Restrooms & Plumbing

Every building with a water supply uses plumbing to convey and control the water. Plumbing fixtures are a ubiquitous part of our daily lives. Almost all buildings used by people have at least one restroom. Examples are schools, hospitals, hotels, service stations, stores, government buildings, places of worship, office buildings, convenience stores, and entertainment sites.

Plumbing fixtures are a ubiquitous part of our daily lives. Restrooms and plumbing fixtures are prime targets for new design or retrofit with high-efficiency technologies.

Because of the large numbers of plumbing fixtures and the enormous amounts of water they collectively use, federal and California statues set water-use standards for some fixtures and appliances. Manufacturers and water interests have continued to examine opportunities for water efficiency and associated energy efficiency. In addition, performance testing for some plumbing fixtures resulted in new specifications, such as the EPA WaterSense specification for high-efficiency toilets (HETs). New specifications for faucets and shower heads are being developed, resulting in a series of improved products. Restroom and plumbing fixtures are prime targets for new design or retrofit with high-efficiency technologies.

Water-using technologies that have specific potential for water conservation are discussed in this section. For each technology, alternative water-efficiency methods are scored "High" (better than 50 percent savings), "Medium" (10-50 percent savings), or "Low" (less than 10 percent savings) compared with standard technologies. These include:

Restroom and Bathroom Fixtures
- Toilets
- Urinals
- Showers and baths
- Floor-drain trap primers

Faucets
- Hand-washing lavatories
- Kitchen and food-service sinks
- Pre-rinse spray valves (*see "Food Service – Scullery"*)
- Janitorial (mop) sinks
- Outdoor faucets (hose-bibs)

Valves and Other Devices
- Emergency shut-off valve access and isolation valves
- Water-heater temperature pressure-relief (TPRVs) and relief valves
- Pumps
- Backflow preventers
- Fire-protection systems
- Surge tanks and other forms of potable water storage

The following checklist may be used for approving selection of equipment for restrooms and bathrooms, as well as plumbing fixtures.

Checklist of Water-Efficiency Measures for Restrooms and Plumbing Fixtures

End Water Use	Proven Practices	Additional Practices
Restroom and Bathroom Fixtures		
Toilets	☐ Not more than 1.3 gallons per flush (gps)	☐ Non-potable water for flushing where codes and health departments permit
Urinals	☐ 0.5 gallon or less per flush ☐ Prohibit continuous water-flushing systems ☐ Prohibit automatic water-flushing systems	☐ .25 gallons or 1 liter per flush or less ☐ Non-potable water for flushing, where codes and health departments permit
Showers and baths	☐ Prohibit shower heads that have a flow rate greater than 2.0 gallons per minute (gpm) ☐ One shower head per personal shower stall (ensure that a properly selected mixing valve is used to reduce scalding hazards) ☐ For group showers, such as in school gyms and prisons, require individual valves for each shower head	☐ Specify use of timers on recirculating hot-water systems for large buildings ☐ Select point-of-use hot-water heaters for small applications ☐ Substitute showers for bathtubs whenever possible ☐ If bathtubs are necessary, use low-volume tubs
Floor-drain trap primers	☐ Meet plumbing codes	☐ Avoid continuous-flow trap primers ☐ Install pressure-activated or electronic trap primers, each serving several drains
Faucets		
Hand-washing lavatories	☐ Prohibit emitting more than 1.5 gpm at 60 pounds per square inch (psi) or meet the USEPA WaterSense standard, whichever is less, for residential faucets ☐ Use laminar-flow faucets that use no more than 1.5 gpm, where required in medical facilities ☐ Use self-closing faucets with flows of 0.5 gpm or less in public restrooms	☐ Commercial lavatory faucets should use no more than 1.0 gpm ☐ Low-flow-rate faucets with unremovable aerators are also available
Kitchen and food-service sinks	☐ Flow should not exceed 2.2 gpm	☐ Install variable-flow aerators on faucets
Pre-rinse spray valves (*see "Food Service – Scullery"*)	☐ Use pre-rinse spray valves for dish rinsing ☐ Prohibit valves that emit more than the current flow standard (1.5 gpm in 2007)	
Janitorial (mop) sinks	☐ Faucet flow not to exceed 2.2 gpm	

End Water Use	Proven Practices	Additional Practices
Outdoor faucets (hose bibs)	☐ Faucet flow should not exceed 5.0 gpm	☐ Install outdoor pipes and fixtures so they can be drained before freezing weather ☐ For hose bibs attached to walls of heated buildings, use freeze-proof bibs ☐ Install self-closing nozzles and valves on equipment connected to hose bibs
Valves and Other Devices		
Emergency shut-off valve access and isolation valves	☐ Meet plumbing codes	☐ Add isolation valves to all pieces of water-using equipment, if not provided by the manufacturer ☐ Place additional emergency shut-off valves near critical water-use areas ☐ Plainly mark the location of emergency shut-off valves ☐ Attach information on the valve, stating which portions of the facility are supplied by the valve
Water-heater temperature pressure-relief valves (TPRVs) and relief valves	☐ Meet plumbing codes	☐ Make the outlets to valve-discharge pipes easy to inspect for flow ☐ Insert visible indicators that will show if the valve has activated
Pumps	☐ Meet plumbing codes	☐ Choose pumps with mechanical seals rather than packing ☐ Carefully test pumps upon installation and initial operation
Backflow preventers	☐ Install backflow preventers and vacuum breakers as required by code and utilities	☐ Locate devices in easy-to-observe locations, and provide easy access for inspection and testing
Fire-protection systems	☐ No connections to fire-protection system except for fire protection ☐ Install flow-detection meters on fire services	☐ Conspicuously mark fire-protection-system plumbing
Surge tanks and other forms of potable-water storage		☐ Provide visible and audible signals when tanks overflow ☐ Provide monitoring wells to capture and make visible any leakage

