## AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS



ASHRAE STANDARD 188P:

LEGIONELLOSIS: RISK MANAGEMENT FOR BUILDING WATER SYSTEMS





Fourth Public Review (Complete Draft for Full Review)

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at <u>www.ashrae.org/standards-research-technolog/jpublic-review-drafts</u> and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at <u>www.ashrae.org/bookstore</u> or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada). Technical Consensus about what must be done to prevent Legionellosis associated with building water systems.

The new standard will require that facility managers implement stronger safeguards through pro-active risk assessment and risk management practices.

American Society of Heating, Refrigerating and Air Conditioning Engineers

#### Future of ASHRAE 188P

Expected that many agencies, including The Joint Commission, will adopt this standard as best practice.



Limit the liability of your organization by adhering to best practices



#### HACCP (Hazard Analysis and Critical Control Points)

#### History

- HACCP was developed in 1960 for food safety
- Committee working on ASHRAE 188P chose HACCP approach because of its <u>success</u> in the food industry, cosmetic industry, NASA food production, pharmaceutical industry
- HACCP plan is based on risk assessment where it seeks out unsafe practices <u>before</u> production





#### WHAT IS AN ASHRAE STANDARD?

American Society of Heating, Refrigerating and Air Conditioning Engineers

- ASHRAE publishes standards and guidelines relating to HVAC systems.
- Standards are often referenced in building codes, and considered useful standards by consulting engineers, mechanical contractors, architects, government agencies.
- These are legally unenforceable, but commonly accepted standards in the industry.



#### DIFFERENCE BETWEEN POLICIES, STANDARDS, GUIDELINES AND PROCEDURES?



#### WHAT DOES THIS STANDARD MEAN FOR FACILITIES?

ASHRAE 188P standard applies to buildings with any one of the following:

- Multiple rooms served by centralized water heater
- Ten or more stories
- Is a healthcare facility where patient stays exceed 24 hours
- Immuno-compromised individuals
- Cooling towers, ornamental fountains, whirlpool spas
- Housing occupants over the age of 65 years





#### **COMPLY WITH ASHRAE 188P**



#### WATER MANAGEMENT PROGRAM MUST INCLUDE:

- Members of Program Team
- Process Flow Diagrams
- Hazard Analysis Summaries
- Monitoring Schedule
- Equipment Device Maintenance
- Validation Summary
- Verification Schedule
- Legionella Response Plan



#### ASHRAE 188P REQUIRED ACTIONS

1. Form PROGRAM TEAM and conduct HAZARD ANALYSIS (by conducting a Water Systems Survey)

2. Determine **CONTROL LOCATIONS** (by assessing the Water Systems Survey. These are points in which *Legionella* bacteria growth and transmission can be minimized)

3. Establish CONTROL LIMITS for each Control Location

4. Establish a **SYSTEM TO MONITOR CONTROL** of the Control Locations.

5. Establish **CORRECTIVE ACTION** to be taken when monitoring indicates that a particular Control Location is not under control

6. Establish PROCEDURES FOR VERIFICATION AND VALIDATION to confirm Water Management Program is working effectively

7. Establish **DOCUMENTATION** concerning all procedures and records

#### WATER MANAGEMENT PROGRAM VALIDATION:

- Sampling Management Plan
- Sampling selection and response  $\rightarrow$  Decided by Program Team
- Use CDC ELITE Lab

Environmental Legionella Isolation Techniques Evaluation (ELITE) Program

The ELITE Program was created by the CDC as a way for laboratories to test their *Legionella* isolation techniques against standardized samples.



#### What is the HACCP approach?

 Preventative, systematic approach to safety. It looks at an entire process, and identifies steps where risk is prevalent. In our case, the hazard is Legionnaires' disease



- The HACCP Plan addresses:
  - What are the hazards?
  - How are they being controlled?
  - How do you know the controls are working?



#### 1. Make a HACCP team

Group of people that are responsible for developing, implementing, and maintaining the HACCP plan.

