

# Guidelines for the Control of Legionella

in Manufactured Water Systems  
in South Australia, 2008

Revised 2013



Government  
of South Australia

SA Health

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Control of Legionella in Manufactured Water Systems in South Australia

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Public Health Services  
Public Health and Clinical Systems  
Department for Health and Ageing  
on the recommendation of the Chief Public Health Officer

National Library of Australia Cataloguing-in-Publication Entry

*Title:* Guidelines for the control of legionella in  
manufactured water systems in South Australia / Health Protection Programs.

*Edition:* Revised 2013

*ISBN:* 9781742435169 (paperback)

*Subjects:* Legionella – South Australia – Prevention.  
Microbial contamination – South Australia – Prevention.  
Waterborne infection – South Australia – Prevention.  
Water – Pollution – Health aspects – South Australia – Prevention.

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South Australia. Department for Health and Ageing. Health Protection Programs

*Dewey Number:* 614.59241

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## Foreword

In a modern and highly mechanised world, water is used in a wide range of devices designed to improve standards of living. However, these devices have to be correctly managed and maintained to ensure that they do not present risks to human health. There are many micro-organisms that can grow in water and, while most are harmless, some may give rise to human illness.

Manufactured water systems that contain heated water and produce aerosols are of particular concern. Although this includes a diverse range of devices, some evaporative water-based air-cooling systems, warm water systems and spas have been identified as having the greatest potential to grow and disseminate *Legionella*, the cause of Legionnaires' disease and Pontiac Fever.

Pursuant to section 109(2)(o) of the *South Australian Public Health Act 2011* (the Act), this document is a prescribed guideline to assist in the administration and operation of the South Australian Public Health (Legionella) Regulations 2013 (the Legionella Regulations). Schedule 3 contains the mandatory decontamination procedures prescribed by the Legionella Regulations.

Although this Guideline applies to a range of manufactured water systems, the focus of the Legionella Regulations is on high risk manufactured water systems; namely, cooling water systems and warm water systems. This Guideline specifies:

- > maintenance and decontamination procedures;
- > the keeping of records and manuals;
- > the responsibilities of owners and occupiers of premises on which manufactured water systems are situated; and
- > the role of relevant authorities in monitoring the operation of such systems.

The Legionella Regulations do not apply to high risk manufactured water systems installed in Class 10, Class 1A or 4 buildings or sole-occupancy units in Class 2 buildings (as defined in the Building Code of Australia), excluding warm water systems that serve more than one dwelling.

This Guideline references a number of other documents that should be read in conjunction with it. These documents include the Act, the Legionella Regulations, Australian/New Zealand Standard (AS/NZS) 3666: Parts 1, 2 and 3 Air-handling and water systems of buildings – Microbial control, Handbook SAA/SNZ HB32 Control of microbial growth in air-handling and water systems in buildings, Australian/New Zealand Standard (AS/NZS) 3500.4 National Plumbing and Drainage Part 4: Heated water services, and the Building Code of Australia.

Users of this Guideline should also be aware of the requirements of the Act, the South Australian Public Health (General) Regulations 2013 (the General Regulations) and the Standard for the Operation of Swimming Pools and Spa Pools in South Australia.

### Note:

Applications for determinations or approvals by the Minister under the Legionella Regulations should be posted to:

The Minister for Health and Ageing  
C/-Health Protection Programs  
SA Health  
PO Box 6 Rundle Mall  
ADELAIDE SA 5000

Or by email to: [legionella@health.sa.gov.au](mailto:legionella@health.sa.gov.au)



1. Introduction	1	8. Operation and maintenance of systems	13
2. Definitions	3	8.1 Cooling water systems	13
3. Legionella Regulations cross-reference	5	8.2 Warm water systems	13
4. <i>Legionella</i> and illness	6	8.3 Hot water systems	14
4.1 <i>Legionella</i> in the environment	6	8.4 Spa baths	14
4.2 Risk factors for illness	7	8.5 Air-houses, humidifiers and nebulisers	14
4.3 Reducing risk in manufactured water systems	7	8.6 Decorative fountains and other aerosol producing devices	14
5. Spa pools and hydrotherapy pools	8	8.7 Ice machines and other non-aerosol producing devices	14
6. Design, installation and commissioning of systems	9	8.8 Water treatment	15
6.1 Cooling water systems	9	9. Microbiological testing	16
6.2 Hot water systems and warm water systems	10	9.1 Testing for <i>Legionella</i>	16
6.3 Spa baths	10	9.2 Heterotrophic colony count	17
6.4 Air-houses, humidifiers and nebulisers	11	10. System decontamination	18
6.5 Decorative fountains	11	11. Operating and maintenance manuals and maintenance log books	19
6.6 Ice machines and other non-aerosol producing devices	11	12. The role of relevant authorities	20
7. Responsibility for manufactured water systems	12	12.1 Annual compliance inspections	20
		12.2 Random inspections	20
		12.3 Legionellosis investigations	20
		12.4 Registration of systems	21

## Schedule 1

Hot and warm water systems (diagrams) 22

## Schedule 2

Procedure for sampling for microbiological testing 25

## Schedule 3

Procedures for decontamination of cooling water systems and hot water and warm water systems 27

Part 1 – procedure for off-line decontamination of cooling water systems 27

Part 2 – procedures for decontamination of hot water systems and warm water systems 28

## Schedule 4

Responses to detection of *Legionella* in cooling water systems and warm water systems 29

Part 1 – control strategies for the presence of *Legionella* in cooling water systems 29

Part 2 – control strategies for the presence of *Legionella* in warm water systems 29

Acknowledgements 30

Bibliography 31

## Appendix A

Resources and further reading 33

# 1. Introduction

This document is a prescribed Guideline under the *South Australian Public Health Act 2011* (the Act) to assist relevant authorities in the administration and operation of the South Australian Public Health (Legionella) Regulations 2013 (the Legionella Regulations). It deals specifically with the control of *Legionella* in manufactured water systems. It is concerned with all manufactured water systems that allow *Legionella* growth and that have the potential to generate aerosols resulting in human exposure to airborne *Legionella*. Of particular focus are high risk manufactured water systems which are cooling water systems and warm water systems. Although a potential source of *Legionella*, spa pools, are dealt with by other legislation; the South Australian Public Health (General) Regulations 2013 (the General Regulations).

Manufactured water systems that can grow *Legionella* but that do not create aerosols (such as ice machines and some chilled water dispensers) are not considered to be a high risk for most people but do represent a risk to immunocompromised people and are mentioned briefly in this Guideline.

The most effective way of minimising the growth of *Legionella* is to keep water systems visibly clean and to apply appropriate water treatment. The presence of biofilms, sediments, sludge, solids, scale, corrosion and micro-organisms provide a favourable environment for *Legionella* growth.

This Guideline outlines operation and maintenance procedures intended to keep systems visibly clean and to minimise *Legionella* contamination. It also details the prescribed decontamination procedures that must be followed by system owners when specified concentrations of *Legionella* are detected in a water sample collected from regulated high risk manufactured water systems.

This Guideline describes the role of relevant authorities in monitoring and enforcing compliance with the Legionella Regulations and in maintaining registers of high risk manufactured water systems. This Guideline also provides advice and information for use by designers, installers, owners, operators and maintenance personnel to ensure that manufactured water systems are constructed, operated and maintained to minimise the risk of legionellosis outbreaks and to comply with the requirements of the Act and the Legionella Regulations.

In summary, the key points of this Guideline and the Legionella Regulations are that:

## > Manufacture

- manufactured water systems should be manufactured, installed, maintained and operated in a manner that prevents the transmission of disease organisms to persons
- a cooling water system must be fitted with an automatic biocide dosing device and be operating effectively at all times while the system is in operation
- drift eliminators must be fitted to every cooling tower in a cooling water system unless otherwise determined by the Minister
- pipes after thermostatic mixing valves or their equivalent to outlet points on hot water or warm water systems should not exceed 6 metres in length

## > Maintenance

- high risk manufactured water systems must be inspected at least monthly as part of a routine maintenance program and be cleaned if found to be dirty
- cooling water systems must be cleaned at least 6 monthly, or more frequently where required to maintain cleanliness
- the temperature of water stored in warm water systems must be maintained at a minimum of 60°C
- hot water system and warm water system outlet taps that are not used on a weekly basis should be flushed every week
- dead legs (lengths of pipe that do not allow circulation of water) should be removed or disconnected
- warm water systems must be completely flushed at least 6 monthly with water of not less than 70°C for 5 minutes (or an equivalent temperature/time combination) or be treated with chlorine to provide a minimum free chlorine residual of 1 mg/L at all outlets
- temperature controlling devices such as thermostatic mixing valves or tempering valves should be regularly serviced in accordance with the manufacturer's instructions and AS 4032 and, in any case, at least once every 12 months

> Administration

- the owner of premises on which a cooling water or warm water system is situated must ensure that plans of the system and manuals for the operation and maintenance of the system are available and that records are maintained of any inspection, maintenance, repair, replacement, alteration or upgrading of the system. Records will include the result of any testing of the system, microbiological testing of water samples and details of the type and use of biocide

