



Guidance for *Legionella* and Building Water System Closures

331-658 • 9/14/2020

The focus of this guidance is to reduce microbial pathogen growth including *Legionella*, and metal corrosion concerns that occur when there is a large drop in building water use. The guidance focuses on potable water plumbing systems inside larger buildings with complex plumbing and the information is general in nature. Each building is different and will require different actions based on its plumbing systems, use patterns, and source of water supply. This guidance was developed primarily for use in Washington State where public water systems typically use free chlorine for disinfection (not chloramines) and rarely have lead service lines.

Please see the department's [Guidance for Shutting Down and Reopening Water Recreation Facilities](#) for information about how to maintain and treat pools and spas. More information about cooling towers and HVAC systems can be found on the [New York State's Department of Health webpage](#).

What is the problem and who does it apply to?

Many buildings are closed to the public or have limited access in order to help slow the spread of COVID-19. The resulting drop in building water use increases the risk for the formation of biofilm which supports *Legionella* growth in building plumbing and associated equipment like cooling towers, pools, decorative fountains, hot tubs and other equipment. To prevent *Legionella* growth, **these systems must be actively managed and maintained.**

If *Legionella* grows during low-use periods, building users have a higher risk of contracting Legionnaires' disease and Pontiac Fever during the shutdown and when full use resumes. While *Legionella* is a primary risk, other opportunistic pathogens (*Mycobacterium avium*) and metal corrosion concerns (lead scale release) are increased by closure or reduced use situations.

Building closures and reduced occupancy affect all environmental systems operating inside buildings including 1) potable and non-potable water systems, 2) cooling towers, and 3) heating, ventilation and air conditioning (HVAC) that regulate interior relative humidity and control mold. These systems must be actively managed and maintained to protect the health of building users. In addition to managing systems during shutdown periods, building owners and operators need to implement well thought out start up protocols to ensure public health protection. By implementing procedures now, you can protect the public and minimize the steps needed to safely re-open closed or partially closed facilities.

Key points about *Legionella* risk and building water systems in Washington State

- ◆ Prior to the start of the COVID-19 pandemic, Legionnaires' disease sickened

and killed more people in the United States than any other reportable waterborne disease.³

- ◆ *Legionella* transmission occurs primarily through breathing contaminated aerosols into the respiratory system.
- ◆ The optimum growth range for *Legionella* is between 77°F (25°C) and 108°F (42°C), however, *Legionella* can survive and grow outside of this temperature range. To reduce bacteria growth, keep hot water systems above 122°F (50°C) at all fixtures and cold water systems below 74°F (23°C). Always follow plumbing and safety standards to prevent scalding at the point of use.
- ◆ Loss of free and total chlorine residual in building plumbing as a result of stagnant or very low water use is a significant factor that allows *Legionella* bacteria to flourish.
- ◆ Nearly all large and medium sized **municipal** water systems in Washington State use free chlorine for both primary disinfection and for distribution disinfectant residual (secondary disinfection). If you are not sure if your water system is disinfected, please contact your water utility.
- ◆ Microbial disinfection of water using free chlorine depends primarily upon the concentration of free chlorine and time. Temperature and pH also impact chlorine disinfection efficiency against microbes. "CT" is the term used in the drinking water industry to quantify disinfection. C stands for "concentration of free chlorine in mg/L units." T stands for time in minutes. Example: Free chlorine residual of 50 mg/L held in piping for 120 minutes (two hours) equals a CT of 6,000 mg-min/L.

Recommended Monitoring and Management of Building Water Systems

Monitoring building water quality

Because temperature and chlorine residual are primary factors affecting *Legionella* presence in building plumbing, DOH strongly recommends that temperature and chlorine residuals be accurately measured and used to manage building water age. All building water systems should have an accurate digital chlorine residual test kit that uses an EPA-approved test method for use in drinking water compliance.^{5,7} Test strips and color wheels are not accurate and not recommended testing methods for water systems. Thermometers should be accurate to within +/- 1°C. Operators should measure daily chlorine residual and temperature of water entering the facility from the water utility supplier. Chlorine concentrations in building plumbing will be less than or equal to utility concentrations. Building cold water temperatures will be equal to or higher than utility temperatures.

