**Plumbing Material, Fixtures, LEED**


**Web Site** http://codes.iapmo.org/home.aspx?code=UPC
**2021 UPC** https://epubs.iapmo.org/2021/UPC/

**Uniform Plumbing Code (UPC)**
The Uniform Plumbing Code provides consumers with safe and sanitary plumbing systems while, at the same time, allowing latitude for innovation and new technologies.

The public at large is invited and encouraged to take part in IAPMO's open consensus code development process. This code is updated every three years. The Uniform Plumbing Code is dedicated to all those who, in working to achieve "the ultimate plumbing code," have unselfishly devoted their time, effort, and personal funds to create and maintain this, the finest plumbing code in existence today.

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


**Web Site** http://www.bsc.ca.gov/codes.aspx
**2019 California Plumbing Code** https://epubs.iapmo.org/2019/CPC/

**BASIC PLUMBING MATERIALS**

Pipe – Cylindrical Tubing
Fittings – used to make connections between pipes and equipment
Valves – used to regulate fluid flow
Meters – Used to measure and indicate fluid flow

Classification of Pipe and Pipe Fitting Materials

Plastic
Copper
Cast Iron Soil Pipe
Steel

Check your plumbing code to determine which materials and products may be used for each application, what product standards apply, and whether there are any special provisions regarding use of the materials.

**PLASTIC PIPE AND FITTINGS**

Plastics

Petroleum-based products
Thermosetting resin – cannot be re-melted after it is formed and cured
Thermoplastic resin – can be heated and reformed

Plastic Pipe

Excellent resistance to solvents and corrosives
Resistance to heat and high temperature
Smooth interior walls
Resist bacteria growth
Good flexibility
Do not conduct electricity

Plastic Piping Used for Plumbing

Acrylonitrile-Butadiene-Styrene (ABS)
Polyvinyl Chloride (PVC)
Chlorinated Polyvinyl Chloride (CPVC)
Cross-Linked Polyethylene (PEX)

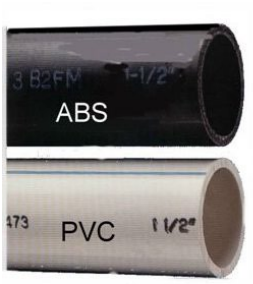
Some Jurisdictions

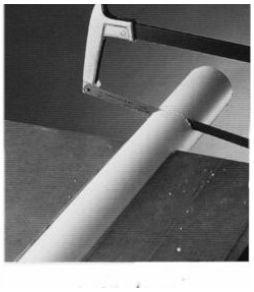
Polyethylene (PE)
Polybutylene (PB)
Polypropylene (PP)

Local plumbing code determines what type may be used.

| **APPLICATION** | Water Distribution | Sewer and Mains | Drain, Waste, and Vent | Hot and Cold Water Distribution | Fire Sprinklers | Industrial Process Piping |
|---|---|---|---|---|---|---|
| **COLOR** | Black, light blue, white, clear, or gray | Green, white, black, or gray | Black, or white | Tan, red, white, blue, silver, or clear | Orange | Dark gray – PVC<br>Light gray - CPVC |
| **PLASTIC PIPING MATERIALS** | ABS | ABS | ABS | CPVC | CPVC | PVC |
| | PVC | PVC | PVC | PEX | PB | CPVC |
| | CPVC | | PP | PB | | |
| | PEX | | | PP | | |
| | PE | | | | | |
| | PB | | | | | |

***Acrylonitrile-Butadiene- Styrene (ABS) Pipe and Fittings***
Schedule 40 ABS DWV
Black plastic
Sanitary Drainage and Vent piping
Aboveground and underground storm water drainage
Easier to install and cheaper than metal pipe. Less time needed to rough-in than metal DWV
-40˚F to 180˚F
No priming required
1 ¼" – 6"
10' and 20' pipe lengths



***Polyvinyl Chloride (PVC) Pipe and Fittings***
Schedule 40 PVC DWV
White plastic
Sanitary Drainage and vent piping
Aboveground and underground storm water drainage
Water mains
Water service lines
Joined by solvent cementing
1 ¼" – 6"
10' and 20' pipe lengths
Up to 16" available – underground drainage piping
ABS can only be joined to PVC using the proper transition coupling

