



WaterSense at Work

Sanitary Fixtures and Equipment 3.3 Faucets



Best Management Practices for
Commercial and Institutional Facilities



May 2023

WaterSense® is a voluntary partnership program sponsored by the U.S. Environmental Protection Agency (EPA) that seeks to protect the nation’s water supply by transforming the market for water-efficient products, services, and practices.

WaterSense at Work is a compilation of water efficiency best management practices intended to help commercial and institutional facility owners and managers from multiple sectors understand and better manage their water use. It provides guidance to help establish an effective facility water management program and identify projects and practices that can reduce facility water use.

An overview of the sections in *WaterSense at Work* is below. This document, covering water efficiency for faucets, is part of **Section 3: Sanitary Fixtures and Equipment**. The complete list of best management practices is available at www.epa.gov/watersense/best-management-practices. WaterSense has also developed worksheets to assist with water management planning and case studies that highlight successful water efficiency efforts of building owners and facility managers throughout the country, available at www.epa.gov/watersense/commercial-buildings.

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EPA 832-F-23-003
Office of Water
U.S. Environmental Protection Agency
May 2023

This document is one section from *WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities* (EPA-832-F-23-003). Other sections can be downloaded from www.epa.gov/watersense/best-management-practices. Sections will be reviewed and periodically updated to reflect new information. The work was supported under contract 68HERC20D0026 with Eastern Research Group, Inc. (ERG).

Overview

Faucets can be found in restrooms, kitchens, break rooms, and service areas in commercial and institutional buildings. Lavatory (i.e., restroom) faucets are designed for either private or public use. Private-use faucets are generally found in homes, hotel guest rooms, dorms, barracks, and hospital rooms. Public-use lavatory faucets are those intended for unrestricted use by more than one individual (i.e., employees, visitors, other building occupants) in facilities, such as public restrooms in offices, malls, schools, restaurants, or other commercial, industrial, and institutional buildings.

When it comes to improving faucet water efficiency in these lavatories, there are two different ways to apply technology: optimizing faucets and using faucet accessories. A faucet accessory is a component that can be added, removed, or replaced easily and, when removed, does not prevent the faucet from functioning properly.¹ Faucet accessories include flow restrictors, flow regulators, aerators, and laminar flow devices. While faucet accessories can be incorporated into new faucet design to control the flow rate, most often, accessories are external components that screw onto an existing faucet's end spout.



In addition to typical, hand-operated components, lavatory faucets can also be equipped with automatic sensors to trigger the on/off mechanism when users place their hands under and/or remove them from the fixture. Depending on use patterns before installation, appropriately programmed automatic sensors may or may not provide additional water savings.² In most cases, automatic sensors open the faucet valve completely when in use, whereas users of manually controlled faucets typically do not turn the tap fully on. Some jurisdictions may mandate the use of automatic sensors by code in certain applications, especially so where public health and safety is of concern. Automatic sensors can provide health and sanitation benefits in public-use facilities, since they are a hands-free option. However, some research suggests that automatic sensor faucets may be more likely to be contaminated with bacteria (including *Legionella*, the opportunistic waterborne pathogen

¹ American Society of Mechanical Engineers (ASME), Canadian Standards Association (CSA). A112.18.1/CSA B125.1 *Plumbing Supply Fittings*.

² Gauley, Bill and Koeller, John. March 2010. *Sensor-Operated Plumbing Fixtures: Do They Save Water?* <https://map-testing.com/wp-content/uploads/2022/11/Sensor-Operated-Fixtures-Final-Report-March-2010.pdf>.

responsible for Legionnaire's Disease), compared to old-style fixtures with separate handles for hot and cold water. This may be because the electronic faucet technology has more surfaces for the bacteria to become trapped and grow, or it may be because of the low flow rate of the faucets tested.³

Medical facilities, senior care facilities, and other facilities with immunocompromised populations may want to consider facility-specific health and safety needs before installing water-efficient faucets or faucets with automatic sensors. For example, these facilities may want to install laminar flow devices instead of faucet aerators. Faucet aerators inject air into the water, and as the air and water mix, there is a chance bacteria could be released into the surrounding air via small droplets or aerosolized particles. Since laminar flow faucets do not inject air into the water, there may be a lower risk of bacterial contamination or aerosolization of the water.