Restrooms & Bathroom Fixtures

Water-use standards for plumbing fixtures used in restrooms were set by both federal and California statute and are now included in the Uniform Building Codes. The current code sets the following maximum-flow requirements:

Type of Fixture	California Maximum Rate of Water Use	EPA WaterSense or High-Efficiency (HE) Specification
Toilets (tank-type)	1.6 gpf	1.28 gpf (USEPA WaterSense 2007 standard)
Toilets (flush-valve)	1.6 gpf	1.3 gpf (HE)
Urinals	1.0 gpf	0.5 gpf (HE)
Shower heads (except for safety uses)	2.2 gpm at 60 psi	2.0 gpm (HE)
Lavatory faucets	2.2 gpm at 60 psi	1.5 gpf at 60 psi for lavatory faucets (draft WaterSense)
Self-closing faucets	Public restrooms use self-closing faucets with flows of 0.5 gpm or less	
Metering faucets	0.25 gallons per cycle	

Since these standards were set a decade ago, advances to improve water efficiency in plumbing fixtures have continued. New models have come to the market that improve water efficiency and, sometimes, energy efficiency by as much as 20 percent. The initial cost of the new higher efficiency models is in the same range as the better quality older models. Choice of plumbing fixtures for new structures should be driven not by the minimum standards, but rather by the life-cycle cost for the building operator.

In addition to fixtures that are more water-efficient, non-potable water supplies are being used to flush toilets. These water supplies include treated municipal wastewater and lavatory wash water. To date the acceptance is limited, but the potential for water savings is large.

Toilets

A few models of the early 1990's gave water-efficient toilets a bad name by failing to remove the waste with a single flush. Since then manufacturers have redesigned the shape of the bowl, the diameter and glazing of the trapway, and the water volume used to achieve effective performance. Continued improvements are subjected to improved testing standards for endorsement by water utilities and government agencies. Now, the highest efficiency models have been well documented to perform better than older high-flush-volume toilets (Veritec and Koeller, 2006).

A toilet flush can be actuated by manual mechanical levers, push buttons, or electronic sensors. The hands-free sensors eliminate the need for human contact with the valve, but sometimes flush needlessly while the toilet is still in use. Some studies have shown that these hands-free sensors actually use more water than manually activated models.

Although the primary purpose of toilets is to remove human waste and initiate transportation to a wastewater treatment facility, toilets in public places are often used to dispose of other materials. Toilets for public locations should have a glazed trap of at least two inches diameter — the bigger the diameter the better to prevent clogging.

Major requirements for minimizing water use in toilet operations include: (1) flush the toilet bowl clear, (2) transport waste through pipelines to the sanitary sewer, (3) operate reliably, and (4) have a leak-proof discharge valve.

Aquia Dual-flush Toilet

Description of End Use

Toilets come with a variety of features:

- Floor-mounted or wall-mounted
- Methods of actuating flush:
  - » Traditional lever
  - » Push-buttons
  - » Electronic sensors
- Flush mechanism
- Volume of water used per flush
- Glazing and diameter of the trap
- Models for prison use

Water-Savings Potential

Water consumption for any toilet installation varies with the number of employees, customers, or visitors and the type of activity at the site. An American Water Works Association (AWWA) Research Foundation study found that:

- Office buildings are prime candidates for high-efficiency plumbing fixtures and appliances.
- Restaurant toilet and urinal use is significant and would benefit from high-efficiency devices.
- Supermarket bathrooms receive a surprising amount of use and would benefit from high-efficiency fixtures.
- One-half to three-fourths of hotel indoor water use was for toilets, faucets, and showers. These should be the first targets of a hotel water conservation program. Leakage from stuck flappers in toilets yielded a significant loss of water, with some toilets running for days.

High-efficiency toilets (HETs), dual-flush, and pressure-assisted models all use at least 20 percent less water than ultra-low-flow toilets (ULFTs), at an average of 1.3 gpf.

Some toilets use flush valves or internal tanks to control flush volume. Others use "flapper valves." Flapper valves have had leakage problems. Leak-free replacement of flapper valves may require the toilet manufacturer name and model number. It is hoped that future flapper-valve materials will resist the chemical and mechanical erosion that causes leaks.

Process or Equipment Alternatives	Water-Savings Potential
HETs using less than 1.3 gallons per flush	Medium
Non-potable water for flushing, where codes and health departments permit	High

Cost-Effectiveness Analysis

Example: HET (1.3 gpf) *versus* 1.6 gpf ULFT in an office building with 50 staff and 50 visitors per day.

