ASHRAE Guideline 12-2000

# ASHRAE® STANDARD

# Minimizing the Risk of Legionellosis Associated with Building Water Systems

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in hot water tanks and in peripheral plumbing fixtures that accumulate sediment. Legionellae growth appears to be heaviest at the solid-liquid interface with the development of slime deposits.

**4.1.5 Associated Cases of Legionnaires' Disease.** Potable heated water systems are an important potential source of Legionellosis in all buildings and are of particular importance in hospitals, nursing homes, and other health care facilities.[25] Many reports link legionellae in hospital tap water to epidemics and clusters of nosocomial (hospital-acquired infection) Legionnaires' disease, often involving immunosuppressed patients.[26]

**4.1.6 Recommended Treatment.** Where practical in health care facilities, nursing homes, and other high-risk situations, cold water should be stored and distributed at temperatures below 20°C (68°F), while hot water should be stored above 60°C (140°F) and circulated with a minimum return temperature of 51°C (124°F). However, great care should be taken to avoid scalding problems. One method is to install preset thermostatic mixing valves. Where buildings cannot be retrofitted, periodically increasing the temperature to at least 66°C (150°F) or chlorination followed by flushing should be considered. Systems should be inspected annually to ensure that thermostats are functioning properly.

Where practical in other situations, hot water should be stored at temperatures of 49°C (120°F) or above.

Those hot or cold water systems that incorporate an elevated holding tank should be inspected and cleaned annually. Lids should fit closely to exclude foreign materials.

Detailed current plans for hot and cold water piping systems should be readily available. Hot water heaters and storage vessels for such systems should have a drainage facility at the lowest point, and the heating element should be located as close as possible to the bottom of the vessel to facilitate mixing and prevent water temperature stratification. In high-risk applications, insulated recirculation loops should be incorporated as a design feature. For all situations, the pipe runs should be as short as practical. Moreover, where recirculation is employed, the pipe runs should be insulated and long dead legs avoided. New shower systems in large buildings, hospitals, and nursing homes should be designed to permit mixing of hot and cold water near the showerhead. The warm water section of pipe between the control valve and showerhead should be self-draining.

Copper-silver ionization is a relatively new approach to controlling *Legionella* in hot water distribution systems and has been used successfully in a number of hospitals.[27-29] Electrolytically generated copper and silver ions build up in the hot water recirculating system to levels effective in eradicating *Legionella*, typically in the range of 0.2-0.8 mg/L copper and 0.02-0.08 mg/L silver. The optimal concentration of copper-silver ions for controlling *Legionella* in hot water is not known. A particular concentration may not be universally effective because of variables in water quality and system design. It is also important to note that the efficacy of copper-silver ions, like chlorine, is adversely affected by elevated pH.[30]

Where decontamination of hot water systems is necessary (typically due to implication of an outbreak of Legionellosis) the hot water temperature should be raised to 71-77°C (160-170°F) and maintained at that level while progressively flushing each outlet around the system. A minimum flush time of five minutes has been recommended by the Center for Disease Control Hospital Infection Control Practices Advisory Committee.[31] However, the optimal flush time is not known and longer flush times may be necessary. In the original report describing this method, multiple 30-minute flushes were required to significantly reduce *Legionella* colonization.[17] The number of outlets that can be flushed simultaneously will depend on the capacity of the water heater and the flow capability of the system. Local building and sanitary codes should be checked for any temperature limits of water discharged to the sewer. Appropriate safety procedures to prevent scalding are essential. When possible, flushing should be performed when the fewest building occupants are present (e.g., nights and weekends). For systems where thermal shock treatment is not possible, shock chlorination may provide an alternative.[32,33] However, there is less experience with this method of decontamination. Also, users should realize that the required levels of free chlorine residual can cause corrosion of metals. Chlorine should be added to achieve a free chlorine residual of at least 2 mg/L throughout the system. This may require chlorination of the water heater or tank to levels of 20 to 50 mg/L. The pH of the water should be maintained between 7.0 and 8.0. Each outlet should be flushed until the odor of chlorine is detected. The chlorine should remain in the system for a minimum of 2 hours (not to exceed 24 hours), after which the system should be thoroughly flushed.

Once the decontamination is complete, recolonization is likely to occur unless the proper temperatures are maintained, continuous supplemental chlorination is continued, or alternative approaches, such as the use of a silver/copper ionization device, are employed.

In high-risk applications, monthly removal of shower heads and tap aerators to clean out sediment and scale and to clean them in a chlorine bleach solution is recommended.

For potable water systems that were opened for repair or other construction or systems that were subjected to water pressure changes associated with construction (which may cause water to become brown and the concentration of *Legionella* to dramatically increase),[34] it is recommended that as a minimum the system be thoroughly flushed. High-temperature flushing or chlorination may be appropriate, and this judgement should be made on a job-specific basis. If only a portion of the system is involved, high-temperature flushing or chlorination may be used on only that portion of the system.

### 4.2 Emergency Water Systems—Safety Showers, Eye Wash Stations, and Fire Sprinkler Systems

**4.2.1 System Description.** All three of these systems are generally plumbed to the potable water system, have little or no flow with resulting stagnant conditions, and may reach temperatures warmer than ambient. Legionellae, heterotrophic bacteria, and amoebae have been cultured from these systems.[35] When the devices are used, aerosolization is expected.