Plumbing Systems

Plumbing Material

International Association of Plumbing and Mechanical Officials (IAPMO)

Plumbing Material

International Association of Plumbing and Mechanical Officials (IAPMO)

The **International Association of Plumbing and Mechanical Officials** shall be recognized by the building industry and the general public, both at home and abroad, as the world-wide leader in the plumbing and mechanical industry for:

- protecting health and safety
- supporting sustainability and emerging technology
- and delivering code education.

This shall be accomplished through the use of IAPMO codes and related services in cooperation with industry partners. IAPMO shall have recruited, retained, and empowered a diverse membership and staff that makes this possible.

Plumbing Material

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.

http://epubs.iapmo.org/UPC/mobile/index.html#p=1

Plumbing Material

http://www.iapmo.org/

Plumbing Material

2016 California Plumbing Code

http://www.bsc.ca.gov/codes.aspx

Available Online

http://epubs.iapmo.org/2016/CPC/#p=1

Plumbing Material

BASIC PLUMBING MATERIAL

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

Plumbing Material

Classification of Pipe and Pipe Fitting Materials

Plastic
Copper
Cast Iron Soil Pipe
Steel

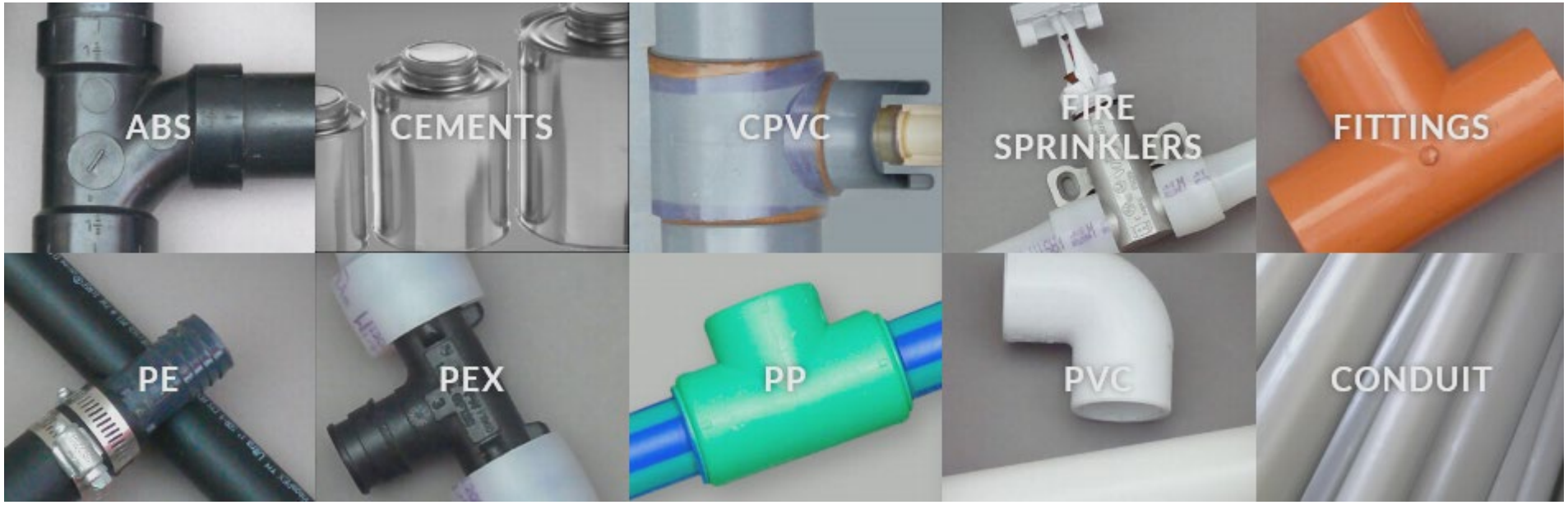
Check your plumbing code to determine which materials and products may be used for each application, what product standards apply, and whether there are any special provisions regarding use of the materials.

