply with Section 604.9.2.1 or 604.9.2.2 as applicable.

604.9.2.1 Minimum area. The minimum area of a wheelchair accessible compartment shall be 60 inches (1525 mm) minimum in width measured perpendicular to the side wall, and 56 inches (1420 mm) minimum in depth for wall hung water closets, and 59 inches (1500 mm) minimum in depth for floor mounted water closets measured perpendicular to the rear wall.

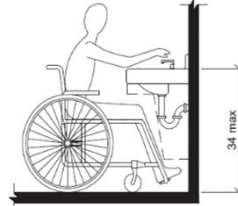


604.9.2.2 Compartment for children's use. The minimum area of a wheelchair accessible compartment primarily for children's use shall be 60 inches (1525 mm) minimum in width measured perpendicular to the side wall, and 59 inches (1500 mm) minimum in depth for wall hung and floor mounted water closets measured perpendicular to the rear wall.

ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

606 Lavatories and Sinks

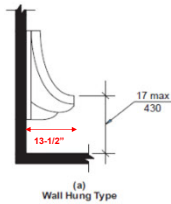
606.3 Height. The front of lavatories and sinks shall be 34 inches (865 mm) maximum above the floor, measured to the higher of the rim or counter surface.



ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

605 Urinals

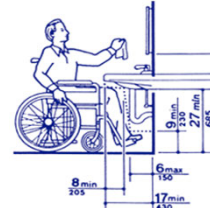
605.2 Height and Depth. Urinals shall be of the stall type or shall be of the wall hung type with the rim at 17 inches (430 mm) maximum above the floor. Wall hung urinals shall be 13- 1/2 inches (345 mm) minimum depth measured from the outer face of the urinal rim to the wall.



ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

606 Lavatories and Sinks

606.6 Exposed Pipes and Surfaces. Water supply and drainpipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks.



ICC A117.1 - Chapter 6 – Plumbing Elements and Facilities

606 Lavatories and Sinks

606.2 Clear Floor Space. A clear floor space complying with Section 305.3, positioned for forward approach, shall be provided. Knee and toe clearance complying with Section 306 shall be provided.

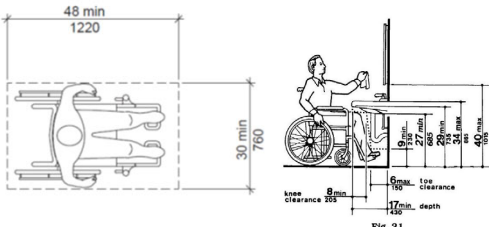


Fig. 31
Lavatory Clearances

Section 407.0 - Lavatories

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) by a device that complies with ASSE 1070/ASME A112.1070/CSA B125.70. The water heater thermostat shall not be considered a control for meeting this provision.

407.2 Water Consumption. The maximum water flow rate of faucets shall comply with Section 407.2.1 and Section 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) and 2.2 gpm at 60 psi (8.3 L/m at 414 kPa) for private lavatory faucets.

407.2.2 Metering Faucets. Metered faucets shall deliver a maximum of 0.25 gallons (1.0 L) per metering cycle.

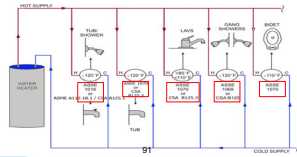


ASSE 1070

Section 408.0 – Showers

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.

Gang showers, where supplied with a single temperature-controlled water supply pipe, shall be controlled by a mixing valve that complies with ASSE 1069. Handle position stops shall be provided on such valves and shall be adjusted per the manufacturer's instructions to deliver maximum mixed water setting of 120°F (49°C). Water heater thermostats shall not be considered a suitable control for meeting this provision.



Section 415.0 — Drinking Fountains

415.2 Drinking Fountain Alternatives. Where food is consumed indoors, water stations shall be permitted to be substituted for drinking fountains. Bottle filling stations shall be permitted to be substituted for drinking fountains up to 50 percent of the requirements for drinking fountains. Drinking fountains shall not be required for an occupant load of 30 or less.

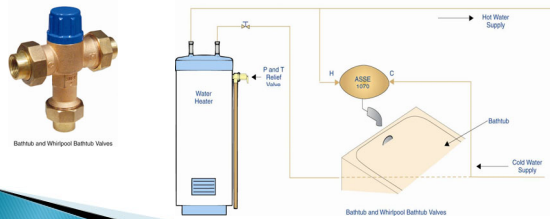


415.4 Location. Drinking fountains shall not be installed in toilet rooms.

Section 409.0 – Bathtubs and Whirlpool Bathtubs.

409.4 Limitation of Hot Water 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) by a device that complies with ASSE 1070/ASME A112.1070/CSA B125.70. The water heater thermostat shall not be considered a control for meeting this provision.

Temperature - Limited to a maximum of 120°F
Controlled by - ASSE 1070-04, Performance Requirements for Water Temperature Limiting Device



Section 418.0 - Floor Drains

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.



418.3 Location of Floor Drains. Floor drains shall be installed in the following areas:

- (1) Toilet rooms containing two or more water closets or a combination of one water closet and one urinal, except in a dwelling unit.
- (2) Commercial kitchens and in accordance with Section 704.3.
- (3) Laundry rooms in commercial buildings and common laundry facilities in multi-family dwelling buildings.
- (4) Boiler rooms.

Floor Drains 95

Section 412.0 - Urinals

412.1 Application. Urinals shall comply with ASME A112.19.2/CSA B45.1, ASME A112.19.19, or CSA B45.5/IAPMO Z124. Urinals shall have an average water consumption not to exceed 1 gallon (3.8 Lpf) of water 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.



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Section 422.2 - Separate Facilities

422.2 Separate Facilities. Separate toilet facilities shall be provided for each sex.

Exceptions:

- (1) Residential installations.
- (2) In occupancies with a total occupant load of 10 or less, including customers and employees, one toilet facility, designed for use by no more than one person at a time, shall be permitted for use by both sexes.
- (3) In business and mercantile occupancies with a total occupant load of 50 or less including customers and employees, one toilet facility, designed for use by no more than one person at a time, shall be permitted for use by both sexes.

► Exception #3 relaxes the burden on small spaces so that they do not require two accessible toilet rooms, which take up a disproportionate amount of space.

Section 422.2.2 — Family or assisted-use toilet facilities serving as separate facilities



- Added to allow two “no sex designated” family or assisted-use toilet rooms to serve a space that requires only one water closet per sex.
- Advantage is that because either toilet room can be used by either sex, there is more availability of facilities in smaller spaces without needing to offer multiple-user toilet facilities.

TABLE 422.1 MINIMUM PLUMBING FACILITIES¹

Each building shall be provided with sanitary facilities, including provisions for persons with disabilities as prescribed by the Department Having Jurisdiction. Table 422.1 applies to new buildings, additions to a building, and changes of occupancy or type in an existing building resulting in increased occupant load.

TYPE OF OCCUPANCY ²	WATER CLOSETS (FIXTURES PER PERSON) ³		URINALS (FIXTURES PER PERSON) ⁴	LAVATORIES (FIXTURES PER PERSON) ⁴		BATHUBS OR SHOWERS (FIXTURES PER PERSON)	DRINKING FOUNTAINS/FACILITIES (FIXTURES PER PERSON)	OTHER
	Male	Female	Male	Male	Female			
A-1 Assembly occupancy (fixed or permanent seating)- theaters, concert halls, and auditoriums	1: 1-100	1: 1-25	1: 1-200	1: 1-100	1: 1-100		1: 250	1 service sink or laundry tray
	2: 101-200	2: 26-50	2: 201-300	2: 201-300	2: 201-300		2: 251-500	
	3: 201-400	3: 51-100	3: 301-400	3: 301-400	3: 401-600		3: 501-750	
		4: 101-200	4: 401-600	4: 601-750	5: 301-500		6: 301-750	
	Over 400, add 1 fixture for each additional 500 males and 1 fixture for each additional 125 females.	Over 600, add 1 fixture for each additional 300 males.	Over 750, add 1 fixture for each additional 250 males and 1 fixture for each additional 200 females.			Over 750, add 1 fixture for each additional 500 persons.		
A-2 Assembly occupancy- restaurants, pubs, lounges, nightclubs and banquet halls	1: 1-50	1: 1-25	1: 1-200	1: 1-50	1: 1-50		1: 1-250	1 service sink or laundry tray
	2: 51-150	2: 26-50	2: 201-300	2: 151-200	2: 151-200		2: 251-500	
	3: 151-300	3: 51-100	3: 301-400	3: 201-400	3: 201-400		3: 501-750	
	4: 301-400	4: 101-200	4: 401-600	4: 201-400	4: 201-400		Over 750, add 1 fixture for each additional 500 persons.	
	Over 400, add 1 fixture for each additional 250 males and 1 fixture for each 125 females.	Over 600, add 1 fixture for each additional 300 males.	Over 400, add 1 fixture for each additional 250 males and 1 fixture for each additional 200 females.					

Section 422.4 - Toilet Facilities Serving Employees and Customers

Required toilet facilities for employees and customers located in shopping malls or centers shall be permitted to be met by providing a centrally located toilet facility accessible to several stores. The maximum travel distance from entry to any store to the toilet facility shall not exceed 300 feet (91.440 mm).

Required toilet facilities for employees and customers in other than shopping malls or centers shall have a maximum travel distance not to exceed 500 feet (152 m).