> Public Authorities

- the relevant authority must maintain a register that records details of premises on which cooling water systems or warm water systems are situated
- Cooling water systems and warm water systems must be inspected for compliance, at least once a year by the relevant authority. Alternatively, the relevant authority can issue a notice to the system owner, requiring that they engage an independent, competent third party to undertake the inspection and prepare a report. The costs incurred in the annual inspection are to be met by the owner of the premises
- the relevant authority may require testing for the presence of *Legionella* organisms in the event that a high risk manufactured water system is inadequately operated or maintained. Testing may also be required as part of an investigation of a case or suspected case or an outbreak of legionellosis
- If an owner of premises on which a manufactured water system is situated fails to comply with a notice given by the relevant authority, the relevant authority may require the system to be remediated, shut down and/or decontaminated and may recover all necessary associated costs from the owner

## 2. Definitions

<b>the Act</b>	the <i>South Australian Public Health Act 2011</i> .
<b>aerosol</b>	airborne water particles less than 10µm in diameter.
<b>air-house</b>	an industrial humidifier commonly used in paint, electroplating and finishing shops.
<b>authorised officer</b>	a person appointed to be a State or local authorised officer under Part 3 Division 5 of the Act.
<b>automatic biocide dosing device</b>	a device that automatically discharges a measured amount of biocide to a cooling water system using a feedback control loop or timer.
<b>biocide</b>	a substance capable of killing micro-organisms, including <i>Legionella</i> .
<b>biofilm</b>	a complex structure adhering to surfaces that are regularly in contact with water, consisting of colonies of bacteria and other microorganisms.
<b>bleed-off</b>	the removal of water from a system to limit the concentration of total dissolved solids and suspended solids.
<b>calorifier</b>	an apparatus for indirect heating of water in a vessel, the source of heat is contained within a pipe or coil immersed in the water.
<b>clean</b>	free from visible sludge, foam, slime, rust, scale, dirt, dust and any deposit or accumulation of impurities, or any foreign material.
<b>cfu/mL</b>	colony forming units per millilitre.
<b>cooling tower</b>	a device for lowering the temperature of water by evaporative cooling in which atmospheric air is in contact with falling water thereby exchanging heat. The term also includes those devices which incorporate a water-refrigerant or water-water heat exchanger.
<b>cooling water system</b>	a heat exchange system comprising a heat-generating plant, a heat-rejection plant and interconnecting water recirculating pipe work and associated pumps, valves and controls. The term includes cooling towers and evaporative condensers.
<b>competent person</b>	as described in the Legionella Regulations.
<b>container (heated water)</b>	a vessel, including fittings, in which heated water is stored, sometimes referred to as a storage container, cylinder or tank.
<b>dead leg</b>	a section of a hot water or warm water system that does not permit the circulation of hot or warm water.
<b>decontamination</b>	the reduction, to negligible or low concentrations, of a known or suspected contaminant, such as <i>Legionella</i> .
<b>drift</b>	water lost from a cooling tower as liquid droplets in the exhaust air, excluding condensation. Drift is not to be confused with plume which is condensed water vapour.
<b>DPD Test Kit</b>	a test kit containing 'diethyl-p-phenylene diamine' a chemical reagent used in a colorimetric comparator for testing water for free, combined and total chlorine.
<b>evaporative condenser</b>	a heat exchanger in which refrigerant is cooled by a combination of air movement and water spraying.
<b>The General Regulations</b>	South Australian Public Health (General) Regulations 2013.
<b>heterotrophic colony count</b>	a measure of heterotrophic aerobic bacteria present in a water sample. It is also referred to as a heterotrophic plate count, standard plate count or total plate count.
<b>high risk manufactured water system</b>	a cooling water system or warm water system.

<b>hot water system</b>	a reticulated water system that distributes or recirculates hot water ( $\geq 60^{\circ}\text{C}$ ) through the majority of its branches. A hot water system may include temperature control devices located near outlets to regulate the delivery temperature. See Figures 3 and 4 in Schedule 1.
<b>instantaneous water heater</b>	an unvented water heater in which the heat energy is applied only while the water flows to an outlet.
<b>The Legionella Regulations</b>	South Australian Public Health (Legionella) Regulations 2013.
<b>manufactured water system</b>	a manufactured system that incorporates water as part of its functionality.
<b>mg/L</b>	milligrams per Litre.
<b>outbreak (legionellosis)</b>	two or more cases of legionellosis linked by time or place.
<b>owner/occupier</b>	in relation to premises, means a person who has, or is entitled to possession or control of the premises and includes a person who is in charge of the premises. A reference to an owner of premises includes a reference to an occupier of the premises.
<b>pH</b>	a scale (ranging from 0 to 14) that indicates the acidity (0 to $<7$ ) or alkalinity ( $>7$ to 14). Water with a pH of 7 is neutral.
<b>relevant authority</b>	the Chief Public Health Officer or a council.
<b>sporadic case</b>	a single case of legionellosis with no discernible link to another case by time or place.
<b>TDS (total dissolved solids)</b>	the total weight of dissolved solids in water, which would remain if all the water were evaporated.
<b>temperature control device</b>	a device used to alter the water temperature to produce water that reduces the risk of scalding to users. Examples include thermostatic mixing valves and tempering valves.
<b>tempering valve</b>	a mixing valve that is temperature actuated and is used to temper a hot water supply with cold water to provide hot water at a lower temperature, e.g. $50^{\circ}\text{C}$ , at one or more outlet fixtures.
<b>thermostatic mixing valve</b>	a mixing valve in which the temperature of the water from the mixed water outlet is automatically controlled by a thermostatic element/sensor to a preset temperature that is suitable for direct contact with the skin.
<b>the Minister</b>	the Minister of the Crown to whom the administration of the Act has been committed by the Governor, or in whom the administration of the Act is otherwise vested.
<b>storage water heater</b>	a water heater that incorporates a thermally insulated container in which the water is heated and stored for subsequent use. Heated water must be stored at a minimum temperature of $60^{\circ}\text{C}$ to inhibit the growth of <i>Legionella</i> bacteria. A storage water heater does not include a calorifier.
<b>warm water</b>	water that is $<60^{\circ}\text{C}$ and $\geq 30^{\circ}\text{C}$ .
<b>warm water system</b>	a reticulated water system that distributes or recirculates warm water through the majority of its branches at a nominal temperature of $45^{\circ}\text{C}$ by means of a temperature controlling device. See Figures 5 and 6 in Schedule 1.

### 3. Legionella Regulations cross-reference

Table 1 briefly summarises individual regulations with specific requirements from the Legionella Regulations, and provides a reference to the relevant location within this Guideline and to the corresponding Australian Standards referred to within the regulation where applicable. Regulations that are not referenced within this Guideline have not been included.

**Table 1**

Cross-reference between the Legionella Regulations, relevant Australian Standards and references within this Guideline.

Regulation number and title	Requirement	Relevant Australian Standard	Reference in this Guideline	Page no.
5. Duty to <b>register</b> high risk manufactured water system	All high risk manufactured water systems must be registered with the relevant authority		<b>12.4</b>	21
6. <b>Register</b> of high risk manufactured water systems	Each relevant authority must keep a register of high risk manufactured water systems registered by the relevant authority		<b>12.4</b>	21
7. Cooling water systems to be fitted with <b>automatic biocide dosing devices</b>	The owner of premises on which a cooling water system is installed must ensure that an automatic biocide dosing device is fitted to the system and is operating effectively at all times while the system is in operation		<b>6.1</b> <b>8.8.1</b>	9 15
8. Cooling water systems to be fitted with <b>drift eliminators</b>	Drift eliminators to be fitted to all cooling towers (unless the Minister determines otherwise)		<b>6.1</b>	9
9. <b>Commissioning</b> of high risk manufactured water systems	Cooling water systems and components to have appropriate cleaning, pretreatment and microbial control before being brought into service	<b>AS/NZS 3666.1 – Clause 4.7</b>	<b>6.</b>	9
10. <b>Plans and manuals</b> relating to high risk manufactured water systems to be kept readily accessible	Plans, operating and maintenance manuals to be kept on the premises in a readily accessible place and be available for inspection upon request by an authorised officer	<b>AS/NZS 3666.2 – Clause 2.6.1</b> <b>HB32</b>	<b>6.</b> <b>11.</b>	9 19
11. High risk manufactured water systems to be <b>operated and maintained</b> by <b>competent person</b>	The owner of premises with a high risk manufactured water system installed to ensure that the system is operated and maintained by sufficiently competent and knowledgeable person		<b>7.</b>	12
12. <b>Maintenance of cooling water systems</b>	Cooling water systems to be maintained in accordance with the relevant Australian Standard or a program approved by the Minister	<b>AS/NZS 3666.2 – Section 2.5</b> or <b>AS/NZS 3666.3 – Section 3</b>	<b>8.1</b>	13
13. <b>Maintenance of warm water systems</b>	Warm water systems to be maintained in accordance with the requirements set out in regulation 13	<b>AS 4032</b> (for temperature control devices)	<b>8.2</b>	13
14. <b>Maintenance log books</b>	Up-to-date maintenance log books to be kept on premises in a readily accessible place and be available for inspection upon request by an authorised officer Log books to be kept for at least 5 years	<b>AS/NZS 3666.2 – Clause 2.6.2</b> <b>HB32</b>	<b>11.</b>	19
15. <b>Annual inspection and microbiological testing</b>	High risk manufactured water systems are to be inspected and have microbiological testing conducted at least once in every 12 months	<b>AS/NZS 3896</b> (for microbiological testing)	<b>9.</b> <b>12.1</b> <b>Schedule 2.</b>	16 20 25
16. Power of authority to require <b>microbiological testing</b> in other circumstances	The authority may serve a notice requiring microbiological testing when investigating an occurrence of legionellosis or if a system is not being maintained in accordance with the Legionella Regulations	<b>AS/NZS 3896</b> (for microbiological testing)	<b>12.</b> <b>Schedule 2.</b>	20 25
17. Responses to <b>detection of Legionella</b>	Upon receipt of specified <i>Legionella</i> water testing results from a high risk manufactured water system, the owner must immediately shut down or decontaminate the system and report the test results to the relevant authority within 24 hours		<b>9.1</b> <b>Schedule 2.</b> <b>Schedule 4.</b>	16 25 29
18. <b>Determinations and approvals</b>	Applications for determinations and approvals to be made to the Minister on an approved form accompanied by the relevant fee and necessary information		<b>Foreword</b>	