Plumbing Material

Plumbing Material

PLASTIC PIPE AND FITTINGS

PPFA



Plumbing Material

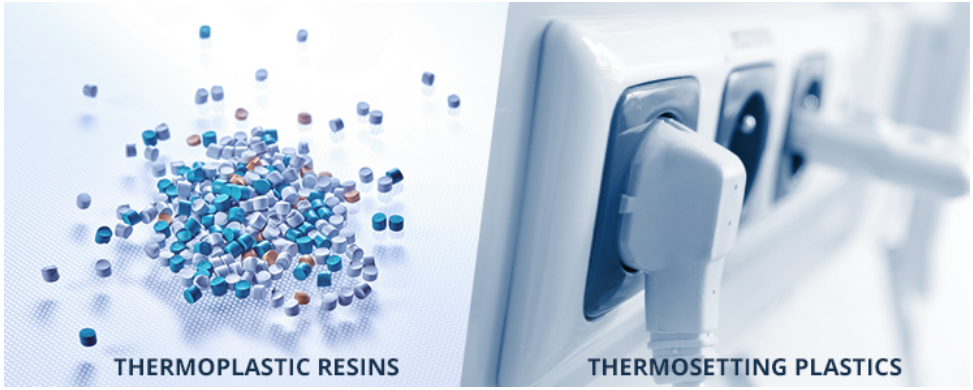
PLASTIC PIPE AND FITTINGS

Plastics

Petroleum-based products

Thermosetting resin – cannot be re-melted after it is formed and cured

Thermoplastic resin – can be heated and reformed



Plumbing Material

Plastic Pipe

Excellent resistance to solvents and corrosives

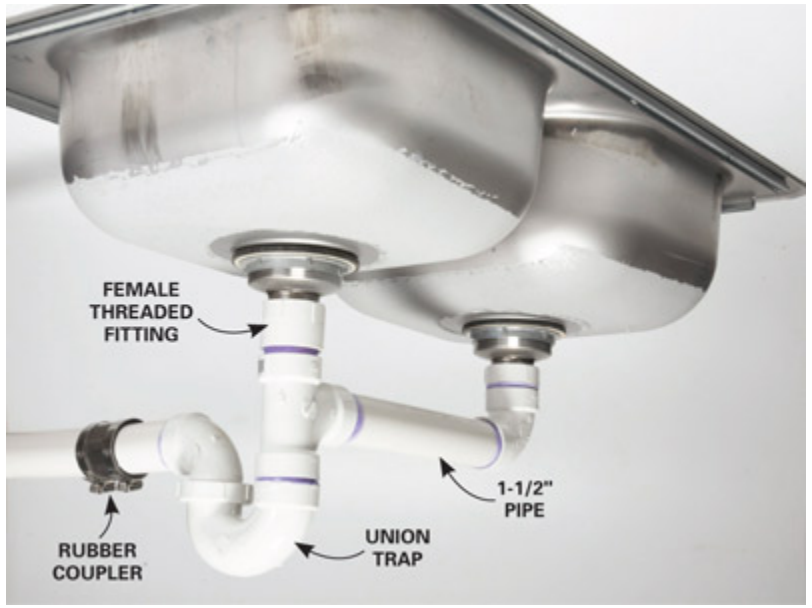
Resistance to heat and high temperature

Smooth interior walls

Resist bacteria growth

Good flexibility

Do not conduct electricity



Plumbing Material

Plastic Piping Used for Plumbing	Some Jurisdictions
Acrylonitrile-Butadiene-Styrene (ABS)	Polyethylene (PE)
Polyvinyl Chloride (PVC)	Polybutylene (PB)
Chlorinated Polyvinyl Chloride (CPVC)	Polypropylene (PP)
Cross-Linked Polyethylene (PEX)	

Local plumbing code determines what type may be used.

Plumbing Material

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 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					

Plumbing Material

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

Plumbing Material

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

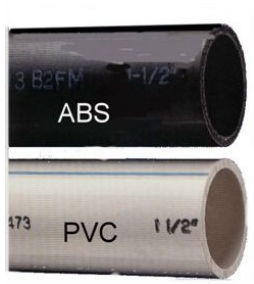
Joined by solvent cementing

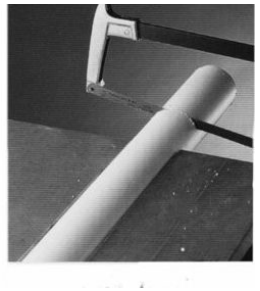
1 ¼” – 6”

10’ and 20’ pipe lengths

Up to 16” available – underground drainage piping

ABS can only be joined to PVC using the proper transition coupling





Plumbing Material

Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings

Cream-colored thermoplastic
Commonly used for hot and cold water distribution
Potable water distribution
Fire Suppression Materials
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