Table 422.1 - Minimum Plumbing Fixtures

Notes to UPC 2018 Table 422.1

- Notes:**
- The figures shown are based upon one fixture being the minimum required for the number of persons indicated or any fraction thereof.
 - A restaurant is defined as a business that sells food to be consumed on the premises.
 - The number of occupants for a drive-in restaurant shall be considered as equal to the number of parking stalls.
 - Hand-washing facilities shall be available in the kitchen for employees.
 - The total number of required water closets for females shall be not less than the total number of required water closets and urinals for males.
 - For each urinal added in excess of the minimum required, one water closet shall be permitted to be deducted. The number of water closets shall not be reduced to less than two-thirds of the minimum requirement.
 - Group lavatories that are 24 linear inches (610 mm) of wash sink or 18 inches (457 mm) of a circular basin, where provided with water outlets for such space, shall be considered equivalent to one lavatory.
 - Metering or self-closing faucets shall be installed on lavatories intended to serve the transient public.

Table 422.1 - Minimum Plumbing Fixtures

- The number of fixtures provided shall be determined based on the actual occupancy classification and function of the spaces within buildings.
 - Example Application:** A proposed restaurant.
 - Locate the Classification and Description of this space by referencing Table 422.1.

TABLE 422.1 MINIMUM PLUMBING FACILITIES¹ (continued)

TYPE OF OCCUPANCY ²	WATER CLOSETS (FIXTURES PER PERSON) ³		URINALS (FIXTURES PER PERSON) ⁴	LAVATORIES (FIXTURES PER PERSON) ⁴		BATHUBS OR SHOWERS (FIXTURES PER PERSON)	DRINKING FOUNTAINS/FACILITIES (FIXTURES PER PERSON)	OTHER
	Male	Female	Male	Male	Female			
B Business occupancy (office, professional or service-type transactions)- banks, vet clinics, hospitals, car wash, banks, beauty salons, ambulatory health care facilities, hair salons and dry cleaning, educational institutions (college high schools), or training facilities not located within school, post office and printing shops	1: 1-50	1: 1-15	1: 1-100	1: 1-75	1: 1-50		1 per 150	1 service sink or laundry tray
	2: 51-100	2: 16-30	2: 101-200	2: 76-150	2: 51-100			
	3: 101-200	3: 31-50	3: 201-400	3: 151-200	3: 101-150			
	4: 201-400	4: 51-100	4: 401-600	4: 201-300	4: 151-200			
	Over 400, add 1 fixture for each additional 500 males and 1 fixture for each additional 150 females.	Over 600, add 1 fixture for each additional 300 males.	Over 400, add 1 fixture for each additional 250 males and 1 fixture for each additional 200 females.					

Consider a Group B office building with an occupant load of 76 occupants. What is the minimum number of fixtures required?

- 76/2 = 38 male & 38 female
- Male WC:** 1 WC for 1-50 males = **1 WC Required**
- Male UR:** 1 UR for 1-100 males = **1 UR Required (Note 4 does not apply here)**
- Female WC:** 3 WC for 31-50 females = **3 WC Required**

Note 4: For each urinal added in excess of the minimum required, one water closet shall be permitted to be deducted. The number of water closets shall not be reduced to less than two-thirds of the minimum requirement.

Understanding the 2018 UPC Plumbing Requirements

TABLE 422.1 MINIMUM PLUMBING FACILITIES¹ (continued)

TYPE OF OCCUPANCY ²	WATER CLOSETS (FIXTURES PER PERSON) ³		URINALS (FIXTURES PER PERSON) ³		LAVATORIES (FIXTURES PER PERSON) ⁴		BATHROOMS OR SHOWERS (FIXTURES PER PERSON)	DRINKING FOUNTAINS (FIXTURES PER PERSON)	OTHER
	Male	Female	Male	Female	Male	Female			
B Business occupancy (office, professional or service type transactions), banks, vet clinics, hospitals, car wash, banks, heavy vehicles, ambulatory health care facilities, laundries and dry cleaning, educational institutions (above high school), or training facilities not located within school, post offices and printing shops	1: 1-50	2: 16-30	1: 1-100	1: 1-50	1: 1-75	1: 1-50			
	2: 51-100	3: 31-50	2: 101-200	2: 51-100	2: 76-150	2: 51-100			
	3: 101-200	4: 51-100	3: 201-400	3: 151-200	3: 151-200	3: 101-150			
	4: 201-400	5: 101-200	4: 401-600	4: 201-300	4: 201-300	4: 151-200			
		6: 101-200		5: 301-400	5: 301-400	5: 201-300		1 per 150	1 service sink or laundry tray
		7: 101-200		6: 301-400		6: 301-400			
	Over 400, add 1 fixture for each additional 500 males and 1 fixture for each additional 150 females.	Over 600, add 1 fixture for each additional 300 males.	Over 400, add 1 fixture for each additional 250 males and 1 fixture for each additional 200 females.						

Consider a Group B office building with an occupant load of 76 occupants. What is the minimum number of fixtures required?

- 76/2 = 38 male & 38 female
- **Male LAV:** 1 LAV for 1-75 males = 1 LAV Required
- **Female LAV:** 1 LAV for 1-50 females = 1 LAV Required

TABLE 422.1 MINIMUM PLUMBING FACILITIES¹ (continued)

TYPE OF OCCUPANCY ²	WATER CLOSETS (FIXTURES PER PERSON) ³		URINALS (FIXTURES PER PERSON) ³		LAVATORIES (FIXTURES PER PERSON) ⁴		BATHROOMS OR SHOWERS (FIXTURES PER PERSON)	DRINKING FOUNTAINS (FIXTURES PER PERSON)	OTHER
	Male	Female	Male	Female	Male	Female			
B Business occupancy (office, professional or service type transactions), banks, vet clinics, hospitals, car wash, banks, heavy vehicles, ambulatory health care facilities, laundries and dry cleaning, educational institutions (above high school), or training facilities not located within school, post offices and printing shops	1: 1-50	2: 16-30	1: 1-100	1: 1-50	1: 1-75	1: 1-50			
	2: 51-100	3: 31-50	2: 101-200	2: 51-100	2: 76-150	2: 51-100			
	3: 101-200	4: 51-100	3: 201-400	3: 151-200	3: 151-200	3: 101-150			
	4: 201-400	5: 101-200	4: 401-600	4: 201-300	4: 201-300	4: 151-200			
		6: 101-200		5: 301-400	5: 301-400	5: 201-300		1 per 150	1 service sink or laundry tray
		7: 101-200		6: 301-400		6: 301-400			
	Over 400, add 1 fixture for each additional 500 males and 1 fixture for each additional 150 females.	Over 600, add 1 fixture for each additional 300 males.	Over 400, add 1 fixture for each additional 250 males and 1 fixture for each additional 200 females.						

Consider a Group B office building with an occupant load of 76 occupants. What is the minimum number of fixtures required?

- **Service Sink:** 1 Service sink required.

TABLE 422.1 MINIMUM PLUMBING FACILITIES¹ (continued)

TYPE OF OCCUPANCY ²	WATER CLOSETS (FIXTURES PER PERSON) ³		URINALS (FIXTURES PER PERSON) ³		LAVATORIES (FIXTURES PER PERSON) ⁴		BATHROOMS OR SHOWERS (FIXTURES PER PERSON)	DRINKING FOUNTAINS (FIXTURES PER PERSON)	OTHER
	Male	Female	Male	Female	Male	Female			
B Business occupancy (office, professional or service type transactions), banks, vet clinics, hospitals, car wash, banks, heavy vehicles, ambulatory health care facilities, laundries and dry cleaning, educational institutions (above high school), or training facilities not located within school, post offices and printing shops	1: 1-50	2: 16-30	1: 1-100	1: 1-50	1: 1-75	1: 1-50			
	2: 51-100	3: 31-50	2: 101-200	2: 51-100	2: 76-150	2: 51-100			
	3: 101-200	4: 51-100	3: 201-400	3: 151-200	3: 151-200	3: 101-150			
	4: 201-400	5: 101-200	4: 401-600	4: 201-300	4: 201-300	4: 151-200			
		6: 101-200		5: 301-400	5: 301-400	5: 201-300		1 per 150	1 service sink or laundry tray
		7: 101-200		6: 301-400		6: 301-400			
	Over 400, add 1 fixture for each additional 500 males and 1 fixture for each additional 150 females.	Over 600, add 1 fixture for each additional 300 males.	Over 400, add 1 fixture for each additional 250 males and 1 fixture for each additional 200 females.						

Consider a Group B office building with an occupant load of 76 occupants. What is the minimum number of fixtures required?

- 76/2 = 38 male & 38 female
- **Drinking Fountains:** 76 Occupants. 1 Drinking fountain required for male and female use.

Water Heaters

Chapter 5

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Note: Drinking Fountains

2018 IBC Section 1109.5.1 Minimum number. Not fewer than two drinking fountains shall be provided. One drinking fountain shall comply with the requirements for people who use a wheelchair and one drinking fountain shall comply with the requirements for standing persons.

WHERE THE PLUMBING CODE REQUIRES THIS NUMBER OF DRINKING FOUNTAINS

THE BUILDING CODE REQUIRES EITHER OF THESE CONFIGURATIONS

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Section 501.1 – Water Heater Requirements

Listed appliances shall be installed in accordance with the manufacturer's installation instructions, accepted water heater appliance standards is referenced in Table 501.1(1).