Maximum length of rigid plastic DWV piping is 35'
Where pipe penetrates fire-rated walls, floors, and ceilings must use firestop (caulk), foam, or restricting collar

***Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings***
Cream-colored thermoplastic
Commonly used for hot and cold water distribution
Potable water distribution
Fire Suppression systems
Industry fluid handling
Rated for 180˚F at 100 psi of pressure
Joined by solvent cementing
½" to 12"
Schedule 40 and Schedule 80
10' pipe length


***Cross-Linked Polyethylene (PEX) Pipe and Fittings***
Water Service piping
Hot and cold water distribution
¼" to 2"
Straight lengths of 20'
Coils of 100', 300', 400', 500', and 1000'
Fast to install
Corrosion resistance
Superior strength
High-temperature and high-pressure resistant

## COPPER TUBE AND FITTINGS

### TABLE 1. Copper Tube: Types, Standards, Applications, Tempers, Lengths

| Tube Type | Color Code | Standard | Application[1] | Commercially Available Lengths[2] | | |
|---|---|---|---|---|---|---|
| | | | | Nominal or Standard Sizes | Drawn | Annealed |
| TYPE K | Green | ASTM B 88[3] | Domestic Water Service and Distribution, Fire Protection, Solar, Fuel/Fuel Oil, HVAC, Snow Melting, Compressed Air, Natural Gas, Liquified Petroleum (LP) Gas, Vacuum | **STRAIGHT LENGTHS:** | | |
| | | | | 1/4-inch to 8-inch | 20 ft | 20 ft |
| | | | | 10-inch | 18 ft | 18 ft |
| | | | | 12-inch | 12 ft | 12 ft |
| | | | | **COILS:** | | |
| | | | | 1/4-inch to 1-inch | — | 60 ft |
| | | | | | — | 100 ft |
| | | | | 1 1/4 inch and 1 1/2-inch | — | 60 ft |
| | | | | 2-inch | — | 40 ft |
| | | | | | — | 45 ft |
| TYPE L | Blue | ASTM B 88 | Domestic Water Service and Distribution, Fire Protection, Solar, Fuel/Fuel Oil, Natural Gas, Liquified Petroleum (LP) Gas, HVAC, Snow Melting, Compressed Air, Vacuum | **STRAIGHT LENGTHS:** | | |
| | | | | 1/4-inch to 10-inch | 20 ft | 20 ft |
| | | | | 12-inch | 18 ft | 18 ft |
| | | | | **COILS:** | | |
| | | | | 1/4-inch to 1-inch | — | 60 ft |
| | | | | | — | 100 ft |
| | | | | 1 1/4 inch and 1 1/2-inch | — | 60 ft |
| | | | | 2-inch | — | 40 ft |
| | | | | | — | 45 ft |
| TYPE M | Red | ASTM B 88 | Domestic Water Service and Distribution, Fire Protection, Solar, Fuel/Fuel Oil, HVAC, Snow Melting, Vacuum | **STRAIGHT LENGTHS:** | | |
| | | | | 1/4-inch to 12-inch | 20 ft | N/A |
| DWV | Yellow | ASTM B 306 | Drain, Waste, Vent, HVAC, Solar | **STRAIGHT LENGTHS:** | | |
| | | | | 1 1/4-inch to 8-inch | 20 ft | N/A |
| ACR | Blue | ASTM B 280 | Air Conditioning, Refrigeration, Natural Gas, Liquified Petroleum (LP) Gas, Compressed Air | **STRAIGHT LENGTHS:** | | |
| | | | | 3/8-inch to 4 1/8-inch | 20 ft | [4] |
| | | | | **COILS:** | | |
| | | | | 1/8-inch to 1 5/8-inch | — | 50 ft |
| OXY, MED, OXY/MED, OXY/ACR, ACR/MED | (K)Green (L)Blue | ASTM B 819 | Medical Gas Compressed Medical Air, Vacuum | **STRAIGHT LENGTHS:** | | |
| | | | | 1/4-inch to 8-inch | 20 ft | N/A |

