RISCAuthority

administered by FPA Fire Protection Association

RC63: Recommendations for minimising the impact of legionella in firefighting systems

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Contents

Summary of Key Points

This document has been developed through the RISCAuthority and published by the Fire Protection Association (FPA). RISCAuthority membership comprises a group of UK insurers that actively support a number of expert working groups developing and promulgating best practice for the protection of people, property, business and the environment from loss due to fire and other risks. The table below summarises the key points of the document.

Keep the problem in perspective	• Legionella infection is most commonly associated with droplets of water originating from water fountains and shower heads rather than wet pipe sprinkler systems.
Eliminate the hazard where possible	• Drain and remove old or redundant tanks and pipework at the earliest opportunity.
Maintain the installations	• The danger from legionella is unlikely provided suitable precautions are taken.
Prepare an emergency plan	• Take steps to ensure the continued smooth running of the business by making a suitable emergency plan to include the actions to be taken if legionella were to be discovered on site.
Manage the hazard	• Use suitable water treatments to kill legionella or limit their ability to grow.
Keep pipework clean	• Clean systems of charged pipework following the discovery of significant amounts of corrosion or other contamination in the relevant storage tank.

Symbols used in this guide


Good practice


Bad practice


Discussion topic

Frequently asked question

1 Introduction

A significant number of cases of Legionnaires' disease occur in the UK each year, with a mortality rate reported to be between 10-15%. Many of the outbreaks occur in buildings such as hotels frequented by large numbers of the public; they are most notably associated with droplets of water originating from cooling towers, drinking and ornamental fountains and shower heads. However the reality is that no outbreaks of legionella anywhere in the world have been identified as having originated in a firefighting system: the probability is that the water droplets generated during the operation of these systems are too large to be a vector for the transmission of the bacilli.

The bacterium legionella pneumophila and related bacteria are common in natural water sources such as rivers, lakes and reservoirs, but usually in low numbers. Since they are widespread in the environment, they may also contaminate and grow in purpose-built water systems such as cooling towers, evaporative condensers, hot and cold water systems and whirlpool spas.

There is also a potential hazard with regard to firefighting systems, in that legionella could develop in water supplies for water mist, sprinkler, drencher and hose reel installations together with site firefighting ring mains. Portable fire extinguishers of traditional design are not considered a risk in this respect.

Any water system that has the right environmental conditions could potentially be a source for legionella bacterial growth. There is a reasonably foreseeable legionella risk in any water system if:

- water is stored or re-circulated;
- the water temperature in all or some part of the system is between 20–45°C; or
- there are deposits that can support bacterial growth, such as rust, sludge, scale and organic matter.

People that are particularly at risk from infections caused by these bacteria are men over 45 years of age, smokers, heavy drinkers, those suffering from respiratory or kidney diseases and anyone with an impaired immune system; infection occurs solely through the inhalation of extremely small water droplets. There is no evidence that the disease can be transmitted from person to person. A system could pose a threat if:

- water droplets of an appropriate size could be produced and dispersed in the atmosphere;
- employees, contractors or visitors could be exposed to such contaminated water droplets.

Under UK health and safety legislation, an employer or person in control of a workplace (such as a landlord) has well-specified health and safety duties and any such duty holder needs to take suitable precautions to prevent or control the risk of exposure to legionella. Comprehensive information regarding legionella in the workplace, including the responsibilities of the duty holder, is set out in HSE publication L8: **Legionnaires' disease. The control of legionella bacteria in water systems** (ref 1). Related technical guidance is available as HSG 274, parts 1-3 (refs 2-4). The detailed information in these documents is not repeated in this publication but it should be noted that sprinkler systems are specifically included as 'other risk' systems in part 3 of HSG 274.

- Ensure that a competent person undertakes a risk assessment to meet the requirements of the HSE Approved Code of Practice L8.
- Ensure that the assessment addresses the potential for droplet formation during installation, maintenance and cleaning operations as well as during emergency operation of the firefighting system.