- Estimated capital costs: The same for HET and ULFT.
- Estimated equipment lifetime: The same — up to 20 years.
- Water and energy savings: 20 percent water savings.
- Incremental cost per acre foot (AF) of efficient equipment: Zero. Annual savings per toilet are 0.004 AF of water and $5.87 for water and wastewater charges. Over the toilet's lifetime, the savings achieved may be 0.072 AF and $117.

Recommendations

Proven Practices for Superior Performance

- Toilets that use not more than 1.28 gallons per flush.

Additional Practices That Achieve Significant Savings

- Use non-potable water for flushing, where codes and health departments permit.

Urinals

Description of End Use

Urinals are made to accept liquid waste, but not solid waste. They come in several configurations and combinations of features:

- Wall-mounted urinals for single-person use. These are flushed after each use, either manually by the user or by automatic actuator.
- Wall mounted troughs for simultaneous multiple-person use. Intended for high-use areas such as sports venues, they are flushed continuously during the high-use period and are controlled with a valve and timer, but not by the user.
- Wall-mounted waterless urinals for single-person use that require neither flushing nor water-supply plumbing.

Water-Savings Potential

Potential for savings depends upon the number of users at the site. Males use urinals more often than they do toilets in buildings with both fixtures available. Based upon U.S. Green Building Council numbers, males use urinals two to three times a day. Facilities where large numbers of males work or gather have the largest potential for water savings.

Process or Equipment Alternatives	Water-Savings Potential
Prohibit continuous water-flushing systems in urinals and toilets	Medium to High
Prohibit automatic optical or motion-sensing flushing systems for toilets and urinals	Medium
Install urinals using 0.5 gpf or less	High
Install urinals using 1.0 pint per flush or waterless urinals	High
Use non-potable water for flushing, where codes and health departments permit	High

Urinal Type	Flush Volume	Cost Range
Automatic-flush urinal	1.0 gpf	$600-900 with electronic sensor
Electronic-flush valve	N/A	$160-530
Manual-flush urinal	1.0 gpf	$300-325
Manual-flush valve	N/a	$70-200
No water — no flush	0	$520-600
Automatic-flush urinal with proximity flush sensor	0.5 gpf	$625
Urinal without flush valve	0.5 gpf	$300
Trough – 6 foot length	variable	$1700 with flush pipe and valve

Urinal Discharge Volume	Annual Water Volume in Gallons	Annual Savings Compared to 1.0 gpf Urinal	Annual Water & Wastewater Fees at $2.85/Ccf*	Annual Water & Wastewater Savings Compared with 1.0 gpf Urinal
1.0 gpf	19,500	0	$74	$ 0
0.5 gpf	9,750	9,759	$37	$37
Waterless	0	19,500	0	$74

*Ccf = one-hundred cubic feet

Cost-Effectiveness Analysis

Examples: Compare urinals requiring flush volumes of 1.0 gpf, 0.5 gpf, and 0 gpf (waterless).

- Equipment capital costs:
  - » New urinal with automatic flush valve cost is about $625.
  - » New waterless urinal cost is $500. Operational costs for sealant fluid and quarterly cartridge replacement are $240 per year.
- Estimated equipment life: Approximately 10 years for all types, per Federal Emergency Management Agency (FEMA).
- Water and energy savings: Assuming 2 uses per day per male employee, and 25 male employees and 25 male visitors per day, 260 work days per year.
- Water-efficient urinals reduce the need to pump water to higher elevations in high-rise buildings.
- Incremental cost per AF of efficient equipment:
  - » During the 10-year life of the equipment, capital and operating costs of the 0.5 gpf urinal are approximately $370 less than those of the 1.0 gpf urinal and $1,275 less than for the waterless urinal.
  - » For the same 10-year period, the benefit of using the 0.5 gpf device *versus* the 1.0 gpf urinal is approximately $7,450 per AF.

Recommendations

Proven Practices for Superior Performance

- 1 gallon or less per flush urinals are required by code.
- Prohibit continuous water-flushing systems in urinals and toilets.
- Prohibit automatic water-flushing systems in toilets.

Additional Practices That Achieve Significant Savings

- Install urinals using 0.5 gpf or less.
- Use non-potable water for flushing, where codes and health departments permit and where reclaimed water is available.

Showers and Baths

Description of End Use

Both showers and baths are used for personal hygiene. Conventional bathtubs have a water capacity of 40-50 gallons. The hospitality sector touts the relaxation and luxury of infinity and whirlpool baths (approximately 90 gallons per fill). Medical facilities and nursing homes may have tubs with a lift to lower patients into the water. Normally this water is used once, then discharged to waste. Proper mixing valves should be installed in showers to prevent scalding hazards.

Hot tubs are also popular. The water (several hundred gallons) is often circulated through filters and heaters. Disinfectants are added manually or in the recirculation cycle. When not in use, they should be covered to reduce loss of heat and water.

Shower heads are available with a variety of spray patterns, water-droplet sizes, and pulsations. Both shower and bathtub water are used and typically discharged to sanitary wastewater. In locker rooms and similar situations, several people may wash in a communal shower room with multiple shower heads. Tubs come in various sizes. The use of standard-size tubs should be recommended, since they hold, and therefore use, less water.