***Copper Tube Fittings***

Cast copper alloy
Cast Bronze
Wrought Copper

***Joining***

Solder Joint Fittings
Copper Press Fittings
Rolled Groove Joint Fittings
Flared Joint Fittings
Compression Joint Fittings

**CAST IRON SOIL PIPE AND FITTINGS**

Gray cast iron – strong, corrosion-resistant
Leakproof, nonabsorbent, easily cut and joined
No-hub and Bell-and-spigot
*No-hub*: aboveground sanitary drainage, vent, and storm water drainage piping
*Bell-and-spigot*: underground sanitary drainage, vent, and storm water drainage piping

**STEEL PIPE AND FITTINGS**

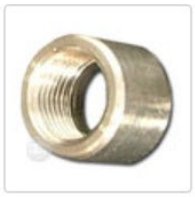
Water distribution, sanitary waste and vent, storm water drainage, and gas piping systems
Inexpensive, strong, and rugged
Weight and installation cost are factors


90° Elbows


90° Street Elbows


45° Elbows


Couplings


Half Couplings


Bell Reducer Couplings


Tees


Unions


Caps


Plugs


Hex Locknuts


Hex Bushings


Nipples


Close Nipples


Barbed Nipples


Reducing Barbed Nipples

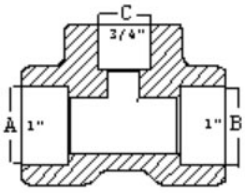

Ball Valves

**Reading Reducing Fittings**

A variety of types most commonly required for piping systems are illustrated on this page. In these illustrations, each opening of the fitting is identified with a letter which indicates the sequence to be followed in reading the size of the fitting.

In designating the outlets of reducing fittings, the openings should be read in the order indicated by the sequence of the letters "A", "B", "C", and "D". The following information is based on ASME B16.11 and MSS SP-106.

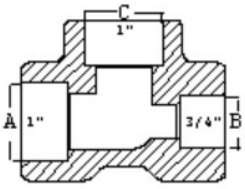
**Tee**




Reducing on outlet

(1 x 1 x 3/4)

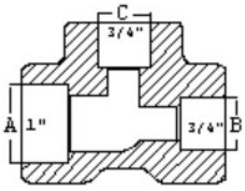
**Tee**




Reducing on one run

(1 x 3/4 x 1)

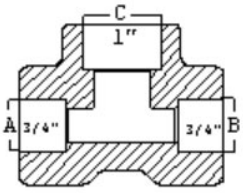
**Tee**




Reducing on one run and outlet

(1 x 3/4 x 3/4)

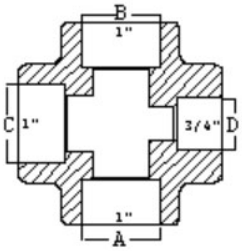
**Tee**




Reducing on both run (bullhead)

(3/4 x 3/4 x 1)

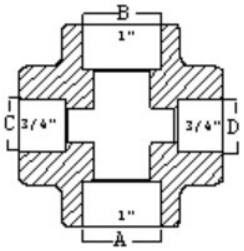
**Cross**




Reducing on one outlet

(1 x 1 x 1 x 3/4)

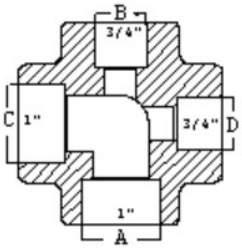
**Cross**




Reducing on both outlets

(1 x 1 x 3/4 x 3/4)

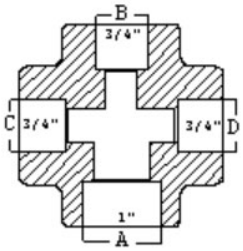
**Cross**




Reducing on one run and outlets

(1 x 3/4 x 1 x 3/4)

