# LEGIONNAIRES' DISEASE

## A Guide for Employers and Building Owners

### What is Legionnaires' Disease?

Legionnaires' disease is a potentially fatal pneumonia caused by the inhalation of small water droplets contaminated with Legionella bacteria. The bacteria can also cause a less-severe flu-like respiratory illness called Pontiac Fever. These diseases cannot be transmitted through human contact and although everyone is potentially susceptible to the infection, some people are at higher risk than others.

### High Risk Individuals

- Smokers
- Heavy Drinkers
- People 45 years of age and older
- Anyone suffering from chronic respiratory or kidney disease
- Those with compromised immune systems

### Where is Legionella found?

Legionella bacteria are common in natural water systems and soils and they can drift in air-borne water droplets to other locations, such as cooling towers and domestic hot and cold water systems. They are resilient, they spread easily, and they grow rapidly.

High temperatures effectively kill Legionella bacteria, but they thrive between 20°C and 50°C (68°F-121°F), especially if a supply of nutrients such as rust, sludge, scale, algae, or other bacteria is available.

### Who is this information intended for?

This guide is intended for all employers who own or manage premises with hot/cold water services and/or evaporative cooling systems (e.g. cooling towers and evaporative condensers). Workplace health and safety committees will also be interested in this information.

### Why is this information important to me?

The obligation of preventing Legionnaires' disease is the responsibility of the employer and the building owner. This guide was written to help you, as an employer, understand the health risks associated with Legionella bacteria, encourage you to take all necessary risk reduction measures, and help to determine whether a professional risk assessment is justified at your facility.


## What are my regulatory obligations?

Occupational Health and Safety regulations require employers to take every reasonable precaution to protect their workers and the public. If you own or manage premises with water-related services, or your facility uses evaporative cooling systems such as cooling towers and evaporative condensers, you need to proactively manage the risk those services present.

## This includes:

1. Following all regional regulations
2. Being aware of the risks associated with Legionella bacteria, and
3. Implementing the necessary precautions to minimize those risks

The law places the responsibility for compliance on the employer and the building owner. As a supplier of cooling water treatment systems, we are highly motivated to do whatever we can to help prevent illness and death. We encourage our customers to follow the laws and the precautionary advice of the experts in this area. We are committed to helping you minimize your organization's liability, should a case of Legionnaires' disease develop at your facility.

## Regional Regulations

Please see the attached Addendum for information on any regulations that are specific to your area or industry. Specialized regulations currently exist for:

- The Province of Quebec
- The City of Hamilton, Ontario
- The City of Vancouver, British Columbia
- Canadian federal Public Works and Government Services (PWGS)
- U.S Veterans Affairs Hospitals (VA Hospitals)
- New York City and New York State
- Centers for Medicare and Medicaid Services

## The Cost of Negligence

The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has included its best recommendations for effective Legionella risk management in Standard 188 – Legionellosis: Risk Management for Building Water Systems and Guideline 12. The term Standard has legal significance. The neglect of established best practices can be used to prove negligence in a court of law. For example:

- Over 20 deaths and more than 100 confirmed cases were attributed to Legionella in 2005 at Toronto's Seven Oaks Home for the Aged. A class action lawsuit resulted in penalties of $1.2 million.
- The New York City outbreak in 2015 resulted in the illness of 120 people and the death of 12. These events sparked lawsuits and the rapid implementation of local regulations regarding evaporative cooling systems. Many other municipalities are considering similar actions in an effort to mitigate risk.

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## Which Systems Present the Greatest Risk?

Cooling towers, fluid coolers, evaporative condensers and domestic hot and cold water systems have been associated with outbreaks of Legionnaires' disease, as well as humidifiers, decorative fountains, and spa baths.

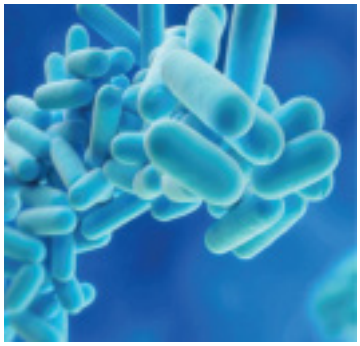
## Assessing the Risk

Assessing the risk is the first step in establishing a reasonable risk management plan.