Maintaining systems under low use conditions (but not closed)

The best means of ensuring good water quality throughout your building is to ensure fresh water is maintained throughout the building plumbing.

1. Flush cold water systems to maintain temperature and chlorine residual. The frequency of flushing will depend upon occupancy, water use and your specific water and plumbing characteristics.
2. Monitor and maintain temperatures in hot water systems at the farthest (distal) fixtures. Or turn off the heating system, drain and flush the hot water tank, and refill with cold water. Then flush the hot water system with the cold water supply to maintain temperature and chlorine residual similar to the cold water system.
3. Measure and record temperature and chlorine residual of the supply water from the utility every day. Use these values, not time, as your optimum target for flushing at your distal measurements sites. Individual buildings have too much plumbing variability for time to be a useful flushing parameter.
4. Maintain cold water distribution free chlorine residuals at or above 0.2 mg/L (mg/L is the same as parts per million (ppm) at low concentrations). Measure it with an approved device. The supplying utility's chlorine levels may limit your ability to maintain this minimum plumbing distribution residual. Contact your utility to better understand their water quality operating parameters.
5. You may also want to make sure that the building's p-traps do not dry out. You can do this by flushing water down all drains to prevent sewer gas intrusion into the building.
6. Document all measurements and maintenance actions in a daily log.

Starting up building water systems after closures and sustained low use

You should give yourself two to three weeks lead time to start up your water plumbing system to make sure that you have time for testing and possible disinfection if needed. To ensure you and your employee's safety from both chemical and biological exposure while disinfecting and flushing the building plumbing, conduct appropriate training and use PPE. You can find guidance on worker safety for *Legionella* control and prevention on the [OSHA website](#).

1. Flush the entire water system to replace all water. Use an approved chlorine testing device to measure residual chlorine, flush until measured levels are equal to or slightly less than the supplying utility's chlorine residuals. Some flushing considerations are listed below. Additional flushing guidance can be found at the Environmental Science, Policy, and Research Institute (ESPRI) ¹¹ website.
2. Verify that testing for back flow assemblies is up-to-date prior to flushing.
3. Create a list of all plumbing fixtures that need to be flushed including ice machines, dishwashers, and point of use (POU) treatment devices to ensure that no fixture is overlooked. Replace point of use filters.

4. Some facilities receive their water from their water supplier through large diameter water mains frequently associated with needed fire flows. These large diameter water mains must be flushed before building plumbing is flushed. Refer to the flushing guidance referenced above for special concerns for large diameter pipe flushing.
5. Make sure that fixture drains are functioning and can handle expected flows without overflowing.
6. Remove all aerator screens before flushing. Clean or replace aerator screens to get rid of scale deposits that may contain harmful metals (lead) or microbial biofilms. Disinfect, heat sterilize, or replace shower heads especially if vulnerable populations have access to the showers
7. During flushing operate all valves in the fully open position so that any particulate matter can be flushed through. Pay close attention to float-operated or other restrictive valves that need to be manually opened to clear particulates and prevent fouling of the valves.
8. Adjust valves back to normal operating positions to ensure that the system is rebalanced.
9. Return hot water systems to normal operating temperatures.
10. Document all start up actions in the daily maintenance log.
11. Evaluate the effectiveness of your startup procedures **relative to *Legionella*** by testing for

Legionella using an approved culture method or one cited by the National Academies of Science³ for testing of *Legionella* in water. Collect samples at least 48 hours after final flushing and return of normal operation of the water system. **Samples collected too early may give false negative results.**¹ Collect samples from critical locations.⁸ ([CDC toolkit.](#)) The CDC maintains a [list of labs certified](#) for *Legionella* testing called ELITE labs. Other labs may be available in your area that are not on the CDC ELITE list of labs. Discuss with the labs if their method is suitable for conducting environmental testing of water for *Legionella*.