Considerations for Legionella and Other Pathogens

Commercial and institutional facilities, particularly those intended for high-risk populations (e.g., medical facilities and senior care facilities) should take into consideration the risk of *Legionella* and other opportunistic pathogens within building water systems, including hot water distribution systems that provide water to faucets and showerheads. These facilities may want to install laminar flow devices since they do not inject air into the water, lowering the risk of bacterial contamination or aerosolization of the water.

Some restrooms can also be equipped with metering or self-closing faucets. Metering faucets, when activated by the user, dispense water for a preset amount of time before shutting off. Self-closing faucets, operated with a spring-loaded knob or sensor, automatically shut the water off when the user releases the knob or withdraws their hands.

The standard flow rate of a faucet is dictated by its intended end use, as described below.

Private-Use Lavatory Faucets

The U.S. Department of Energy (DOE) adopted a 2.2 gallons per minute (gpm) (8.3 liters per minute [lpm]) at 60 pounds per square inch (psi) (414 kilopascals [kPa]) maximum flow rate standard for private-use lavatory faucets in 1998 (see 63 *FR* 13307; March 18, 1998).⁴

³ Johns Hopkins Medicine. March 31, 2011. "Latest Hands-Free Electronic Water Faucets Found to Be Hindrance, Not Help, in Hospital Infection Control."

www.hopkinsmedicine.org/news/media/releases/latest_hands_free_electronic_water_faucets_found_to_be_hindrance_not_help_in_hospital_infection_control.

⁴ The Energy Policy Act (EPA) of 1992 originally set the maximum allowable flow rate for both lavatory and kitchen faucets at 2.5 gpm (9.5 lpm) at 80 psi (552 kPa). In 1994, ASME established a performance standard in *A112.18.1M-1994* to which all faucets were required to comply and set the maximum flow rate for lavatory faucets at 2.2 gpm (8.3 lpm) at 60 psi (414 kPa). In response to industry's request for conformity with a single standard, DOE adopted a uniform standard maximum flow rate of 2.2 gpm (8.3 lpm) at 60 psi (414 kPa) for all faucets in 1998.

To promote and enhance the market for water-efficient, private-use lavatory faucets, the U.S. Environmental Protection Agency's (EPA's) WaterSense® program published *the High-Efficiency Lavatory Faucet Specification*, which includes water-efficient, high-performing residential lavatory faucets and faucet accessories (e.g., aerators, laminar devices).⁵ WaterSense labeled lavatory faucets and faucet accessories are independently certified to use 1.5 gpm (5.7 lpm) at 60 psi (414 kPa) or less. They are also required to have a flow rate of at least 0.8 gpm (3.0 lpm) at 20 psi (138 kPa). This minimum flow rate helps ensure user satisfaction in buildings with low water pressure.

While DOE establishes the maximum allowable flow rate for faucets at the national level, some states and municipalities have adopted regulations mandating that private-use lavatory faucets have a flow rate of 1.5 gpm (5.7 lpm) or less, consistent with the WaterSense specification. A few states, including California, Hawaii, and Washington, require private-use lavatory faucets to have a flow rate of 1.2 gpm (4.5 lpm) or less.⁶ It is important to note that, while some of these regulations establish flow rate criteria consistent with or more stringent than the WaterSense specification, they may not require products to be WaterSense labeled or to meet WaterSense's performance criteria. Looking for the WaterSense label when purchasing faucets will ensure that the product meets both efficiency and performance criteria.

Public-Use Lavatory Faucets

The Energy Policy Act (EPA) of 1992 addresses metering faucets found in public restrooms and sets a maximum water use of 0.25 gallons per cycle (gpc) (0.95 liters per cycle [lpc]). Metering faucets have no maximum flow rate that is established by EPA or any other federal regulation or model plumbing code; however, most use similar faucet accessories (e.g., aerators, flow restrictors) as non-metering faucets and therefore can have flow rates between 0.5 and 2.5 gpm (1.9 and 9.5 lpm).