Background and occurence

Legionellosis can only be contracted by inhaling fine aerosols from a water source contaminated with legionella bacilli. Potential aerosol producing sources may include running taps, showers, fountains, air conditioning cooling towers, whirlpool spas, misting devices such as humidifiers and potentially, although unlikely, from the water supplies for fixed firefighting systems.

Only the very smallest water droplets pass through the lung membranes and only where those droplets contain the legionella bacillus can infection take place. It is generally accepted that legionella can only be transmitted from aerosols which are less than 5µm in diameter. It is therefore unlikely that legionella will be transmitted via the much larger droplets associated with firefighting systems (see Table 1).

Legionnaires' disease is potentially fatal and develops within 2-10 days of exposure to the L pneumophila bacteria. Symptoms may include loss of energy, headache, nausea, high fever, muscular pain and pneumonia. Pontiac fever develops within 5 hours to 3 days of exposure and produces influenza-like symptoms. An occurrence of Legionnaires' disease is reportable under the RIDDOR Regulations (ref 5) if it is contracted as a result of work being carried out on a system.

Direct sunlight onto water may inhibit the multiplication of legionella but can result in the production of algae. The formation of biofilms is thought to provide favourable growing conditions for the bacteria.

Legionella bacteria may contaminate firefighting systems including (see Table 1):

- sprinklers and water mist systems: where heat activated heads connected to pipework are designed to control a fire within a building;
- drenchers: where open sprinkler heads are designed to drench internal or external areas; and
- site firefighting ring mains that feed hydrants located around the site.

Associated with these systems will be pipework, pumps and water supplies which may be fed from a public water main or a private supply consisting of a gravity tank, elevated reservoir or pressure tank. Private supplies may be fed by a local river or pond.

FAQ

- What is the size of water droplets that can carry legionella?
- Do dry pipe sprinkler systems or dry rising mains pose a legionella threat?
- What action should be taken if pipework is thought to be suffering from corrosion?

Firefighting system/equipment	Average droplet size µm
Sprinkler systems	>1000
Deluge systems	>1000
Water spray systems	300-1000
Watermist systems	100-300
Fixed foam systems	300-1000
Kitchen suppression systems	150-300
Fire hose reels	300-1000
Water-based portable fire extinguishers	100-1000
Water-based mobile fire extinguishers	300-1000

Table 1: Firefighting systems and equipment containing water (Adapted from Guidance on legionella in fire fighting systems and equipment, FIA ref 13)

A comparison of the conditions commonly found in firefighting systems with those required for the growth of legionella is shown in Table 2.

In practice aerosols with a particle size of 5µm or less are unlikely to be inhaled as a result of the extinguishing agent being released to fight a fire as such droplets would either evaporate in the hot gases or be carried away by the convection currents associated with the flames. Infection is therefore only likely to result from the release of droplets during non-fire events such as leakages or during maintenance.

Neither the British Automatic Fire Sprinkler Association nor the Fire Industry Association has received or recorded any report of incidence of infection relating to wet fire suppression systems. This situation also holds true in North America, Australia and New Zealand. Additionally, it would appear that there are no reports of outbreaks of legionella anywhere in the world where a water-based firefighting system has been identified as the source.

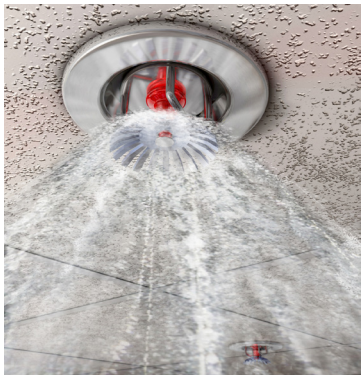

Figure 1: There is no recorded incidence of legionella infection from a wet fire suppression system

2 Scope

This document is intended to provide background information for insurers, property owners, specifiers and fire/health and safety managers concerning legionella in water supplies maintained for firefighting purposes. Supplies of water for other uses, including those intended for cooling of industrial processes, for drinking and the preparation of food are outside the scope of this publication.