## Ask yourself:

- If conditions in your system are likely to encourage bacteria to multiply. Is the water temperature in your water system between 20°C and 50°C? Do stagnant areas exist?
- If it's possible that small water droplets are being produced and, if so, could they be dispersed over a large area through, for example, showers and aerosol spray from cooling towers?
- If it's likely that any high risk individuals will come into contact with contaminated droplets?

You may be able to carry out a risk assessment yourself within your own organization but, if not, or you are uncertain how to do this, you should consult a specialist in this area. **Ask your Technical Representative for advice.**



## Preventing and Controlling Risk

If an unavoidable risk is identified, you must introduce proper controls as part of a management plan in order to ensure that all reasonable precautions have been taken. The person within your organization who is responsible for the management plan should know enough about your system to be able to manage the risk control plan effectively. This person should also have the authority and budget to be able to hire contractors to carry out any mechanical work required, including any work required in order to implement an effective water treatment program.

For facilities with known risk factors, a Water Safety Plan is recommended or may be required to effectively categorize and mitigate the risks associated with Legionella.

## Should I Take Samples to Test for Legionella?

Sampling and testing for Legionella is a way to validate that your system is under control. In Quebec, monthly testing of cooling towers is a requirement. Testing of water is typically recommended as part of an ASHRAE 188 Water Safety Plan. This is not a simple test - sampling and detecting Legionella requires the services of a specialized microbiological laboratory. We can provide the sampling and testing services needed to meet your requirements. Please consult your Technical Representative for more information.

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## *Where Can I Find Additional Information on This Topic*

The Association of Water Technologies, the Cooling Technologies Institute, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, the US Occupational Safety and Health Administration and the Centres for Disease Control have all published excellent technical position papers:

http://www.awt.org

http://www.cti.org

http://www.ashrae.org

http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_7.html

http://www.cdc.gov/legionella/about/index.html

## *What Should I Do Next?*

As a supplier of water treatment services, we take an active role in Legionella-related education. This is a topic of concern and we encourage you to take all steps necessary to minimize the risks associated with the water services at your facility. We can also work with you to carry out a Risk Assessment and Water Safety Plan specific to your facility.

**Please acknowledge that we have communicated this information to you:**

☐ I have read this guide and I understand the intent.

☐ I would like to be contacted for a proposal to perform a Risk Assessment and prepare a Water Safety Plan. (It is recommended that all healthcare facilities and high risk sites have a Water Safety Plan in place).

☐ Our facility has a current Water Safety Plan in place.

**Print Name & Title:** _____

**Signed:** _____ **Date:** _____

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# WATER SAFETY PLAN

## For Cooling Tower and Evaporative Condensers


### Why have a Water Safety Plan?

*Legionella* is a type of bacteria commonly found in water. Water re-circulates throughout cooling tower and evaporative condenser systems at the **ideal temperature** range for *Legionella* growth, and **airborne water droplets** can contain *Legionella*. Therefore, cooling towers have been **associated with high-profile outbreaks of Legionnaires' Disease.**

A Water Safety Plan approach has been recognized by organizations such as the **World Health Organization** and **ASHRAE** as the industry best practice for managing risk and potential liability.

ANSI/ASHRAE Standard 188-2015, Legionellosis: Risk Management for Building Water Systems, provides a holistic risk management framework to create and successfully implement a Water Safety Plan.

### What is a Water Safety Plan?

A Water Safety Plan includes a **hazard analysis**, ongoing program for managing risk, including **monitoring** and preventative maintenance **procedures**, as well as requirements to **confirm and document** that the program is effective at controlling the hazard.

### Do Water Safety Plans only apply to Cooling Tower and Evaporation Condenser Systems?

***Legionella* can be present in any building water system**; however, certain types of water systems and facilities have been associated with higher levels of risk. Criteria in the ASHRAE 188 Standard specify that any facility with a cooling tower or evaporative condenser is subject to the requirements of the standard for those systems. Your representative can determine if a Water Safety Plan is also required for water systems other than your cooling systems.