- Employees
- Suppliers
- Consultants
- ✓ HACCP expert
- Infectious Control
- ✓ Head of Operations
- ✓ Safety Director
- Medical Director
- Environmental Services Director





#### Water System Inventory Data

- Water Source Well, municipal, surface, disinfectant used
- Buildings Numbers of floors, square footage, year it was opened, occupancy
- Water Feeds Where it enters buildings, what buildings and systems use the feeds
- Softeners or Filters on water feeds?
- Cooling Towers Location, number of cells, months operating, chillers
- Domestic Hot Water Water heater location, buildings served, system recirculation
- Points of use Dishwashers, showers, coffee machines
- Decorative Fountains Water source, location
- Any filters in use-Ice machines, coffee machines, water dispensers





## 2. Determine water source and all points of END use – use this information to create flow diagrams

Determine water source
 Determine all points of end use
 Create Simple Flow Diagrams





# 2. Use flow diagrams to identify critical control points



Does this point have a potential for *Legionella* bacteria growth and transmission?

> If Yes, it is a Critical Control Point!

Steps in the process where we can prevent or eliminate the hazard







Note that each processing step is named and numbered; these names and numbers are used in

the Hazard Analysis Summaries (Table B1 and B2).

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#### 3. Establish control limits for each critical control point

 For each Critical Control Point, Control Measures and Control Limits must be applied

Note: Control Measures are evidence based







#### 4. Establish a system to monitor control of the Critical Control Points

 For each Critical Control Point, determine the monitoring procedure and monitoring frequency

			2 A Division of the second sec	control of the second s
4	ACTION ITEM	FREQUENCY	RESPONSIBLE	LOCATION OF RECORDS
	DOMESTIC	WATER		
15	urvey the buildings and remove piping/fixture no longer used	Tearly		
2(4)	lush unused piping which cannot be removed for min 30 seconds	Monthdy		
30	rspect backflow prevention devices	Yearly		
40	est total chilorine at points of entry	Monthly	-	
3(7	rain, clean, disinfect cold and hot water storage tanks	Tearly		
6/7	lush emergency showers	1		
79	lush eyewash stations	Weekly		
4(0	Dean or replace all filters	PMR*		
9(2)	lush systems after plumbing or construction work	As Neededa		
30,91	lush showers, faucets and toilets - areas that are clue of but not drained	Warth		
11(4)	lush showers, faucets and toilets - areas used as could be or storage, etc.	ber ber		
12[P]	lush showers, faucets and toilets - employee are	of the last		
13(4)	lush showers, faucets and tollets - patient rooms	Wweekly		
34(F)	iush showers, faucets and toilets - patient rooms	for to occupancy		
1500	Sean and disinfect ice machines	biannually		

er.



#### 5. Corrective actions to take when control limits are out of range

#### Analyze Hazards Establish Potential hazards to the foods safety are recognized, in addition. measures to regulate and control the hazards are identified. Corrective Identification of CCP's Critical Control Points throughout the production process of the product Actions are established. for each critical **CCP Prevention Measures** A prevention measure is established at all CCP's: for example, minimal cooking time or temperature at a certain point in the product line. control limit Monitoring of CCP Prevention Measures A system is established to monitor prevention measures at a CCP: for ensample, a computer system would monitor and log the temperature. CCP Not Met Establish a precaution when the OCP hasn't been met, for example, if the temperature is too low, the computer will alarm the batch to be destroyed. HACCP & CCP Log Maintain a log system of all the CCP's; also, this would include records of CCP control methods and action taken to correct potential problems. 2200 0.57 In the Print Dear A statistic for the State of the Stat BACK



## 6. VERIFY & VALIDATE

<u>Verify</u>

- That a Plan is in place
- The Plan has been implemented
- Ongoing compliance of the Plan

Validate effectiveness of plan to minimize Legionnaires' Disease Risk

Validation can occur in 3 ways:

 Cite studies showing Legionella bacteria were reduced in similar water systems after implementing similar control measures.
 Circumstantial

> Monitor cases of facility-acquired Legionnaires' Disease.

Testing issues and reporting (availability of test)

Routinely test building water systems for Legionella bacteria and evaluate results.