## 4. *Legionella* and illness

*Legionella* bacteria must be inhaled to cause illness. However, most people who are exposed to aerosols containing *Legionella* do not become ill. *Legionella* generally infects the lungs, causing a disease known as legionellosis.

Legionellosis can take the form of the pneumonic, often very severe and potentially fatal Legionnaires' disease or the non-pneumonic, usually non-fatal Pontiac fever. *L. pneumophila*, *L. anisa*, *L. feellii* and *L. micdadei* have been associated with Pontiac fever, while Legionnaires' disease is most commonly caused by subtypes of *L. pneumophila* serogroup 1, although other species can also cause disease. The usual incubation period for legionellosis is 2–10 days, and infection causes flu-like symptoms including fever, chest pain, cough, breathlessness, and diarrhoea. Diagnosis is usually made by a series of blood tests. Infections caused by *L. pneumophila* serogroup 1 may also be rapidly identified by a urinary antigen test. Occasionally the organism is grown from a sample of sputum or lung fluid.

Legionellosis infection generally requires treatment with antibiotics. Severe cases of *Legionella pneumophila* serogroup 1 infection are treated in hospital and may require intensive care.

Infections caused by *Legionella* are notifiable conditions in South Australia, meaning the doctor and the laboratory diagnosing the disease are required to notify all cases to the Communicable Disease Control Branch of the South Australian Department for Health and Ageing.

Other species have also been identified as causes of pneumonic illness, including *L. longbeachae* which is associated with potting mixes. While legionellosis from potting mixes is not covered in this Guideline, further information can be obtained from other SA Health publications as referenced in Appendix A.

### 4.1 *Legionella* in the environment

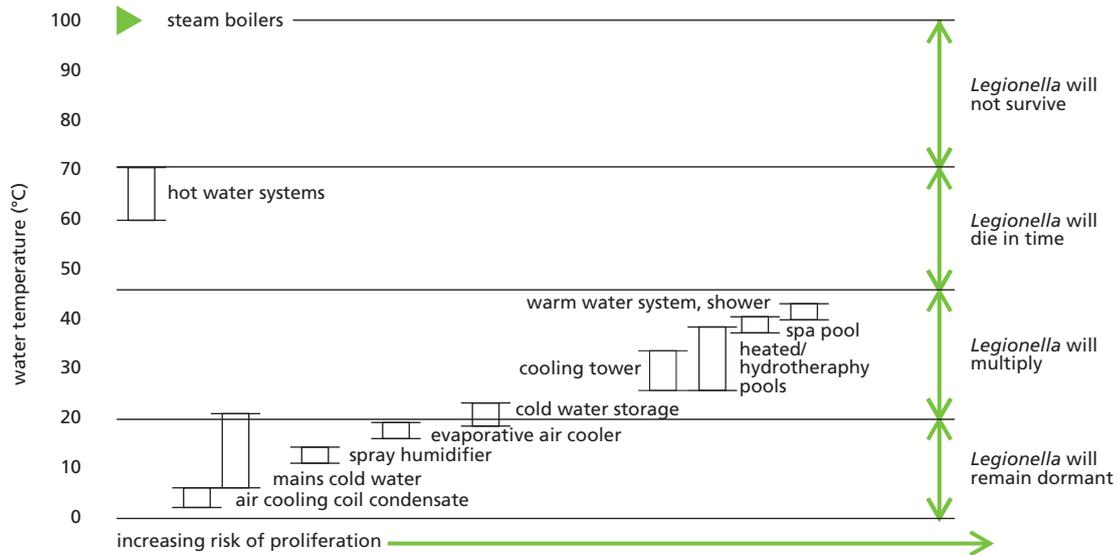
*Legionella* are widely distributed in the natural environment and have been isolated from water sources such as lakes, rivers, streams, groundwater, thermal lagoons, and habitats such as soils and mud. *Legionella* obtains nutrients from other micro-organisms such as algae, protozoa and other bacteria, and by the utilisation of some organic and inorganic substances. *Legionella* multiply at temperatures ranging from 20°C to 45°C, with maximum growth occurring between 32°C and 43°C. They can survive freezing and are killed with increasing speed as temperatures exceed 45°C. Survival time decreases from hours at 50°C to minutes at 60°C, while at 70°C the organism is killed almost immediately.

*Legionella* from natural sources can enter and colonise manufactured water systems such as air-handling systems incorporating cooling towers or evaporative condensers (collectively known as cooling water systems), water supplies, cold, warm and hot water pipework, spa pools, spa baths, hydrotherapy pools, air-houses, humidifiers, nebulisers and decorative fountains. These systems are commonly found in commercial, industrial, educational, child care, aged and health care facilities. The potential for *Legionella* to grow in such systems is shown in Figure 1.

Figure 1 shows the relationship between proliferation of *Legionella* and temperatures of various water systems. The bars represent the average range of operating temperature of various manufactured water systems.

*Legionella* growth is temperature dependent. In broad terms, the temperature characteristics are:

below 20°C	dormant
20 to 25°C	virtually dormant although very slow growth is possible
25 to 30°C	slow growth if other factors are satisfied
30 to 37°C	increase in growth rate
37 to 43°C	optimum temperature range for replication of <i>Legionella</i>
45°C	maximum temperature for growth
46°C	stationary phase (dies over about 1 week)
50°C	dies slowly (about 10 hours)
55°C	dies in about 1 hour
63°C	dies in a few minutes
70°C	dies in seconds.



**Figure 1**

### Water temperature & increasing risk of *Legionella* proliferation

(Modified from: New South Wales Health Department, Code of Practice for the Control of Legionnaires' disease.)

## 4.2 Risk factors for illness

*Legionella* infection or illness can result from the inhalation of aerosols containing *Legionella* bacteria which may be generated by some manufactured water systems. However, most people who are exposed to *Legionella* do not become ill. The risk of illness is increased by:

- > smoking
- > being male (possibly related to smoking)
- > chronic heart or lung disease
- > diabetes
- > kidney failure
- > some forms of cancer
- > being aged over 50

Infection caused by *Legionella* cannot be transmitted from person to person.

## 4.3 Reducing risk in manufactured water systems

*Legionella* present in biofilms or protected within amoebae may proliferate in a manufactured water system if temperatures are favourable (25–45°C). The most effective way of minimising the presence and growth of *Legionella* and reducing the risk of disease is to keep systems clean and to use appropriate biocide programs and disinfection procedures. In any manufactured water system, all wetted surfaces and water basins should be kept clean and the stagnation of water should be avoided at all times.

The development of biofilms and the effectiveness of disinfection will be influenced by corrosion and the deposition of scale and solids. Degraded plumbing, such as decomposing gaskets and sealing washers and corroded pipes provide sites for the development of biofilms. Some plumbing materials are known to contain nutrients that enhance the growth of biofilms. The formation of biofilms and deposition of scale and solids should be minimised. Materials used in potable water systems should comply with AS/NZS 4020 and all plumbing and drainage products should comply with SAA MP 52.

The inhalation of contaminated aerosols by a susceptible person may result in legionellosis. Minimising the generation and spread of any aerosols will reduce the risk of disease in the community.

## 5. Spa pools and hydrotherapy pools

Spa pools and hydrotherapy pools can produce aerosols and provide conditions suitable for *Legionella* growth. Spa and hydrotherapy pool operators must be knowledgeable and competent in the operation and maintenance of public pools and spas in accordance with the General Regulations and the associated prescribed Standard and Guideline.

## 6. Design, installation and commissioning of systems

Manufactured or other water systems that contain warm water and produce aerosol can represent a risk of legionellosis.

Evaporative air conditioners, while falling into this category, have not been associated with any cases of legionellosis in Australia. However, units should be regularly maintained and kept clean as per the manufacturer's recommendations (for further information, refer to AS/NZS 3666.2).