Excluded from this discussion are shower heads required for emergency cleaning of personnel due to chemical and other contamination.

Water-Savings Potential

Choose shower heads that perform well, are vandal- and tamper-proof, and limit flow to 2.0 or less gpm (at 60 psi) collectively for all shower heads in the shower stall. In locker-room showers, flow to each shower head should be controlled individually by the user.

Select shallower bathtubs that have smaller water capacity. The water level will cover the bather when immersed.

In the hospitality sector, hot water is often circulated from a water heater, through a pipeline loop, to the guest rooms. Unused water returns to the water heater. This provides hot water quickly to the guest showers/baths and reduces the water wasted while waiting for warm water. The circulated hot water should be placed on a timer (may increase energy use).

Where plumbing code and health officials allow, the wastewater from showers and baths may be captured, treated, and redirected for toilet flushing or other non-potable, non-contact uses.

Process or Equipment Alternatives	Water-Savings Potential
Use shower heads that allow not more than 2.0 gpm	3.5 gallons/shower
Install only one shower head per personal shower stall	30 gallons/shower
Install individual valves for each shower head in a gang-type shower	Medium
Specify recirculating hot-water systems for large buildings	High
Select point-of-use hot-water heaters for small applications	Medium
Substitute showers for bathtubs whenever possible	20 gallons/shower
If bathtubs are necessary, use low-volume tubs	15 gallons

Recommendations

Proven Practices for Superior Performance

- Use shower heads that allow flow of not more than 2.0 gpm.
- Install only one shower head per personal shower stall.
- For group showers, install individual valves to control each shower head.

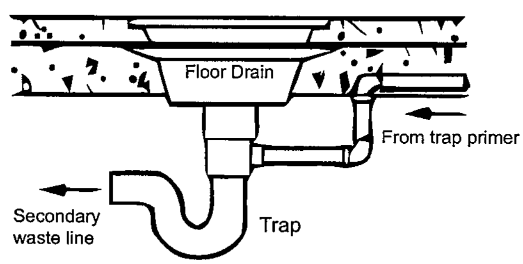
Additional Practices That Achieve Significant Savings

- Specify recirculating hot-water systems for large buildings.
- Select point-of-use hot-water heaters for small applications (do not use on recirculating lines or at the far end of the water line).
- Substitute showers for bathtubs whenever possible.
- If bathtubs are necessary, use low-volume tubs.

Floor-drain Trap Primer

Description of End Use

Floor drains often exist in spaces where regular water use may spill or where floors may be washed frequently. Plumbing codes require traps to prevent gases and odors from seeping from sanitary sewers into the room through the drains. The gas is blocked by water trapped below the drain in an "S" shaped pipe called a "P trap." In some rooms the trapped water dries up (evaporates) when the floor is seldom washed, damp-mop floor-cleaning methods are used, or little water reaches the drain. This condition may allow the sewer gasses, other odors, and/or vermin to enter the room.



(Adapted from J.R. Smith Manufacturing Co.)

To sustain water in the trap, additional water must be added with a device called a trap primer. A trap primer is a valve or other connection from a water source that allows a small amount of water to flow through pipes to recharge traps of one or more drains. The common types of trap primers include:

- continuous flow
- pressure-drop activated
- flush-valve activated
- electronically timed

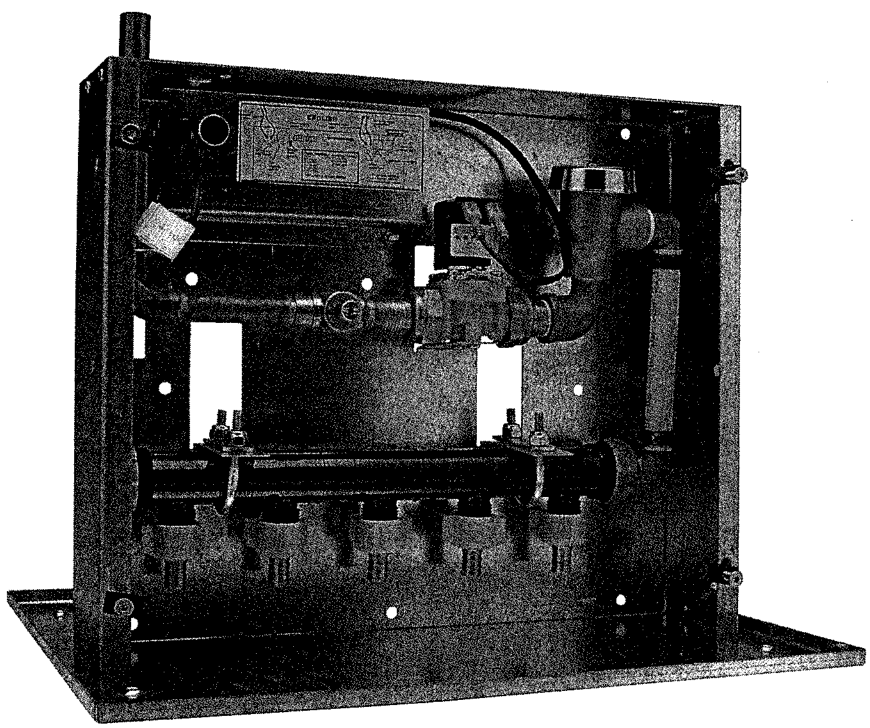
Water sources include cold-water pipes, the discharge side of flush valves, or wash-basin drain pipes, depending upon the distance to the drain and the frequency that the supply device provides water. One concern is that a seldom-used valve might provide inadequate water to maintain the trap function. The opposite concern is that continuous-flow primers waste water. Automatic or electronic controllers, such as the Zurn model pictured on the next page, allow the option to set the volume and frequency of flow. Other types of trap primers sense a pressure change in the supply line and allow a small amount of water to trickle to the trap.