TYPE	STANDARD
Electric, Household	UL 174
Oil-Fired Storage Tank	UL 732
Gas, 75 000 Btu/h or less	CSA Z21.10.1
Gas, Above 75 000 Btu/h	CSA Z21.10.3
Electric, Commercial	UL 1453
Solid Fuel	UL 2523

For SI units: 1000 British thermal units per hour = 0.293 kW

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Section 504.0 – Water Heater Requirements

504.0 Water Heater Requirements.

504.1 Location. Water heater installations in bedrooms and bathrooms shall comply with one of the following [NFPA 54:10.27.1]:



(1) Free-standing water heaters shall be permitted to 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. Combustion air for such installations shall be obtained from the outdoors in accordance with Section 506.4. The closet shall be for the exclusive use of the water heater.

(2) Water heater shall be of the direct vent type. [NFPA 54:10.27.1(2)]

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.

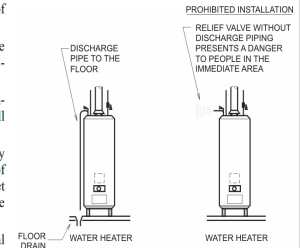
Exception: Where acceptable to the Authority Having Jurisdiction, gasketing of non-combustible or limited-combustible material shall be permitted to be applied to the frame, provided closing and latching of the door are not inhibited.

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Section 608.5 – Discharge Piping

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) Equal to 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.
- (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.



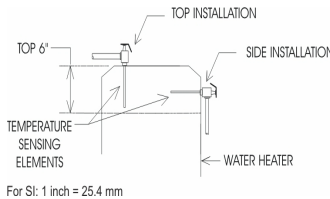
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Section 504 - Installation of temperature and pressure relief valves

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.



For SI: 1 inch = 25.4 mm

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Section 506.4 - Outdoor Combustion Air

Outdoor combustion air shall be provided through opening(s) to the outdoors in accordance with Section 506.4.1 or 506.4.2. The minimum dimension of air openings shall be not less than 3 inches.

1. Section 506.4.1 Two-permanent-openings method.
2. Section 506.4.2 One-permanent-opening method.

Section 504 - Installation of temperature and pressure relief valves

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.

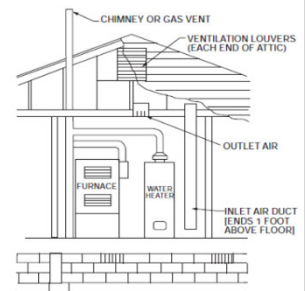
504.6 Temperature, Pressure, and Vacuum Relief Devices. Temperature, pressure, and vacuum relief devices or combinations thereof, and automatic gas shutoff devices shall be installed in accordance with the terms of their listings and the manufacturer's installation instructions. A shutoff valve shall 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.



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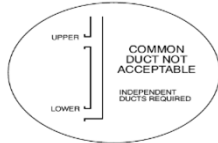
Two-Opening Method Air From Ventilated Attic

Section 506.4.1: Where directly communicating with the outdoors, or where communicating with the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4,000 Btu/h of total input rating of all appliances in the enclosure.



Combustion Air Ducts – 506.9

- In general, combustion air ducts must:
 - Be composed of corrosion-resistant material.
 - Terminate in an unobstructed space.
 - Serve a single appliance enclosure.
 - Not serve both upper / lower combustion openings.



Two Opening Method

Step 1: Summation of all gas appliances located within enclosure.
 150,000Btu/h + 50,000 Btu/h = 200,000 Btu/h

Step 2: Determine minimum net free area for each duct.
 200,000Btu/h / (4,000 Btu/h / 1 sq. in.) = **50 square inches**

Note: Some minimum square ducts that could be use are:

- 14x4 (56 sq. in.)
- 10x6 (60 sq. in.)
- 8x8 (64 sq. in.)

Calculate minimum round duct size?

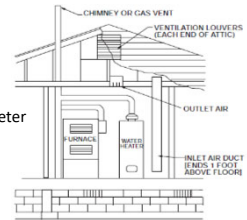
$$A = (\pi \times D^2) / 4$$

Re-write equation to solve for diameter

$$D = (A \times 4/\pi)^{1/2}$$

$$D = (50 \times 4/\pi)^{1/2}$$

$$D = 8 \text{ inches}$$



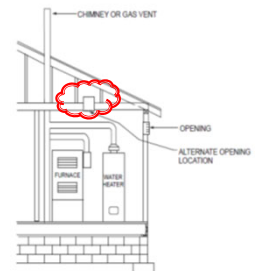
Combustion Air Ducts – 506.9

- In general, combustion air ducts must: **(cont.)**
 - Maintain separation between openings at air source.
 - Not be screened where terminating in attic.
 - Horizontal combustion air ducts shall not slope downward toward the source of combustion air.
 - Duct openings to outdoors are at least 12 inches above grade.

One-Permanent Opening Method

Section 506.4.2: One permanent opening, commencing within 12 inches of the top of the enclosure, shall be provided. The *appliance* shall have clearances of not less than 1 inch (25 mm) from the sides and back and 6 inches (152 mm) from the front of the *appliance*.

The opening shall directly communicate with the outdoors, or through a vertical or horizontal duct, to the outdoors or spaces that freely communicate with the outdoors (see Figure) and shall have a minimum free area of **1 square inch per 3,000 Btu/h** of the total input rating of all appliances located in the enclosure and **not less than** the sum of the areas of all vent connectors in the space.

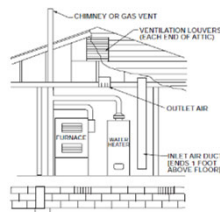


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Two Opening Method

Given: Appliance input ratings regarding a **150,000 Btu/h gas furnace** and **50,000 Btu/h gas water heater** will be installed in a mechanical room with two vertical combustion air ducts to a ventilated attic.

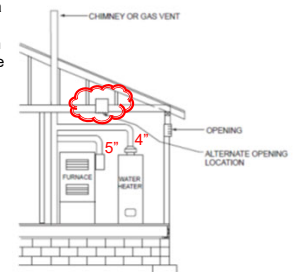
Calculated the minimum net free area (square inches) required for each vertical combustion air utilizing the "Two Opening Method"



One Opening Method

Given: Appliance input ratings regarding a **150,000 Btu/h gas furnace** and **50,000 Btu/h gas water heater** will be installed in a mechanical room with one opening in the exterior wall.

Calculated the minimum net free area (square inches) required for the exterior wall combustion air opening utilizing the "One-Permanent Opening Method"



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One Opening Method

Step 1: Summation of all gas appliances located within enclosure.
 $150,000\text{Btu/h} + 50,000\text{ Btu/h} = 200,000\text{ Btu/h}$

Step 2: Determine minimum net free area for opening.
 $200,000\text{Btu/h} / (3,000\text{ Btu/h} / 1\text{ sq. in.}) = \mathbf{67\text{ square inches}}$

Step 3: Check total area for 5" diameter and 4" diameter connectors

$$A = \pi \times D^2 / 4$$

$$= [\pi \times 5^2 / 4] + [\pi \times 4^2 / 4]$$

$$= 19.64\text{ in}^2 + 12.56\text{ in}^2$$

$$= 32.20\text{ in}^2 \text{ (Less than } 67\text{ in}^2\text{)}$$

Therefore, a minimum net free area of 67 square inches must be provided for the one opening.

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One Opening Method

Step 1: Summation of all gas appliances located within enclosure.
 $150,000\text{Btu/h} + 50,000\text{ Btu/h} = 200,000\text{ Btu/h}$

Step 2: Determine minimum net free area for opening.
 $200,000\text{Btu/h} / (3,000\text{ Btu/h} / 1\text{ sq. in.}) = \mathbf{67\text{ square inches}}$

Note: Some minimum square ducts that could be used are:

- 14x6 (84 sq. in.)
- 12x6 (72 sq. in.)
- 10x8 (80 sq. in.)

Calculate minimum round duct size?

$$A = (\pi \times D^2) / 4$$

Re-write equation to solve for diameter

$$D = (A \times 4 / \pi)^{1/2}$$

$$D = (67 \times 4 / \pi)^{1/2}$$

$$D = \mathbf{10\text{ inches}}$$

Provide wood louver for exterior wall opening!

2018 Combustion Air & Venting
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One Opening Method

Step 1: Summation of all gas appliances located within enclosure.
 $150,000\text{Btu/h} + 50,000\text{ Btu/h} = 200,000\text{ Btu/h}$

Step 2: Determine minimum net free area for opening.
 $200,000\text{Btu/h} / (3,000\text{ Btu/h} / 1\text{ sq. in.}) = \mathbf{67\text{ square inches}}$

Note: Some minimum square ducts that could be used to the attic are:

- 14x6 (84 sq. in.)
- 12x6 (72 sq. in.)
- 10x8 (80 sq. in.)

Calculate minimum round duct size?

$$A = (\pi \times D^2) / 4$$

Re-write equation to solve for diameter

$$D = (A \times 4 / \pi)^{1/2}$$

$$D = (67 \times 4 / \pi)^{1/2}$$

$$D = \mathbf{10\text{ inches}}$$

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506.8 Louvers, Grilles, and Screens

506.8 Louvers, Grilles, and Screens. The required size of openings for combustion, ventilation, and dilution air shall be based on the net free area of each opening. Where the free area through a design of louver, grille, or screen is known, it shall be used in calculating the size opening required to provide the free area specified. Where the louver and grille design and free area are not known, it shall be assumed that wood louvers have 25 percent free area and metal louvers and grilles have 75 percent free area. Nonmotorized louvers and grilles shall be fixed in the open position. [NFPA 54-9.3.7.1]

506.8.1 Minimum Screen Mesh Size. Screens shall be not less than 1/4 of an inch (6.4 mm) mesh. [NFPA 54-9.3.7.2]

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One Opening Method

Given: Provide the one opening on the exterior wall with a wood or metal louver.

