

Controlling *Legionella* in Cooling Towers

Purpose

Use this document to:

1. Help evaluate hazardous conditions associated with all types of cooling towers and evaporative condensers
2. Implement *Legionella* control measures for cooling towers per ASHRAE Guideline 12-2020
3. Complement existing resources for water management programs
4. Support environmental assessments conducted during public health investigations

Key Points

- Scale, corrosion, sediment controls, and system cleaning are critical for cooling tower operations and Legionnaires' disease prevention.
- Disinfectant residual should be monitored and adjusted by an automated system.
- *Legionella* risks are similar for open and closed-circuit cooling tower systems.

Sediment and biofilm, temperature, water age, and disinfectant residual are the key factors that affect *Legionella* growth in cooling towers.

Design

Open- vs. Closed-Circuit Cooling Towers

All cooling towers use the evaporation of water to remove heat and release it into the atmosphere. Cooling towers use circulating water to cool chillers, heat pumps, compressors, condensers, heat exchangers, and other process devices. Both kinds of cooling towers, open- and closed-circuit, require the same basic operation and maintenance protocols. Both types of cooling towers can release aerosolized water to the atmosphere. If *Legionella* is present, the aerosolized water can spread the bacteria over miles. However, closed-circuit cooling towers have an additional, closed loop that can keep the fluid used in the cooling processes from being exposed to the atmosphere. Closed-circuit cooling towers can operate in cool temperatures in a “dry” mode that does not use water or generate aerosols.

Design Recommendations

Understanding cooling tower design components is critical for *Legionella* control.

- Use high-efficiency drift eliminators.
- Locate cooling towers at least 25 feet from building air intakes to ensure that the cooling tower's drift plume is not drawn into a ventilation system.
- Ensure system piping is designed to avoid stagnation or dead legs.
- Recirculate water during intermittent operation.
- Design and install an automated water treatment system.



Operation, Maintenance, and Control Limits

Safe operation and regular cooling tower maintenance protect building operators, staff, visitors, and the adjacent community from exposure to *Legionella*. The necessary frequency of these activities depends on the cooling load, the environmental conditions present in the area where the cooling tower is located, and the cooling tower's design. Use a water management program to establish, track, and improve operation and maintenance activities. Operate and maintain cooling towers with the following guidelines in mind:

- Follow manufacturer recommendations for cleaning and disinfection prior to commissioning, before startup, when idling, and after shutdown.
- Operate cooling tower systems at the lowest possible water temperature, and below the most favorable *Legionella* growth range (77–113°F, 25–45°C), if possible.
- Automate anti-corrosion, anti-scale, and disinfectant addition and monitoring.
- Monitor water parameters, like disinfectant residual and pH, on a regular basis. Measurement frequency should be based on performance of the water management program or *Legionella* performance indicators for control. Adjust frequency according to the stability of performance indicator values. For example, the measurement frequency should be increased if there is a high degree of measurement variability.
- Flush low-flow pipe runs and dead legs at least weekly.
- Balance operating times among cooling towers to prevent stagnation when multiple cooling towers or cells exist.
- Implement automated blowdown (intentional discharge of system water and replacement with supply water) to maintain system water quality.
- Consider filtration to reduce the level of suspended solids in the cooling water based on system factors (e.g., cooling tower location, particle load).
- Perform an off-line disinfection and cleaning at least annually.
- Monitor cooling towers for water service disruptions and develop plans to respond accordingly.
- Consider testing for *Legionella* in accordance with Routine Testing for *Legionella* (Page F1).
- Maintain site-specific log sheets, test procedures, service reports, and test results on-site.

Remediation

If an outbreak or illness is suspected, test in conjunction with public health in order to:

- Confirm the presence of *Legionella* before performing remediation.
- Confirm elimination of *Legionella* after remediation activities.

Cleaning, disinfecting, and remediating cooling towers involves a hierarchy of protocols. Determine how the following response protocols fit into your water management program. The protocols are listed in order of increasing intensity from routine treatment to offline emergency disinfection. Consult ASHRAE Guideline 12-2020 for instructions for each response. These steps may require customization based on system components, operating conditions, or other factors.

- Online remedial treatment
- Online disinfection
- Offline cleaning and disinfection
- Offline emergency cleaning and disinfection

If an associated outbreak or illness is suspected by the public health authority having jurisdiction (AHJ), perform an offline emergency cleaning and disinfection using the procedures below. Note: The public health AHJ determines whether there are associated illness(es) or an outbreak.