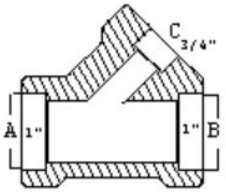
**Cross**




Reducing on one run and both outlets

(1 x 3/4 x 3/4 x 3/4)

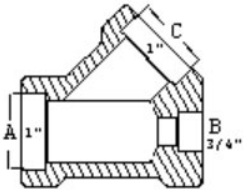
**Lateral**




Reducing on branch

(1 x 1 x 3/4)

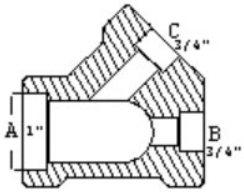
**Lateral**




Reducing on one run

(1 x 3/4 x 1)

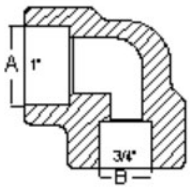
**Lateral**




Reducing on one run and branch

(1 x 3/4 x 3/4)

**Elbow**




Reducing elbow

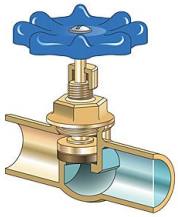
(1 x 3/4)

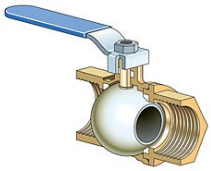
**PLUMBING VALVES**

Used to regulate fluid flow

On or off

Control direction, pressure, and/or temperature





***Types of Valves:***

| | | | | |
|---|---|---|---|---|
| Gate | Globe | Compression stop | Stop-and-waste | Sillcocks |
| Boiler drains | Core cocks | Ball | Butterfly | Check |
| Backwater | Pressure-reducing | Relief | | |

Ball Valves

Gate, Check, Low Pressure & Y-Strainers

Cast Iron Valves

Heating Valves

Thermoplastic Valves

Specialty Products

Backflow Preventers

**WATER METERS**

Measure and indicate water usage for a building in order to be charged for the amount of water used.

Measures in cubic feet or gallons

Installed at the end of the water service pipe – inside or outside the building


DIGITAL

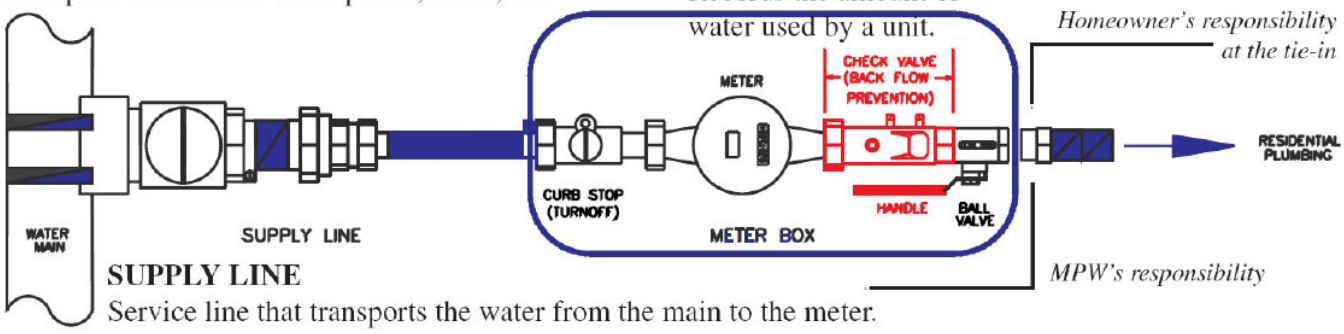

ANALOG

**WATER MAIN**

Transports water from water plants, tanks, etc.

**METER ***

Records the amount of water used by a unit.




**SUPPLY LINE**

Service line that transports the water from the main to the meter.