12. Since there are no *Legionella* drinking water standards in Washington State, you may use the European Union Action levels for *Legionella* in Potable Hot and Cold Water Systems⁴ to evaluate test results and identify additional steps needed. See Table 6 below.
13. If testing reveals widespread or high levels of *Legionella* in the water system, or you have other concerns, then remedial measures may be needed. Two remedial measures recommended by CDC and EPA are shock chlorination and thermal disinfection.
 - a. For shock chlorination, fully disinfect the cold-water system by flushing all fixtures and outlets with chlorinated water achieving a CT of no less than 3,000 mg- min/L. The chlorine concentration used in calculating CT is the lowest free chlorine residual **measured throughout the building at the end of the hold time** using an approved measuring device. For high chlorine doses, the sample will have to be diluted to accurately measure the residual with typical approved devices. A CT target of 3,000 mg-min/L is a minimum recommendation.

Systems with heavy biofilms or extensive *Legionella* colonization may need to use higher CT targets. Refer to DOH's publication entitled [*Shock Chlorination Guidance for Building Water Systems*](#) for a more complete description of this process.

- b. Thermal disinfection can only be practically done on the hot water plumbing system and creates a scalding risk. For these reasons, details of this procedure are not covered in this document.
- c. After any remedial measures, it is important to sample again in accordance with Step 11 outlined above.

References

1. European Society of Clinical Microbiology and Infectious Disease—[*Guidance for Managing Legionella during the Coronavirus Pandemic 2020*](#).
2. [*Safe Management of Water Systems in Buildings During the COVID-19 Outbreak*](#), 25 March 2020, Legionella Control Association, Staffordshire, UK.
3. National Academies of Sciences, Engineering and Medicine 2019. [*Management of Legionella in Water Systems*](#). Washington D.C. The National Academies Press.
4. [*European Technical Guidelines for the Prevention, Control and Investigation, of Infections Caused by Legionella species*](#). June 2017.
5. Deem, S. & Feagin, N., 2016. [*Disinfection Data Integrity in Washington State*](#). Journal AWWA, 108:10:24.
6. [*Emergency Disinfection of Small Water Systems, Publication 331-242*](#) revised February 2020, Washington State Department of Health.
7. [*Measuring Free Chlorine 331-442*](#) revised January 2020, Washington State Department of Health.
8. [*Developing a Water Management Program to Reduce Legionella Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards*](#) June 2017. U.S. Department of Health and Human Services CDC.
9. Technologies for *Legionella* Control in Premise Plumbing Systems: Scientific Literature Review. EPA Report USEPA. 2016—EPA 810-R-16-001. USEPA, Washington, DC.
10. [*Restoring Water to Medical, Residential, and Commercial Buildings, Shutdowns, Unsafe Water*](#), Purdue University Center for Plumbing Safety.
11. [*Building Water Quality and Coronavirus: Flushing Guidance for Periods of Low or No Use*](#), Environmental Science Policy and Research Institute.
12. [*Shock Chlorination Guidance for Building Water Systems*](#), April 2020, Washington State Department of Health.

Section 3.185 Table 6: European Union Action Levels for *Legionella* in Potable Hot and Cold Water Systems

<i>Legionella</i> CFU/Liter	Action Required
Not Detected	Acceptable—continue monitoring
< 100 to 1,000	Refer to responsible person and assure water quality values are within target
> 1,000 to < 10,000	<ul style="list-style-type: none"> i) Resample if small percentage (10-20%) are positive; review control measures ii) If >20% positive may indicate low level colonization, disinfection of system, and risk assessment to determine additional actions
≥ 10,000	Resample, immediate review of control measures, disinfection of whole system

Source: EU (2017).

The EU guidelines emphasize the goal to achieve no cultural *Legionella*, but acknowledge that occasional detection (<20%) of low levels of *Legionella* (< 1,000 CFU/L) may be acceptable provided that other water quality values (e.g., temperature, disinfectant) and operational parameters are within the water management plan guidelines. Intermediate levels (> 1,000 to < 10,000 CFU/L) and high levels (≥ 10,000 CFU/L) trigger a series of actions including resampling, remedial measures such as disinfection, and overall review of the water management plan program.

For more information

Our publications are online at doh.wa.gov/drinkingwater.

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