Where drains are used as sanitary sewers, such as in animal pens, additional water may be applied to the drain rim to flush debris from the surface of the drain.

Another alternative, where code and conditions permit, is to manually add a fluid, such as water, to the drain. On the other hand, if maintenance staff remembered to add water to the trap, there would be no need for the plumbing codes to call for trap primers.

Water-Savings Potential

The most efficient floor-trap primer will have a connection size and discharge frequency that provides a volume of water only slightly greater than the evaporation from the trap. Most pressure-sensitive, flush-activated or electronic trap primers discharge only a few ounces of water for each outlet during each operating cycle. Primers connected to sink drains use wastewater. However the debris screens to these inlets need to be cleaned periodically.



Zurn Electronic Trap Primer Model Z1020

Sample Water Use of Trap Primers

Primer Type	Number of Actuations per Day	Daily Water Use per Drain Served	Annual Water Use in Gallons
Continuous	Continuous	0.25 gpm yields 360 gallons per day (gpd)	131,400
Flush-activated	Depends upon flush valve use	For 10 flushes: 0 × 1 oz = 0.08 gallons	28
Pressure-sensitive	Depends upon fixture use	For 10 uses: 10 × 1 oz = 0.08 gallons	28
Electronic	1	0.008 Gallons	3

Process or Equipment Alternatives	Water-Savings Potential
Avoid continuous-flow trap primers	High
Install pressure-activated or electronic trap primers, each serving several drains	High

Cost-Effectiveness Analysis

Example: Compare continuous-flow with pressure- or flush-activated trap-flow primers.

- Equipment capital costs: When compared on a per-drain-served basis, the costs are very similar: between $5 and 20 per drain.
- Estimated equipment life: The same.
- Water and energy savings: Annual water use for a continuous-flow device at 0.25 gpm is 131,400 gallons, compared with 30 gallons per year for a flush-activated primer connected to a flush valve used 10 times per day.
- Incremental cost per AF of efficient equipment: Water and wastewater fee savings (at $2.85 per Ccf) for 131,370 gallons is $783 per year or $1942 per AF.

Recommendations

Proven Practices for Superior Performance

- Meet plumbing code.

Additional Practices That Achieve Significant Savings

- Avoid continuous-flow trap primers.
- Install pressure-activated or electronic trap primers, each serving several drains.

Faucets

Faucets are valves operated by people for indoor purposes. Outdoor hand-operated valves are known as hose bibs.

Hand-Washing Lavatories

Description of End Use

Several types of faucets offer different flow durations and flow rates:

- Manually operated faucets require someone to open the valve and to close the valve.
- Self-closing faucets run as long as the user holds the handle in the open position. Once released, the spring-loaded faucet closes itself.
- Metering faucets are actuated manually or automatically. They deliver a preset amount of water (some models deliver 0.25 gallons during a 5- to 10-second cycle; others models have cycles that can be set to 45 seconds) before shutting off. Operating conditions, such as water pressure, temperature, and flow rate, may affect the timing cycle. Some manufacturers provide a 5-year warranty.
- Automatic faucets sense the proximity of the user and start the flow of water, which is maintained while the user is within sensor range. Then the faucet shuts itself off.
- Drinking-water bubblers operate with self-closing faucets.

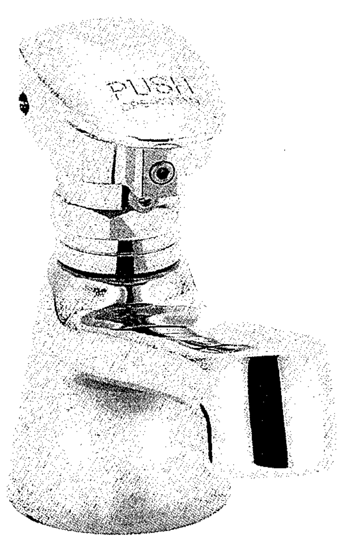
Aerators may be added to faucets to entrain air, reduce splash, and reduce the water flow. Common aerator flow rates are 0.5, 1, and 2.2 gpm. An aerator is a circular screen disk attached to the end of the faucet. Vandal- and tamper-proof aerators should be installed in non-residential buildings. Aerators with manual flow adjustment are available for kitchen faucets.

Because aerators entrain air which may contain pathogens into the water stream, and the pathogens may reside on the internal aerator screens, aerators should not be used in medical facilities. California regulations prohibit aerator use in hospitals, but laminar-flow restrictors may be used to prevent splash and reduce flow without air entrainment. Other aerators should be replaced or at least cleaned every few years.