Most recommended way to validate



#### RECOGNIZED LEGIONELLA TESTING METHOD

The laboratory we utilize has accreditations through multiple agencies:

American Industrial Hygiene Association (AIHA), CDC ELITE Legionella Program National Voluntary Laboratory Accreditation Program

- Live Culture Method is the gold standard buffered charcoal yeast extract (BCYE) agar. Takes 10-14 days. Serotype if there are positive results.
- Other methods are not recognized Polymerase Chain Reaction (PCR) and Direct Fluorescent Antibody (DFA)

## LEGIONELLA BACTERIA SOURCES FOR LEGIONNAIRES' DISEASE

- Cooling Towers
- Humidifiers
- Showerheads
- Faucets
- Water Fountains
- Whirlpool Baths or Spas
- Hot Springs
- Decorative Fountains
- Misting Machines at Grocery Store
- Dental Lines
- Ice Machines



## Legionella bacteria Control

## **Preventive Measures**

#### WHAT IS LEGIONNAIRES' DISEASE?

- Each year, between 8,000 and 18,000 people are hospitalized with Legionnaires' disease in the U.S.
- Legionella bacteria contaminated water must be inhaled into lungs to cause the disease
- Water droplets must be between 1 and 5 microns in diameter to enter deepest part of the lung
- Legionella bacteria are found naturally in the environment, usually in warm water



## According to the CDC

#### **Top 3 Conditions Common in Legionnaires' Disease Outbreaks**

- 1. Lack of familiarity with water systems
  - 1. Not understood
  - 2. Not maintained
- 2. Lack of effective microbiological control
  - 1. Disinfectant too low
  - 2. Domestic hot water piping not insulated properly
- 3. Lack of coordinated prevention efforts
  - 1. Disconnect between Infection Control and Facility Managers
  - 2. No teamwork or education





## LEGIONELLA BACTERIA BACKGROUND INFORMATION

- Aerobic, rod-shaped, gram-negative bacteria
- 50 identified species, 60 serogroups, hundreds of strains
- May survive 135 days+ in room temperature in distilled water and over a year in tap water
- Resistant to low levels of free chlorine
- Rubber and some plastics facilitate growth



#### LEGIONELLA SPECIES THAT CAUSE DISEASE

- L. pneumophila (Lp) causes 80 to 90% cases of Legionnaires' disease in the US, with 75% caused by Serotype 1 (Lp1)
- In Australia 80% of LD cases are caused by *L. longbeachae*
- A hospital in NYC had an outbreak caused by *L. micdadeii*
- A different hospital in NYC had an outbreak caused by Lp6
- A hospital in NC had an outbreak caused by *L. feeleii*



## LEGIONELLOSIS

- Not transmitted person to person
- Legionnaires' disease:
  - 2 10 day incubation period causing serious pneumonia that can last weeks
  - Low attack rate (5%) but High morbidity rate (15-30%)
  - Long term effects for survivors, including cognitive impairment

#### • Pontiac Fever:

- 24 48 hours incubation period
- High attack rate (95%) but Non Fatal
- Flu-like symptoms
- Lasts 2 5 days



#### COOLING TOWER GENERAL RECOMMENDATIONS FOR LEGIONELLA PREVENTION AND CONTROL

- Clean and disinfect cooling towers (2 x year if seasonal, yearly if used year-round)
- Use proper water treatment chemicals
- Use dual biocide program
- Test for Total Bacteria Counts (Dipslides)
- Maintain and inspect tower
- Keep foreign objects out of tower



#### **AMPLIFICATION CONDITIONS - LEGIONELLA BACTERIA**

- Stagnant conditions
- Warm water (68F to 122F)
- Optimal growth 90F to 110F
- pH = 5.0 to 8.5
- Sediment, scale, deposition
- Biofilm





#### **ECOLOGY OF LEGIONELLA**

- Naturally occurring in all surface waters, groundwater, soil, compost and sludge
- Present in fresh, brackish and salt water
- Geographical prevalence: in the US is found more frequently in the Northeast, Mid-Atlantic, Mid West, South East – very high in NY, MD and Illinois
- Observed difference in species and strains per geography
- Cases reported in every state
- 20-25% of all the Legionnaires' disease reported to CDC is travel-associated to hotels or aboard cruise ships
- An increased presence in the US from months June to November, although cases occur year round in hospitals and nursing homes



## LEGIONNAIRES' DISEASE – HIGHLY SUSCEPTIBLE POPULATION

- >50 years old
- Compromised immune system
- Heavy smokers
- Patients with respiratory disease
- Healthy people are also at risk!\*

Can be treated with correct choice and dose of antibiotics near onset of disease with relatively good success.