3 Synopsis

These recommendations outline the potential low-level threat to personnel from the growth of legionella bacteria in fixed firefighting installations. Measures to address the hazards associated with the design, installation, maintenance and management of these systems are identified and measures to minimise the growth of legionella bacilli discussed.

4 Definitions

Aerosol
A cloud of fine droplets or particles.

Biofilm
A layer of micro-organisms contained in a matrix which may appear as slime on the surface of water.

Legionellosis
Legionellosis is the generic term used to describe diseases caused by bacteria from the genus legionella. This includes legionella pneumophila, found in soil and watercourses, which can cause severe pneumonia, often known as Legionnaires disease, in susceptible people. The same bacteria can cause a mild fever, known as Pontiac fever, in otherwise healthy individuals.

Micron
A dimension of one millionth of a metre ($1x10^{-6}$m), commonly shown as 1µm.

5 Recommendations

5.1 Compliance with legislation

5.1.1 In England, Wales and Scotland all employers or other duty holders should undertake a risk assessment in respect of their employees and persons not employed under Regulation 3 of the Management of Health and Safety at Work Regulations 1999 (ref 6) (in Northern Ireland Regulation 3 of the Management of Health and Safety at Work Regulations (Northern Ireland) 2000) (ref 7).

5.1.2 The risk assessment indicated in 5.1.1 should be undertaken in accordance with the HSE Approved Code of Practice L8 (ref 1) by a competent person. Additional advice is set out in BS 8580 (ref 8) and a guide from the Water Management Society (ref 9). The assessment should include the potential for bacterial growth, the potential for legionella transmission and the potential for human infection.

5.1.3 The legionella assessment should include:

- the identity of the competent person with regard to legionella protection;
- firefighting systems identified as posing a risk;
- schematic diagrams of those systems;
- monitoring, inspection and maintenance procedures;
- records of the monitoring results, inspections and checks carried out; and
- a review date.

5.1.4 The assessment should also address the potential for droplet formation during installation, maintenance and cleaning operations, and during emergency operation of the firefighting system.

Component	Bacteria growth requirement	Pipework and installations	Water supply				
Property			Public mains	Elevated private reservoir	Gravity tank	Automatic tank	Pressure tank
Temperature range	25-45 °C	Ambient	Ambient	Ambient	Ambient	Ambient	Ambient
Stagnant water	+	+	#	+	+	+	+
Contamination							
Organic	+	#	#	?	#	#	#
Iron	+	+	+	+	+	+	+
Oxygen	+	#++	+	+	+	+	+
Light	+	#	#	?	#	#	#
Bacterial growth	-	#	#	?	#	#	#
+ condition present							
# condition not present							
? condition possible							
++ Deoxygenation from rust formation							

Table 2: Comparison of conditions in firefighting system and those required for growth of legionella (from the LPC Rules for Automatic Sprinkler Installations 2009)

5.1.5 Any occurrence of Legionnaires disease contracted as a result of work being carried out on a system should be reported to the HSE in compliance with the RIDDOR Regulations (ref 5).

5.2 Business continuity

5.2.1 All organisations should take steps to ensure the continued smooth running of their business by making a suitable emergency plan. Guidance for this is set out in **Business resilience: A guide to protecting your business and its people** (ref 10). The emergency plan should address the implications of a fire, flood or other perceived disaster, such as the possibility of legionella being discovered on the site, on all facets of the business model. It should indicate the lines of communication that should be followed and the contact details for specialist assistance, providers of alternative accommodation and suppliers of manufacturing plant or services.

5.2.2 When complete, the emergency plan should be rehearsed by means of a tabletop exercise, with the results being assessed and amendments made to the plan as necessary.