Public-use faucets

The American Society of Mechanical Engineers (ASME) A112.18.1/Canadian Standards Association (CSA) B125.1 specifies a maximum flow rate of 0.5 gpm (1.9 lpm) at 60 psi (414 kPa) for non-metering public-use lavatory faucets. Although not a federal regulation,

⁵ U.S. Environmental Protection Agency's (EPA's) WaterSense program. Bathroom Faucets. www.epa.gov/watersense/bathroom-faucets.

⁶ Appliance Standards Awareness Project. State Standards. <https://appliance-standards.org/states>.

the ASME/CSA standard has been incorporated into both the International Plumbing Code (IPC) and the Uniform Plumbing Code (UPC), two of the major model plumbing codes adopted in most states and jurisdictions across the United States. Despite code requirements, many existing public-use faucets in the built environment still operate at higher flow rates, typically between 2.0 and 2.5 gpm (7.6 and 9.5 lpm).

Check Your State Standards

While DOE establishes the national maximum flow rate criteria for different faucets, some states have set more stringent efficiency standards for certain products, such as kitchen faucets. To determine what requirements may apply in your state, look for your state's regulations online. Refer to the Appliance Standards Awareness Project to get started at <https://appliance-standards.org/product/faucets>.

Kitchen and Bar Faucets

Similar to private-use lavatory faucets, DOE adopted a 2.2 gpm (8.3 lpm) at 60 psi (414 kPa) maximum flow rate standard for kitchen faucets in 1998. While DOE establishes the maximum allowable flow rate for faucets at the national level, some states and municipalities have adopted regulations mandating that kitchen faucets have a flow rate of 1.8 gpm (6.8 lpm) or less. Some of these regulations allow kitchen faucets to have a temporary override, which allows the faucet to temporarily operate at a flow rate up to 2.2 gpm (8.3 lpm), intended for pot filling or other volume-dependent behavior. Some voluntary codes and standards, such as the International Association of Plumbing and Mechanical Officials (IAPMO) *Water Efficiency and Sanitation Standard for the Built Environment* (WE•Stand)⁷ and the ASHRAE/ICC/USGBC/IES *Standard 189.1 Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings*,⁸ contain similar requirements.

Bar faucets (also referred to as prep faucets) are similar to kitchen faucets but are often installed at a secondary sink location that is used for food preparation or as a workstation. Like other faucet types, DOE requires bar faucets to have a flow rate of 2.2 gpm (8.3 lpm) or less at 60 psi (414 kPa). Bar faucets that meet the criteria from the WaterSense specification for lavatory faucets (i.e., have a maximum flow rate of 1.5 gpm (5.7 lpm) or less at 60 psi (414 kPa) are eligible for the WaterSense label.

Service Sinks

Sinks present in some facilities have purposes other than traditional kitchen or lavatory uses. These sinks can be found in janitorial closets, laundries, laboratories, classrooms, theaters, gymnasiums, or other areas. There are no federal regulations limiting the flow

⁷ International Association of Plumbing and Mechanical Officials (IAPMO). 2020. *WE•Stand Water Efficiency and Sanitation Standard for the Built Environment*. Chapter 4.

⁸ American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) and International Code Council (ICC). 2020. *American National Standards Institute (ANSI)/ASHRAE/ICC/U.S. Green Building Council (USGBC)/Illuminating Engineering Society (IES) Standard 189.1-2020 Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings*. Section 6: Water Use Efficiency.