## What is Required to Prepare a Water Safety Plan for Cooling Towers and Evaporative Condensers?

We take a two-step approach to prepare a Water Safety Plan for these systems:

1. Environmental assessment to compare the facility to known risk factors
2. Preparation of a draft Water Safety Plan and formation of an internal team at the facility to review and agree on the content of the final Water Safety Plan

## What are the Ongoing Plan Requirements for Managing Risk?

Facility management is then responsible to implement and verify/validate the actions included in the Water Safety Plan. We have the tools to assist with implementation and confirmation that the ongoing program is effectively controlling hazards, such as:

- Monthly verification of control measures
- Disinfection Kits
- Legionella sampling and culturing for validation
- Online portal for document management
- Annual audit and comprehensive program review



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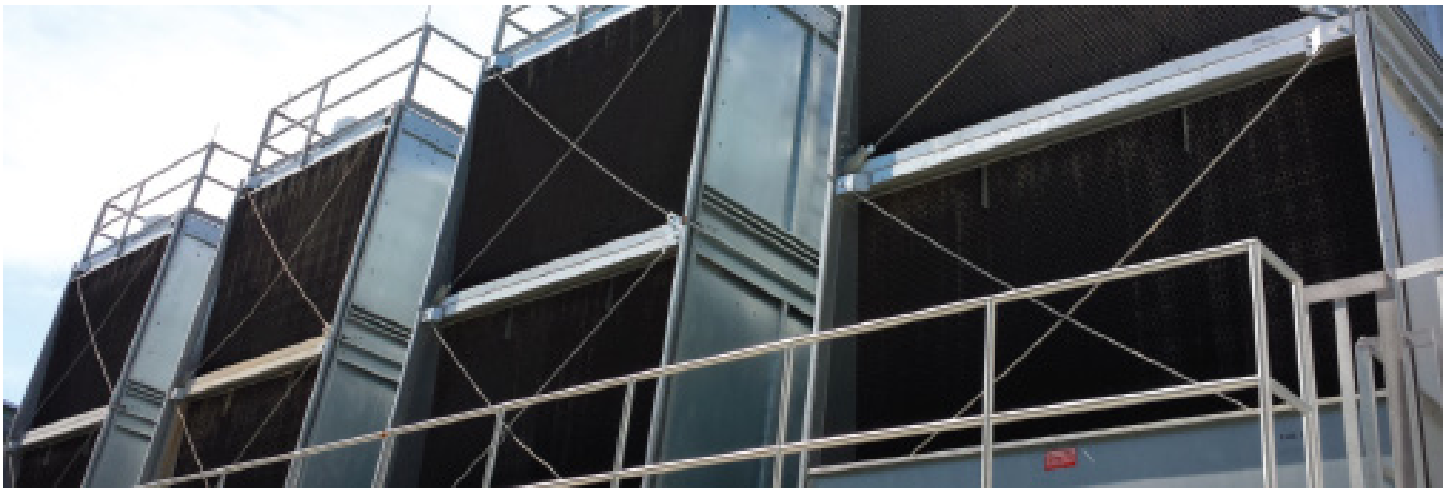
# HVAC COOLING SYSTEMS

## Best Practices for Evaporative Cooling System Start-Up

Many HVAC evaporative cooling systems are idle or off throughout the winter months, and are often drained to prevent freezing. These extended shutdowns provide excellent conditions for deposits to form and bacteria to grow. When starting up the system for cooling operation, some basic steps should be completed to ensure peak mechanical performance, and to verify that best practices for Legionella prevention are in place. Each cooling tower manufacturer may also have its own seasonal preventative maintenance requirements for mechanical components such as fans and controls. These will be specific to each cooling tower and should be followed along with your regular start-up procedure.



While this brochure deals with best practices for starting up your system, end-of-season care is also important. Refer to our brochure "HVAC Cooling Systems: Best Practices for Tower and Chiller End-of-Season Care" for more information.

Evaporative cooling system start-up can be described in five steps. These steps incorporate information from various guidelines including: ASHRAE Guideline 12, Cooling Tower Institute Guideline WTB-148, and Association of Water Technologies (AWT) 2003 Update and Statement. If starting up from an un-drained system, additional measures may be required to prevent creation of aerosol spray from formerly stagnant cooling water. Contact your representative for further information.