\*According to the World Health Organization (WHO) 20-25% of all the Legionnaires' disease reported to CDC is travel-associated to hotels or aboard cruise ships. http://www.cdc.gov/legionella/faq.htm

# Legionnaires' disease is preventable if water systems are managed properly

- Prevent stagnant conditions flush outlets and reduce dead legs
- Clean and treat cooling towers (2x per year, recommended by OSHA)
- Clean and blow down domestic hot water tanks
- Clean / Change showerheads
- Measure and record domestic hot water temperatures
- Follow manufacturers' preventive maintenance (ice machines, domestic water tanks, ornamental fountains, among others)



#### SHOULD I SAMPLE FOR LEGIONELLA ROUTINELY?

- NYS DOH in certain situations (transplant units) test quarterly
- Veterans Hospital Directive Veterans Health Administration (VHA) Directive 1061 applies only to VHA facilities – test faucets and showers quarterly
- CTI is working on passing Standard 159 testing in towers quarterly
- ASHRAE 188P Program team should decide how often/how many samples based on many factors – Legionella testing is usually part of validation

Total Bacteria Counts on Towers are recommended for a Water Management Program, but no correlation has been found between TBC and *Legionella* results.



#### COOLING TOWER GENERAL RECOMMENDATIONS FOR LEGIONELLA PREVENTION AND CONTROL

#### Minimize transmission to people:

- Good drift eliminators
- Keep drift away from people and air intakes
- Have workers wear proper PPE





#### PREVENTIVE MEASURES FOR CRITICAL CONTROL POINTS

- 1. Cleaning Services:
  - Cooling Tower cleaning and disinfection
  - Ice Machines cleaning and sanitation
  - Domestic water tank cleaning and sterilization
  - Decorative fountain cleaning and disinfection
  - Coil cleaning service
- 2. Secondary disinfection solutions

Monochloramine - Preferred

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## DOMESTIC WATER GENERAL RECOMMENDATIONS FOR LEGIONELLA PREVENTION AND CONTROL

- Hot water tank temperatures at 140F (minimum)
- Hot water temperature at coldest point in distribution system above 124F (Install anti-scald valves on all outlets)
- Check outlets because large, complex piping can cause stagnation at dead legs and other issues
- Chlorine concentration recommendation >0.5 ppm total.
- Inspect and clean storage tanks annually as a minimum
- Continually run circulation pumps. Flush system on regular basis

Federal (EPA) drinking water standards require testing for Coliform bacteria, but not for *Legionella* bacteria.

Following disinfection, municipal water can travel for miles before reaching end use (disinfectant residuals may have decreased during the journey).

#### WHAT TO DO IF THERE ARE POSITIVE RESULTS FOR LEGIONELLA BACTERIA?

In the absence of outbreak:

- ASHRAE 188P says Program Team should decide what to do
- OSHA has general guidelines (based on number of *Legionella* bacteria, CFU/mL)
- Other guidelines recommend disinfection of the water system if more than 30% of the outlets yield positive results (based on percent positive)



# OSHA guidelines to assess the effectiveness of water system maintenance

- Intended to apply only to water systems being used by healthy individuals and are not necessarily protective for persons who are immunocompromised
- Levels requiring action vary for the source of exposure based on the assumption that some routes or exposure result in a greater dose to the lung.

Action 1: Prompt cleaning and/or biocide treatment of the system. Action 2: Immediate cleaning and/or biocide treatment. Take prompt steps to prevent employee exposure.

Action	Cooling tower	Domestic water	Humidifier
1	100 cfu/mL	10 cfu/mL	1 cfu/mL
2	1,000 cfu/mL	100 cfu/mL	10 cfu/mL

## MICROBIAL CONTROL IN DOMESTIC WATER SYSTEMS- SECONDARY TREATMENTS- ON-GOING

- Monochloramine- Extremely Effective in controlling specifically Legionella.
- Reduced Corrosion Rates vs. Chlorine and Chlorine Dioxide
- Chlorite NOT a Byproduct