5.2.3 Consideration may be given to applying commercially available computer programmes, such as the ROBUST software (Resilient Business Software Toolkit) that is available free of charge (ref 11), or other appropriate product, to develop and check the adequacy of the plan.

- During installation avoid the use of materials that encourage the growth of legionella.
- Keep pipe lengths as short as possible and eliminate dead ends and similar areas where water could stagnate.

5.3 The design of the installation

5.3.1 The designer should provide adequate information to the end user regarding the hazards that the installation presents and the measures necessary to ensure that the system will not pose a risk to personnel when in use.

- Why are portable fire extinguishers not considered to be a significant legionella hazard?
- What sources of firefighting water may pose a legionella risk?

5.3.2 Water tanks should be covered or enclosed wherever possible to exclude sunlight and particulate matter.

5.3.3 The design of the installation should keep pipe lengths as short as possible and eliminate dead ends and similar areas where water could stagnate.

5.3.4 During installation the use of materials that encourage the growth of legionella should be avoided. The Water Fittings and Materials Directory (ref 12) references fittings, materials and appliances approved for use on the UK Water Supply System by the Water Regulations Advisory Scheme.

5.4 Maintenance

5.4.1 All tanks should be subject to an annual visual inspection of their condition to monitor for rust, internal deposits and biofilm.

5.4.2 Private water supply tanks may be constructed from a range of materials, such as concrete, glass fibre reinforced plastic, galvanized (or unglavanized) steel and aluminium lined with butyl rubber. Tanks fed from public mains should be subject to a suitable cleaning and maintenance regime every 15 years; tanks fed from alternative sources should be cleaned and maintained every three years.

5.4.3 Pumps should be tested, and maintained weekly.

5.4.4 Where systems are supplied by charged or 'wet' pipework, this should be cleaned following the discovery of significant amounts of corrosion or other contamination in the relevant storage tank, or if solid accumulations are suspected to be in the pipework for other reasons. There is no risk from legionella in empty ('dry') pipework.

5.4.5 Testing and maintenance procedures for sprinkler and hose reel systems should be designed to minimise the potential for the production of aerosols and air borne water droplets. The risk of exposure of witnesses and other persons in the vicinity to aerosols should be minimised. All testing and maintenance procedures should be recorded.

5.5 Managing the hazard

5.5.1 The surveillance of wet pipe firefighting installations should be incorporated into any existing legionella monitoring programme.

5.5.2 In addition to the risk assessment, it is prudent for water quality in firefighting systems to be monitored by a competent person on a regular basis (for example annually) using a simple bacterial assay to measure total bacterial content (not just legionella). Where a positive result is obtained, a programme of treatment and further testing should be undertaken until a satisfactory result is achieved.

Figure 2: Pipe work runs should be kept as short as possible but still provide full protection for the premises

5.5.3 Suitable water treatments should be utilised where possible to kill legionella or limit their ability to grow.

5.5.4 The preferred method for of chemical water treatment for the control of legionella (and other bacteria) in a firefighting installation is the use of a biocide such as chlorine dioxide. One of the difficulties associated with biocides, however, is the lack of biofilm penetration. It may therefore be necessary to incorporate a dispersant with the biocide to assist in the disinfection.

5.5.5 Prior to undertaking chemical water treatment, an assessment should be made of the possible effect of the levels of chlorine or other agent on the materials from which the tank and other relevant parts of the installation are constructed.

5.5.6 All water treatment should be undertaken by a competent person.

5.5.7 Old or redundant tanks and pipework should be drained and removed at the earliest opportunity, following consultation with the insurers of the property.