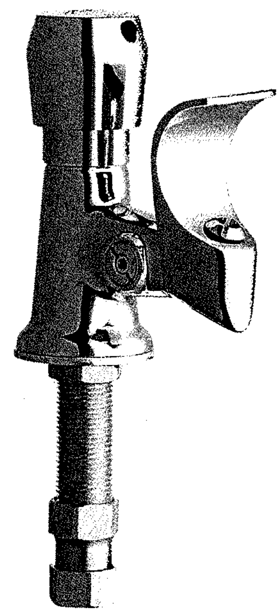
Water-Savings Potential

- For public restrooms, hand washing for personal hygiene needs a minor flow rate to lubricate the soap, flush grime and bacteria from the skin, and rinse soap from the hands.
- For motel and hotel guest-room bathrooms, the wash basin is used for various hygiene and grooming purposes. The U.S. Environmental Protection Agency (USEPA) WaterSense program reports that flows of no more than 1.5 gallons per minute are adequate.
- For medical buildings, doctors' offices, and light industry or commercial facilities where business practices require regular hand washing, install self-closing faucets that are actuated with a foot pedal.
- Combining a self-closing faucet with a low-flow aerator provides water savings at nominal cost.

Process or Equipment Alternatives	Water-Savings Potential
Public restrooms should use self-closing faucets with flows of 0.5 gpm or less	High
Businesses with high hand-washing demand should use self-closing faucets with foot-pedal actuators	Medium to High
Lavatory faucets should use no more than 1.5 gpm @ 60 psi	Medium
Combination of a self-closing faucet with low-flow aerator or laminar-flow restrictor	Medium



Single-hole metering faucet
(Speakman Faucets www.plumbingsupply.com)



Drinking-water bubbler
(Chicago faucets www.plumbingsupply.com)

Cost-Effectiveness Analysis

Example: Manually operated faucet compared with a metering, self-closing faucet.

- Equipment capital costs: $75 for manually operated faucet, compared with $105 for a metering, self-closing faucet.
- Estimated equipment life: 5-15 years; assume 10 years.
- Water and energy savings:
  - » For a busy location, assume 50 uses per day for 260 days per year and a 10-year lifetime.
  - » A metering, self-closing faucet uses 0.25 gallons per cycle. Assume 1 cycle per person. Annual water consumption equals 3,250 gallons (0.01 AF). Over 10 years, consumption will be 32,500 gallons (0.10 AF).
  - » A manual 2.2 gpm faucet will stay on for at least 30 seconds, yielding approximately 1 gallon per use. Annual consumption will be 13,000 gallons (0.04 AF). Over 10 years, the consumption will be 130,000 gallons (0.40 AF).
- Incremental cost per AF of efficient equipment:
  - » Both faucets will incur the same rates for water and wastewater: $2.85 per 100 cubic feet (748 gallons).
  - » Metering, self-closing faucet — the annual cost of water and wastewater will be $12.38. Manual faucet — the annual cost of water and wastewater will be $49.53.
  - » The $30 difference in capital cost will be recovered in 9 months.
  - » Over its lifetime, the water-efficient equipment will save approximately $1,100 per AF of water consumed.
  - » If warm water is used, the cost recovery will be accelerated.

Recommendations

Proven Practices for Superior Performance

- Faucets must not emit more than 1.5 gpm.
- Use laminar-flow faucets that use no more than 1.5 gpm, where required in medical buildings.
- Use self-closing faucets with flows not greater than 0.5 gpm in public restrooms.

Kitchen and Food-Service Sinks

Description of End Use

Kitchen sinks often need the full 2.2 gpm flow for filling pots and pans.

A refrigerator, not running water, should be used to thaw food. *See "Food Service — Refrigerators and Freezers."*

Water-Savings Potential

- Install variable-flow aerators on faucets.
- Install automatic-shutoff faucets for bar sinks.
- Install manual shutoff valves on sink spray hoses. *See "Food Service — Pre-Rinse Spray Valves."*
- Locate water heaters close to faucets and insulate hot-water lines to reduce water lost while waiting for hot water to flow from the faucet.

Process or Equipment Alternatives	Water Savings Potential
Install variable-flow aerators on faucets	Medium
Install manual shutoff valves on sink spray hoses	High
Install automatic shutoff faucets for bar sinks	Medium to high
Insulate hot-water pipelines and locate water heaters close to faucets	Medium

Cost-Effectiveness Analysis

Variable-flow swivel aerators cost less than $6 each, compared with less than $3 for fixed-flow aerators.

Recommendations

Proven Practices for Superior Performance

- Faucet flow should not exceed 2.2 gpm.

Additional Practices That Achieve Significant Savings

- Install variable-flow aerators on faucets.

Pre-Rinse Spray Valves – See "Food Service – Scullery"

(Mop) Sinks

Description of End Use

Large wash basins or set tubs used for janitorial purposes provide water to multi-gallon containers for floor cleaning and mops. Large flows of 2.2 gpm are desired. Sometimes hoses are connected from the faucets to minimize splash and spills to the wash buckets.

Water-Savings Potential

Care exercised by the user will help to achieve water savings.

