



Based on the level of *Legionella Pneumophila* bacteria determined in the laboratory analysis, the following action criteria is recommended:

ACTION CRITERIA FOR *LEGIONELLA PNEUMOPHILA*

<i>Legionella</i> CFU/mL	Cooling Towers and Evaporative Condensers	Potable Water	Humidifier/ Fogger
Detectable, but <1	1	2	3
1 – 9	2	3	4
10 – 99	3	4	5
100 – 999	4	5	5
≥ 1,000	5	5	5

Level 1:

This concentration of *Legionella* represents a low level of concern. Review routine maintenance program recommended by the manufacturer of the equipment and correct any issues (ex. review functionality of engineering controls, clean sump or dirt and debris, replace fouled aerators, etc.). If dual and alternating biocide program is being utilized, verify the recommended levels and increase the feed rate if either is below recommended levels. Retest as recommended by OSHA protocol (see table below).

Level 2:

Implement action 1. This level of *Legionella* represents a minor concern, but the number of organisms detected indicates the system may be a potential amplifier of *Legionella*. If secondary biocide treatment and/or engineering controls are not being utilized, adding these to the water management plan should be considered. If secondary oxidizing biocide treatment is being utilized, an online disinfection¹ and a follow-up analysis are recommended. Retest as recommended by OSHA protocol (see table below).

Level 3:

Implement action 2. This concentration of *Legionella* represents a minor but increased level of concern. Conduct review of premises for direct and indirect contact of bioaerosols with occupants. Additionally, review health risk associated with people who may come in contact with bioaerosols. Based on the results of the review of the premises, action related to cleaning and/or online decontamination² may be indicated. If secondary biocide treatment and/or engineering controls are not being utilized, adding these to the water management plan should be seriously considered. If secondary biocide treatment is being utilized, at a minimum conduct online disinfection¹ and a follow-up analysis. Retest as recommended by OSHA protocol (see table below).



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Level 4:

Implement action 3. This level of *Legionella* represents a moderate level of concern, since it is approaching levels that may cause outbreaks. It is not common for samples to contain this concentration of *Legionella*. Action related to cleaning and/or online decontamination² is indicated. If secondary biocide treatment and/or engineering controls are not being utilized, adding these to the water management plan should be very seriously considered. If secondary biocide treatment is being utilized, at a minimum conduct online decontamination² and a follow-up analysis. If possible, the addition of an antifoulant to assist the oxidizing biocide in biofilm removal should be considered. Retest within 7 days, as recommended by OSHA protocol (see table below).

Level 5:

Immediate offline system decontamination³ of the equipment is highly recommended according to ASHRAE and CDC standards. This concentration of *Legionella* represents a high level of concern since it poses an increased risk for causing an outbreak. It is not common for samples to contain this number of *Legionella*. Perform offline decontamination³ with biocide and, if possible, manually clean or replace the equipment. The addition of an antifoulant to assist the oxidizing biocide in biofilm removal is recommended. Conduct post treatment analysis to ensure effectiveness of the corrective action. Retest within 7 days, as recommended by OSHA protocol (see table below).



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NOTES:

Cooling Tower:

¹Online disinfection – Dose the cooling tower system water with either a different biocide or a similar biocide at an increased concentration than currently used.

²Online decontamination – Turn the fans to the cooling tower off. Dose the recirculation water with a halogen-based compound (chlorine or bromine) equivalent to at least 5 ppm free residual halogen for at least one hour while locking out tower bleed.

³Offline system decontamination - Turn the fans to the cooling tower off. Dose the system and maintain between 5 to 10 ppm free residual halogen for a minimum of one hour. Drain and flush the tower of the disinfected water. Manually clean all wetted surfaces. Refill and dose system to achieve 1 to 5 ppm of free residual halogen and circulate for 30 minutes with bleed locked out. Open bleed and allow halogen level to fall to normal operating levels. Re-establish treatment and retest for verification of treatment.

Potable Water:

¹Online disinfection - Introduce a continuous feed of disinfectant up to 2ppm free chlorine or up to 0.8ppm Chlorine dioxide.

²Online decontamination - Online decontamination is not possible for potable water systems. See Online Disinfection or Offline system decontamination.

³Offline system decontamination – Disallow water to be used in the facility and post notification of disuse at all fixtures. At incoming water source(s), dose liquid chlorine or chlorine dioxide. Flush all fixtures until 3 to 5 ppm residual chlorine dioxide, or 5 to 10 ppm free chlorine is recorded. Follow concentration and contact time guidelines for the disinfectant used. Disconnect chemical feed. Flush all fixtures until less than 0.8 ppm chlorine dioxide or normal chlorine residuals are obtained.

Humidifier/fogger:

¹Online disinfection – Humidifiers cannot be disinfected online due to the nature of the system. Refer to offline system decontamination.

²Online decontamination - Humidifiers cannot be decontaminated online due to the nature of the system. Refer to offline system decontamination.



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³Offline system decontamination – Disallow water to be used in the system. Dose sump with oxidizing product at disinfectant levels. Flush all fixtures until disinfectant residuals are obtained. Follow concentration and contact time guidelines for the disinfectant used. Disconnect chemical feed. Flush all fixtures until system water quality parameters are met.