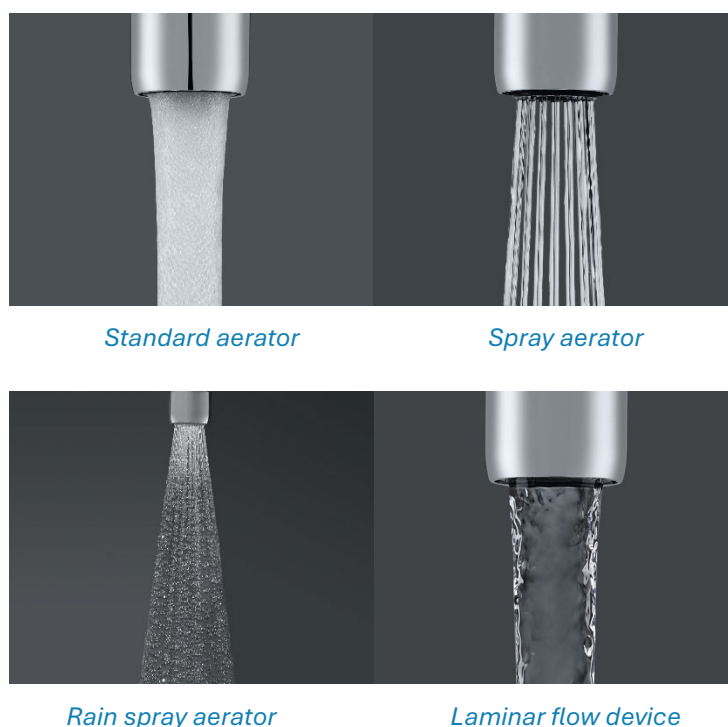
rate of these faucets, but their flow rate should be carefully considered with the intended end use, expected performance, and water efficiency in mind.

Faucet Accessories

Faucet accessories (aerators) are available in a variety of flow rates (between 0.35 and 2.2 gpm or between 1.3 and 8.3 lpm) and spray type/pattern (e.g., aerated, laminar stream, rain spray, spray stream). When choosing a spray type/pattern, it's important to consider the application, as well as whether it is for public or private use.

Standard aerators inject air into the water stream, producing a larger, whiter stream of water that is soft to the touch. They are typically used in residential homes and apartments. Spray aerators are typically used in public restrooms and offer a miniature shower pattern to provide full coverage during hand washing. Rain spray aerators provide a larger, softer stream and wider spray coverage. Finally, laminar flow devices provide a crystal-clear stream of water that is most useful for high-flow applications or healthcare facilities. Figure 1 includes representative spray patterns for each type of accessory.

Figure 1. Faucet Accessory Spray Patterns⁹



Each aerator costs from \$5 to \$10, so they are an inexpensive way to achieve significant savings. When selecting aerators with flow rates below 0.5 gpm (1.9 lpm), consider testing

⁹ Images of faucet accessory spray patterns courtesy of Neoperl, Inc.

the aerator on fixtures first to ensure there is no splash back that will provide a negative experience for the user.

Operation, Maintenance, and User Education

For optimum faucet efficiency, test the system's water pressure to make sure that it is between 20 and 80 psi (138 and 552 kPa). This level ensures the faucet delivers the expected flow and performance. In addition, consider the following:

- Periodically inspect faucets to ensure aerators or other flow restrictors remain installed and properly functioning at the intended flow rate. An easy way to confirm the flow rate of a faucet is to use a timer and collect water in a flow bag, measuring cup, or container of known volume.
- Periodically inspect faucet aerators for scale buildup to ensure flow is not being restricted. Clean or replace the aerator or other spout end device, if necessary.
- If installed, check and adjust automatic sensors to ensure they are operating properly to avoid faucets running longer than necessary.
- Post materials in restrooms and kitchens to ensure user awareness of the facility's water efficiency goals. Remind users to turn off the tap when they are done and to consider turning it off during sanitation activities when it is not being used (i.e., when brushing teeth or washing dishes).
- Post signage and train users to report continuously running, leaking, or otherwise malfunctioning faucets to the appropriate personnel.
- Equip maintenance staff with the appropriate training and tools to maintain faucet aerators. Some faucet accessories require specialized keys to remove them to prevent tampering.