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## Step 1: Physical Cleaning

1. Visually inspect all wet areas of the cooling tower and clean where accessible (water basin, spray nozzles, etc.).
2. Inspect permanent filter housings and clean or replace media if required.
3. Keep written records of work performed.

## Step 2: Fill the System

1. Fill the cooling water system with water and initiate pumps for circulation, with system fans off.
2. Ensure water circulates through all piping and heat exchangers.
3. Place any filtration units online.
4. Re-inspect spray nozzles and wet decks and remove debris that may have accumulated since initiating circulation.
5. Repeat as necessary during the initial operation period; frequency will vary system to system.

## Step 3: Water Quality

1. Consult your water treatment specialist. Water treatment control equipment such as automated pumps, meters, sensors, and valves should be inspected, calibrated, and functional.
2. Perform a sanitization of the cooling tower(s) using an oxidizing biocide and bio-dispersant. Follow a written procedure from your building water management plan or use a sanitization kit such as **AquaAnalytics DK-12000.**
3. After completing sanitization and confirming that water quality is within normal operating levels, turn on system fans.
4. Document completion of this procedure in your log books or building water management plan.

## Step 4: Begin Operation

1. Utilize a load responsive water treatment program designed to minimize corrosion, prevent deposits and fouling and control biological activity.
2. Employ an adequately sized filtration system to maintain recirculating water particulate size below 10 microns for cooling tower and 5 microns for chilled water loops.
3. Ensure that systems utilizing multiple cooling towers, chillers, or heat exchangers are rotated frequently. This ensures that biocides contact all wetted areas regularly, minimizing biological growth. Frequency of rotation will depend on system design.
4. Document rotation in the log books or building water management plan.
5. Take steps to prevent equipment from sitting idle for long periods of time, as stagnation can lead to deposits, fouling, and bacterial growth.

## Step 5: Validation

1. Legionella testing can be used for validation. Take a sample of water from the water basin or flow to spray nozzles for Legionella culture analysis.
2. Document testing results in your log books or building water management plan.
3. Keep detailed records of water quality throughout the season.
4. To confirm proper system operation, additional Legionella culture samples may be completed depending on the requirements of your building water management plan, or in accordance with local laws.

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# HVAC COOLING SYSTEMS

## Best Practices for Tower and Chiller End-of-Season Care

While control of water chemistry is vital to minimizing HVAC system corrosion and preventing deposit formation during the cooling season, additional factors begin to play a critical role during the shoulder season and winter months. Shoulder season temperatures often lead to infrequent system operation, followed by winter shutdown. Operational recommendations published by The Association of Water Technologies (AWT) stress the importance of maintaining circulation during these low-load periods as stagnant water can be damaging to cooling equipment and the associated piping network, regardless of treatment levels [1].

### Prolonged stagnation poses the following risks:

- *Conditions conducive to bacterial growth*
- *Settling of suspended particles on critical heat exchange surfaces*
- *Microbiologically induced corrosion on components including tube sheets, end bells, and piping*

### Recommended Standby Procedures

A proactive management plan used to limit cooling system stagnation will help to minimize and control these risks.

- **Short Term (0-3 days):** Run recirculating pumps for 1 hour, every 6 hours as recommended by the AWT [1].
- **Extended Shutdown (3+ days):** See shutdown and layup procedure below (complete drain/dry as advised by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) in Guideline 12). If dry shutdown is not possible, consult your Technical Representative and follow the recirculation guidelines above to help reduce the effects of stagnation.

[1] P. Sisk et al., "Guidelines for Treatment of Systems Containing Enhanced and Super-Enhanced Tubes", The Association of Water Technologies, www.awt.org/resources/technical_papers.cfm

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## Recommended System Shutdown and Layup Procedure

ASHRAE Guideline 12 recommends draining cooling towers and auxiliary equipment during extended shutdowns. Maintaining a clean and dry environment helps prevent localized corrosion, fouling, and bacterial growth. Many equipment providers also advocate dry layup [2,3]. Please consult your O&M manuals for additional information.

