

4. Procedure for Cleaning Cooling Towers and Related Equipment

- I. Perform these steps prior to chemical disinfection and mechanical cleaning.
 - A. Provide protective equipment to workers who perform the disinfection, to prevent their exposure to chemicals used for disinfection and aerosolized water containing *Legionella* spp. Protective equipment may include full-length protective clothing, boots, gloves, goggles, and a full- or half-face mask that combines a HEPA filter and chemical cartridges to protect against airborne chlorine levels of up to 10 mg/L.
 - B. Shut off cooling tower.
 1. Shut off the heat source, if possible.
 2. Shut off fans, if present, on the cooling tower/evaporative condenser (CT/EC).
 3. Shut off the system blowdown (i.e., purge) valve.
 4. Shut off the automated blowdown controller, if present, and set the system controller to manual.
 5. Keep make-up water valves open.
 6. Close building air-intake vents within at least 30 meters of the CT/EC until after the cleaning procedure is complete.
 7. Continue operating pumps for water circulation through the CT/EC.
- II. Perform these chemical disinfection procedures.
 - A. Add fast-release, chlorine-containing disinfectant in pellet, granular, or liquid form, and follow safety instructions on the product label. Use EPA-registered products, if available. Examples of disinfectants include sodium hypochlorite (NaOCl) or calcium hypochlorite (Ca[OCl]₂), calculated to achieve initial free residual chlorine (FRC) of 50 mg/L: either a) 3.0 lbs [1.4 kg] industrial grade NaOCl [12%–15% available Cl] per 1,000 gallons of CT/EC water; b) 10.5 lbs [4.8 kg] domestic grade NaOCl [3%–5% available Cl] per 1,000 gallons of CT/EC water; or c) 0.6 lb [0.3 kg] Ca[OCl]₂ per 1,000 gallons of CT/EC water. If significant biodeposits are present, additional chlorine may be required. If the volume of water in the CT/EC is unknown, it can be estimated (in gallons) by multiplying either the recirculation rate in gallons per minute by 10 or the refrigeration capacity in tons by 30. Other appropriate compounds may be suggested by a water-treatment specialist.
 - B. Record the type and quality of all chemicals used for disinfection, the exact time the chemicals were added to the system, and the time and results of FRC and pH measurements.
 - C. Add dispersant simultaneously with or within 15 minutes of adding disinfectant. The dispersant is best added by first dissolving it in water and adding the solution to a turbulent zone in the water system. Automatic-dishwasher compounds are examples of low- or nonfoaming, silicate-based dispersants. Dispersants are added at 10–25 lbs (4.5–11.25 kg) per 1,000 gallons of CT/EC water.
 - D. After adding disinfectant and dispersant, continue circulating the water through the system. Monitor the FRC by using an FRC-measuring device with the DPD method (e.g., a swimming-pool test kit), and measure the pH with a pH meter every 15 minutes for 2 hours. Add chlorine as needed to maintain the FRC at ≥ 10 mg/L. Because the biocidal effect of chlorine is reduced at a higher pH, adjust the pH to 7.5–8.0. The pH may be lowered by using any acid (e.g., muriatic acid or sulfuric acid used for maintenance of swimming pools) that is compatible with the treatment chemicals.
 - E. Two hours after adding disinfectant and dispersant or after the FRC level is stable at ≥ 10 mg/L, monitor at 2-hour intervals and maintain the FRC at ≥ 10 mg/L for 24 hours.
 - F. After the FRC level has been maintained at ≥ 10 mg/L for 24 hours, drain the system. CT/EC water may be drained safely into the sanitary sewer. Municipal water and sewerage authorities should be contacted regarding local regulations. If a sanitary sewer is not available, consult local or state authorities (e.g., a department of natural resources or environmental protection) regarding disposal of water. If necessary, the drain-off may be dechlorinated by dissipation or chemical neutralization with sodium bisulfite.
 - G. Refill the system with water and repeat the procedure outline in steps 2–7 in I-B above.
- III. Perform mechanical cleaning.
 - A. After water from the second chemical disinfection has been drained, shut down the CT/EC.
 - B. Inspect all water-contact areas for sediment, sludge, and scale. Using brushes and/or a low-pressure water hose, thoroughly clean all CT/EC water-contact areas, including the basin, sump, fill, spray nozzles, and fittings. Replace components as needed.
 - C. If possible, clean CT/EC water-contact areas within the chillers.
- IV. Perform these procedures after mechanical cleaning.
 - A. Fill the system with water and add chlorine to achieve an FRC level of 10 mg/L.
 - B. Circulate the water for 1 hour, then open the blowdown valve and flush the entire system until the water is free of turbidity.
 - C. Drain the system.
 - D. Open any air-intake vents that were closed before cleaning.
 - E. Fill the system with water. The CT/EC may be put back into service using an effective water-treatment program.