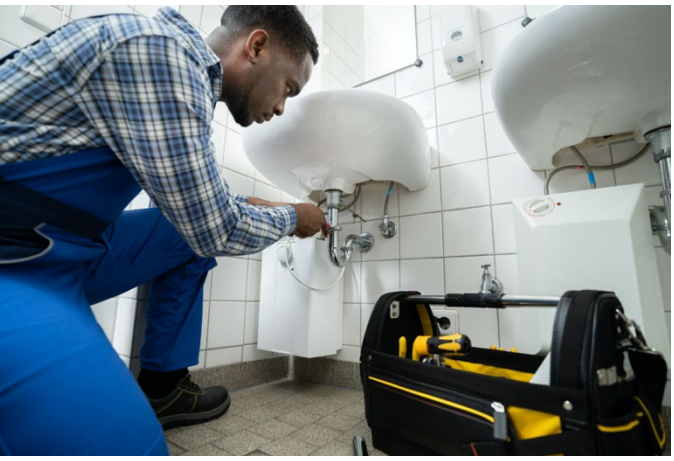

WaterSense at Work

Sanitary Fixtures and Equipment

3.4 Showerheads and Bath and Shower Diverters

Best Management Practices for Commercial and Institutional Facilities

EPA WaterSense

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 showerheads and bath and shower diverters, 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.

- **Section 1. Getting Started With Water Management**
- **Section 2. Water Use Monitoring**
- **Section 3. Sanitary Fixtures and Equipment**
- **Section 4. Commercial Kitchen Equipment**
- **Section 5. Outdoor Water Use**
- **Section 6. Mechanical Systems**
- **Section 7. Laboratory and Medical Equipment**
- **Section 8. Onsite Alternative Water Sources**

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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

Showerheads can be found in shower stalls in a variety of commercial and institutional facilities. Bath and shower diverters are installed in shower stalls combined with a bathtub, which may occur within hotels, hospitals, multifamily properties, or other commercial and institutional facilities that serve more of a permanent or temporary residential function. Ensuring water (and energy) efficiency from both of these products can be fairly simple and cost effective.

Showerheads

Showerheads come in a variety of shapes, sizes, and configurations, including fixed showerheads and rain showers, which are affixed overhead and permanently attached to the wall or ceiling, and handheld showerheads, which have a flexible hose that enables the showerhead to be detached from the wall and moved freely by the user. Other devices used for showering, such as body sprays (also referred to as body jets), spray water onto the user from a direction other than overhead, usually from a vertical column on the shower wall.

Handheld showerhead

In order to reduce overall water use, the Energy Policy Act of 1992 (EPAct 1992) established the maximum allowable flow rate for all showerheads sold in the United States as 2.5 gallons per minute (gpm) (9.5 liters per minute [lpm]). Older showerheads may flow as high as 3.0 to 5.0 gpm (11.4 to 18.9 lpm). While body sprays are not regulated under EPAct 1992, the American Society of Mechanical Engineers (ASME) A112.18.1/Canadian Standards Association (CSA) B125.1 *Standard for Plumbing Supply Fittings* addresses performance criteria and test methods for these products and establishes a maximum allowable flow rate of 2.5 gpm (9.5 lpm).

Since EPAct 1992 was enacted, many showerheads have been designed to use even less water. To evaluate whether reduced flow rate would result in reduced performance, the U.S. Environmental Protection Agency (EPA) supported consumer market research, which identified three key performance attributes that are necessary to ensure user satisfaction under a variety of household conditions: flow rate across a range of pressures; spray

force; and spray coverage. Each of these criteria can be tested using a specific protocol that measures accuracy and reliability. All three criteria must be met to produce a satisfactory shower without using more water.

To address efficiency and advances in showerhead technology, EPA's WaterSense® program published the *WaterSense Specification for Showerheads*.[1] WaterSense labeled showerheads are independently certified to flow at a rate of 2.0 gpm (7.6 lpm) or less, while also meeting or exceeding EPA's performance criteria for spray force and coverage.

While EPAct 1992 established the maximum allowable flow rate for showerheads at the national level, some states and municipalities have adopted regulations mandating that showerheads have a flow rate of 2.0 gpm (7.6 lpm) or less, consistent with the WaterSense specification. A few states, including California, Hawaii, and Washington, require showerheads to have a flow rate of 1.8 gpm (6.8 lpm) or less.[2] 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 showerheads will ensure that the product meets both efficiency and performance criteria.