Would the "net free area" have to be modified?

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One Opening Method

Step 1: Summation of all gas appliances located within enclosure.
 $150,000\text{Btu/h} + 50,000\text{ Btu/h} = 200,000\text{ Btu/h}$

Step 2: Determine minimum net free area for the opening.
 $200,000\text{Btu/h} / (3,000\text{ Btu/h} / 1\text{ sq. in.}) = \mathbf{67\text{ square inches}}$

Note: Calculate minimum opening area for a wood louver when free area is unknown (25%).

$$A = 67\text{ sq. in.} / 0.25$$

$$A = \mathbf{268\text{ sq. in.}}$$

(12x24 = 288 sq. in.)

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Understanding the 2018 UPC Plumbing Requirements

One Opening Method

Step 1: Summation of all gas appliances located within enclosure.

Step 2: Determine minimum net free area for the opening.

Note: Calculate minimum opening area for a metal louver when free area is unknown (75%).

$A = 67 \text{ sq. in.} / 0.75$
 $A = 90 \text{ sq. in.}$

$(12 \times 8 = 96 \text{ sq. in.})$

Calculate minimum round duct size?
 $A = (\pi \times D^2) / 4$
 Re-write equation to solve for diameter
 $D = (A \times 4 / \pi)^{1/2}$
 $D = (67 \times 4 / \pi)^{1/2}$
 $D = 10 \text{ inches}$

2018 Combustion Air & Venting 127

Appliance Interlock – 506.7.2

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

2018 Combustion Air & Venting 128

One Opening Method

Step 1: Summation of all gas appliances located within enclosure.
 150,000 Btu/h + 50,000 Btu/h = 200,000 Btu/h

Step 2: Determine minimum net free area for the opening.
 200,000 Btu/h / (3,000 Btu/h / 1 sq. in.) = 67 square inches

Note: Calculate minimum opening area for a metal louver when free area is unknown (75%).

$A = 67 \text{ sq. in.} / 0.75$
 $A = 90 \text{ sq. in.}$

$(12 \times 8 = 96 \text{ sq. in.})$

2018 Combustion Air & Venting 128

Mechanical Combustion Air Calculation

► Calculate required airflow rate for the proposed combustion air fan (506.7).

FIVE BOILERS (CATEGORY 1) STAGED OPERATION EACH BOILER 150,000 Btu/h INPUT

COMBUSTION AIR FAN

BOILER ROOM

(COMBUSTION AIR FAN INTERLOCKED WITH ALL BOILERS)

2018 Combustion Air & Venting 131

Mechanical Combustion Air Supply – 506.7

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

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

2018 Combustion Air & Venting 129

Mechanical Combustion Air Calculation

Given: Five gas boilers with input ratings of 150,000 Btu/h each will be installed in a boiler room.

Calculated the minimum mechanical combustion air supply in cubic feet per minute (cfm) required for the appliances assuming full load condition.

FIVE BOILERS (CATEGORY 1) STAGED OPERATION EACH BOILER 150,000 Btu/h INPUT

COMBUSTION AIR FAN

BOILER ROOM

(COMBUSTION AIR FAN INTERLOCKED WITH ALL BOILERS)

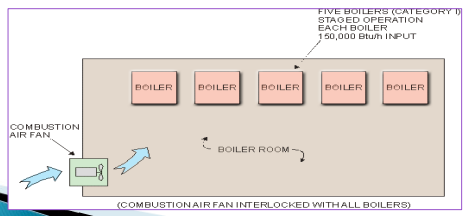
2018 Combustion Air & Venting 131

Mechanical Combustion Air Calculation

Step 1: Total gas input rating of all gas boilers located within enclosure.
 $150,000 \text{ Btu/h} \times 5 = 750,000 \text{ Btu/h}$

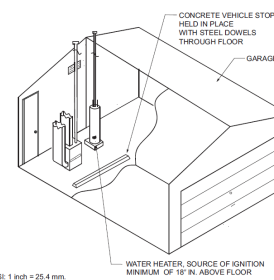
Step 2: Determine minimum supply air flow rate (cfm) required.
 $750,000 \text{ Btu/h} / (1,000 \text{ Btu/h} / 0.35 \text{ cfm}) = 263 \text{ cfm}$

Therefore, a minimum of 263 cfm is required for full load condition.



Section 507.13 - Installation in Residential Garages

507.13 Installation in Residential Garages. Appliances in residential 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 all burners and burners-ignition devices are located not less than 18 inches (457 mm) above the floor unless listed as flammable vapor ignition resistant. [NFPA 54-9.1.10.1]

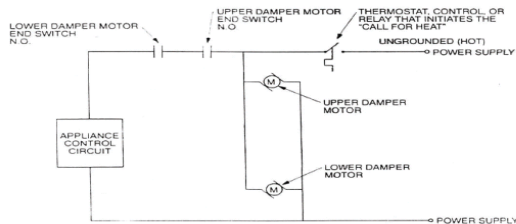


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6

506.8.2- Motorized Louvers

506.8.2 Motorized Louvers. Motorized louvers shall be interlocked with the appliance so they are proven in the full open position prior to main burner ignition and during main burner operation. Means shall be provided to prevent the main burner from igniting should the louver fail to open during burner startup and to shut down the main burner if the louvers close during burner operation. [NFPA 54-9.3.7.3]



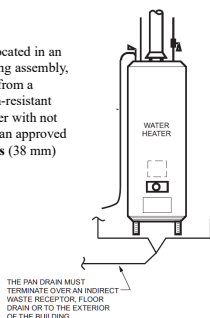
Water Supply and Distribution

Chapter 6

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Section 507.5 - Drainage Pan

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 1/4 of an inch (20 mm) diameter drain to an approved location. Such pan shall be not less than 1 1/2 inches (38 mm) in depth.



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5

Section 601.2 - Hot and Cold Water Required

Except where not deemed necessary for safety or sanitation by the Authority Having Jurisdiction, 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.

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Section 601.3 - Identification of Potable and Nonpotable Water

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: NON-POTABLE 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)
1/2 to 1 1/4	8	1/2
1 1/2 to 2	8	3/4
2 1/2 to 6	12	1 1/4
8 to 10	24	2 1/2
Over 10	32	3 1/2

For SI units: 1 inch = 25.4 mm



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Table 603.3.1 - Minimum Required Air Gaps

**TABLE 603.3.1
MINIMUM AIR GAPS FOR WATER DISTRIBUTION¹**

FIXTURES	WHERE NOT AFFECTED BY SIDEWALLS ² (inches)	WHERE AFFECTED BY SIDEWALLS ² (inches)
Effective openings ³ not greater than 1/2 of an inch in diameter	1	1 1/2
Effective openings ³ not greater than 3/4 of an inch in diameter	1 1/2	2 1/4
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 vacuum of 0 to 25 inches of mercury (85 kPa).

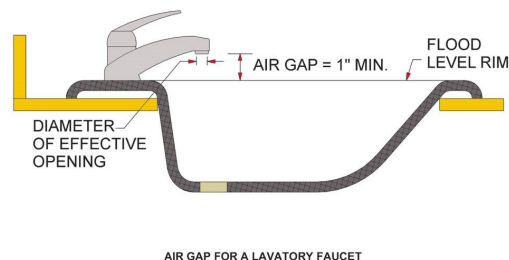
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Section 602.3 – Backflow Prevention

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.

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Air Gap for a Faucet



AIR GAP FOR A LAVATORY FAUCET

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3

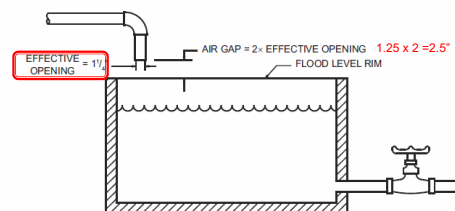
Section 603.3 – Backflow Prevention

603.3 Backflow Prevention Devices, Assemblies, and Methods. Backflow prevention devices, assemblies, and methods shall comply with Section 603.3.1 through Section 603.3.9.

603.3.1 Air Gap. The minimum air gap to afford backflow protection shall be in accordance with Table 603.3.1.

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Air Gap in Piping System

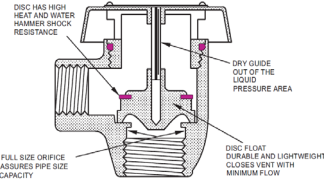


For SI: 1 inch = 25.4 mm.

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Section 603.3.2 – Atmospheric-type vacuum breakers

603.3.2 Atmospheric Vacuum Breaker (AVB). An atmospheric vacuum breaker consists of a body, a check member, and an atmospheric port.