**Plumbing Fixtures**

**Building Water Use – Indoor**
- Flush and Flow Fixtures
- Appliances and Process Water Use

**Building Water Use – Outdoor**
- Landscape Irrigation
- Process Water Use: Cooling and Heating

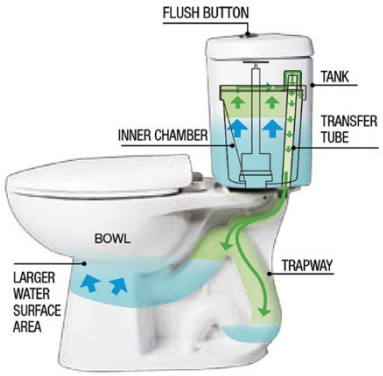
- ☐ Potable water usage in buildings constitutes a large portion of freshwater consumption.
- ☐ Strategies to reduce potable water use in buildings entail the selection of efficient plumbing fittings, fixtures, and equipment.
- ☐ Fixtures that use 20% to 50% less water than code-required levels are now widely available.
- ☐ The WaterSense® label was developed by the U.S. Environmental Protection Agency to identify these efficient fixtures and ensure that higher efficiency does not come at the cost of performance.

WaterSense Take steps each day to save water and protect the environment by choosing WaterSense labeled products in your home, yard, and business. Learn more about WaterSense and how we can all get more by using less.
https://www.epa.gov/watersense

**WaterSense® Products**

https://www.epa.gov/watersense/watersense-products

**Water Closets**




**Floor Mounted Tank**

**Wall Hung**

**Floor Mounted Flushometer**

**2016 California Plumbing Code**

| **Table 1.** Maximum Installed Flush or Flow Rates | | | |
|---|---|---|---|
| **Fixture or fitting** | **2016 CA Plumbing Code** | **EPAct 1992 Federal Standard** | **WaterSense®** |
| **Flush Fixtures** | | | |
| Flushometer-Valve Toilet (Water Closet) | 1.28 gpf | 1.6 gpf | 1.28 gpf |
| Tank Toilet (Water Closet) | 1.28 gpf | 1.6 gpf | 1.28 gpf |
| Urinal (Wall Mounted) | 0.125 gpf | 1.0 gpf | 0.5 gpf |
| Urinal (Floor Mounted) | 0.5 gpf | 1.0 gpf | 0.5 gpf |
| **Flow Fixtures** | | | |
| Residential Lavatory Faucet | 1.2 gpm @ 60 psi | 2.2 gpm @ 60 psi | 1.5 gpm @ 60 psi |
| Public lavatory (restroom) faucet | 0.5 gpm @ 60 psi | 0.5 gpm @ 60 psi | |
| Kitchen Faucet | 1.8 gpm @ 60 psi | 2.2 gpm @ 60 psi | |
| Showerhead | 2.0 gpm @ 80 psi | 2.5 gpm @ 80 psi | 2.0 gpm @ 60 psi |
| Pre-Rinse Spray Valve | 1.6 gpm @ 60 psi | 1.6 gpm @ 60 psi | 1.28 gpm @ 60 psi |

**407.0 Lavatories.**

**407.1 Application.** Lavatories shall comply with ASME A112.19.1/CSA B45.2, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4, ASME A112.19.12, CSA B45.5/IAPMO Z124, or CSA B45.11/IAPMO Z401.

**407.2 Water Consumption.** The maximum water flow rate of faucets shall comply with Section 407.2.1 through Section 407.2.2.1.

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

***407.2.1.1 Kitchen Faucets. [HCD 1]*** *The maximum flow rate of kitchen faucets shall not exceed 1.8 gallons (6.81 L) per minute at 60 psi. Kitchen faucets may temporarily increase the flow above the maximum rate, but not to exceed 2.2 gallons (8.32 L) per minute at 60 psi, and must default to a maximum flow rate of 1.8 gallons (6.81 L) per minute at 60 psi.*

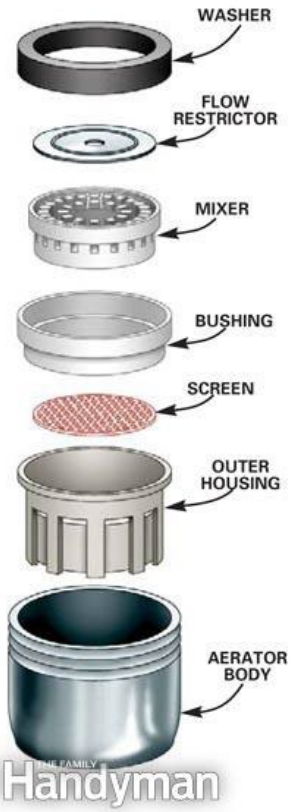
***Note:*** *Where faucets meeting the maximum flow rate of 1.8 gpm (6.81 L) are unavailable, aerators or other means may be used to achieve reduction.*