Bath and Shower Diverters

Bath and shower diverters (also known as tub spout diverters) are devices installed in tub-shower combinations, common in hotels and residences. They are used to divert the flow of water either toward the tub spout (i.e., to the bathtub) or toward a secondary outlet (i.e., the showerhead). An often-overlooked source of wasted water, many bath and shower diverters continuously leak a small amount of water from the tub spout while they are engaged and water is being diverted from the bathtub to the showerhead. Over time, the magnitude of these diverter leaks can increase, sometimes substantially, resulting in significant water wasted down the drain with every shower. In addition, because this water is typically heated, leaking bath and shower diverters can also result in hot water losses, meaning energy is wasted as well.

Bath and shower diverter

[1] U.S. Environmental Protection Agency's (EPA's) WaterSense program. Showerheads. www.epa.gov/watersense/showerheads.
[2] Appliance Standards Awareness Project. State Standards. https://appliance-standards.org/states.

The ASME A112.18.1/CSA B125.1 standard allows bath and shower diverters to have an initial leak rate up to 0.1 gpm (0.4 lpm). Some states have adopted more stringent efficiency regulations, allowing bath and shower diverters to leak no more than 0.01 gpm (0.04 lpm) initially, and there are models available that allow zero leakage. However, when installed beyond their useful life or when corrosion and scaling have impacted diverter performance, water waste from leaky diverters can grow over time. One study found that 34 percent of bath and shower diverters assessed had leaks exceeding 0.1 gpm (0.4 lpm), with an average leak rate of 0.8 gpm (3.0 lpm) and some leak rates as high as 3.0 gpm (11.4 lpm).[3]

Operation, Maintenance, and User Education

For optimum showerhead efficiency, the system pressure should be tested to make sure that it is between 20 and 80 pounds per square inch (psi) (138 and 552 kiloPascals [kPa]). This will ensure that the showerhead delivers the expected flow and performance. In addition, consider the following:

- Verify that the hot and cold water plumbing lines to the showerhead are routed through a shower valve that meets the temperature control performance requirements of the ASSE 1016/ASME A112.1016/CSA B125.16 standard when tested at the flow rate of the showerhead installed. This valve will prevent significant fluctuations in water pressure and temperature at the outlet and can thereby reduce risks of thermal shock and scalding. A plumber can check the compatibility of the showerhead and shower valve and, if necessary, install a valve that meets the recommended standard for the flow rate of the showerhead.

Don't Forget Routine Maintenance

Scale build-up in showerheads and bath and shower diverters may restrict flow, cause leaks, and impact product performance. Add routine maintenance procedures to the facility's operation and maintenance plans to include periodically inspecting showerheads and bath and shower diverters for scale buildup and using cleaning products or white vinegar to remove scale when necessary.

- Periodically inspect showerheads for scale buildup to ensure flow is not being restricted. Certain cleaning products or white vinegar can dissolve scale from showerheads with buildup. Do not attempt to bore holes in the showerhead or manually remove scale buildup, as this may lead to increased water use or cause performance problems.
- Similarly, periodically inspect bath and shower diverters when the shower is turned on to determine whether a significant volume of water (i.e., greater than 0.2 gpm or 0.8 lpm) is leaking from the diverter. If large leaks are present, remove the diverter

[3] Taitem Engineering, PC. 2011. Tech Tip. New York State Homes & Community Renewal, Weatherization Assistance Program, "Leaking Shower Diverters." www.taitem.com/wp-content/uploads/Diverter-Valve-Tech-Tip-2011.7.20.pdf.

and use cleaning products or white vinegar to remove scale buildup, which may reduce or eliminate the leak. If cleaning does not minimize the leak, replace it with a new diverter.

- Periodically inspect showerheads and/or measure the flow rate to make sure integral flow restrictors have not been removed. An easy way to confirm the flow rate of the showerhead is to use a timer and collect water in a flow bag or container of known volume.
- Provide a way for users to track showering time and encourage users to take shorter showers by placing clocks or timers in or near the showers.
- Post signage and train users to report leaking or malfunctioning showerheads to the appropriate personnel.

Retrofit Options

Because showerheads are relatively inexpensive, replacement is often more economical and practical than a retrofit. In general, to reduce the flow rate and save water, avoid retrofitting existing inefficient showerheads with flow control inserts (which restrict water flow). These devices may not provide adequate performance in some facilities and can lead to user dissatisfaction. However, there are some viable retrofit options to consider, including installing thermostatic shutoff valves or installing shower valves for shower stalls with multiple showerheads.