Plumbing Material

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

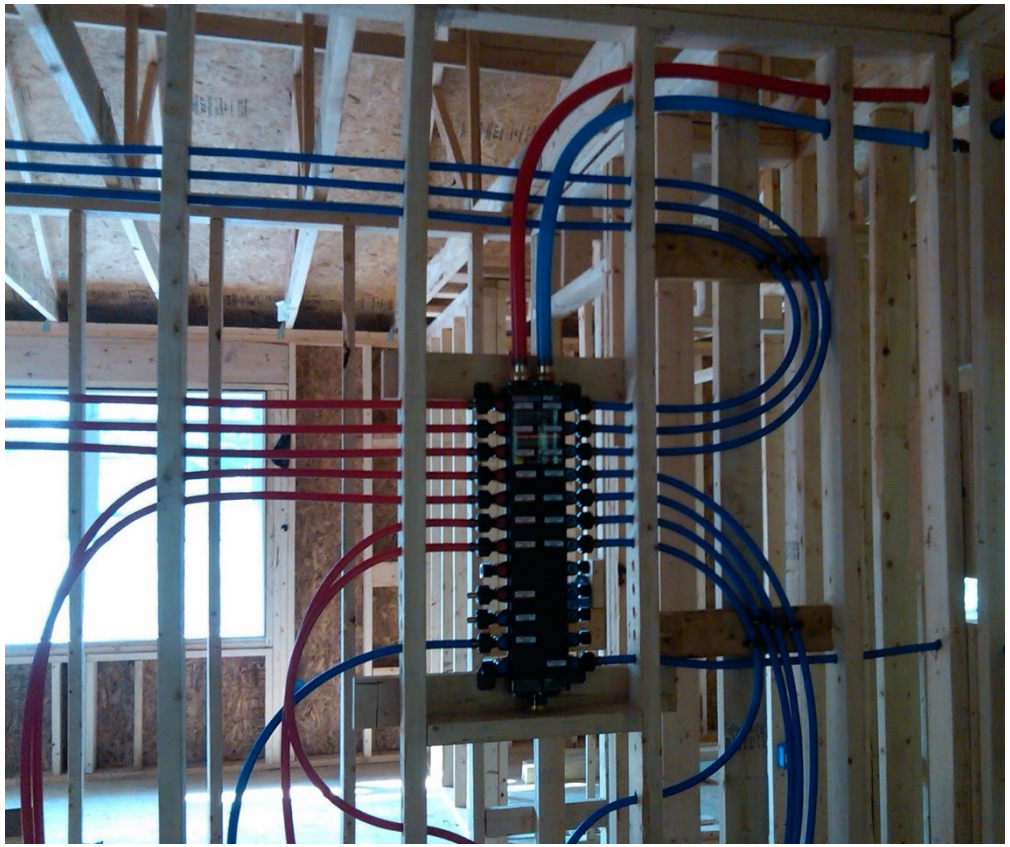
Corrosion resistance

Superior strength

High-temperature and high-pressure resistant

Plumbing Material

Cross-Linked Polyethylene (PEX)



Plumbing Material

COPPER TUBE AND FITTINGS

Plumbing Material

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

Plumbing Material

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

CAST IRON SOIL PIPE INSTITUTE

The Industry Standard Since 1949

Plumbing Material

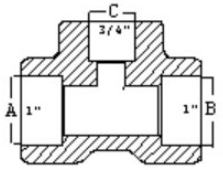
STEEL PIPE AND FITTINGS

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

Plumbing Material

READING REDUCING FITTINGS

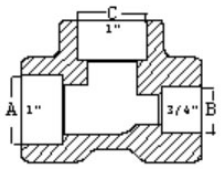
Tee



Reducing on outlet

(1 x 1 x 3/4)

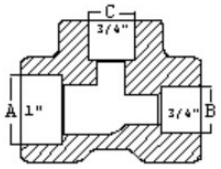
Tee



Reducing on one run

(1 x 3/4 x 1)

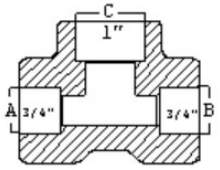
Tee



Reducing on one run and outlet

(1 x 3/4 x 3/4)

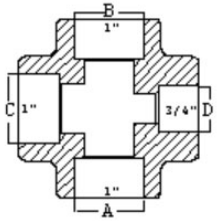
Tee



Reducing on both run (bullhead)

(3/4 x 3/4 x 1)

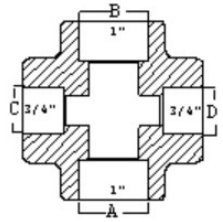
Cross



Reducing on one outlet

(1 x 1 x 1 x 3/4)

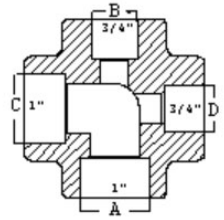
Cross



Reducing on both outlets

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

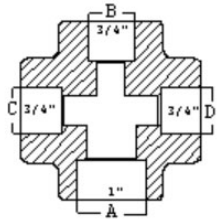
Cross



Reducing on one run and outlets

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

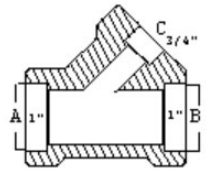
Cross



Reducing on one run and both outlets

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

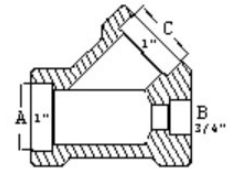
Lateral



Reducing on branch

(1 x 1 x 3/4)

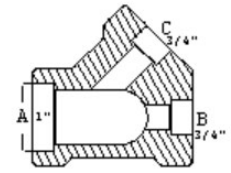
Lateral



Reducing on one run

(1 x 3/4 x 1)

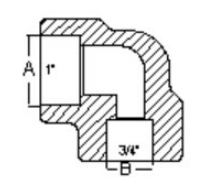
Lateral



Reducing on one run and branch

(1 x 3/4 x 3/4)

Elbow



Reducing elbow

(1 x 3/4)