The design and installation of new manufactured water systems and modification of existing systems must comply with the Legionella Regulations, and should comply with AS/NZS 3666.1 and this Guideline. The commissioning of new or modified plant must include thorough cleaning and the provision of operation and maintenance manuals. It is important to ensure during the design, installation and commissioning of manufactured water systems that they are appropriately located, with consideration given to access and clean-ability issues. Dead legs in cooling water systems, hot water systems and warm water systems should be avoided. For air-handling devices incorporating cooling water systems, the location of air inlet and discharge points in relation to building geometry, and the location of inlet and discharge points of adjacent buildings and predominant wind direction should be considered. Materials used in plant construction should be corrosion resistant and able to withstand extremes in water quality and the presence of water treatment chemicals.

Upon installation and commissioning of new high risk manufactured water systems, Regulation 10 of the Legionella Regulations requires the owner to keep plans showing the location of all parts of the system. These components include (but are not limited to) cooling towers, condensers, drift eliminators, filtration devices, automatic biocide dosing devices, water inlets, waste outlets and discharge points, water heating devices and water storage facilities.

The owner of the premises is required to ensure the plans for the system are kept in a readily accessible place and made available to an authorised officer upon request.

### 6.1 Cooling water systems

Air-handling systems that incorporate water cooling, such as cooling towers and evaporative condensers, contain warm water and can generate aerosols. These systems typically have large internal surface areas and, if not well maintained, may accumulate considerable quantities of organic material and debris, and provide nutrients and ideal environments for microbial growth.

These systems can be associated with many types of facilities, including: factories with process cooling operations, commercial buildings, hospitals, hotels, shopping centres, schools, dairies, wineries, fruit and vegetable storage sheds, ice works, cold rooms and dry cleaners.

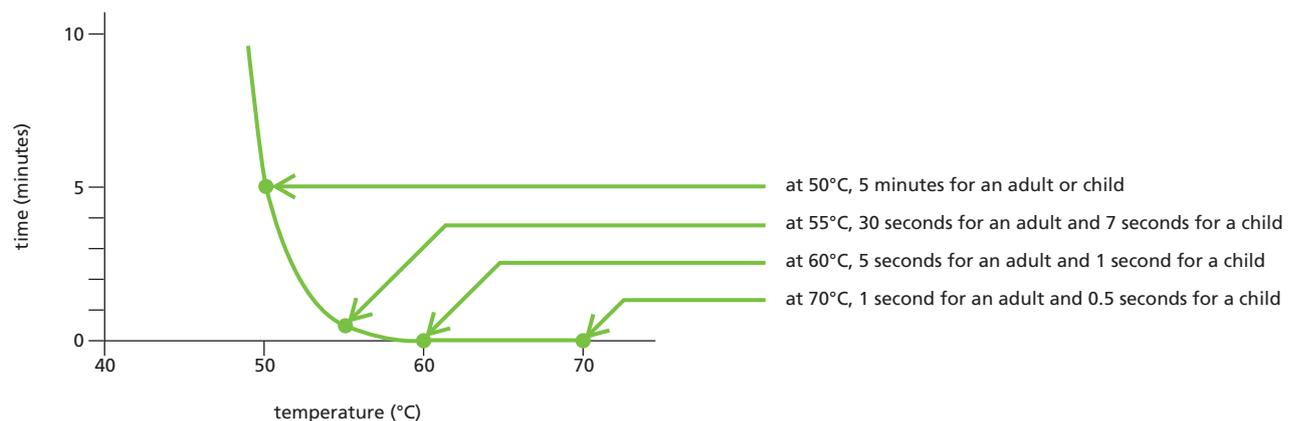
Well designed systems should be easy to clean and disinfect and should not contain dead legs or sections where debris and biofilms may accumulate. Systems should be designed and commissioned with consideration given to the quality of the outside air introduced into the system, and installed at a suitable distance from nearby cooling towers. In accordance with the provisions of AS/NZS 3666.1, sections 4.3 and 4.6, cooling towers should be located in areas free from accumulated soils and other material that may be a source of nutrients able to be sucked into the system.

Regulation 7 of the Legionella Regulations requires an automatic biocide dosing device to be fitted to a cooling water system and to be operating effectively at all times while the system is in operation. Regulation 8 of the Legionella Regulations requires drift eliminators to be fitted to all cooling towers unless the Minister has determined otherwise.

## 6.2 Hot water systems and warm water systems

Hot water systems and warm water systems are used to provide heated water in buildings for a range of purposes (e.g. bathing or cleaning). Hot water systems are those that heat water and distribute or recirculate it through the majority of the pipe work at  $\geq 60^{\circ}\text{C}$ . To inhibit the growth of *Legionella* bacteria, Regulation 13 of the Legionella Regulations requires heated water in warm water systems to be stored at a minimum  $60^{\circ}\text{C}$ . In order to reduce the likelihood of growth of *Legionella*, section 1.9.1 of AS/NZS 3500.4 requires heated water in hot water systems to be stored at a temperature above  $60^{\circ}\text{C}$ , or for a water heater certified to AS 3498 to be installed. Temperature stratification should be avoided in heaters and storage containers; this can be achieved by the installation of a stirring or mixing device. Further information can be found in SAA/SNZ HB32:1995.

Warm water systems are typically found in care facilities such as hospitals, early childhood centres, primary and secondary schools, nursing homes for young, aged, sick or disabled persons and other health care facilities. Warm water systems are those that distribute or recirculate water through the majority of the pipe work at a nominal temperature of  $45^{\circ}\text{C}$ . This is achieved by the use of a temperature controlling device, mixing valve or by way of setting the thermostat on an instantaneous or heat exchange heating system. The temperature in warm water systems is ideal for the growth of *Legionella*. However, there is increased risk of scalding associated with water temperatures exceeding  $50^{\circ}\text{C}$ . As a consequence, warm water systems require greater maintenance to minimise risks from *Legionella*. Figure 2 provides details of the relative contact times for full thickness burns to occur at varying water temperatures.



**Figure 2**

### Full thickness burns – contact times with water

*Reference: Henriques FC, Moritz AR. Studies of thermal injury V: the predictability and the significance of thermally induced rate processes leading to irreversible epidermal injury. Arch Pathol 1947; 43: 489–502.*

Dead legs should be avoided in warm water systems and hot water systems. Where possible, branch mains should be less than 6 metres in length. Where thermostatic mixing valves or their equivalent are fitted, the length of pipework after the valve should be minimised.

## 6.3 Spa baths

Spa baths are used as 'fill and empty' type devices. Spa baths should be designed and installed to ensure that all pipe work and pumps are self-draining to prevent stagnation of water. Spa baths should comply with AS 3861.

## 6.4 Air-houses, humidifiers and nebulisers

Air-houses are industrial humidifiers used in paint, electroplating and finishing shops. Humidifiers can be found as part of an air handling plant, manufacturing processes, fruit or vegetable storage and in domestic settings. Nebulisers are commonly found in hospitals, health care facilities and in homes. Air-houses, humidifiers and nebulisers incorporating water reservoirs generate aerosols and have the potential to transmit *Legionella*, making it imperative that these systems are properly managed and maintained in a clean state. Only sterile water should be used to fill a nebuliser reservoir or basin.

## 6.5 Decorative fountains

Aerosols may be generated by the splashing or spraying of water in a fountain. The recirculating water in such systems may be inadvertently heated (for example by submerged lighting) producing conditions that may favour the growth of *Legionella*. When designing fountains these factors should be taken into consideration.

## 6.6 Ice machines and other non-aerosol producing devices

Manufactured water systems such as ice machines and chilled water dispensers can also produce conditions that enable *Legionella* to survive and grow, but due to their lack of aerosol production these devices are only considered to be a high risk to the severely immunocompromised through pulmonary aspiration. Where extraordinary procedures such as air filtration and restricted food diets are used to protect high risk patients from infection, these procedures should extend to drinking water and ice machines. Ice machines should be inspected monthly and cleaned as necessary as per the manufacturer's instructions, and in any event at least once annually.

## 7. Responsibility for manufactured water systems

Regulation 5 of the Legionella Regulations requires the owner of premises on which a cooling or warm water system is located to register the system with the relevant authority. Regulation 11 of the Legionella Regulations also requires the owner of premises on which such a system is installed to ensure that the person responsible for the operation and maintenance of the system is sufficiently knowledgeable and competent to ensure that the system is operated and maintained as required. A competent person is someone who has had the appropriate training or practical experience (or both), sufficient to provide safe and satisfactory performance of the system in compliance with the legislative requirements. The knowledge and competence of an operator may be assessed by observing the standard of water quality within the system and the level of compliance with the Legionella Regulations.

The competent person nominated by the owner may be a contractor or company.

## 8. Operation and maintenance of manufactured water systems

The safe operation and maintenance of manufactured water systems requires frequent visual inspections, regular cleaning and, in some cases, the use of water treatment processes. Inspections should be carried out at least once every month and can be used as a basis for assessing the efficacy of the system performance, cleaning programs and water treatment processes. It is the system owner's responsibility to ensure this takes place.