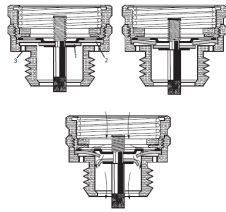
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Table 603.2

DEVICE ASSEMBLY OR METHOD ¹	APPLICABLE STANDARDS	DEGREE OF HAZARD				INSTALLATION ²
		POLYUTION (LOW HAZARD)		CONTAMINATION (HIGH HAZARD)		
		BACK-SIPHONAGE	BACK-PRESSURE	BACK-SIPHONAGE	BACK-PRESSURE	
Air gap	ASSE 1122.2	X	—	X	—	See Table 603.3.1 in this chapter.
Air gap fittings for use with plumbing fixtures, appliances, and appurtenances.	ASSE 1122.3	X	—	X	—	Air gap fittings in devices are not required for pipe, and typical installation includes plumbing fixture, appliance, and appurtenance. The critical level shall not be installed below the flood level rim.
Atmospheric vacuum breaker (consists of a body, check member and atmospheric port)	ASSE 1001 at CSA B64.1.1	X	—	X	—	Upright position. No valve downstream. Minimum of a 1/2 inch pipe diameter above all downstream piping and flood level rim.
Atmospheric air valve (checkback for gravity water) (check back breaker)	ASSE 1002; ASSE 1122.1002; CSA B61.25.12	X	—	X	—	Installation of gravity water check back valve and air valve with the air valve installed with the critical level rim (see Table 1) shall allow the opening of the overflow pipe. ³
Vacuum breakers with hydrants, hose bibbs, freeze resistant, automatic draining type	ASSE 1019 at CSA B64.2.1.1	X	—	X	—	Installations include wall hydrants and hose bibbs. Such devices are not for use under continuous pressure conditions (areas of abutment downstream of device is prohibited). ⁴
Hose connection vacuum breaker	ASSE 1011	X	—	X	—	Such devices are not for use under continuous pressure conditions. No valve downstream. ⁵
Hose connection backflow preventer	ASSE 1012	X	—	X	—	Such devices are not for use under continuous pressure conditions. ⁶
Hose connection backflow preventer wall hydrants, freeze resistant	ASSE 1013	X	—	X	—	Such devices are not for use under continuous pressure conditions. ⁶
Freeze resistant sanitary vent for drains	ASSE 1017	X	—	X	—	Such devices are not for use under continuous pressure conditions. ⁶
Backflow preventer for carbonated beverage dispensers (two independent check valves with a vent to the atmosphere)	ASSE 1022	X	—	—	—	Installation includes carbonated beverage machines or dispensers. These devices operate under continuous or continuous pressure conditions. ⁷
Split-Function Pressure Vacuum Breaker (check valve with air inlet and means of field testing)	ASSE 1054	X	—	X	—	Upright position. Minimum of 12 inches or listed distance above all downstream piping and flood level rim of receptor. ⁸
Double Check Valve Backflow Prevention Assembly (three independent check valves with a vent to the atmosphere)	ASSE 1045; AS/NZS 4711; CSA B64.4.1; CSA B64.4.1	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. Installation includes a fire protection system and is designed to operate under continuous pressure conditions.

Section 603.3.3 – Hose Connection Backflow Preventer

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.



► Hose connection vacuum breakers consist of two check valves with an atmospheric vent between the check valves.

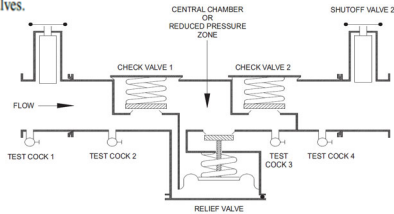
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Table 603.2

DEVICE ASSEMBLY OR METHOD ¹	APPLICABLE STANDARDS	DEGREE OF HAZARD				INSTALLATION ²
		POLYUTION (LOW HAZARD)		CONTAMINATION (HIGH HAZARD)		
		BACK-SIPHONAGE	BACK-PRESSURE	BACK-SIPHONAGE	BACK-PRESSURE	
Double Check Valve Backflow Prevention Assembly (three independent check valves with a parallel atmospheric vent consisting of a water supply 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 (check valve, atmospheric vent, normally loaded check valve, and means for field testing)	ASSE 1020 at CSA B64.1.2	X	—	X	—	Upright position. May have valve downstream. Minimum of 12 inches above all downstream piping and flood level rim of the receptor. May discharge water.
Backflow Preventer (two Backflow Prevention Assembly three independent check valves, differential pressure relief valve and means for field testing)	ASSE 1015; AS/NZS 4711; 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 Backflow Preventer (two independent check valves, differential pressure relief valve, water meter and a differential 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. Installation includes a fire protection system and is designed to operate under continuous pressure conditions.

Section 603.3.7 – Reduced pressure principle backflow prevention assemblies

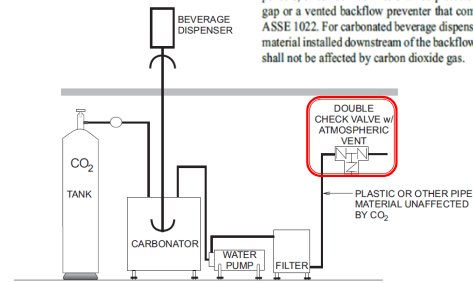
603.3.7 Reduced-Pressure Principle Backflow Prevention Assembly (RP). A reduced-pressure principle backflow prevention assembly consists of two independently acting internally loaded check valves, a differential pressure relief valve, four properly located test cocks, and two isolation valves.



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Section 603.5.12 – Beverage dispensers

603.5.12 Beverage Dispensers. Potable water supply to beverage dispensers carbonated beverage dispensers, or coffee machines shall be protected by an air gap or a vented backflow preventer that complies with ASSE 1022. For carbonated beverage dispensers, piping material installed downstream of the backflow preventer shall not be affected by carbon dioxide gas.

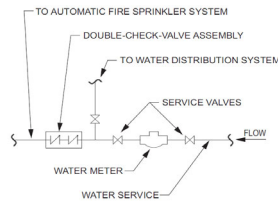


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Section 603.5.14 – Connections to fire sprinkler systems

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



A RPZ would be required if the fire sprinkler system is directly connected to a nonpotable secondary water supply or the fire sprinkler system contains chemical additives, antifreeze or liquid foam concentrates.

Section 606.0 -Valves

- ▶ Valves must be compatible with the type of piping being used
- ▶ Valves shall meet the standards in Section 606.1.
- ▶ Valves to supply drinking water shall comply with NSF 61



Section 604.1 – Materials for Water Supply & Distribution

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 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.



Section 606.2 – Fullway Valves

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 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.

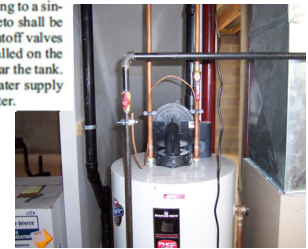
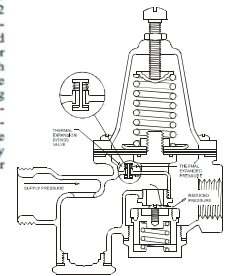


TABLE 604.1 MATERIALS FOR BUILDING SUPPLY AND WATER DISTRIBUTION PIPING AND FITTINGS			
MATERIAL	BUILDING SUPPLY PIPE AND FITTINGS	WATER DISTRIBUTION PIPE AND FITTINGS	REFERENCED STANDARD(S)
Copper and Copper Alloys	X	X	ASTM B42, ASTM B43, ASTM B75, ASTM B88, ASTM B135, ASTM B231, ASTM B302, ASTM B447
CPVC	X	X	ASTM D2846, ASTM F441, ASTM F442, CSA B137.6
CPVC-AL-CPVC	X	X	ASTM F2855
Ductile-Iron	X	X	AWWA C151
Galvanized Steel	X	X	ASTM A53
Malleable Iron	X	X	—
PE	X ^a	—	ASTM D2239, ASTM D2377, ASTM D3035, AWWA C901, CSA B137.1
PE-AL-PE	X	X	ASTM F1282, CSA B137.9
PE-AL-PEX	X	X	ASTM F1986
PE-RT	X	X	ASTM D3035, ASTM F1055, ASSE 1061, ASTM F1807, ASTM F2089, ASTM F2159, ASTM F2735, ASTM F2969, CSA B137.18
PEX	X	X	ASSE 1061, ASTM F1077, ASTM F1807, ASTM F1960, ASTM F1961, ASTM F2089, ASTM F2159, ASTM F2735, CSA B137.5
PEX-AL-PEX	X	X	ASTM F1281, CSA B137.10, ASTM F2282
PP	X	X	ASTM F2389, CSA B137.11
PVC	X ^a	—	ASTM D1785, ASTM D2241, AWWA C900
Stainless Steel	X	X	ASTM A269, ASTM A312

^aFor building supply or exterior cold-water applications, not for water distribution piping. For brazed fittings only.

Section 608.2 – Excessive Water Pressure

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 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 accessible 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.



Pressure-Reducing Valve with Thermal Expansion Bypass

Section 608.3 – Expansion Tanks, and Combination Temperature and Pressure-Relief Valves

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. 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.



Part III: Sanitary Drainage, Indirect Wastes, Traps, & Vents

Section 608.7 – Vacuum Relief Valves

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.