## Step 1: Disinfect

To best protect equipment from biological contaminants, disinfection helps remove microbial growth accumulated due to stagnation during the shoulder season.

1. Shut off cooling tower fans, keep circulation pumps running, and close all air intake vents within 30m of the cooling tower.
2. Use the **DK-12000 Disinfection Kit** as instructed on product packaging to achieve the free residual chlorine (FRC) levels required for disinfection. Consult your representative for additional details.

✓ Please follow safety precautions for handling oxidizing chemicals – refer to MSDS.

✓ High oxidizer levels will increase system corrosion rates and/or damage wooden parts. Inspection of susceptible components should be completed regularly on systems undergoing frequent disinfection.

## Step 2: Dilute

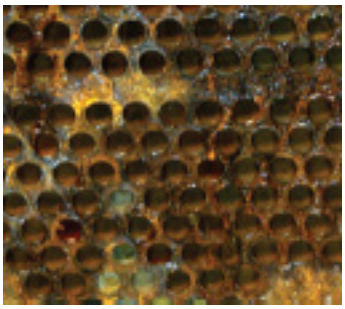
Reducing the concentration of dissolved and suspended particles will help prevent excess deposit formation when the system is drained. Inhibitor can be added to facilitate solids removal prior to shut-down.

1. Lower tower cycles to 1-1.2 via manual or automated bleed.
2. Consult your representative regarding inhibitor addition.
3. Circulate system water for 48 hours.

## Step 3: Drain

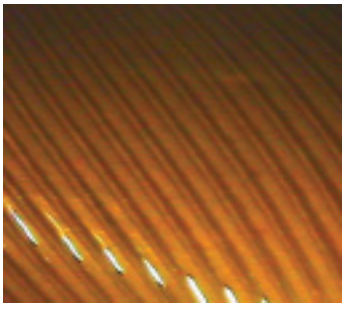
A complete system drain will help prevent damage and freezing in the offseason.

1. Drain the tower basin, sump, and piping as completely as possible.
2. Clean all wetted areas, including the basin, sump, fill, and spray nozzles.
3. Open the chiller condenser and brush tubes.
4. Fully dry and ventilate tube sheets, storing open with end bells removed.



*Fouled Tube Sheet*

*Clean Tube Sheet*



*Enhanced Tubes*

*Drained Cooling System*

[2] "Operation and Maintenance Instructions: For Evapco Induced Draft and Forced Draft Cooling Towers", Bulletin 113E, Evapco, 2014.
[3] "Operations and Maintenance: Centrifugal Liquid Chillers", Form 160.75-O1 (211), York by Johnson Controls.

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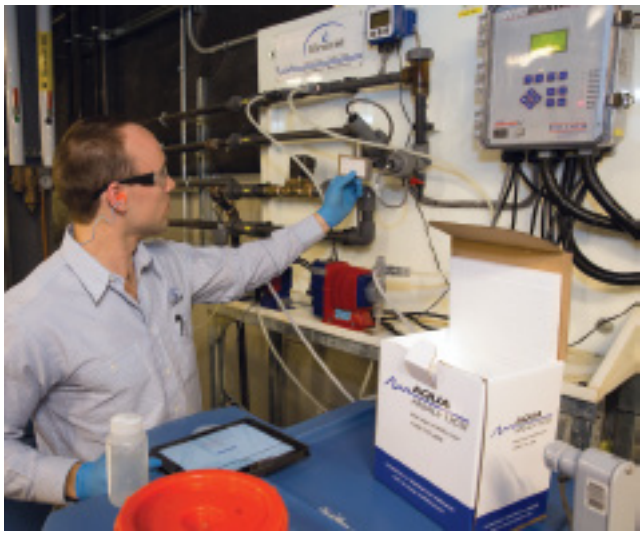
# CHECKLIST FOR MINIMIZING *LEGIONELLA* RISK