Plumbing Material

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

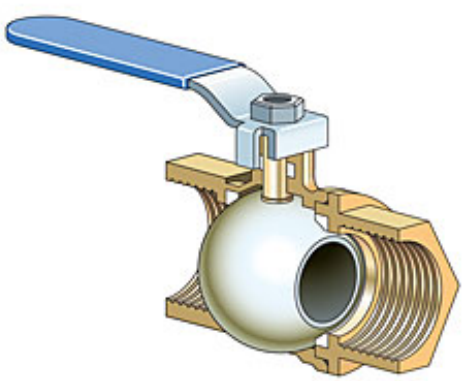
Cast Iron Valves

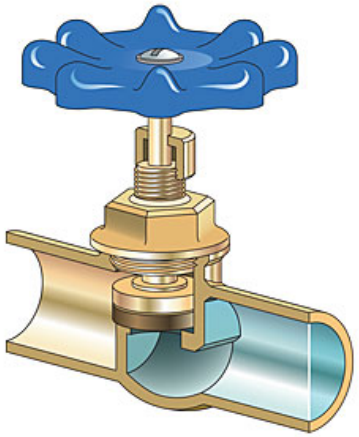
Heating Valves

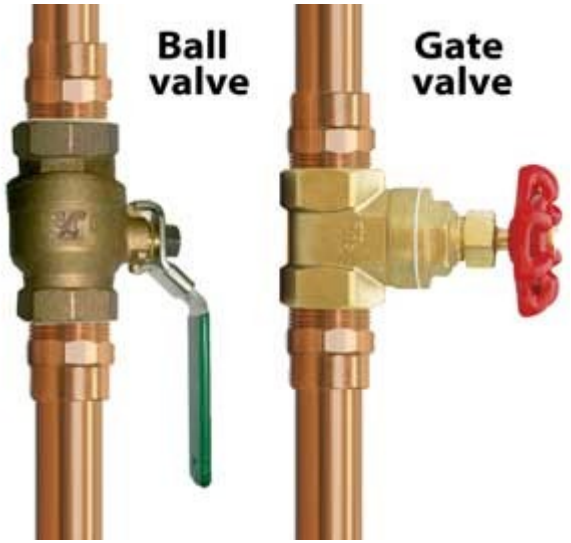
Thermoplastic Valves

Specialty Products

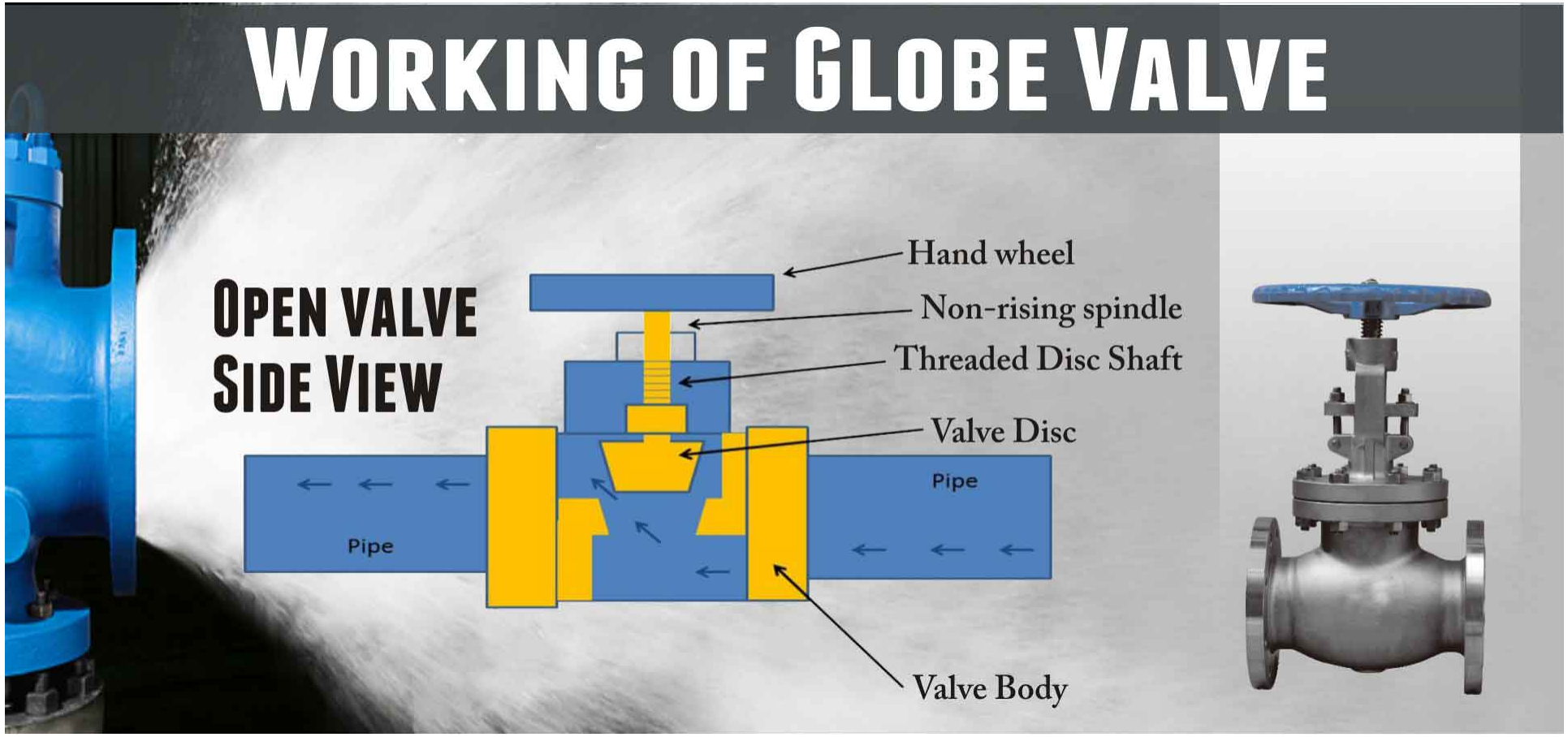
Backflow Preventers





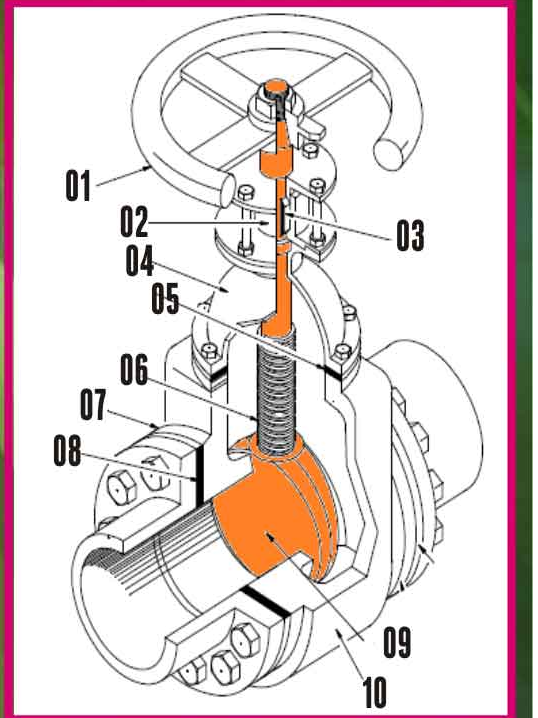

Ball valve
Gate valve

Working of Globe Valve

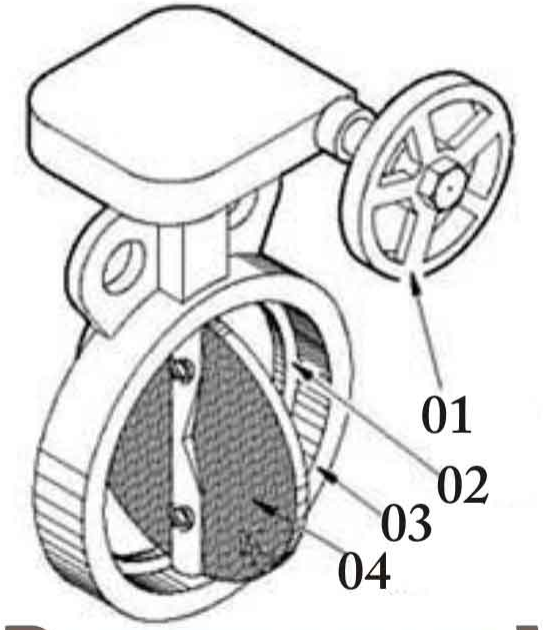


Working of Gate Valve

01-Handweel
02-Stuffing Box
03-Packing Material
04-Bonnet
05-Gasket
06-Stem
07-Flange
08-Gasket
09-Disk