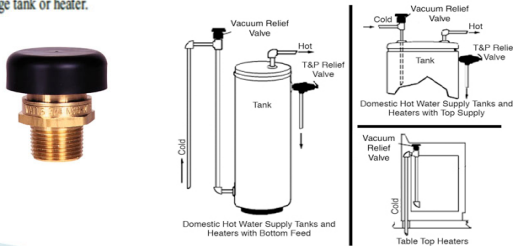


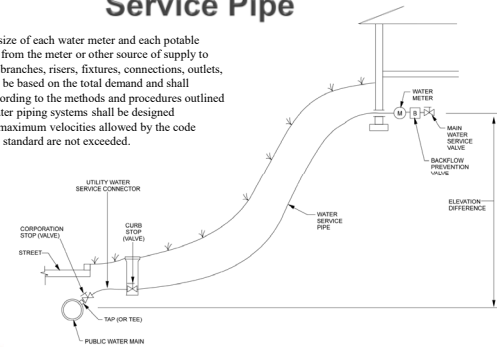
FIGURE 608.7 VACUUM RELIEF VALVE INSTALLATION

Sanitary Drainage

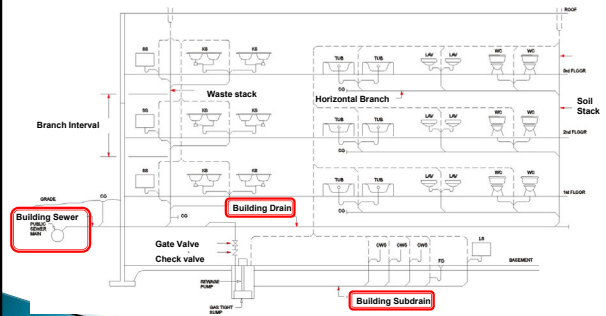
Chapter 7

Section 610.1 - Size of Water Service Pipe

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.



Section 701 - Sanitary Drainage



Section 701.2 - Drainage Piping

- 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) aboveground.
 - (2) ABS and PVC DWV piping installations shall be installed in accordance with applicable standards referenced in Table 701.2 and Chapter 14 "Firestop Protection." 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.
 - (3) No vitrified clay pipe or fittings shall be used aboveground or where pressurized by a pump or ejector. They shall be kept not less than 12 inches (305 mm) belowground.
 - (4) Copper or copper alloy tube for drainage and vent piping shall have a weight of not less than that of copper or copper alloy 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 and the stainless steel couplings used to join these products shall be listed and tested in accordance with standards referenced in Table 701.2. Such pipe and fittings shall be marked with the country of origin, manufacturer's name or registered trademark as defined in the product standards, the third party certifier's mark, and the class of the pipe or fitting.



TABLE 701.1
DRAINAGE FIXTURE UNIT VALUES (DFU)

PLUMBING APPLIANCES, APPURTENANCES, OR FIXTURES	MAXIMUM PIPE TRAP AND TRAP ARM (inches)	PRIVATE	PUBLIC	ASSEMBLY*
Bathbath or Combination Bath/Shower	2.0	2.0	2.0	—
Bidet	1.5	1.0	—	—
Choker	1.5	—	—	—
Clothes Washer, domestic, standtype ¹	3.0	—	3.0	3.0
Disposal Unit, residential	1.5	—	—	—
Drinkschutch, domestic, with independent drain ²	1.5	2.0	—	—
Drinking Fountain or Water Cooler	1.5	0.5	—	—
Food Waste Disposer, commercial	2	—	0.0	—
Floor Drain, emergency	2	2.0	—	—
Floor Drain (for additional sizes see Section 703.0)	2	2.0	—	—
Shower, multiple head trap	2	2.0	—	—
Manifold, each additional	1.5	1.0	—	—
Laundry in unit	1.5	2.0	—	—
Washbasin	1.5	2.0	—	—
Washstand	1.5	—	—	—
Mobile Home, trap	3	12.0	—	—
Receptor, indirect waste ³	—	—	See footnote ⁴	—
Receptor, indirect waste ³	2	—	See footnote ⁴	—
Receptor, indirect waste ³	3	—	See footnote ⁴	—
Sink	1	1.0	—	—
Trap	1.5	1.0	—	—
Urinal	1.5	—	2.0	2.0
Commercial with fixed waste ⁵	1.5	—	3.0	3.0
Excuse Basin	1.5	—	1.0	—
Special Purpose ⁶	1.5	2.0	3.0	3.0
Special Purpose ⁶	2	3.0	4.0	4.0
Special Purpose ⁶	3	—	0.0	0.0
Receptor, emergency ⁷	1.5	2.0	2.0	—
with or without fixed waste disposal, dishwasher, or boiler	1.5	2.0	2.0	2.0
Receptor, facility or without discharge from a clothes washer ⁸	2	—	3.0	3.0
Service or Man Basin	2	—	3.0	3.0
Service or Man Basin	2	—	3.0	3.0
Service, flushing rim	2	—	0.0	0.0
Wash, each end of fixture	3	—	—	—
Wash, each end of fixture	3	—	—	—
Urinal, tubular	1.5	2.0	2.0	—
Urinal, integral trap, 1.0 GPM ⁹	2	1.0	1.0	1.0
Urinal, integral trap, greater than 1.0 GPM	2	2.0	2.0	2.0
Urinal, equipped trap, any size ⁹	1.5	2.0	2.0	2.0
Water Closet, 1.0 GPM Flushometer Valve ¹⁰	3	3.0	4.0	4.0
Water Closet, 1.0 GPM Flushometer Valve ¹⁰	3	3.0	4.0	4.0
Water Closet, greater than 1.0 GPM Flushometer Valve ¹⁰	3	4.0	6.0	6.0
Water Closet, greater than 1.0 GPM Flushometer Valve ¹⁰	3	4.0	6.0	6.0

Notes:
 1 Indirect waste receptors shall be sized based on the total drainage capacity of the fixtures that drain thereto, in accordance with Table 702.2(2).
 2 Provide a 2 inch (50 mm) extension drain.
 3 For refrigerators, coffee urns, water stations, and similar low demands.
 4 For commercial sinks, dishwashers, and similar residential or heavy demands.
 5 Providing a trap is not a condition for use with these fixtures in a facility of five or more kitchen units; shall be sized as if Fixture units each for purposes of setting correct horizontal and vertical drainage piping.
 6 Where shown shall be connected to a fixture under circumstances equal to each shown based on Appendix B of this code.
 7 Trap size shall not be increased at the point where the fixture discharge is capable of being inadequate to maintain their self-cleaning properties.
 8 For SI units: 1 inch = 25 mm.
 9 Assembling Public Use from Table 422.1.1.

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 STANDARDS (DRAINAGE)	REFERENCED STANDARDS (FITTINGS)
ABS (Schedule 40)	X	X	X	ASTM D2688, ASTM D2089 ^a	ASTM D2688, ASTM D2089 ^a
Cast-iron	X	X	X	ASTM A74, ASTM A88, CSPI 301	ASME B16.12, ASTM A74, ASTM A88, CSPI 301
Co-Extruded ABS (Schedule 40)	X	X	X	ASTM F428	ASTM D2688, ASTM D2089 ^a
Co-Extruded Composite (Schedule 40)	X	X	X	ASTM F1488	ASTM D2688, ASTM D2089 ^a , ASTM F1866
Co-Extruded PVC (Schedule 40)	X	X	X	ASTM F1991, ASTM F1790	ASTM D2688, ASTM F1991, ASTM F1866
Copper and Copper Alloy (Type DWV)	X	X	X	ASTM B43, ASTM B75, ASTM B271, ASTM B302, ASTM B306	ASME B16.23, ASME B16.29
Galvanized Malleable Iron	—	X	—	—	ASME B16.3
Galvanized Steel	—	X	—	ASTM A53	—
Polystyrene	—	—	X	ASTM F714, ASTM F1864	—
PVC (Schedule 40)	X	X	X	ASTM D1785, ASTM D2688, ASTM F794 ^a	ASTM D2688, ASTM F794 ^a , ASTM F1866
PVC (Sewer and Drain)	—	—	X	ASTM D1729	ASTM D1729
PVC FIM	—	—	X	ASTM D384	ASTM D384
Stainless Steel 304	—	X	—	ASME A112.1.1	ASME A112.1.1
Stainless Steel 316L	X	X	X	ASME A112.1.1	ASME A112.1.1
Vitrified Clay (Extra strength)	—	—	X	ASTM C790	ASTM C790

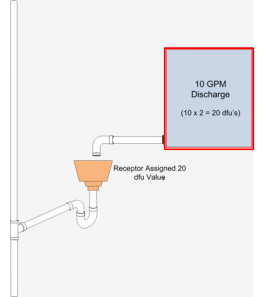
^a For building sewer applications.

Section 702.2 Intermittent Flow

TABLE 702.2(2)
DISCHARGE CAPACITY IN GALLONS PER MINUTE FOR INTERMITTENT FLOW ONLY¹

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

For SI units: 1 gallon per minute = 0.06 L/s.
 * Discharge capacity exceeding 50 gallons per minute (3.15 L/s) shall be determined by the Authority Having Jurisdiction.



Section 702.1 – Fixture Units

- 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).



Section 703.0 – Size of Drainage Piping

- 703.0 Size of Drainage Piping.**
- 703.1 Minimum Size.** The minimum size 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 701.2 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.
- 703.3 Sizing per Appendix C.** For alternate method of sizing drainage piping, see Appendix C.
- 703.0 Grade of Horizontal Drainage Piping.**
- 703.1 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 ¼ inch per foot (10.4 mm/m) or 1 percent, where first approved by the Authority Having Jurisdiction.