OSHA Legionella Test Interpretation:

<1 CFU/mL:	Retest in one month
≥1 – 9 CFU/mL:	Retest in one month
10 – 99 CFU/mL:	Retest in 7 days
100 – 999 CFU/mL:	Disinfect promptly and retest
≥ 1,000 CFU/mL:	Disinfect immediately and retest

Legionella Response – Cooling Tower General Guidance

Please note that although there is no specific OSHA standard for Legionella, section 5(a)(1) of the Occupational Safety and Health Act of 1970, 29 USC 654(a)(1), commonly referred to as the “General Duty Clause” requires employers to furnish to each worker “employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to its workers.” OSHA may enforce the General Duty Clause where a workplace has recognized serious hazard for which there is no specific OSHA standard (e.g., occupational exposure to Legionella in water systems).

Legionella Pneumophila Serogroup 1 Result

Published and peer reviewed articles found in the US National Library of Medicine indicate that Legionella Pneumophila Serogroup 1 is responsible for approximately 84 - 92% of all cases/outbreaks of Legionnaires' disease. As such, a Legionella Pneumophila Serogroup 1 result should be treated seriously and actions to reduce/eliminate legionella bacteria in cooling tower systems should be taken.

Legionella Pneumophila Serogroup 2-14 Result

Legionella Pneumophila Serogroups 2-14, although displaying a lower probability of community acquired cases than Serogroup 1, do have the ability to give individuals Legionnaires' disease or Pontiac Fever. Additionally, the presence of legionella indicates that there is contamination in the system. As such, a Legionella Pneumophila Serogroup 2-14 result should be treated seriously and actions to reduce/eliminate legionella bacteria in cooling tower systems should be taken.

Controlling Legionella Pneumophila in Cooling Tower Systems

Legionella bacteria occur naturally in waters and soils. As such, it is common for legionella bacteria to exist when water is claimed for human use from reservoirs and/or groundwater sources. Additionally, cooling towers naturally scrub the air of any dusts/water/fumes/pollens/etc., as they exchange heat from the system to the environment. This often causes contamination even if the source water is free of legionella bacteria. Other common factors are system debris, dead legs, and excess bio-loading. Although, countless other factors may also contribute to positive legionella results in cooling tower water systems. A properly implemented Water Management Plan can reduce the risks associated with Legionella Pneumophila in cooling tower systems.

System Debris

It is recommended that the cooling tower sump and system be inspected for any possible stagnant debris that may harbor bacterial growth. Cooling towers naturally scrub the air of any dusts/water/fumes/pollens/etc., as they exchange heat from the system to the environment. This often results in a buildup of muds and debris in the cooling tower system (normally the sump as it is the “low flow area”). Legionella bacteria typically grow in areas beneath muds and debris that biocides cannot make contact with due to lack of water contact. ***Please note that OSHA recommends manually cleaning cooling towers at least twice annually.*** Dirty water tower basins should be flushed and cleaned.

Dead Legs

It is recommended that the cooling tower system be inspected for dead legs. Dead legs can include dead end piping, machinery that is not used for periods of longer than 3-5 days, or even a tower fill if the distribution deck or spray nozzles are defective. Biocides become exhausted when sitting in stagnant water, so ensuring that all equipment/piping are introduced with fresh, chemically treated, water at least weekly is vital to controlling bacterial growth. Dead legs should be eliminated.

Excess Bio-Loading

Placing a cooling tower near a source of excess bio-loading is one of the main causes of inability to control biological growth in cooling tower systems. In situations where excess bio-loading occurs, additional bacteria is added to the system, existing bacteria is provided with nutrients which support the formation of biofilms, biocides are prematurely exhausted due to addition of carbon sources, and system debris often accumulates due to materials scrubbed out of the air. Areas of excess bio-loading include, but are not limited to, areas where excess soils/dusts enter the cooling tower system (examples: loading docks or construction zones), areas where excess nutrients enter the cooling tower system (examples: kitchen exhaust systems or chicken coops), and/or areas where excess carbon sources enter the cooling tower system (examples: brake pads and engine exhaust near busy highways). Cooling towers should be located away from sources of excess bio-loading.

Equipment Malfunction

It is recommended that equipment in place for biological growth control be inspected for malfunction. This may include general system malfunctions that limit flow, malfunctions in filtration, malfunctions in biocide feed equipment, and/or malfunctions in equipment such as a Pulse Pure. Malfunctioning equipment should be repaired/replaced.

System Deemed to be Contaminated

If a system is deemed to be contaminated, bacteria have likely established a prominent biofilm. A biofilm can be defined as a community of microorganisms adhering to a surface and surrounded by a complex matrix of extracellular polymeric substances. These substances act similarly to debris by shielding the bacteria from water contact. A bio-penetrant should be considered to combat any biofilm growth in conjunction with any other recommended corrective actions and/or disinfections/decontamination procedures. Additionally, multiple cleanings and flushes may be necessary to control the bacterial growth within the system.