10-Body



Working



01- **Operator**

02- **Seal**

03- **Body**

04- **Rotating Plate**

Definition

A Valve Consisting of a Rotating Circular Plate or a Pair of Hinged Semicircular Plates, Attached to a Transverse Spindle and Mounted Inside a Pipe in Order to Regulate or Prevent Flow.

Butterfly Valve

Plumbing Material

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

ANALOG

DIGITAL

Plumbing Material

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
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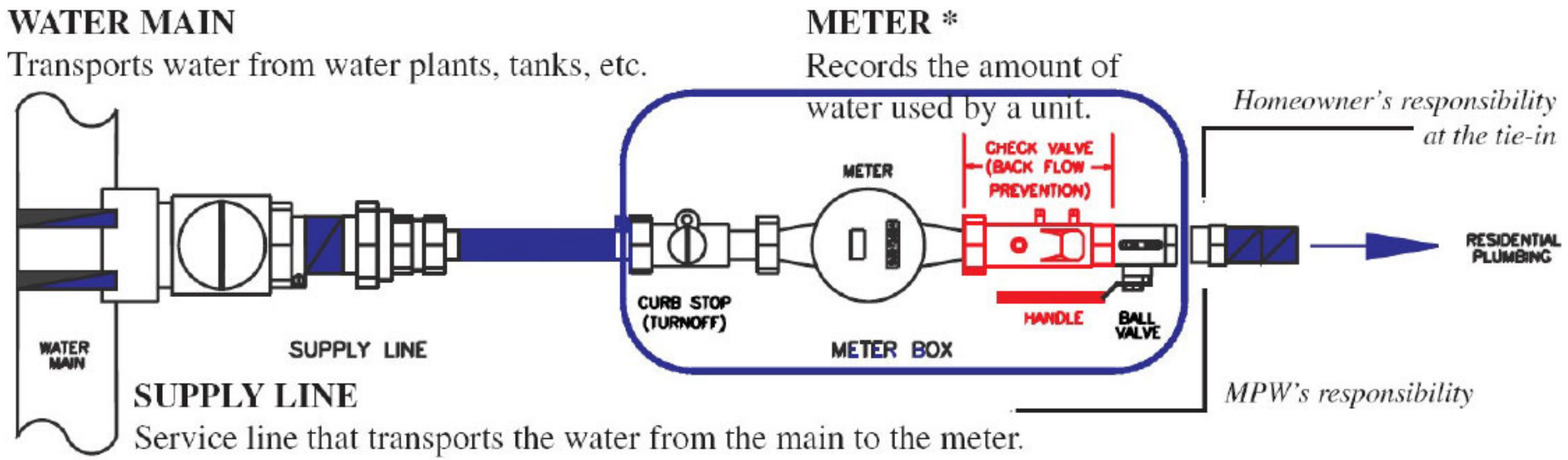
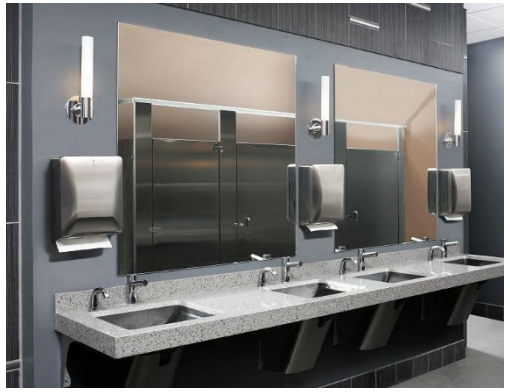