Table 703.2

**TABLE 703.2
MAXIMUM UNIT LOADING AND MAXIMUM LENGTH OF DRAINAGE AND VENT PIPING**

SIZE OF PIPE (inches)	1½	2	3	4	5	6	8	10	12
Maximum Units									
Drainage Piping ¹	1	2 ²	16 ²	48 ²	256	600	1380	3600	5600
Horizontal	1	1	8 ²	35 ²	210 ²	428 ²	720 ²	2640 ²	4680 ²
Maximum Length									
Drainage Piping	45	65	85	212	300	390	510	750	—
Vertical, (feet)	—	—	—	—	—	—	—	—	—
Horizontal (unlimited)	—	—	—	—	—	—	—	—	—
Vent Piping									
Horizontal and Vertical ³	1	8 ³	24	84	256	600	1380	3600	—
Maximum Units	45	60	120	212	300	390	510	750	—
Maximum Lengths, (feet)	—	—	—	—	—	—	—	—	—

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

- Notes:**
- Excluding trap arm.
 - Except for sinks, urinals, and dishwashers — exceeding 1 fixture unit.
 - Except for six-unit traps or water closets.
 - Only four water closets or six-unit traps allowed on a vertical pipe or stack, and not to exceed three water closets or six-unit traps on a horizontal branch or drain.
 - Based on 1/4 inch per foot (20.8 mm/m) slope. For 1/2 of an inch per foot (10.4 mm/m) slope, multiply horizontal fixture units by a factor of 0.8.
 - The diameter of an individual vent shall be not less than 1 1/2 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.

Section 712.1 - Testing

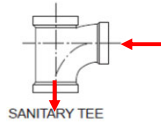
712.0 Testing.

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.

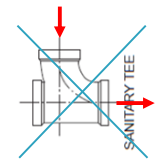
- Water:** Each section shall be filled with water, but no section shall be tested with less than a 10 foot head of water (15 minutes).
- Air:** Pressurize system until there is a uniform gauge pressure of 5 pounds-force per square inch (15 minutes).

Section 706.0 - Changes in Direction of Drainage Flow

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.

Indirect Wastes

Chapter 8

Section 707.0 - Cleanouts

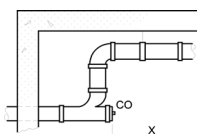
707.1 Plug. Each cleanout fitting for cast-iron pipe shall consist of a cast-iron or copper alloy body and an approved plug. Each cleanout for galvanized wrought iron, galvanized steel, copper, or copper alloy pipe shall consist of a plug as specified in Table 707.1, or a standard weight copper alloy 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.

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 18 inches (457 mm) by 18 inches (457 mm) in front of the cleanout. Cleanouts in piping exceeding 2 inches (50 mm) shall have a clearance of not less than 24 inches (610 mm) by 24 inches (610 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 5 feet (1524 mm) from an access door, trap door, or crawl hole.

**TABLE 707.1
CLEANOUTS**

SIZE OF PIPE (inches)	SIZE OF CLEANOUT (inches)	THREADS (per inch)
1½	1½	11½
2	1½	11½
2½	2½	8
3	2½	8
4 & larger	3½	8

For SI units: 1 inch = 25 mm



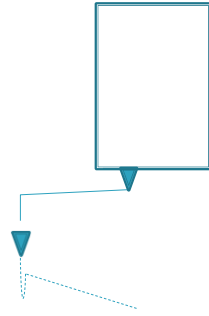
Section 804.1 - Standpipe Receptors

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. 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.



Section 801.3.2 – Walk-In Coolers

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.

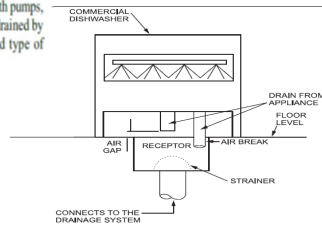


Traps

Chapter 10

Section 807.1 – Commercial dishwashing machines

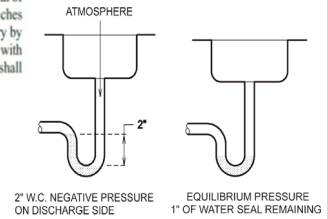
807.1 Non-Classified Apparatus. Commercial dishwashing machines, silverware washing machines, and other appliances, devices, equipment, or other apparatus not regularly classed as plumbing fixtures, which are equipped with pumps, drips, or drainage outlets, shall be permitted to be drained by indirect waste pipes discharging into an approved type of open receptor.



Section 1005.0 - Trap Seals

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.

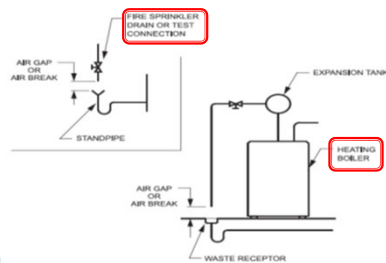


901.3 Trap Seal Protection. The vent system shall be designed to prevent a trap seal from being exposed to a pressure differential that exceeds 1 inch water column (0.24 kPa) on the outlet side of the trap.

Section 812.1 – Clear Water Waste

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.



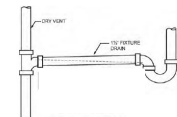
Section 1002.2 – Fixture Traps

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)
1 1/2	2 1/2	30
1 1/2	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 1/8 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).



Section 1007 – Trap Seal Protection

1007.0 Trap Seal Protection.

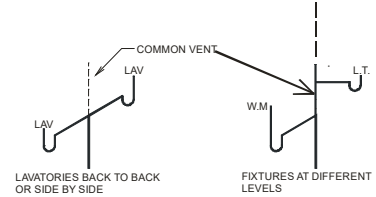
1007.1 General. Floor drain or similar traps directly connected to the drainage system and subject to infrequent use shall be protected with a trap seal primer, except where not deemed necessary for safety or sanitation by the Authority Having Jurisdiction. Trap seal primers shall be accessible for maintenance.

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.



Section 904.1 – Vent Size

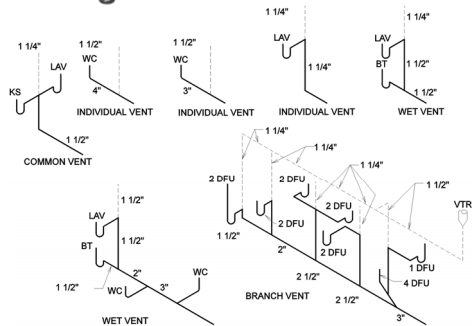
904.1 Size. The size of vent piping shall be determined from its length and the total number of fixture units connected thereto, in accordance with Table 703.2. The diameter of an individual vent shall be not less than 1/4 inches (32 mm) nor less than one-half the diameter of the drain to which it is connected.



Vents

Chapter 9

Vent Sizing



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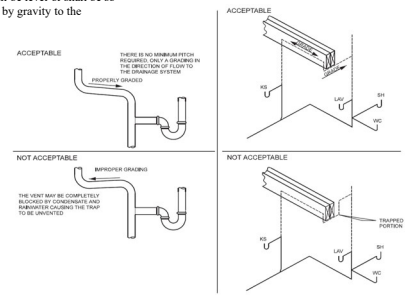
Vents – Chapter Nine

- ▶ Venting protects the trap seal by reducing differential pressures within the drainage system.
- ▶ Only plumbing systems with traps require vents, example: rainwater systems

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Section 905.1 – Grade of Vents

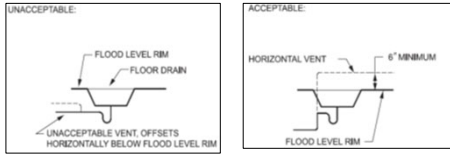
905.1 Grade. Vent and branch vent pipes shall be free from drops or sags, and each such vent shall be level or shall be so graded and connected as to drip back by gravity to the drainage pipe it serves.



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Section 905.3 - Vent Pipe Rise

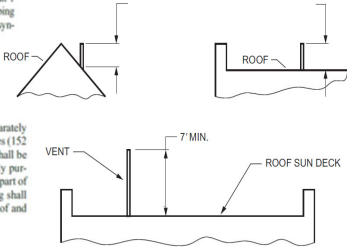
905.3 Vent Pipe Rise. Unless prohibited by structural conditions, each vent shall rise vertically to a point not less than 6 inches (152 mm) above the flood-level rim of the fixture served before offsetting horizontally, and where two or more vent pipes converge, each such vent pipe shall rise to a point 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.



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Section 906.3 - Use of Roof

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.

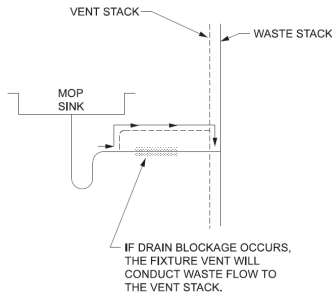


906.3 Use of Roof. Vent pipes shall be extended separately or combined, of full required size, not less than 6 inches (152 mm) above the roof or firewall. Flagpoles of vents shall be prohibited except where the roof is used for assembly purposes or parking. Vents within 10 feet (3048 mm) of a part of 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.

For SI: 1 foot = 304.8 mm.

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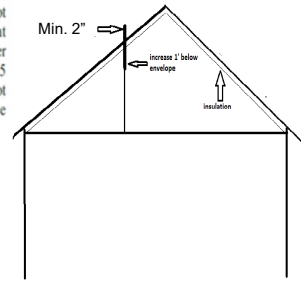
Improperly Connected Vent Serving a Drain



188

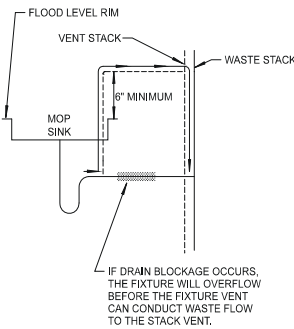
Section 906.7 - Frost closure

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.