6.0 Checklist

		Yes	No	N/A	Action required	Due date	Sign on completion
6.1	**Compliance with fire safety legislation (section 1)**						
6.1.1	Has the employer or other duty holder undertaken a risk assessment in respect of their employees and persons not employed under Regulation 3 of the Management of Health and Safety at Work Regulations 1999 (or equivalent legislation in Northern Ireland? (5.1.1)						
6.1.2	Has the risk assessment to meet the requirements of the HSE Approved Code of Practice L8 been undertaken by a competent person? (5.1.2)						
6.1.3	Does the legionella assessment: • identify the competent person with regard to legionella protection; • identify the firefighting systems posing a risk; • include schematic diagrams of those systems; • detail the monitoring, inspection and maintenance procedures; • include records of the monitoring results, inspections and checks carried out; • include a review date. (5.1.4)						
6.1.4	Does the assessment address the potential for droplet formation during installation, maintenance and cleaning operations, and during emergency operation of the firefighting system? (5.1.5)						
6.1.5	Are procedures in place to report to the HSE any occurrence of Legionnaires disease contracted as a result of work being carried out on a system, in compliance with the RIDDOR Regulations? (5.1.6)						
6.2	**Business continuity (section 2)**						
6.2.1	Has an emergency plan for the business been prepared? (5.2.1)						
6.2.2	Has the emergency plan been rehearsed by means of a tabletop exercise, with the results being assessed and amendments made to the plan as necessary? (5.2.2)						
6.2.3	Has consideration been given to applying commercially available computer programmes, such as the ROBUST software (Resilient Business Software Toolkit), to the business operations? (5.2.3)						
6.3	**The design of the installation (section 3)**						
6.3.1	Has the designer provided adequate information regarding the hazards that the installation presents and the measures necessary to ensure that the water system will not be a risk to personnel when in use? (5.3.1)						
6.3.2	Are water tanks covered or enclosed wherever possible to exclude sunlight and particulate matter? (5.3.4)						
6.3.3	Does the design keep pipe lengths as short as possible and eliminate dead ends and similar areas where water could stagnate? (5.3.5)						
6.3.4	During installation is the use of materials that encourage the growth of legionella avoided? (5.3.6)						
6.4	**Maintenance (section 4)**						
6.4.1	Are all tanks subject to an annual visual inspection of their condition to monitor for rust, internal deposits and biofilm? (5.4.1)						
6.4.2	Are tanks fed from public mains subject to a suitable cleaning and maintenance regime every 15 years and tanks fed from alternative sources cleaned and maintained every three years? (5.4.2)						
6.4.3	Are pumps tested and maintained weekly? (5.4.3)						

		Yes	No	N/A	Action required	Due date	Sign on completion
6.4.4	Are systems of charged or 'wet' pipework cleaned following the discovery of significant amounts of corrosion or other contamination in the relevant storage tank, or if solid accumulations are suspected to be in the pipework? (5.4.4)						
6.4.5	Are testing and maintenance procedures recorded and designed to minimise the potential for the production of aerosols and air borne water droplets? (5.4.5)						
6.5	**Managing the hazard (section 5)**						
6.5.1	Is the surveillance of wet pipe firefighting installations incorporated into an existing legionella monitoring programme? (5.5.1)						
6.5.2	Is water quality in firefighting systems monitored by a competent person on a regular basis using a simple bacterial assay to measure total bacterial content (not just legionella)? (Where a positive result is obtained, is a programme of treatment and further testing undertaken until a satisfactory result is achieved?) (5.5.2)						
6.5.3	Are suitable water treatments utilised where possible to kill legionella or limit their ability to grow? (5.5.3)						
6.5.4	Is a dispersant incorporated with the biocide to assist in the disinfection process by penetrating biofilms? (5.5.4)						
6.5.5	Prior to undertaking chemical water treatment, is an assessment made of the possible effect of the levels of chlorine or other agent on the materials from which the tank and other relevant parts of the installation are constructed? (5.5.5)						
6.5.6	Is all water treatment undertaken by a competent person? (5.5.6)						
6.5.7	Are old or redundant tanks and pipework drained and removed at the earliest opportunity? (5.5.7)						

7 References

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