Chemical Disinfection and Decontamination

A chemical disinfection or decontamination may be performed based on the severity of the bacterial issues within the cooling tower system. *If a chemical disinfection or decontamination is performed prior to completing the tasks above, conditions may exist that prevent complete effectiveness of the chemical treatment protocols.* A lower concentration of *Legionella pneumophila* may only require a chemical disinfection to control bacterial infection. A higher concentration of *Legionella pneumophila* will require a chemical decontamination to control the bacterial contamination. Additional references which compare CFU/mL results, severity of contamination, suggested corrective actions, and the differences between a chemical disinfection and a chemical decontamination can be found in the *Legionella Response Guidance* that accompanies this letter.

Chemical Biocide Program Review

It is recommended that the maintenance biocide feeds are reviewed to ensure that they are proper for the application. If the cooling tower system is deemed as clean, if no dead legs are identified, and feed rates are deemed as proper for the system, then adjustments may need to be made. This may include increasing dosage rates of chemical biocides on-line, adding additional chemical biocides to the system, and/or applying chemical biocides to the system that are more appropriate for the application.

Single Biocide Program

Bacteria may develop a resistance to a singular biocide due to their ability to reproduce quickly and, as such, adapt to harsh environments. For this reason, a dual biocide program which alternates a feed of oxidizing and non-oxidizing biocide and has proven to be extremely effective in the control of legionella and other microbiological growth and is recommended over a single biocide as a maintenance program.



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Positive Result on Re-Test

It is not uncommon to have low level detections after performing chemical and mechanical cleanings. Any time there is an environmental change in a system that has biofilm growth in it, the first response of the bacteria and associated amoebas is to release from the surface they are attached to. These environmental changes could be introduction of new chemicals, pH changes, temperature changes, laminar flow changes, etc. Subsequently, through normal operation of the tower, these amoebas are now more susceptible to biocide treatment, and are eventually carried out through regular tower bleed.

FINAL REPORT

Guardian CSC
6000 Susquehanna Plaza Drive
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Account #: 5940
SPL Project ID: 2307-00712
Project Name: 10-PHILAPE
PO Number: 56478
Sampled By: John Chambers
Date Received: 07/13/2023
Date Final: 07/20/2023

Summary

This summary is provided for your convenience. Complete report on the following pages.

Environmental Culture Test-Legionella

Location	Result	Concentration	Species
Cell 1	Positive	5.0 CFU/mL	L. pneumophila, serogroup 2-14
Cell 2	No Legionella pneumopt		

Approved by: Brian Verdi



Janet E. Stout, Ph.D.
Laboratory Director, Special Pathogens Laboratory



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Sampled By: John Chambers
Date Received: 07/13/2023
Date Final: 07/20/2023

Location:	Cell 1	Date Collected: 07/12/2023
Sample ID:	2307-00712.001	Sample Type: Water
		Time Collected: 12:00 pm

Test Requested:	Environmental Culture Test-Legionella	Status: Complete 07/20/2023
Result:	Positive	
Concentration:	5.0 CFU/mL	
Species:	L. pneumophila, serogroup 2-14	
Report Comments:	Lp 2-14 - Specific serogroup indeterminant due to DFA cross reactivity	
Date Processed:	07/13/2023	
Volume Examined:	0.2 ml of processed sample	

Location:	Cell 2	Date Collected: 07/12/2023
Sample ID:	2307-00712.002	Sample Type: Water
		Time Collected: 12:00 pm

Test Requested:	Environmental Culture Test-Legionella	Status: Complete 07/20/2023
Result:	No Legionella pneumophila detected	
Date Processed:	07/13/2023	
Volume Examined:	0.2 ml of processed sample	

Approved by: Brian Verdi

Janet E. Stout, Ph.D.
Laboratory Director, Special Pathogens Laboratory

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NOTES

Environmental Culture Test-Legionella

- CFU/mL (or swab)=Colony Forming Units per milliliter or swab.
- The limit of detection (LOD)* is approximately - 0.5 - 5 CFU/mL for Potable Water; 5 CFU/mL for Non-Potable Water (Cooling Towers); 0.5 - 5 CFU/mL for Hot Water Tanks; 10 -100 CFU/swab for Swabs.
- * Sensitivity (LOD) may be affected if less than recommended sample volume is submitted for testing and if high concentration of non-Legionella bacteria are present in the sample. LOD values are mathematically derived according to the sample type, volume, and process.
- Results are reported as Not Detected, Positive, or Not Detected*
- Not Detected* The presence of Legionella could not be determined due to overgrowth of non-Legionella bacteria.
- Probable identification. Contact laboratory if further identification by 16S sequencing required.
- Method: ISO 11731:2017 (E). QA/QC performed on the date processed. Turnaround time is 7-10 days.
- Samples should be analyzed within 2 days of collection.
- Accredited by the American Association for Laboratory Accreditation (Cert. No. 2847.01) and CDC ELITE certified.
- Isolates saved upon request. Request must be received 1 week from receipt of report. Extra charges may apply.
- 'Project Name', 'Sampled By', 'Location', 'Date Collected', 'Time Collected' and 'Client Notes' are provided by the customer.

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