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Properly Connected Vent Serving a Drain



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Section 908.2 - Horizontal Wet Venting for a Bathroom Group

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.

Wet vent starts at "A" and ends at "C"

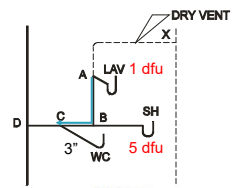


TABLE 908.2.2
HORIZONTAL LENGTHS OF TRAP ARMS
(EXCEPT FOR WATER CLOSETS AND SIMILAR FIXTURES)^{1, 2}

TRAP AND PIPE DIAMETER (inches)	VENT BRANCH TO VENT TERMINAL (inches)	LENGTH MAXIMUM (inches)
1 1/2	2 1/2	30
1 1/2	3	40
2	4	60
2	5	75
3	6	120
4	8	150
Exceeding 4	2 x Diameter	150

For 10 inches: 1 inch = 25.4 mm.

¹ Maximum: 10 inches per floor slope (20:1 maximum).
² The developed length between the trap of a water closet or similar fixture and the vent shall be not less than the length for the same size of the vent and shall not exceed the length for a size 2 diameter.

PLUMBING APPLIANCES, APPURTENANCES, OR FIXTURES	MAXIMUM PIPE SIZE AND TRAP SIZE (Inches)		
	PRIVATE	PUBLIC	ASSEMBLY*
Halfbath or Combination Bath/Shower	2,0	2,0	2,0
Bidet	1,0	1,0	1,0
Bidet	1,0	1,0	1,0
Clothes Washer, domestic, standpipe ¹	3,0	3,0	3,0
Drainal Unit, composite	2,0	2,0	2,0
Drainal Unit, composite, with independent drains ²	2,0	2,0	2,0
Drinking Fountain or Water Cooler	0,5	0,5	1,0
Drinking Fountain or Water Cooler	1,5	1,5	1,5
Floor Drain, emergency	—	0,0	0,0
Floor Drain, emergency	—	0,0	0,0
Floor Drain (for additional sizes see Section 702.0)	2	2,0	2,0
Shower, single-head trap	2	2,0	2,0
Shower, single-head trap, LT	2	2,0	2,0
Lavatory	1,5	1,5	1,5
Lavatory, each additional	—	0,5	0,5
Washbasin	1,5	1,5	1,5
Washbasin	1,5	1,5	1,5
Mobile Home, trap	12,0	12,0	12,0
Receptor, indirect waste ³	—	—	See Footnote ⁴
Receptor, indirect waste ⁴	—	—	See Footnote ⁵
Receptor, indirect waste ⁶	—	—	See Footnote ⁷
Sink	1	1,0	1,0
Sink	1,5	1,5	1,5
Bar	—	2,0	2,0
Bar	—	0,0	0,0
Commercial with food waste ⁸	—	3,0	3,0
Exam Room	1,5	1,5	1,5
Special Purpose	2,0	2,0	2,0
Special Purpose	3,0	3,0	3,0
Special Purpose	—	0,0	0,0
Receptor, domestic	1,5	2,0	2,0
Receptor, domestic	1,5	2,0	2,0
Receptor, domestic	1,5	2,0	2,0
Receptor, domestic	1,5	2,0	2,0
Receptor, domestic	1,5	2,0	2,0
Service or Map Basin	—	3,0	3,0
Service or Map Basin	—	3,0	3,0
Service, Flushing rim	—	0,0	0,0
Wash, each set of fixtures	—	2,0	2,0
Urinal, Integral trap, 1.0 GPF ⁹	2	2,0	2,0
Urinal, Integral trap, greater than 1.0 GPF	2	2,0	2,0
Urinal, integral trap, greater than 1.0 GPF	2	2,0	2,0
Urinal, exposed trap, Gravity Trap ¹⁰	1,5	2,0	2,0
Water Closet, 1.6 GPF Flushometer Valve ¹¹	3	4,0	4,0
Water Closet, 1.6 GPF Flushometer Valve ¹²	3	4,0	4,0
Water Closet, greater than 1.6 GPF Gravity Tank ¹³	3	4,0	4,0
Water Closet, greater than 1.6 GPF Flushometer Valve ¹⁴	3	4,0	4,0

Section 910 – Combination Waste and Vent System

- In a combination waste and vent system, the drain also serves as the vent for the fixture.
- The system is commonly used when floor drains are installed.

SIZE OF PIPE (Inches)	1 1/4	1 1/2	2	3	4	6	8	10	12	
Maximum Units										
Drainage Piping ¹										
Vertical	1	2 ¹	8 ¹	48 ²	256	600	1380	3600	5600	8400
Horizontal	1	1	35 ²	216 ³	428 ³	720 ³	2640 ³	4680 ³	8200 ³	—
Maximum Length										
Drainage Piping (feet)										
Vertical (unlimited)	45	65	85	212	300	390	510	750	—	—
Vent Piping										
Horizontal and Vertical ⁴										
Maximum Units	1	8 ³	24	84	256	600	1380	3600	—	—
Maximum Lengths (feet)	45	60	120	212	300	390	510	750	—	—

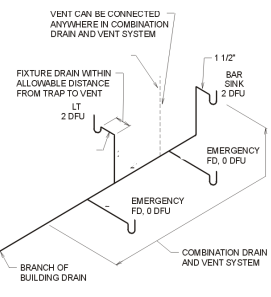
Section 910.3 - Vents

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.

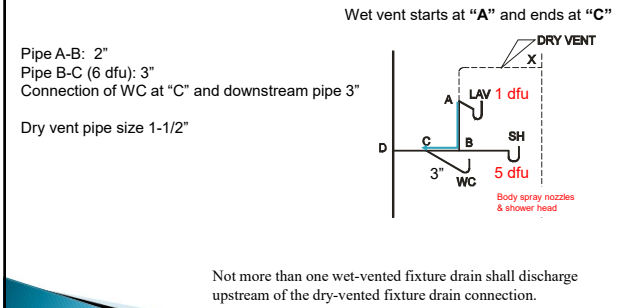
910.4 Size. Each waste pipe and each trap in such a system shall be not less than two pipe sizes exceeding the sizes required by Chapter 7 of this code, and not less than two pipe sizes exceeding a fixture tailpiece or connection.

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.



Section 908.2 - Horizontal Wet Venting for a Bathroom Group



PLUMBING APPLIANCES, APPURTENANCES, OR FIXTURES	MAXIMUM PIPE SIZE AND TRAP SIZE (Inches)		
	PRIVATE	PUBLIC	ASSEMBLY*
Halfbath or Combination Bath/Shower	2,0	2,0	2,0
Bidet	1,0	1,0	1,0
Bidet	1,0	1,0	1,0
Clothes Washer, domestic, standpipe ¹	3,0	3,0	3,0
Drainal Unit, composite	2,0	2,0	2,0
Drainal Unit, composite, with independent drains ²	2,0	2,0	2,0
Drinking Fountain or Water Cooler	0,5	0,5	1,0
Drinking Fountain or Water Cooler	1,5	1,5	1,5
Floor Drain, emergency	—	0,0	0,0
Floor Drain, emergency	—	0,0	0,0
Floor Drain (for additional sizes see Section 702.0)	2	2,0	2,0
Shower, single-head trap	2	2,0	2,0
Shower, single-head trap, LT	2	2,0	2,0
Lavatory	1,5	1,5	1,5
Lavatory, each additional	—	0,5	0,5
Washbasin	1,5	1,5	1,5
Washbasin	1,5	1,5	1,5
Mobile Home, trap	12,0	12,0	12,0
Receptor, indirect waste ³	—	—	See Footnote ⁴
Receptor, indirect waste ⁴	—	—	See Footnote ⁵
Receptor, indirect waste ⁶	—	—	See Footnote ⁷
Sink	1	1,0	1,0
Sink	1,5	1,5	1,5
Bar	—	2,0	2,0
Bar	—	0,0	0,0
Commercial with food waste ⁸	—	3,0	3,0
Exam Room	1,5	1,5	1,5
Special Purpose	2,0	2,0	2,0
Special Purpose	3,0	3,0	3,0
Special Purpose	—	0,0	0,0
Receptor, domestic	1,5	2,0	2,0
Receptor, domestic	1,5	2,0	2,0
Receptor, domestic	1,5	2,0	2,0
Receptor, domestic	1,5	2,0	2,0
Receptor, domestic	1,5	2,0	2,0
Service or Map Basin	—	3,0	3,0
Service or Map Basin	—	3,0	3,0
Service, Flushing rim	—	0,0	0,0
Wash, each set of fixtures	—	2,0	2,0
Urinal, Integral trap, 1.0 GPF ⁹	2	2,0	2,0
Urinal, Integral trap, greater than 1.0 GPF	2	2,0	2,0
Urinal, integral trap, greater than 1.0 GPF	2	2,0	2,0
Urinal, exposed trap, Gravity Trap ¹⁰	1,5	2,0	2,0
Water Closet, 1.6 GPF Flushometer Valve ¹¹	3	4,0	4,0
Water Closet, 1.6 GPF Flushometer Valve ¹²	3	4,0	4,0
Water Closet, greater than 1.6 GPF Gravity Tank ¹³	3	4,0	4,0
Water Closet, greater than 1.6 GPF Flushometer Valve ¹⁴	3	4,0	4,0