Regulation 14 of the Legionella Regulations requires up to date maintenance log books to be kept (see Part 11).

### 8.1 Cooling water systems

Regulation 12 of the Legionella Regulations requires cooling water systems to be maintained in accordance with section 2.5 of AS/NZS 3666.2 or AS/NZS 3666.3 or an alternative maintenance program approved by the Minister.

AS/NZS 3666.2 requires cooling water systems to be inspected at least monthly for mechanical condition, biocide dosing and cleanliness, and to be cleaned at least once every 6 months. A clean system is free from visible sludge, foam, slime, rust, scale, dirt, dust and other deposits or growths. Cleaning procedures are detailed in AS/NZS 3666.2 and SAA/SNZ HB32. Water quality parameters such as pH, TDS and temperature should be monitored and recorded. Inspections and cleaning should be carried out more frequently as required by operational conditions or as indicated by visual inspections (operating conditions, water quality parameters, and the general condition of the cooling tower and basin). Stagnation of water should be avoided, as this can be conducive to the growth of *Legionella*. AS/NZS 3666.2 requires that cooling water systems that have been shut down are drained, cleaned, kept in a dry condition and for water treatment to be reinstated before start-up. Alternatively water treatment can be left in continuous operation, and cooling water circulated through the entire system at intervals of not greater than once every 48 hours.

Areas around cooling towers should be kept clean to minimise the accumulation of soil, dust or other organic material that could enter the system.

#### 8.1.1 Filtration devices

Water filters are designed to reduce particulate matter that is suspended in the water. Suitably designed and correctly installed water filtration systems can help to reduce fouling of cooling water systems with particulate matter and may increase the effectiveness of disinfection processes.

The efficacy of filters vary depending on factors such as type, pore size and media used. Filters should be regularly inspected, cleaned, and flushed as per the manufacturer's instructions. Filters should be kept visibly clean, and should be inspected during monthly inspection and annual compliance inspection. The filter media should be replaced periodically, in accordance with the manufacturer's instructions.

#### 8.1.2 Trade waste discharge

Discharges from cooling towers have the potential to adversely affect the sewerage system as they can contain high levels of suspended solids, organic matter, biocides and heavy metals and they may be considered a 'trade waste'. Appropriate management practices at each site are to be employed in accordance with SA Water's Cooling Water Discharge Trade Waste Guideline.

### 8.2 Warm water systems

The maintenance requirements for warm water systems are set out in regulation 13 of the Legionella Regulations. Temperatures should be monitored at the most distal outlet and at a range of outlets randomly selected within the system (the number will depend on the size and design of the system). The intent of this monitoring is to measure the temperature at the key outlets in order to detect any temperature changes over time and throughout the system. If relatively low temperatures are indicated in any area of a warm water system, the area should be investigated for evidence of poor water flow or stagnation. All warm water outlets that are not frequently used should be flushed weekly at full flow for at least 15 seconds, and all outlets on individual branches should be flushed simultaneously.

### 8.3 Hot water systems

Hot water systems should be inspected at least once every month and the water temperatures of stored heated water and at outlets should be measured. All outlets that are not frequently used should be flushed weekly at full flow for at least 15 seconds. At least once in every 12 months, temperature control devices such as thermostatic mixing valves or tempering valves should be:

- (a) maintained and serviced as recommended by the manufacturer and set out in AS 4032; and
- (b) decontaminated (for example, using chlorine or by pasteurisation) before being returned to service.

All pipework downstream of thermostatic mixing valves and tempering valves should be decontaminated (for example, using chlorine solution or by pasteurisation) at least once every 12 months. Refer to Schedule 3 Part 2 for decontamination instructions.

### 8.4 Spa baths

Spa baths should be cleaned using a suitable cleaning agent and rinsed between uses. It is important to keep the pipework and pump clean and free from dirt and build-up.

### 8.5 Air-houses, humidifiers and nebulisers

Air-houses, humidifiers and nebulisers incorporating water reservoirs should be properly managed and maintained in a clean state. Humidifiers and nebulisers should also be drained, cleaned and kept dry when not in use.

Sterile water should be used in the preparation of aerosol solutions for use in nebulisers. Nebuliser pumps should be serviced and filters changed regularly. Nebuliser bowls should be rinsed after each use, and it is best to wash the chamber and mask daily in hot water with dishwashing liquid. Allow all components to air dry.

### 8.6 Decorative fountains and other aerosol producing devices

Decorative fountains should be cleaned and maintained regularly.

Other aerosol producing devices such as dentist's chairs and misting devices should be properly managed and maintained in a clean state at all times as per manufacturer's instructions. The systems should be drained, cleaned and kept dry when not in use. Periodic decontamination may be required.

### 8.7 Ice machines and other non-aerosol producing devices

Ice machines should be maintained in accordance with the manufacturer's instructions and, in any case, should be drained, cleaned and refilled at least once every 12 months.

Any manufactured device that contains water should be kept clean and be regularly maintained and serviced. Periodic decontamination may be required.

## 8.8 Water treatment

Effective water treatment programs minimise microbial growth and also inhibit corrosion and the build up of scale. When choosing a water treatment system, the efficacy of the treatment regime should be established, including its suitability for the materials used in the construction of the manufactured water system. It is usually necessary to engage a specialist water treatment contractor who can provide advice on appropriate treatment and monitoring regimes. It is important to ensure that mixtures of water treatment chemicals are compatible.

### 8.8.1 Disinfection

Disinfection of water systems reduces the numbers of *Legionella*, algae, fungi, protozoa and other bacteria. Disinfection can be achieved by the addition of chemical biocides or by using processes such as ultraviolet (UV) light irradiation and ozonation. It should be noted that UV irradiation and ozonation do not provide residual disinfectant throughout water systems, although may be useful adjuncts to other disinfectants that do produce a residual. The use of UV as a stand-alone biocide does not fulfil the requirements of the Legionella Regulations.

Automatic biocide dosing devices are required for cooling water systems in accordance with regulation 7 of the Legionella Regulations. The types of biocides used should be alternated on a regular basis to reduce the potential for bacterial resistance to develop. It is important that biocide is distributed in effective concentrations throughout the entire system.

### 8.8.2 Corrosion

Corrosion and scale development can cause fouling of manufactured water systems, resulting in poor system efficiency and premature failure. These factors can also provide an environment that promotes the colonisation and growth of microorganisms such as *Legionella*.

### 8.8.3 Discharges

Wastewater must not be discharged to stormwater, surface waters (such as rivers, streams, wetlands or lakes) or underground waters. It may be disposed of to a sewer or community wastewater management scheme, but not to a septic tank unless it can be demonstrated to the relevant authority that the biocide concentrations or the quantity or hydraulic flow will not have adverse impacts on the operation of the septic tank. Approval for discharge into a sewer or community wastewater management scheme must be obtained from the appropriate authority or authorities which may be the local council, SA Water, the Department for Health and Ageing or the Environment Protection Authority.

## 9. Microbiological testing

The Legionella Regulations requires water samples to be collected from high risk manufactured water systems and analysed for *Legionella* presence and concentration in the following circumstances:

- > Samples must be collected in conjunction with mandatory system compliance inspections.
- > The relevant authority may require the collection of water samples during a legionellosis disease investigation or if it has reason to believe that a system is not being maintained in accordance with the Legionella Regulations.

The microbial analysis of water samples must be undertaken by a laboratory that is NATA accredited to perform the required testing. Prior to the collection of samples, it is essential that the testing laboratory is contacted to ensure it has the capacity to process the samples within 24 hours as described in Appendix A of AS/NZS 3666.3. Methods for collecting samples for microbiological testing are set out in Schedule 2.

High risk manufactured water system owners should have an effective process for the communication of microbiological results. A documented process should be implemented to ensure an effective response to results exceeding mandatory reporting and decontamination levels (e.g. detection of *Legionella* at  $\geq 10$  cfu/mL in a warm water system or  $\geq 1000$  cfu/mL in a cooling water system). The owner of the premises may consider specifying reporting methods and deadlines in agreements or contracts of service.

### 9.1 Testing for *Legionella*

Regular maintenance, inspection and cleaning programs are the key to reducing the risk of *Legionella* transmission. The microbiological monitoring of manufactured water systems for *Legionella* should never be used to replace these practices, but may be used in conjunction with them to validate their effectiveness. Microbiological monitoring only provides a snapshot of the water quality at a given time and is never acceptable as a stand-alone measure or as an indicator of on-going water quality, without the continuation of regular inspections, cleaning and maintenance.

Testing for *Legionella* is useful in the following circumstances:

- > Special Investigations – if there is any evidence or suspicion of legionellosis associated with a manufactured water system or if the operation or maintenance of such a system indicates unsatisfactory conditions.
- > Validation – that maintenance programs are effectively controlling *Legionella*.

Validation testing should be conducted upon the installation of a new or the modification of an existing high risk manufactured water system, when a new or modified water treatment program is implemented, upon implementation of a new maintenance program or following remedial action resulting from *Legionella* detection. As a guide, a minimum of weekly samples for 4 to 6 weeks could be collected from cooling towers, while a minimum of 4 to 6 sets of samples could be collected on a fortnightly basis from 2 or more locations within warm water systems. The verification process could be extended for warm water systems, in particular, by taking samples for measurement of heterotrophic bacterial counts (Refer Section 9.2).