Plumbing Fixtures

Building Indoor Water Use

- Flush and Flow Fixtures
- Appliances and Process Water Use





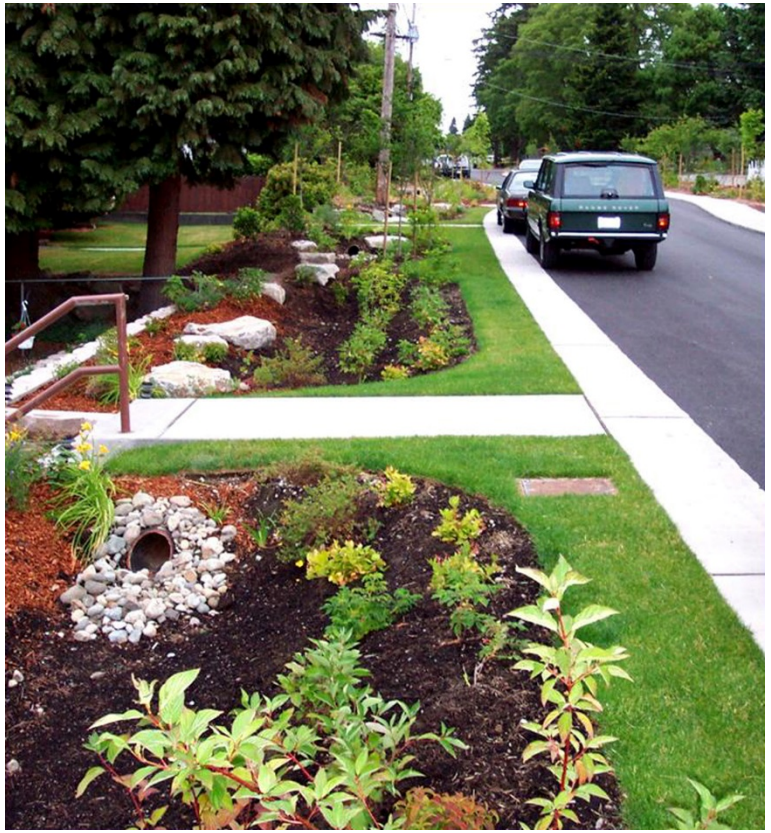




Plumbing Fixtures

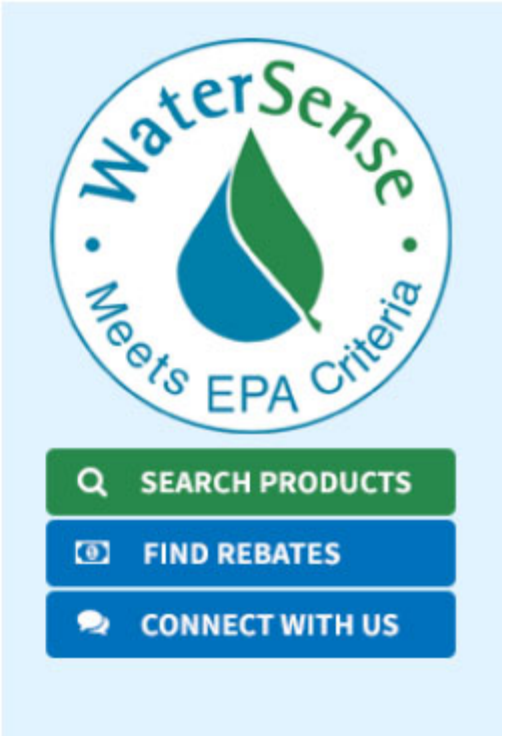
Building Outdoor Water Use

- Landscape Irrigation
- Process Water Use: Cooling and Heating



Plumbing Fixtures

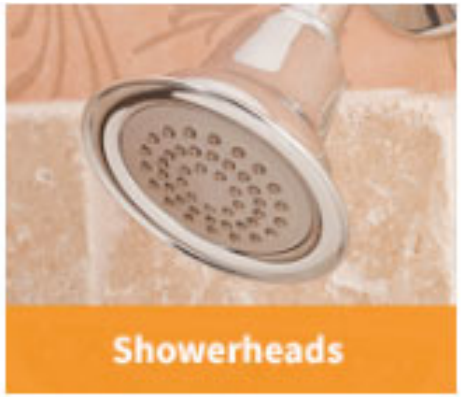
WaterSense

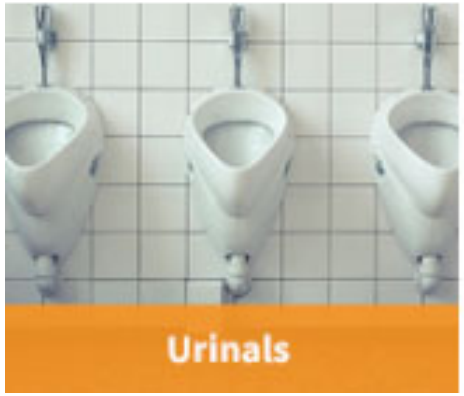


https://www.epa.gov/watersense

Plumbing Fixtures

WaterSense® Products





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

Plumbing Fixtures

Water Closets

Flushometer

Plumbing Fixtures

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

Plumbing Fixtures

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.*

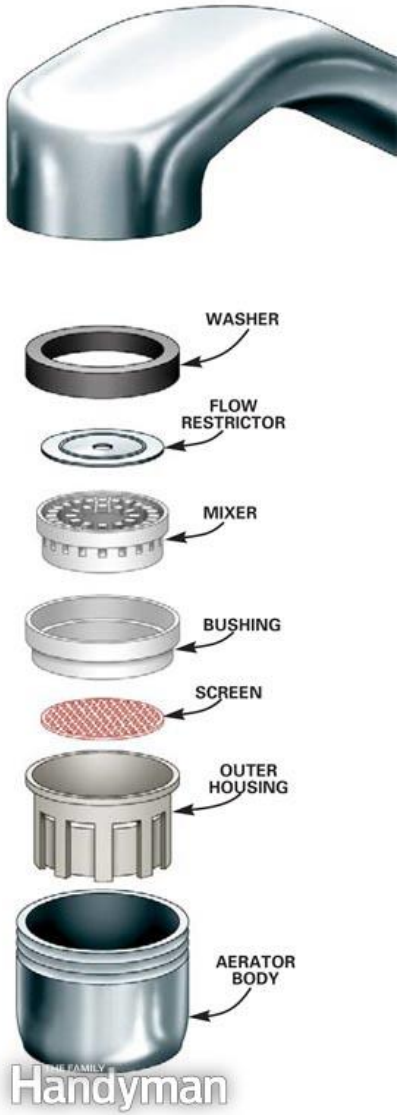
Note: *Where faucets meeting the maximum flow rate of 1.8 gpm (6.81 L) are unavailable, aerators or other means may be used to achieve reduction.*

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-*



Plumbing Fixtures

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

WATER EFFICIENCY

Credit Category
Water Efficiency (WE)

Water Efficiency (WE)

Adaptation	NC	CS	S	R	DC	WDC	HOS	HC
Total	11	11	12	12	11	11	11	11
Outdoor Water Use Reduction	req	req	req	req	req	req	req	req