Thermostatic Shutoff Valves

Showerhead using hot water

Shower users frequently will turn on a shower before entering the stall or tub to allow water to heat up. There are two types of water waste associated with this activity: structural waste, which represents the tepid water that often must be cleared (and drained) from the hot water supply line that connects the water heater to the showerhead; and behavioral waste, which constitutes water that has reached the desired temperature, but that runs down the drain before the occupant starts their shower. Bathers could walk away from the shower or tub while the water heats up, performing other tasks prior to entering the shower. Thermostatic shutoff valves can be installed to eliminate behavioral waste from showering events. Thermostatic shutoff valves greatly reduce the flow of water to the tub spout or showerhead once the water reaches the desired temperature for bathing. When the user is ready to enter the shower, the thermostatic shutoff valve can be reopened to allow the flow of water.

Shower Stalls With Multiple Shower Outlets

In certain circumstances, single shower stalls may be outfitted with multiple showerheads that can be activated simultaneously or individually by the user. In some cases, when these showerheads are turned on simultaneously, they use more water than the federal maximum flow rate of 2.5 gpm (9.5 lpm) for an individual showerhead (e.g., two 2.5 gpm showerheads can use 5.0 gpm or 18.9 lpm). In these instances, stalls can be retrofitted with a shower valve so that the showerheads can only be operated separately rather than simultaneously, or so the total volume of water flowing from all showerheads is equal to or less than 2.0 or 2.5 gpm (7.6 or 9.5 lpm). This may require replacing the existing showerheads with more efficient ones. For shower stalls designed for two persons in residences and private bathrooms in lodging facilities, EPA recommends that a second shower valve be installed not less than 96 inches (244 cm) from the first valve.[4]

The retrofit suggestions for single shower stalls provided here do not apply to communal showers used in prisons, locker rooms, and barracks. Communal showers may have multiple showerheads that each flow at a rate equal to or less than 2.0 gpm (7.6 lpm), since the showerheads are designed to be used by multiple users at once.

Replacement Options

When installing new showerheads or replacing older, inefficient showerheads, choose WaterSense labeled models. WaterSense labeled showerheads[5] are independently certified to use 2.0 gpm (7.6 lpm) or less and thus are 20 percent more water-efficient than standard showerheads on the market. In addition, WaterSense labeled showerheads are independently certified to meet or exceed minimum performance requirements for spray coverage and force.

Except for communal settings in prisons, locker rooms, and barracks, avoid installing multiple showerheads or body sprays when remodeling, particularly if they can be operated simultaneously or so that the total volume of water flowing from all showerheads

Look for WaterSense Labeled Showerheads

When replacing old, inefficient showerheads or purchasing new showerheads 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 showerheads that save water and perform well. Facilities can also use WaterSense's Product Search Tool to find labeled showerheads. Go to www.epa.gov/watersense/product_search to get started.

[4] Recommendations are consistent with the Plumbing Manufacturers International and Alliance for Water Efficiency Memorandum of Understanding. November 7, 2019. www.allianceforwaterefficiency.org/sites/default/files/assets/AWE_PMI_MOU_Multi-Showerhead_Signed.pdf.

[5] EPA's WaterSense program, *op. cit.*

is greater than the 2.0 gpm (7.6 lpm) WaterSense specification maximum. These multiple showerhead systems can waste a significant amount of water and energy.

For showerheads installed at locations with frequent use by transient individuals (e.g., locker rooms, beach access locations), consider installing shower systems with automatic shut-off capabilities. Once activated, these systems allow showers to operate for a fixed amount of time before shutting off, ensuring water is never left running. The run time is often adjustable, so facilities should adjust timers to align with intended use patterns.

When installing new or replacing older bath and shower diverters, install models that minimize leakage. Look for products tested to achieve a 0.00 gpm leak rate in pre-life cycle and post-life cycle testing. Use the California Energy Commission's Modernized Appliance Efficiency Database System (MAEDbS) to help identify models.[6]

Savings Potential

Water savings can be achieved by replacing existing showerheads and bath and shower diverters.

WaterSense labeled showerhead

Showerheads

Replacing existing showerheads with WaterSense labeled models can achieve significant water and energy savings in frequently used shower facilities. To estimate facility-specific water and energy savings and payback, use the following information:

Current Water Use

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

- Flow rate of the existing showerhead: Showerheads installed in 1994 or later may have a flow rate of 2.5 gpm (9.5 lpm) or less. Older showerheads may flow at a rate as high as 3.0 to 5.0 gpm (11.4 to 18.9 lpm).
- Average duration of each shower: The average shower duration is approximately eight minutes.[7]

[6] The California Energy Commission's Modernized Appliance Efficiency Database System can be accessed at https://cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx.
[7] Water Research Foundation (WRF). 2016. *Residential End Uses of Water, Version 2*. Table 6.9.