Removing an aerator for inspection

Retrofit and Replacement Options

If retrofitting, replacing, or installing new faucet fixtures or accessories, consider the following:

- In public restrooms, install lavatory faucet fixtures, aerators, or laminar flow devices that flow at 0.5 gpm (1.9 lpm) (with or without the self-closing feature) or metering faucets that use a faucet accessory (e.g., aerator, flow restrictor) that limits the flow rate to no more than 0.5 gpm (1.9 lpm), regardless of the gallon per cycle setting.
- In private restrooms, select WaterSense labeled lavatory faucets and accessories (aerators or laminar flow devices), which have flow rates of 1.5 gpm (5.7 lpm) or less at 60 psi (414 kPa) and no less than 0.8 gpm (3.0 lpm) at 20 psi (138 kPa).¹⁰
- In kitchens, install faucet fixtures, aerators, or laminar flow devices that flow between 1.5 and 1.8 gpm (5.7 and 6.8 lpm). Where feasible, consider installing temporary shut-off or foot-operated valves for kitchen faucets. These valves stop water flow during intermittent activities, such as scrubbing or dishwashing. The water can be reactivated at the previous temperature without the need to remix hot and cold water.
- Medical facilities, senior care facilities, and other facilities with immunocompromised populations should consider facility-specific health and safety needs before installing high-efficiency faucets or faucets with automatic sensors. For example, medical facilities may want to install faucets with laminar flow devices instead of faucet aerators; since laminar flow faucets do not inject air into the water, there is a lower risk of bacterial contamination.¹¹ Consult the local health code for specific requirements.
- For service sinks, install faucets or faucet accessories that flow at a rate as low as possible without inhibiting the use of the sink (i.e., if the sink's function is volume-

Look for WaterSense Labeled Faucets

When replacing old, inefficient faucets or purchasing new faucets, look for the WaterSense label. A product with the label uses at least 20 percent less water than standard models and is independently certified for performance. Looking for the label is a simple way to quickly identify faucets that save water and perform well. Facilities can also use WaterSense's Product Search Tool to find labeled faucets. Go to www.epa.gov/watersense/product-search to get started.



¹⁰ Use WaterSense's product search tool at www.epa.gov/watersense/product-search to help identify WaterSense labeled models.

¹¹ U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Federal Energy Management Program (FEMP). Best Management Practice #7: Faucets and Showerheads. www.energy.gov/eere/femp/best-management-practice-7-faucets-and-showerheads.

dependent, do not reduce faucet flow rate to the point that it has to be used significantly longer to fill water containers).

Savings Potential

Water savings for both private- and public-use lavatory faucets can be achieved by retrofitting existing faucets with aerators or replacing existing faucets. The same amount of water savings can be expected for a retrofit or replacement; however, retrofitting existing faucets with aerators will yield the shortest payback period due to minimal equipment costs.

To estimate facility-specific water savings and payback, use the following information:

Current Water Use

To estimate the current water use of an existing faucet, identify the following information and use Equation 1 on the next page:

- Flow rate of the existing faucet: Private- and public-use lavatory faucets installed in 1996 or later generally have flow rates of 2.2 gpm (8.3 lpm) or less. Public- and private-use lavatory faucets installed between 1994 and 1996 generally have flow rates of 2.5 gpm (9.5 lpm) or less. Some public-use lavatory faucets installed in more recent years may flow at 0.5 gpm (1.9 lpm). Faucet flow rate is typically inscribed directly on the fixture or aerator itself.
- Average daily use time: Public-use faucets are typically used between 15 and 30 seconds per use for general handwashing and used three or four times per occupant per day. EPA estimates the average private-use lavatory faucet use is approximately 3 minutes per person per day. Kitchen faucets in residential settings are used approximately 7 minutes per person per day;¹² however, use of kitchen faucets may vary significantly in commercial and institutional settings.
- Number of building occupants.
- Days of facility operation per year.

¹² Based on information from EPA's WaterSense program. February 2021. *WaterSense Technical Evaluation Process for Approving Home Certification Methods, Version 1.0*. www.epa.gov/sites/production/files/2021-02/documents/watersense_final_technical_evaluation_process_for_home_certification_v1.0.pdf; and Water Research Foundation (WRF). 2016. *Residential End Uses of Water, Version 2*. Table 6.10.