## Evaporative Cooling Systems

- Operate a **water treatment program** that uses automation for corrosion inhibitor addition and bleed control to manage scale and corrosion.
- Use a **halogen biocide** (chlorine or bromine) in conjunction with a bio-dispersant to minimize bio-film. Biocide addition can be meter-initiated or use ORP control.
- Have your staff **test the water regularly** – at least twice a week.
    - At a minimum, test for total dissolved solids, disinfectant levels, and the total bacterial count.
    - Record and maintain the following data in a dedicated system logbook: test results, make-up water meter readings, and an inventory of all water treatment chemicals.
    - Respond promptly to automation or pumping failures.
    - Maintain chemical inventory to prevent disruptions in the treatment program.
- Employ an **AquaAnalytics Representative** to test the water and review plant records monthly. Follow recommendations for maintenance and system component upgrades to ensure reliability.
- Install and properly maintain adequate **filtration** to remove silt and organics from the system. Sufficient flow should be maintained through the filters to ensure that a minimum of 10 times the system volume is filtered daily.
- Avoid conditions conducive to *Legionella* growth. **Minimize stagnation** as per ASHRAE Guideline 12-2000, and ensure that system dead legs are eliminated or that stagnant sections are flushed periodically. Keep sump lids closed and **shield wet surfaces from sunlight** where possible.



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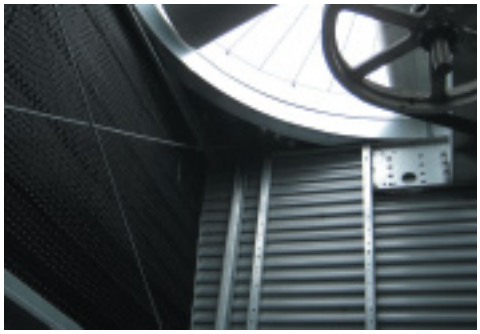
# CHECKLIST FOR MINIMIZING *LEGIONELLA* RISK

## Evaporative Cooling Systems



- Conduct regular **physical cleanings** of the cooling tower, fluid cooler or evaporative condenser; visual inspection can be used to determine the frequency. Any accumulation of bio-film or sediment should be removed immediately. Contracting a reputable cooling tower maintenance company for this work is recommended, as good results require specialized equipment.
- Conduct **regular sanitizations**. The industry standard is twice per cooling season but this should be increased during any construction projects that create dust, particularly excavation, as Legionella is often released from soil. Please contact your representative for details regarding the recommended procedure for system sanitization.
- Conduct regular maintenance on the mechanical system. Inspect all major components for proper operation, particularly the drift eliminators and the wet deck distribution system. Follow the manufacturer's recommendations for bearings, fans and pumps.
- Read the AquaAnalytics ***Legionnaires' Disease: A Guide for Employers and Building Owners*** to ensure you understand your legal obligation. It is an industry best practice to have a documented Water Safety Plan to comply with ASHRAE Standard 188 for cooling systems. Contact your representative for information regarding Water Safety Plans and/or completion of a Risk Assessment if your facility meets the criteria for increased risk. This process will help to determine further actions that may be warranted for the facility.

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# DISINFECTION PROCEDURE

## Evaporative Cooling Systems

Disinfection helps to eliminate microbial contamination in cooling towers, fluid coolers and evaporative condensers, and is regarded as an industry best practice. A disinfection should be completed:

- When commissioning a new evaporative system
- Before and after shut down periods greater than 4 weeks
- Twice per year in the spring and fall, as recommended industry best practices
- When test results indicate the presence of high levels of Legionella bacteria (please consult AquaAnalytics Legionella Testing Action Plan)
- As required if inspection has indicated the presence of biofilm or accumulation of particulate
- When Legionnaires' disease is known or suspected (please consult your representative)

The following procedure is based on ***Legionella* 2003: "An Update and Statement by the Association of Water Technologies"**.

1. Shut off cooling tower fans.
2. Keep makeup water valves open and the circulation pumps operating.
3. Close outdoor air intake vents located within 30 meters of the cooling tower.
4. Use the DK-12000 Disinfection Kit as instructed on product packaging to achieve an initial free residual chlorine (FRC) level of ≥50ppm. Consult your Water Treatment Representative for further details.
5. Maintain a minimum of 10 ppm FRC for 24 hours.
6. Drain and refill the system. Repeat steps 4 to 5 at least once to removeall visible algae-like film.
7. Using a brush and water hose, thoroughly clean all water-contact areas, including the basin, sump, fill, spray nozzles, and fittings.
8. Circulate 10 ppm FRC for one hour, and then flush the system until free of all sediment.
9. Refill the system with clean water and return to service, establishing normal water quality parameters.