- Average use rate of showers in terms of number of showers each person takes per day: In buildings that serve a residential function (e.g., hotel, dorm, multifamily building), it can be assumed that occupants shower approximately 0.7 times per day.[8]
- Number of building occupants.
- Days of facility operation per year.

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

= Showerhead Flow Rate x Duration of Use x Use Rate x Number of Building Occupants x Days of Facility Operation

Where:

- Showerhead Flow Rate: Gallons or liters per minute
- Duration of Use: Minutes per shower
- Use Rate: Showers per person per day
- Number of Building Occupants: Persons
- Days of Facility Operation: Days per year

Water Use After Replacement

To estimate the water use of a replacement WaterSense labeled showerhead, use Equation 1 above, substituting the flow rate of the replacement showerhead. WaterSense labeled showerheads use no more than 2.0 gpm (7.6 lpm).

Water Savings

To calculate water savings that can be achieved from replacing an existing showerhead, identify the following information and use Equation 2 on the next page:

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

[8] *Ibid*.

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

= Current Water Use of Showerhead – Water Use of Showerhead After Replacement

Where:

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

Energy Savings

Because showerheads 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 replacing an existing showerhead can be estimated using the water savings calculated in Equation 2 for showerheads, and the assumptions presented in Equation 3 below:

Equation 3. Energy Savings From Showerhead or Bath and Shower Diverter Replacement (kWh of electricity or Mcf of natural gas per year)

= Water Savings x Average Percent of Shower Water That Is Hot x (Energy per Gallon or Liter Heated ÷ Water Heater Efficiency)

Where:

- Water Savings: Gallons or liters per year
- Average Percent of Shower Water That Is Hot: 67.8%
- Energy per Gallon or Liter Heated (assuming 75°F 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):
  - 1.00 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 savings associated with replacing an existing showerhead, consider: the equipment and installation cost of the replacement; the water and energy savings as calculated respectively in Equation 2 and Equation 3; and the facility-specific cost of water, wastewater, and water heating fuel (e.g., electricity, natural gas). Showerheads are available across a range of prices, so use the price of the models you intend to purchase to calculate cost savings and payback.

Bath and Shower Diverters

Replacing leaking bath and shower diverters with models that do not leak can help save water and energy. To estimate facility-specific water and energy savings and payback, use the following information:

Current Water Use

To estimate the current water use of a leaking bath and shower diverter, identify the following information and use Equation 4 on the next page:

- Leak rate of the existing diverter: Use a bucket or bag to manually collect water under the tub spout while the water is running and measure the water collected over a one-minute period.
- Average duration of each shower: The average shower duration is approximately eight minutes.[9]
- Average use rate of showers in terms of number of showers each person takes per day: In buildings that serve a residential function (e.g., hotel, dorm, multifamily building), it can be assumed that occupants shower approximately 0.7 times per day.[10]
- Number of building occupants.
- Days of facility operation per year.

[9] WRF, *op. cit.*
[10] *Ibid.*

Equation 4. Water Use of Leaking Bath and Shower Diverter (gallons or liters per year)

= Diverter Leak Rate x Duration of Use x Use Rate x Number of Building Occupants x Days of Facility Operation

Where:

- Diverter Leak Rate: Gallons or liters per minute
- Duration of Use: Minutes per shower
- Use Rate: Showers per person per day
- Number of Building Occupants: Persons
- Days of Facility Operation: Days per year

Water Savings

Replacing a leaking bath and shower diverter with a new model tested to have no leaks should eliminate that water use entirely. Therefore, savings should be approximately equal to the water use identified in Equation 4.

Energy Savings

Because bath and shower diverters leak 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 replacing a leaky diverter can be estimated using the water savings calculated in Equation 4 and the assumptions presented in Equation 3.

Payback

To calculate the simple payback from the savings associated with replacing a leaking bath and shower diverter, consider: the equipment and installation cost of the replacement; the water and energy savings as calculated respectively in Equation 4 and Equation 3; and the facility-specific cost of water, wastewater, and water heating fuel (e.g., electricity, natural gas).

Additional Resources

EPA's WaterSense program. Bath and Shower Diverters. www.epa.gov/watersense/bath-and-shower-diverters.

EPA's WaterSense program. Showerheads. www.epa.gov/watersense/showerheads.

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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