Equation 1. Water Use of Faucet (gallons or liters per year)

$$= \text{Faucet Flow Rate} \times \text{Daily Use Time} \times \text{Number of Building Occupants} \\ \times \text{Days of Facility Operation}$$

Where:

- Faucet Flow Rate: Gallons or liters per minute
 - Daily Use Time: Minutes per person per day
 - Number of Building Occupants: Persons
 - Days of Facility Operation: Days per year
-

Water Use After Retrofit or Replacement

To estimate the water use after retrofitting or replacing an existing faucet with a water-efficient model or aerator, use Equation 1, substituting the flow rate of the retrofit or replacement. WaterSense labeled aerators installed in private-use settings use no more than 1.5 gpm (5.7 lpm). Public-use lavatory faucets can be retrofitted with 0.5 gpm (1.9 lpm) aerators.

Water Savings

To calculate water savings that can be achieved from retrofitting or replacing an existing faucet, identify the following information and use Equation 2 below:

- Current water use as calculated using Equation 1.
 - Water use after retrofit or replacement as calculated using Equation 1.
-

Equation 2. Water Savings From Faucet Retrofit or Replacement (gallons or liters per year)

$$= \text{Current Water Use of Faucet} - \text{Water Use of Faucet After Retrofit or Replacement}$$

Where:

- Current Water Use of Faucet: Gallons or liters per year
 - Water Use of Faucet After Retrofit or Replacement: Gallons or liters per year
-

Energy Savings

Because faucets typically use hot water, a reduction in water use will also result in energy savings. The energy required to heat water can be dependent on: the fuel used for water heating (e.g., electricity, natural gas); the efficiency of the water heater; and water heater temperature set points. Since this information is not always readily available, energy savings that can be achieved from retrofitting or replacing an existing faucet can be estimated using the water savings calculated using Equation 2 and the assumptions presented in Equation 3 below:



Faucet using hot water

Equation 3. Energy Savings From Faucet Retrofit or Replacement (kWh of electricity or Mcf of natural gas per year)

$$= \text{Water Savings (gallons or liters)} \times \text{Average Percent of Faucet Water That Is Hot} \times (\text{Energy per Gallon or Liter Heated} \div \text{Water Heater Efficiency})$$

Where:

- Water Savings: gallons per year (or liters per year)
 - Average Percent of Faucet Water That Is Hot: 60.7%
 - Energy per Gallon or Liter Heated [assuming 75°F (24°C) water temperature increase]:
 - 0.183 kilowatt hours (kWh) of electricity per gallon (0.048 kWh per liter); or
 - 0.0006 thousand cubic feet (Mcf) of natural gas per gallon (0.00016 Mcf per liter)
 - Water Heater Efficiency (unless otherwise known by the facility):
 - 1.0 for an electric hot water heater; or
 - 0.75 for a natural gas hot water heater
-

More detailed information to assist in calculating energy savings that result from saving water can be found on WaterSense's data and information web page at www.epa.gov/watersense/data-and-information-used-watersense.

Payback

To calculate the simple payback from the water and energy savings associated with a lavatory faucet retrofit or replacement, consider the equipment and installation cost of the retrofit or replacement faucet or aerator, the water and energy savings as calculated respectively using Equation 2 and Equation 3, and the facility-specific cost of water, wastewater, and water heating fuel (e.g., electricity, natural gas). Aerators typically cost \$5 to \$10 and require no installation cost.

Additional Resources

Alliance for Water Efficiency. Faucet Fixtures.

www.allianceforwaterefficiency.org/resources/topic/faucet-fixtures.

EPA's WaterSense program. Bathroom Faucets. www.epa.gov/watersense/bathroom-faucets.

North Carolina Department of Environment and Natural Resources et al. May 2009. *Water Efficiency Manual for Commercial, Industrial and Institutional Facilities*. Pages 36-37. www.deq.nc.gov/watereducation/water-efficiency-business-2/download.

Texas Water Development Board. May 2018. *Best Management Practices for Commercial and Institutional Water Users*. www.twdb.texas.gov/conservation/BMPs/CI/index.asp.

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Federal Energy Management Program. Best Management Practice #7: Faucets and Showerheads. www.energy.gov/eere/femp/best-management-practice-7-faucets-and-showerheads.

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United States Environmental Protection Agency
(4204M)

EPA 832-F-23-003

May 2023

www.epa.gov/watersense
(866) WTR-SENS (987-7367)