



*NSF International Protocol*

## NSF P453 - 2017

Cooling Tower Water Systems -  
Treatment, Operation, and Maintenance  
to Prevent Legionellosis



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Standards Department  
NSF International  
789 North Dixboro Road, P. O. Box 130140  
Ann Arbor, MI 48113-0140, USA  
Phone: (734) 769-8010 Telex: 753215 NSF INTL  
FAX: (734) 769-0109  
E-mail: [info@nsf.org](mailto:info@nsf.org)  
Web: <http://www.nsf.org>

NSF International Protocol 453

**Cooling Tower Water Systems –  
Treatment, Operation, and Maintenance to  
Prevent Legionellosis**

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## Foreword

*Legionella* bacteria occur naturally in rivers, lakes, and streams, and can enter buildings through a number of ways. In the case of cooling tower water systems, these sources include the makeup from the municipal water supply and from scrubbing dirt and debris from the air. In the absence of control, *Legionella* can amplify in building water systems and then be released into the air in *Legionella*-contaminated aerosols. Based on data from the Centers for Disease Control and Prevention (CDC), the greatest number of outbreaks of Legionnaires' disease investigated between 2000 and 2014 were associated with premise plumbing (56%), followed by cooling tower water systems (22%)<sup>1</sup>. Because relatively more cases were associated with cooling tower outbreaks, the total number of outbreak cases from premise plumbing and cooling towers were roughly equivalent. Each building water system is important and should be addressed by comprehensive water management programs. This Protocol specifically addresses the treatment, operation, and maintenance of cooling tower water systems to prevent Legionellosis from these systems.

Cooling towers remove heat from recirculating water used in water-cooled chillers, heat pumps, air compressors, and other equipment. Heat is rejected from recirculating water in the cooling tower primarily through evaporation. Under certain conditions, the water-associated piping, heat exchangers and other component surfaces, and the bulk water in cooling towers can become contaminated with microbes, including pathogenic bacteria such as *Legionella*. Appropriate treatment, operation, and maintenance practices can control microbial contamination, amplification, and transmission, and help prevent waterborne disease, such as Legionnaires' disease, associated with cooling tower water systems.

The technology of evaporative cooling water systems has advanced steadily since its origin over 100 years ago. Drift has been reduced, fan efficiency has improved, and fill effectiveness has increased. Cooling towers are now lighter and more corrosion resistant than ever before. Cooling towers offer significant environmental benefits over alternative heat rejection systems, such as air-cooled systems, in terms of total system energy savings, carbon footprint, space, and capital cost. These benefits are enhanced by appropriate treatment, maintenance, and operation consistent with the provisions of this NSF Protocol.

This NSF Protocol provides auditable requirements including means, methods, and frequencies for treating cooling towers using readily available chemicals that are identified by their generic names. It provides simple, easy-to-implement procedures as a minimum benchmark. Alternative practices are allowed by this Protocol so long as there is independent, documentary evidence demonstrating that such alternatives can achieve at-least-equivalent efficacy to the benchmark performance of the processes and procedures set forth here.

In some jurisdictions, there are rules, regulations, and codes that cover owners and operators of buildings that are equipped with cooling tower water systems. Where there are differences between the requirements of this Protocol and such rules, regulations, and codes, the more stringent or specific shall apply.

Throughout the development process of NSF P453 *Cooling Tower Water Systems - Treatment, Operation, and Maintenance to Prevent Legionellosis*, NSF International has worked closely with experts from a number of organizations, including government agencies, academic institutions, and the private sector; however, the viewpoints expressed in the document do not necessarily represent the official position of the organization, agency, or institution. This Protocol has benefitted from the public comment process. All comments were carefully considered, and many adjustments were made accordingly.

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1 Garrison LE, Kunz, JM, Cooley LA, et al. Vital Signs: Deficiencies in Environmental Control Identified in Outbreaks of Legionnaires' Disease – North America, 200-2014. MMWR Morb Mortal Wkly Rep 2016; 65: 576 – 584

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Cesar Cordero  
Office of Ground Water and Drinking Water  
US EPA  
Washington, DC

Justin DeWitt, PE  
Division of Environmental Health  
Illinois Department of Public Health  
Chicago, IL

David Dziewulski, PhD  
Center for Environmental Health  
New York State Department of Health  
Albany, NY

Aaron Rosenblatt  
Gordon & Rosenblatt, LLC  
New York, NY

Kenneth Rotert  
Office of Ground Water and Drinking Water  
US EPA  
Washington, DC

Howard Shuman, PhD  
Department of Microbiology  
University of Chicago  
Chicago, IL

## NSF Protocol 453 —

# Cooling Tower Water Systems – treatment, operation, and maintenance to prevent Legionellosis

## 1 Purpose

The purpose of this Protocol is to set forth minimum practices required for treatment, operation, and maintenance of cooling tower water systems, including requirements for documentation, recordkeeping, validation, and auditing in order to prevent Legionellosis.

## 2 Scope

This Protocol covers all owners and operators of buildings and other premises that are equipped with cooling tower water systems, including all building-associated cooling towers used in connection with HVAC systems and all industrial cooling towers and evaporative condensers used in connection with process cooling. This Protocol does not cover hyperbolic towers.

In order for the owner of a cooling tower water system to comply with this Protocol, all of the applicable requirements of this Protocol shall be met.

In some jurisdictions, there are rules, regulations, and codes that cover owners and operators of buildings and other premises that are equipped with cooling tower water systems. Where there are differences between the requirements of this Protocol and such rules, regulations, and codes, the more stringent or specific shall apply.

## 3 Definitions

**3.1 analysis of the cooling tower water system:** The systematic, step-by-step evaluation of potentially hazardous conditions associated with the cooling tower system.

**3.2 authority having jurisdiction (AHJ):** An organization, governmental office, or agency responsible for enforcing codes, rules, or regulations covering the matters to which this Protocol pertains.

**3.3 basin (collection basin):** Vessel within the tower where cooled water is collected and contained after its interaction with the air flow.

**3.4 biocides:** Substances that kill bacteria. Biocides include oxidizing biocides (e.g., chlorine) and non-oxidizing biocides (e.g., glutaraldehyde). Biocides may be used alone or in combinations.

**3.5 blowdown:** Blowdown is the total of all non-evaporative water losses from the cooling tower. When water evaporates from a cooling tower, dissolved solids (such as bromides, calcium, magnesium, chlorides, carbonate, sulfate, and silica) are left behind in the bulk water. As more water evaporates, the concentration of dissolved solids increases. If the concentration gets too high, the dissolved solids can precipitate, cause scale deposits and contribute to corrosion and microbial growth. The concentration of dissolved solids is