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# DK-12000

## Disinfection Kit

The Aqua Analytics DK-12000 kit has been designed to provide you with a set of tools to properly disinfect process water systems that exhibit signs of biological fouling. This kit is designed to work with open evaporative and closed loop systems. Each kit contains enough active ingredients to properly disinfect 12,000 litres of system volume.


### When should disinfection be performed?

- Seasonal startup or following a temporary shutdown of an evaporative cooling system
- Elevated biological test results (plate counts, dip slides, ATP, or other biological tests)
- Elevated Legionella test results
- Discoloration or foul smelling system water
- Fouling of heat exchange surfaces with biological deposits, slime, or film
- Visual evidence of biological growth on open evaporative devices such as cooling towers
- When mandated by local law

Please communicate with your water treatment representative to obtain more information concerning the disinfection procedure and to know more about the conditions that can cause a system to require disinfection.

### The kit contains:

- Anti-foaming agent – Defoamer : 2 bottles of 1 litre
- Bio-dispersant – Ecosperse : 1 bottle of 1 litre
- Biocide granules – D5K :

  4 bags of 1 lb
- Chlorine test strips : 1 vial
- Disposible nitrile gloves : 2 pairs

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# *LEGIONELLA* TESTING ACTION PLAN

## Evaporative Cooling Systems

Regular Legionella testing can be part of a proactive approach towards preventing Legionnaires' disease (LD). Periodic sampling and testing is supported for systems where a ***Legionella* Risk Assessment** has determined it to be a wise risk reduction measure. Test result trends can generally indicate whether preventative measures are effective, and may be part of the ongoing validation of a **Water Safety Plan**.

The following should be noted with respect to *Legionella* testing:

- *Legionella* is native to all water supplies – positive results do not guarantee a LD outbreak, nor do negative results assure one will not occur.
- There is no known specific infectious density for Legionella in a water sample (i.e., concentration required to cause infection).
- Wide variability in test results and collection methods exists from one sample or lab to the next – consistently using the same collection method and testing laboratory can mitigate this.


**Before any *Legionella* testing is conducted, an action plan for disinfection should be in place in the event implementation of the procedure is required. This includes stocking the correct chemicals and equipment to carry out the procedure safely and effectively.**

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| RESPONSE | *Legionella* COUNT (CFU/mL) | RECOMMENDED PRACTICES |
|---|---|---|
| None | <10 (Not Detected) | • Maintain treatment and maintenance program |
| Program Review | 10-100 | • Increase biocide dose and frequency<br>• Review treatment and maintenance program<br>• Retest and repeat as necessary until <10 |
| Action Threshold | 100-1000 | • Disinfect as per the AquaAnalytics Disinfection Procedure<br>• Clean mechanical equipment where accessible<br>• Increase biocide dose and frequency<br>• Review treatment and maintenance program<br>• Retest and repeat as necessary until < 10 |
| Immediate Action (High Health Risk) | >10000 | • Implement immediate measures to minimize human exposure<br>• and eliminate aerosol dispersion<br>• Disinfect as per the AquaAnalytics Disinfection Procedure<br>• Clean mechanical equipment promptly<br>• Review treatment and maintenance program<br>• Retest and repeat as necessary until < 10 |

This action plan is based on *Legionella* 2003: "An Update and Statement by the Association of Water Technologies".

Although eliminating *Legionella* bacteria is the goal of all cooling water treatment biocide programs, eradicating Legionella is not possible. This bacteria is common in the environment and LD cases have not shown a reduction in frequency despite increased efforts over the last 20 years. Studies in hospitals have shown that on average, *Legionella* bacteria is present at a detectable level in over 50% of water samples taken in water distribution systems. The intent of this testing action plan is to act as a guideline for best practices on the recommended response to positive *Legionella* results.

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