Indoor Water Use Reduction*	req	req	req	req	req	req	req	req
Building-Level Water Metering	req	req	req	req	req	req	req	req
Outdoor Water Use Reduction	2	2	2	2	2	2	2	1
Indoor Water Use Reduction	6	6	7	7	6	6	6	7
Cooling Tower Water Use	2	2	2	2	2	2	2	2
Advanced Water Metering	1	1	1	1	1	1	1	1

Plumbing Fixtures

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

WATER EFFICIENCY

Credit Category
Water Efficiency (WE)

Water Efficiency (WE)

Adaptation	NC	CS	S	R	DC	WDC	HOS	HC
Total	11	11	12	12	11	11	11	11
Outdoor Water Use Reduction **Reduce 30%**	req	req	req	req	req	req	req	req
Indoor Water Use Reduction* **Reduce 20%**	req	req	req	req	req	req	req	req
Building-Level Water Metering	req	req	req	req	req	req	req	req
Outdoor Water Use Reduction **No irrigation system or Reduce 50% or 100%**	1	2	2	2	2	2	2	1
Indoor Water Use Reduction **Reduce 25%, 30%, 35%, 40%, 45%, 50%** **EP ≥55%**	6	6	7	7	6	6	6	7
Cooling Tower Water Use **Cycles of Concentration**	2	2	2	2	2	2	2	2
Advanced Water Metering	1	1	1	1	1	1	1	1

Plumbing Fixtures

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%

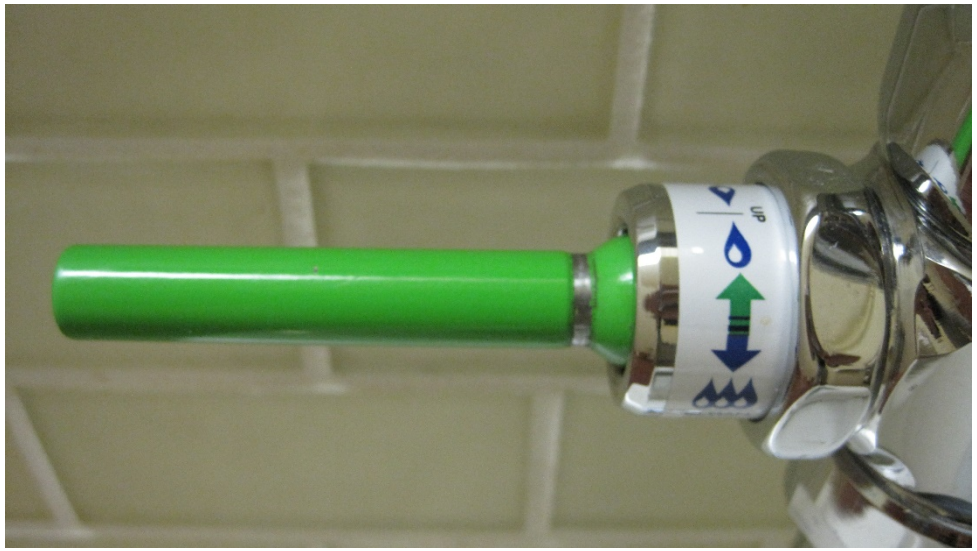
gpf = gallons per flush gpm = gallons per minutes

* The WaterSense® label is available for this fixture type.