During a legionellosis investigation, inspection, cleaning, decontamination or decommissioning of a system, where appropriate, should take priority over testing. The substantial delay (at least 7 days) in current methods used to test water for the presence of *Legionella* requires that corrective measures be taken on a precautionary basis and not in response to testing results.

The interpretation of test results should be carefully considered, as testing has a number of limitations. The detection of *Legionella*, even during an outbreak investigation, should be treated with caution, as legionellosis is only caused by a limited number of strains of *Legionella*. Specific genetic typing is required to demonstrate links between environmental and clinical isolates. The testing of water samples for *Legionella* only detects the bacteria present in the flowing water and not the bacteria that may be present in biofilms within the system.

If testing is performed, appropriate responses are set out in Schedule 4. Regulation 17 of the Legionella Regulations requires the owner to immediately shut down or decontaminate a system and report the test results to the relevant authority within 24 hours if  $\geq 1000$  cfu/mL of *Legionella* are detected in any sample from a cooling water system, or if  $\geq 10$  cfu/mL of *Legionella* are detected in any sample from a warm water system.

## 9.2 Heterotrophic colony count

While no clear relationship exists between heterotrophic colony count results and the presence of *Legionella*, they can be used to give an indication of the effectiveness of maintenance and treatment. Heterotrophic colony counts in excess of 100,000 cfu/mL in cooling water systems and 100 cfu/mL in warm water systems may indicate that maintenance and treatment are not satisfactory.

## 10. System decontamination

In certain circumstances, the owner of a high risk manufactured water system must take prompt remedial action to mitigate potential risks to health, this may include conducting a system decontamination.

System decontamination is required if:

- > a high risk manufactured water system is suspected of being associated with a case or outbreak of legionellosis, or
- >  $\geq 1000$  cfu/mL of *Legionella* is detected in any sample from a cooling water system, or  $\geq 10$  cfu/mL of *Legionella* is detected in any sample from a warm water system, or
- > a system is not being maintained in accordance with the requirements of the Legionella Regulations.

According to regulation 14 of the Legionella Regulations, operating and maintenance manuals must comply with clause 2.6.1 of AS/NZS 3666.2 which requires the manuals to detail decontamination procedures.

The procedure for decontamination of a cooling water system set out in Part 1 of Schedule 3 is prescribed for the purposes of regulation 17 of the Legionella Regulations.

Decontamination of warm water systems and hot water systems can be achieved either by the 'pasteurisation' or 'chlorination' methods. These procedures are detailed in Part 2 of Schedule 3, and are prescribed for the purposes of regulations 13 and 17 of the Legionella Regulations.

System owners may apply to the Minister for approval to use an alternative decontamination procedure.

When carrying out a decontamination procedure, appropriate personal protective clothing and equipment (PPE) must be worn, and the *Work Health and Safety Act 2012* and associated regulations must be complied with. When using the pasteurisation method to decontaminate a warm water system, procedures must be implemented to prevent scalding.

Responses and control strategies for the presence of *Legionella* in high risk manufactured water systems (including system shut down and decontamination) are set out in Schedule 4.

## 11. Operating and maintenance manuals and maintenance log books

All high risk manufactured water systems must have compliant operating and maintenance manuals and maintenance log books. Regulations 10 and 14 of the Legionella Regulations require the owner of a high risk manufactured water system to maintain operating and maintenance manuals and maintenance log books as detailed in 2.6.1 and 2.6.2 of AS/NZS 3666.2 (further information can be found in SAA/SNZ HB32). Maintenance staff, contractors and service agents must record details of inspections, servicing and maintenance work performed and the results of any microbiological testing in the maintenance log books.

Up to date operating and maintenance manuals and maintenance log books must be readily available for inspection at any time by an authorised officer upon request and log books must be retained for a period of at least five years after the last entry is made.

## 12. The role of relevant authorities

Relevant authorities have a key role in the control of *Legionella* in South Australia.

Authorised officers administering the Act and the Legionella Regulations should have a clear understanding of the operation and maintenance of high risk manufactured water systems and be aware of the principles of control and the problems that can be encountered. They should ensure that system owners operate and maintain high risk manufactured water systems in accordance with the requirements of the Act and the Legionella Regulations.

It is important that relevant authorities monitor compliance with the legislation. Inspections are a vital aspect of compliance monitoring. Poorly maintained and defective systems pose considerable risk to public health and are often only identified by inspections. With the exception of annual testing required by regulation 15 of the Legionella Regulations, relevant authorities will not usually collect routine water samples for testing for the presence of *Legionella* bacteria. However, pursuant to regulation 16 of the Legionella Regulations, if a high risk manufactured water system has not been maintained or cleaned properly or during a legionellosis investigation, the relevant authority can issue a written notice requiring the system owner to undertake microbiological testing for the presence of *Legionella*. Such testing is at the expense of the owner. It is an offence if the owner fails to carry out required testing specified in a written notice.

Relevant authorities have the power to issue notices pursuant to section 92 of the Act, requiring system owners to correct any identified non-compliance with the Legionella Regulations. If non-compliance cannot be rectified immediately and the relevant authority believes the system presents a risk to public health, the relevant authority may also require the high risk manufactured water system to be immediately shut down or decontaminated by issuing a notice on the system owner under section 92 of the Act.

### 12.1 Annual compliance inspections

Regulation 15 of the Legionella Regulations requires that registered cooling water systems and warm water systems be inspected for compliance, at least once a year by the relevant authority. Alternatively, the relevant authority can issue a notice to the system owner, requiring that they engage an independent, competent third party to undertake the inspection and prepare a report. The written report prepared by an independent, competent third party must be submitted to the relevant authority within one month of its receipt by the system owner.

SA Health has produced inspection and report proformas to assist local authorities and third party inspectors in undertaking mandatory compliance inspections and producing the required reports. Inspection proformas are published on the SA Health, Public Health, *Legionella* website. These forms are also suitable for use by system owners in determining compliance.

In conjunction with the annual inspection, at least one sample of water must be collected from each cooling water system and at least two samples of water must be collected from each warm water system for the determination of the presence and number of *Legionella*. System owners incur costs for testing and annual inspections.

### 12.2 Random inspections

Random inspections may be undertaken from time to time by the relevant authority. Samples for *Legionella* testing may be collected if it is considered necessary.

### 12.3 Legionellosis investigations

When investigating possible sources of legionellosis, under the provisions of the Act the relevant authority may enter premises, inspect manufactured water systems and collect samples.

## 12.4 Registration of systems

Regulation 6 of the Legionella Regulations requires relevant authorities to maintain a register of cooling water and warm water systems in their area. The Legionella Regulations empower relevant authorities to charge a fee for registrations and the annual renewal of registrations. A relevant authority may refund, reduce or remit a fee as they see fit in a particular case.

The system owner must notify the relevant authority of the system details as required. Owners must, within one month of any change in the particulars registered in relation to a system, notify the authority of the changes. Regulation 5 of the Legionella Regulations requires newly installed systems to be registered within one month of the system being brought into service.

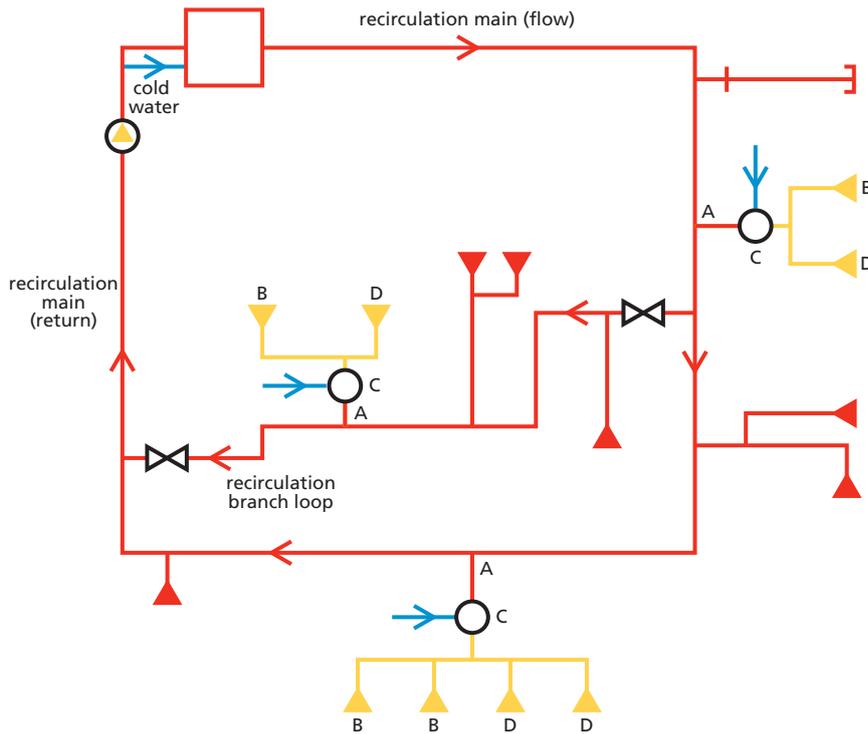
## Schedule 1

This information relates to the following diagrams of hot and warm water systems:

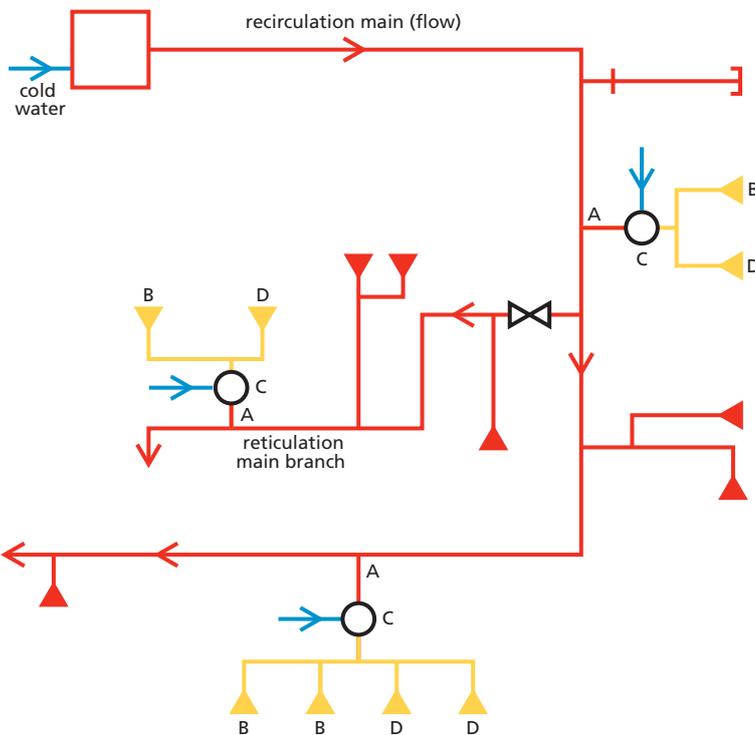
- > All hot and warm water systems are required to comply with AS/NZS 3500.4.2
- > All dead legs (branches without outlets) must be removed
- > Heated water stored in warm water systems must be maintained at a minimum temperature of 60°C
- > Heated water stored in hot water systems must be maintained at a temperature above 60°C or a water heater certified to AS 3498 must be installed
- > Thermostatic mixing valves (TMV's) ensure hot water is delivered to the outlets of all sanitary fixtures used primarily for personal hygiene purposes not exceeding 45°C, to prevent scalding
- > All hot water system branch line outlets should be flushed as often as necessary to ensure that all of the hot water in the branch line is replaced at least once a week
- > Recirculation loops and reticulation mains or branch mains may serve a single storey or multi-storey building(s)
- > When a recirculation branch loop or reticulation branch main is to be isolated for more than 7 days, it is recommended that isolating valves be shut and outlets drained

### Legend

	recirculation pump
	hot water unit (storage or instantaneous)
	direction of flow
	blanked end (dead leg)
	cold water outlet
	hot water outlet
	warm/mixed water outlet
	2-way valve (e.g. TMV)
	3-way valve (e.g. TMV)
	isolating valve

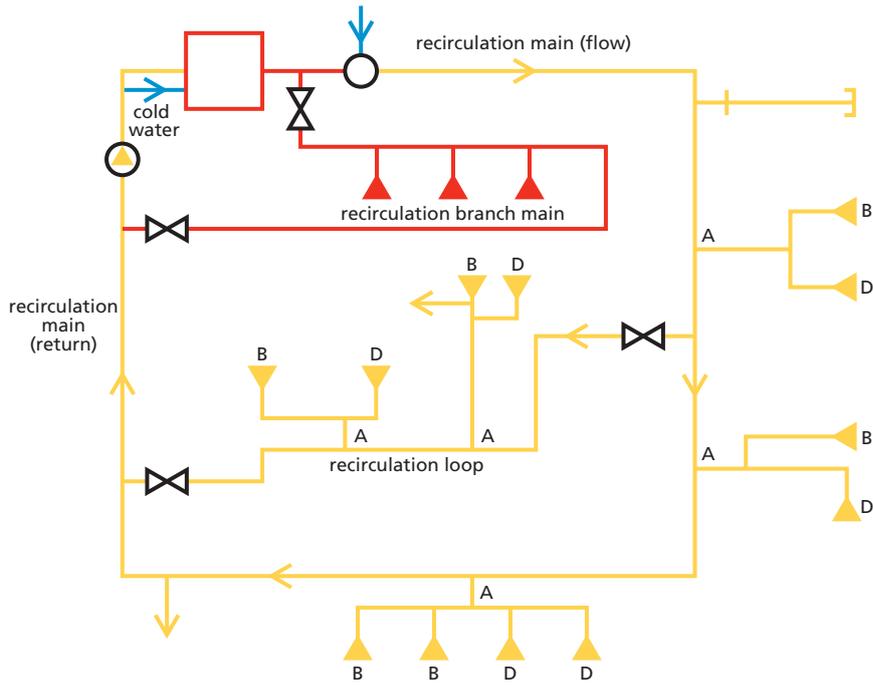


**Figure 3**  
Hot water system – recirculation (flow and return)

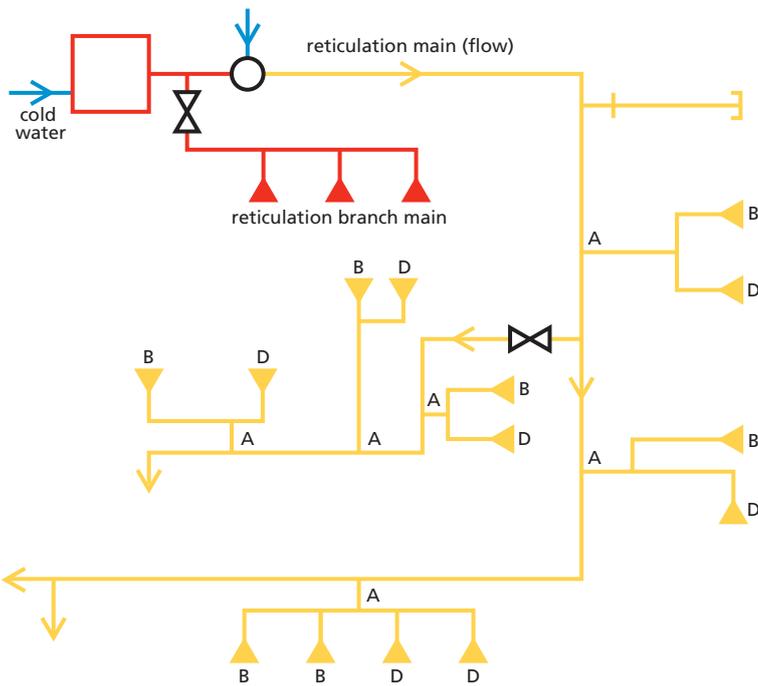


A–D; A–B – preferably less than 6m. C–D; C–B – between 1 and 6m. Hot water lines: 50°C for personal hygiene use in other than facilities for the young, aged, sick, disabled or similar; 60°C for other than personal hygiene use e.g. kitchen/laundry use

**Figure 4**  
Hot water system – reticulation (flow)



**Figure 5**  
Warm water system – with a hot water loop (recirculation, flow and return)



*A–B – preferably less than 6m. Warm water lines: temperatures at outlets not to exceed 45°C  
Hot water lines: used for outlets other than sanitary outlets; typically up to 60°C (kitchen/laundry)*

**Figure 6**  
Warm water system – with a hot water branch (reticulation, flow)

## Schedule 2

### Procedures for sampling for microbiological testing

Prior to the collection of samples, it is essential that the testing laboratory is contacted to ensure it has the capacity to process the samples within 24 hours, as described in Appendix A of AS/NZS 3666.3.

#### 1. Cooling water systems

Samples should be collected from a designated sampling point, preferably on the return line prior to water entering the cooling tower, or from falling water just above the basin, or from the collecting basin, away from the water make-up point and not just downstream of the biocide dosing point of a cooling water system.

The system should be operating, and water circulated through the system for at least one hour prior to the collection of a sample. If the system is not operating, results will not be representative of the microbiological conditions of the system.

1. Label a sterile container with sample location, date, time and sampling officer's name.
2. Fill out a laboratory request form providing the details required by the testing laboratory.

**NOTE:** *It is preferable to have the owner or occupier of the premises, or person responsible for the operation of the system, present to turn off the system if required, and provide access to the collecting basin of the tower.*

3. Take the sample as follows:
  - (a) if sampling from a collecting basin, using gloved hands, remove the sample container cap and hold the cap between the fingers taking care not to contaminate the inside of the cap. Hold the sample container near its base, avoiding contact with the open neck and insert it, neck downwards to about 50mm below the surface of the water in the tower collecting basin and then turn the neck of the bottle upwards and allow the bottle to fill, moving the bottle slowly forwards as it fills. Remove the bottle and replace the cap; or
  - (b) if sampling from water collected from a designated sampling point, allow the water to flow for at least 30 seconds before collecting the sample.