Consult a water treatment professional for guidance on applying these procedures.

1. **Review** the current water treatment program (e.g., cleanliness, maintenance, disinfectant program).
2. **Remove** heat load from the cooling system. Shut off fans associated with the cooling tower. Disengage all automated chemical feed and control equipment.
3. **Shut off** system blowdown and keep make-up water valves open and operating.
4. **Close** building air intake vents near the cooling tower, especially those downwind, until after the cleaning procedure is complete.
5. **Circulate** water through all system equipment, including any bypass or standby components.
6. **Add** an oxidizing disinfectant sufficient to achieve a disinfectant residual of at least 20 ppm as free available oxidant.
7. **Add** an appropriate dispersant and apply antifoam, if needed. Apply appropriate corrosion inhibitors.
8. **Reduce** the cycles of concentration (if necessary) to achieve and maintain a pH of less than 8.0 for chlorine-based disinfectants or less than 8.5 for bromine-based disinfectants.
9. **Maintain** a free available oxidant residual of 10 ppm for a minimum of 24 hours. Shorter contact times can be effective at higher concentrations.
10. **Drain** the system after the disinfection period to the sanitary sewer, following all applicable rules, regulations, and permits that may be required.
11. **Physically clean** all accessible system equipment. Consideration should be given to all cooling tower equipment, including fill pack, drift eliminators, equalizer lines, remote sumps, basins, strainers, chillers, free cooling heat exchangers, and any bypass or standby components.
12. **Refill** the system and circulate water through all system equipment including any bypass or standby components.
13. **Add** an oxidizing disinfectant and maintain a free available oxidant residual of at least 10 ppm for one hour.
14. **Drain** the system after the disinfection period to the sanitary sewer following all applicable rules, regulations, and permits that may be required.
15. **Refill** the system and return all chemical feed and control equipment to normal operation.

Table 1. Legionella Control Measures for Cooling Towers

Water Parameter	Control Measure	Recommendations
Sediment and Biofilm	Cleaning frequency, scale and corrosion inhibitors	<ul style="list-style-type: none"> • Cleaning frequency varies based on operational factors. • Remove from service, clean, and disinfect at least annually. • Monitor scale and corrosion inhibitor levels frequently as indicated by water quality measurements.
Temperature	Control limits	<ul style="list-style-type: none"> • Operate at the lowest possible water temperature outside the favorable growth range for <i>Legionella</i> (77–113°F, 25–45°C).
Water Age	Make-up water quality and turnover frequency	<ul style="list-style-type: none"> • Flush low-flow pipe runs and dead legs at least weekly. • During wet system standby (water remains in system and shutdown for less than 5 days), maintain water treatment program and circulate water 3 times a week through the open loop of a closed-circuit cooling tower and entire open-circuit cooling system. Ensure system water quality is managed through automated system blow down. • Use potable water for system make-up water or ensure reclaimed or condensate sources are appropriately managed.
Disinfectant Residual	Control limits	<ul style="list-style-type: none"> • pH: Maintain based on type of disinfectant used and manufacturer recommendations to prevent corrosion. • Oxidizing disinfectants (e.g., chlorine & bromine): Maintain measurable residuals throughout each day. Consult manufacturer recommendations. • Non-oxidizing disinfectants: Maintain based on product label concentration and contact time.

Resources

- Toolkit for Controlling *Legionella* in Common Sources of Exposure: <https://www.cdc.gov/legionella/wmp/control-toolkit/index.html>
- Toolkit: Developing a Water Management Program to Reduce *Legionella* Growth and Spread in Buildings: <https://www.cdc.gov/legionella/wmp/toolkit/index.html>
- *Legionella* Environmental Assessment Form: <https://www.cdc.gov/legionella/downloads/legionella-environmental-assessment-p.pdf>
- PreventLD Training: <https://www.cdc.gov/nceh/ehs/elearn/prevent-LD-training.html>
- ASHRAE Guideline 12-2020: <https://www.ashrae.org/technical-resources/standards-and-guidelines/guidance-on-reducing-the-risk-of-legionella>
- Cooling Technology Institute Guideline 159(20): <https://cti-marketplace.myshopify.com/products/>