Energy Policy Act (EPAct) of 1992 (Baseline)

Plumbing Fixtures

Dual Flush Water Closets



Plumbing Fixtures

Bathroom Lavatory Faucet

Table 3. Typical public and private lavatory faucet applications	
Lavatory faucet	**Classification**
Restroom sink School classroom sinks (if used primarily for hand washing)	Public (baseline: 0.5 gpm @60 psi)
Residential bathroom sink Hotel or motel bathroom sink Dormitory bathroom sink Patient room sink Patient bathroom sink in hospital or nursing home	Private (baseline: 2.2 gpm @60 psi)

WATER EFFICIENCY PREREQUISITE

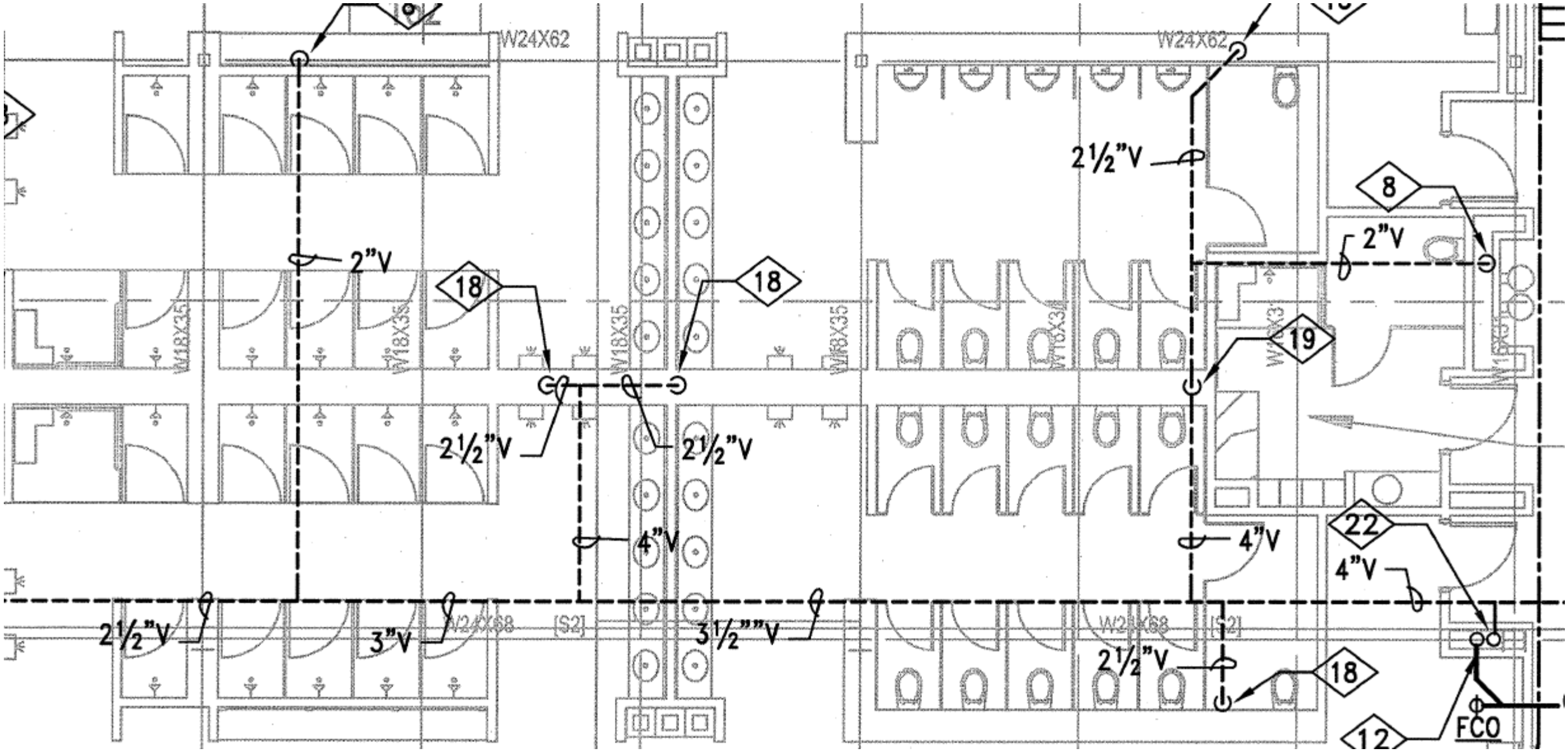
Indoor Water Use Reduction

This prerequisite applies to:

New Construction
Core and Shell
Schools
Retail
Data Centers
Warehouses and Distribution Centers
Hospitality
Healthcare

INTENT

To reduce indoor water consumption.


W24X62
W24X62
2"V
2½"V
8
2"V
18
18
19
W18X35
W18X35
W18X35
W18X35
2½"V
2½"V
4"V
4"V
22
4"V
2½"V
3"V
3½""V
W24X68
[S2]
W24X68
[S2]
2½"V
18
12
FCO