Recommendations

Proven Practices for Superior Performance

- Faucet flow should not exceed 2.2 gallons per minute.

Outdoor Faucets

Description of End Use

Outdoor faucets, often known as hose bibs, sill cocks, water spigots, or hose hydrants, are valves which are often threaded to allow easy connection to hoses, pressure washers, and other equipment. Not subject to the 2.2 gpm flow limitation, flows through hose bibs are determined by the equipment being used.

Water-Savings Potential

For hose bibs where vandalism and unauthorized use is a concern, use a "loose key." Instead of an attached handle, there is a slot for a removable square key to be used to operate the hose bib. Alternatively, provide a locked box over the hose bib or eliminate hose bibs.

Prevent water waste from broken pipes and fixtures during freezing conditions:

- Install pipes so they can be drained before freezing occurs.
- For hose bibs attached to walls of heated buildings, use freeze-proof bibs that extend through the wall into a warm environment.

- Insulate pipes and plumbing attachments and add heat tape for seasonal use.
- Backflow preventers, meters, and all similar devices should be freeze-resistant and installed so as to guard against freezing.

Equipment, especially hoses, connected to hose bibs should all have self-closing nozzles.

Process or Equipment Alternatives	Water-Savings Potential
Use a "loose key" for hose bibs to reduce vandalism	Medium
For freezing climates, install outdoor pipes and fixtures so they can be drained before freezing weather	High
For freezing climates, use freeze-proof bibs to attach to walls of heated buildings	High
Install self-closing nozzles and valves on equipment connected to hose bibs	High

Cost-Effectiveness Analysis

Most of these recommendations can be achieved with minimal, if any, extra costs.

Example: regular hose bibs compared with freeze-proof hose bibs.

- Equipment capital costs: Minimal $4 *versus* $37 for a freeze-proof bib.
- Estimated equipment life: More than 5 years with washer replacements.
- Water and energy savings: Water savings may be achieved, but no wastewater savings.
- Incremental cost per AF of efficient equipment: N/A.

Recommendations

Proven Practices for Superior Performance

- Faucet flow should not exceed 2.2 gpm.

Additional Practices That Achieve Significant Savings

- Use a "loose key" for hose bibs to reduce vandalism.
- Install outdoor pipes and fixtures so they can be drained before freezing weather.
- Use freeze-proof hose bibs when attached to walls of heated buildings.
- Install self-closing nozzles and valves on equipment connected to hose bibs.

Valves and Other Devices

Devices listed in this section are used to limit losses during pipe ruptures, equipment failures, and other emergencies. Unlike much of the other equipment and processes described in this guide, these devices do not readily lend themselves to cost-effectiveness analysis. These controls may be inactive for many months or even years, then their function is immediate. In the meantime, small leaks or overflows may occur. Locate these devices to be easily seen, so leaks may be noted and corrective repairs performed.

Emergency Shutoff Valve and Isolation Valve Accessibility

Description of End Use

Emergency shutoff valves can be used to stop water flow when pipes rupture, connections leak, or equipment fails. During repairs, isolation valves can stop flows to individual pieces of equipment, while avoiding shutting down water to major portions of a building.

Water-Savings Potential

Shutoff valves are relatively cheap compared with the potential damage they can minimize. Their usefulness relates to how well they are marked and their accessibility. Never block access, and plainly mark the location of emergency shutoff valves near the valve site and in the area where the water is used.

If not supplied by the manufacturer, add an isolation valve to each piece of water-using equipment.

Process or Equipment Alternatives	Water-Savings Potential
Add isolation valves to all pieces of water-using equipment if not provided by the manufacturer	Low
Place additional emergency shutoff valves near critical water-use areas	Low
Plainly mark the location of emergency shutoff valves	Low
Attach information on the valve stating which portions of the facility are supplied by the valve	Low

Recommendations

Proven Practices for Superior Performance

- None.

Additional Practices That Achieve Significant Savings

- Add isolation valves to all pieces of water-using equipment if not provided by the manufacturer.
- Place additional emergency shutoff valves near critical water-use areas.
- Plainly mark the location of emergency shutoff valves.
- Attach information on the valve stating which portions of the facility are supplied by the valve.

Water-heater Temperature Pressure-relief Valves (TPRVs) and Relief Valves

Description of End Use

Located on the upper portion of the water tank, this valve prevents the build-up of hazardous pressure by releasing water to an overflow pipe. Water-supply pressure should be within the range recommended by appliance and equipment manufacturers — usually 40 to 60 psi.

Water-Savings Potential

Flows from the valve discharge pipe should be easy to observe. Place visible indictors to show when the valves are actuated and operations need to be corrected.

Process or Equipment Alternatives	Water-Savings Potential
Make valve discharge pipes easy to inspect for flow	Medium
Insert visible indicators that will show if the valve has activated	Low

Recommendations

Proven Practices for Superior Performance

- None.

Additional Practices That Achieve Significant Savings

- Make the outlets to valve discharge pipes easy to inspect for flow.
- Insert visible indicators that will show if the valve has activated.

Pumps

Description of End Use

Pumps are used with many fluids and gasses. Our focus is leakage that may occur from pumps used to move water and to increase water pressure.