***407.2.1.2 Residential Lavatory Faucets. [HCD 1]*** *The maximum flow rate of residential lavatory faucets shall not exceed 1.2 gallons (4.54 L) per minute at 60 psi. The minimum flow rate of residential lavatory faucets shall not be less than 0.8 gallons (3.03 L) per minute at 20 psi.*

***407.2.1.3 Lavatory Faucets in Common and Public Use Areas. [HCD 1 & HCD 2]*** *The maximum flow rate of lavatory faucets, installed in common and public use areas (outside of dwellings or sleeping units) in residential buildings, shall not exceed 0.5 gallons (1.89 L) per minute at 60 psi.*

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

***407.2.2.1 Metering Faucets. [BSC-CG] [DSA-SS & DSA-SS/CC]*** *Metering Faucets shall not deliver more than 0.20 gallons (0.76 L) per cycle in com-*



**LEED for Building Design and Construction (LEED BD+C v4)**

**Credit Category**
**Water Efficiency (WE)**

| | | | |
|---|---|---|---|
| Prereq | Outdoor Water Use Reduction | Reduce 30% | |
| Prereq | Indoor Water Use Reduction | Reduce 20% | |
| Prereq | Building-Level Water Metering | | |
| Credit | Outdoor Water Use Reduction | No irrigation system or Reduce 50% or 100% | |
| Credit | Indoor Water Use Reduction | Reduce 25%, 30%, 35%, 40%, 45%, 50%, | EP ≥55% |
| Credit | Cooling Tower Water Use | Cycles of Concentration | |
| Credit | Water Metering | | |

**Prerequisite Indoor Water Use Reduction**
**LEED Requirement**

**Table 2.** Maximum Installed Flush or Flow Rates

| Fixture or fitting | EPAct 1992 Federal Standard | WaterSense® | LEED BD+C v4 | Percent Savings |
|---|---|---|---|---|
| **Flush Fixtures** | | | | |
| Flushometer-Valve Toilet* | 1.6 gpf | 1.28 gpf | | 20% |
| Tank Toilet* | 1.6 gpf | 1.28 gpf | | 20% |
| Urinal* | 1.0 gpf | 0.5 gpf | | 50% |
| **Flow Fixtures** | | | | |
| Private lavatory faucet* | 2.2 gpm @60 psi | 1.5 gpm @60 psi | | 32 % |
| Public lavatory (restroom) faucet | 0.5 gpm @60 psi | | 0.4 gpm @60 psi | 20% |
| Kitchen faucet | 2.2 gpm @60 psi | | 1.75 gpm @60 psi | 20% |
| Showerhead* | 2.5 gpm @80 psi | 2.0 gpm@60 psi | | 20% |
| Pre-Rinse Spray Valve* | 1.6 gpm @60 psi | 1.28 gpm@60 psi | | 20% |

gpf = gallons per flush gpm = gallons per minutes
* The WaterSense® label is available for this fixture type.
Energy Policy Act (EPAct) of 1992 (Baseline)

The average flush rate for **dual-flush toilets** must be calculated as the average flush volume of one full flush and two reduced flushes, using a 1:2 (high flush:low flush) ratio.

**Table 3. Typical public and private lavatory faucet applications**

| Lavatory faucet | Classification |
|---|---|
| Restroom sink<br>School classroom sinks (if used primarily for hand washing) | Public (baseline: 0.5 gpm @60 psi) |
| Residential bathroom sink<br>Hotel or motel bathroom sink<br>Dormitory bathroom sink<br>Patient room sink<br>Patient bathroom sink in hospital or nursing home | Private (baseline: 2.2 gpm @60 psi) |