Water-Savings Potential

Some vacuum pumps used in health-care facilities use water seals to avoid oil-vapor contamination of the vacuum lines. Choose newer vacuum pumps that do not use water seals. Choose pumps that are air-cooled. If a water-cooled pump is needed, do not use single-pass water-cooling systems. Instead, cool the pump motor with a cooling-water loop. *See "Thermodynamic Processes."*

Pumps with packing glands have a reputation for leaks and frequent need for replacing the packing. Mechanical seals are superior to packing glands in that they are far less likely to fail and leak.

Process or Equipment Alternatives	Water-Savings Potential
Choose pumps with mechanical seals rather than packing	High
Carefully test pumps upon installation and initial operation to ensure leak-free operation	Medium

Recommendations

Proven Practices for Superior Performance

- None.

Additional Practices That Achieve Significant Savings

- Choose pumps with mechanical seals rather than packing
- Carefully test pumps upon installation and initial operation to ensure leak-free operation.

Backflow Preventers

Description of End Use

Backflow preventers and vacuum breakers are required by code so water supplies will not be contaminated by sources at the point of use. If one end of a hose, pipe, drain-trap primer, submersible pump, or other device could be in non-potable water, and if the back pressure of the non-potable water exceeds the supply pressure, this potentially bacteria-laden or contaminated water could be sucked back into the potable-water supply line.

By health regulation, backflow devices between public-water supplies and private facilities should be inspected and tested on a regular schedule. Check with the local water supplier.

Water-Savings Potential

In non-freezing climates, mount exterior backflow preventers above ground so any leaks may be easily observed. For interior devices, place small wells to collect any leak water where it may be observed and repairs ordered.

Process or Equipment Alternatives	Water-Savings Potential
Place backflow prevention devices in easy-to-observe locations and make access for inspection and testing easy	Low

Recommendations

Proven Practices for Superior Performance

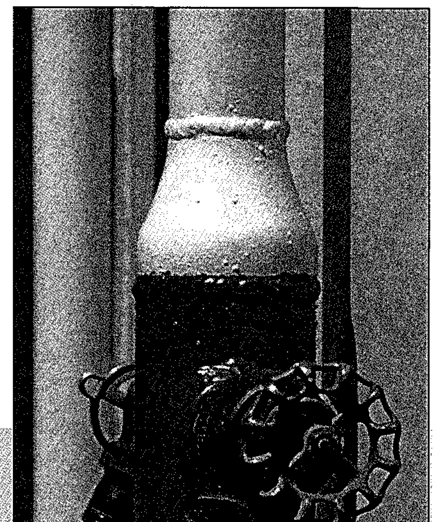
- Backflow preventers and vacuum breakers are required by code.

Additional Practices That Achieve Significant Savings

- Place these devices in easy-to-observe locations, and make inspection and testing easy.

Fire-protection Systems

Description of End Use



On the customer premises, the fire-protection system is typically a dedicated plumbing system. No flow should occur except in case of fire emergency or testing. Connections by the customer for other purposes are prohibited.

Utilities meter and bill fire-protection water-supply lines separately from potable-water supplies for consumption. Flow-detection meters should be installed on fire-service flows to indicate cross connections and improper use of fire water. To have an effective program, these meters need to be read when other meter readings are taken.

Water-Savings Potential

To avoid any cross connections between fire-protection and water-supply plumbing, mark fire-protection plumbing conspicuously. Install flow indicators to show the presence of leaks. Utilities may require flow-check meters capable of detecting small flows (less than 1 gpm) on the fire-supply line.

Process or Equipment Alternatives	Water-Savings Potential
Allow no connections to fire-protection systems except for fire protection	
Place flow-detection meters on fire services	High
Conspicuously mark fire-protection-system plumbing	Low

Recommendations

Proven Practices for Superior Performance

- Allow no connections to fire-protection systems except for fire protection.
- Place flow-detection meters on fire services.

Additional Practices That Achieve Significant Savings

- Conspicuously mark fire-protection-system plumbing.

Surge Tanks and Other Forms of Potable-water Storage

Description of End Use

Storage tanks may be placed atop high-rise buildings to maintain pressure in the building.

Surge tanks absorb the pressure transients (water hammer) of fast-acting valves to reduce plumbing-system damage. Expansion tanks and pressure-relief tanks are safety devices to store expanded heated water and relieve pressure on the plumbing system.

Water-Savings Potential

Tanks and their fittings sometimes leak only intermittently when water pressure is higher. An observation well or collection basin can collect the leakage and provide visible evidence of the leak. Then repairs can be taken.

Altitude-control valves are supposed to sense the level of water in the tank and stop inflow if the storage level exceeds a specified elevation. If the altitude-control valve fails, the tank may overflow with great loss of water and sometimes property damage. The overflow is usually channeled through a pipe to a drain. Install a signal device to show that overflow has occurred.

Process or Equipment Alternatives	Water-Savings Potential
Provide discharge-flow monitors to record evidence and signal when tanks overflow	High
Provide monitoring wells to capture and make visible any leakage	Low

Recommendations

Proven Practices for Superior Performance

- None.

Additional Practices That Achieve Significant Savings

- Provide visible and audible signals when tanks overflow.
- Provide monitoring wells to capture and make any leakage visible.

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