**NOTE:** *Do not:*

- > *stir up sediment from the bottom or side of the collecting basin as it should not be collected with the sample (sediments can be collected as a separate sample if required); or*
- > *collect sample near a make-up water inlet; or*
- > *collect samples from any outlet lines attached to the collecting basin or any other line in the water system (unless it is collected as part of a specific investigation of fittings).*

#### 2. Hot water systems and warm water systems

1. Label a sterile container with sample location, date, time and sampling officer's name.
2. Fill out a laboratory request form providing the details required by the testing laboratory.
3. Collect heated water into a sterile sample container from the initial run of water from the outlet of the shower, bath tap or other outlet.

**NOTE:** *Do not run the water and hence flush the outlet prior to collection (contrary to sampling for other microbiological examinations). Separate samples, collected after flushing are required if evaluating heterotrophic colony counts.*

#### 3. Other manufactured water systems

Water from other kinds of manufactured water systems should be collected from the collecting basins, outlets or reservoirs of the system.

#### 4. Water filters

When conducting specific investigations, swab samples should be collected from any membrane or other solid material filters. A sterile swab and container should be used. Samples of sand or any other loose filter media should be collected in a sterile specimen jar. All samples should be collected using gloved hands.

Samples are to be labelled and documented as for water samples from cooling water systems.

#### 5. Transportation of samples

Samples for *Legionella* testing should be maintained below 20°C, protected from sunlight and promptly transported to the laboratory in insulated containers to minimise significant temperature variations and maintain sample integrity. If other microbiological tests are required, the sample should be cooled to 4°C as soon as possible.

Samples should be received by the laboratory as soon as possible (less than 6 hours) and within 24 hours of collection provided samples remain in the dark and are kept cool (2–10°C).

#### 6. Safety precautions

When carrying out sampling or inspection of air-handling systems, work health and safety legislation must be complied with to ensure that the operator is protected from exposure to hazards. This could require conducting a risk assessment, determining appropriate control measures (e.g. appropriate personal protective equipment), developing safe operating procedures and providing training in the task. A suitable face mask with a particulate filter of at least Class P2 that complies with AS/NZS 1716 should be worn when there is potential for aerosol exposure. Additional PPE may also include gloves, hardhat, and harness. Appendix A of AS/NZS 3666.2 has further details relating to specific tasks and appropriate PPE.

## Schedule 3

### Procedures for decontamination of cooling water systems and hot water and warm water systems

#### Part 1 – procedure for off-line decontamination of cooling water systems

**BEFORE COMMENCING THE PROCEDURE:** ensure that the operator is protected from exposure to hazardous substances and aerosols according to relevant work health and safety legislation. A suitable face mask with a particulate filter of at least Class P2 that complies with AS/NZS 1716 should be worn. Additional PPE may also include gloves, hardhat, and protective clothing. Appendix A of AS/NZS 3666.2 has further details relating to specific tasks and appropriate PPE

1. Shut down the system.
2. Isolate cooling tower fans to prevent operation.
3. Circulate a dispersant throughout the system.
4. Dose with sodium hypochlorite and circulate to maintain a free chlorine residual of 5–10 mg/L at pH 7.0–7.6, maintain these concentrations and monitor at 15 minute intervals for at least 60 minutes.
5. Isolate the system and drain water to a sewer or trade waste in accordance with the requirements of the appropriate relevant regulatory authority, ensuring that any isolated pipe work such as bypass pipes and secondary pumps are also drained.
6. Open all system drains temporarily to flush drain lines with disinfected water.
7. Clean all wetted surfaces in accordance with the manufacturer's instructions or by using water spray and mechanical cleaning as necessary. Exercise care to avoid damaging components.
8. Refill the system.
9. Dose the circulating cooling water with sodium hypochlorite to maintain a free chlorine residual of 1–5 mg/L at pH 7.0–7.6 and monitor the concentrations at 15 minute intervals for at least 30 minutes.
10. Drain the system, refill, reinstate water treatment programs and recommission.

**NOTE:** Wastewater must not be discharged to stormwater, surface waters (such as rivers, streams, wetlands or lakes) or underground waters. It may be disposed to a sewer or community wastewater management scheme, but not to a septic tank unless it can be demonstrated to the relevant authority that the biocide concentrations or the quantity or hydraulic flow will not have adverse impacts on the operation of the septic tank. Approval for discharge into a sewer or community wastewater management scheme needs to be obtained from the appropriate authority which may be the local council, SA Water, SA Health or the Environment Protection Authority. Any cooling water discharged to sewer must comply with the SA Water Cooling Water Discharge Trade Waste Guideline.

## Part 2 – procedures for decontamination of hot water systems and warm water systems

**BEFORE COMMENCING THE PROCEDURE:** ensure that the operator is protected from exposure to hazardous substances and aerosols according to relevant work health and safety legislation. A suitable face mask with a particulate filter of at least Class P2 that complies with AS/NZS 1716 should be worn. Additional PPE may also include gloves, hardhat, and protective clothing. Appendix A of AS/NZS 3666.2 has further details relating to specific tasks and appropriate PPE.

### Pasteurisation method

**NOTE:** take reasonable precautions to ensure that the risk of scalding to building occupants is reduced during the pasteurisation process.

1. Flush water throughout the system at a minimum of 70°C at the outlet (this may involve increasing the temperature of the water at the water heater to above 70°C).
2. Allow each outlet to flow for at least five minutes, starting at the most distal point from the water heater and working back.
3. Measure water temperature at the most distal outlet and at a few chosen outlets throughout the system.

The number of outlets tested will depend on the size and configuration of the system (e.g. the presence of long branch mains). All outlets of the system must be flushed individually; however, all outlets on individual branches should be flushed simultaneously (e.g. hand basins and showers).

**If a temperature of 70°C cannot be achieved:**

1. Flush water through the system at between 60–70 °C (minimum of 60°C), measured at the outlet.
2. Allow each outlet to flow for at least ten minutes, starting at the most distal point from the water heater and working back.

*\* Please note that the minimum acceptable temperature for the pasteurisation method is 60°C. If this temperature cannot be achieved; the chlorination procedure or an alternative decontamination procedure approved by the Minister must be undertaken.*

### Chlorination method

**NOTE:** operators should be aware that chlorine can be corrosive, and is considered a dangerous and hazardous substance and the legislative requirements of the Dangerous Substances Act 1979 and associated regulations must be met.

1. Add chlorine to the system, sufficient to produce a minimum free chlorine residual of 1 mg/L at all outlets. This may require chlorination of a water container at 20–50 mg/L.
2. Allow each outlet to flow for at least five minutes, starting at the most distal point from the water heater and working back.

Chlorine concentration is to be measured by a DPD test kit or similar test kit at the most distal outlet and at a few chosen outlets throughout the system. The number of outlets tested will depend on the size and configuration of the system (e.g. the presence of long branch mains).

All outlets of the system must be flushed individually; however, all outlets on individual branches should be flushed simultaneously (e.g. hand basins and showers).

## Schedule 4

### Responses to detection of *Legionella* in cooling water systems and warm water systems

#### Part 1 – control strategies for the presence of *Legionella* in cooling water systems

Test result (cfu/mL)	Required control strategy
Not detected (<10)	(1) Continue effective maintenance procedures
Detected as $\geq 10$ and <100	(2) Investigate problems (check cleanliness, maintenance procedures, biocide dosing, structural integrity)  Review water treatment programs  Take necessary remedial action including immediate on-line disinfection in accordance with Appendix B of AS/NZS 3666.3, and undertake control strategy (3).
Detected as $\geq 100$ and <1000	Follow control strategy (2) and  (3) Retest water within 3 to 7 days of plant operation after on-line disinfection  (a) If not detected, return to control strategy (1)  (b) If detected at <100 cfu/mL repeat control strategy (2)  (c) If detected at $\geq 100$ cfu/mL investigate problem and review water treatment program, immediately carry out a system decontamination in accordance with the procedure set out in Part 1 of Schedule 3 of this Guideline, and repeat control strategy (3) or shut down and clean cooling water system.
Detected as $\geq 1000$	(4) Immediately shut down the system or decontaminate the system in accordance with a prescribed decontamination procedure (Schedule 3) or a decontamination procedure approved by the Minister  (a) Notify the relevant authority of the result within 24 hours  (b) Investigate problem  Review water treatment program  Take necessary remedial action.  (5) Retest water within 3 to 7 days of plant operation after system decontamination  (a) Respond (as per this table) according to results.

**NOTE:** This table is based on Table 3.1 from AS/NZS 3666.3

#### Part 2 – control strategies for the presence of *Legionella* in warm water systems

If *Legionella* is detected in a water sample collected from a warm water system, the system owner must immediately shut down the system or decontaminate the system.

Decontamination of hot water or warm water systems must be performed by:

- (a) pasteurisation (see Part B of Schedule 3); or
- (b) chlorination (see Part B of Schedule 3); or
- (c) an alternative decontamination procedure approved by the Minister.

Irrespective of the method used, water testing should be conducted 3-7 days after the system decontamination. The number of samples will depend on the size and complexity of the system.

## Acknowledgments

The original version of this Guideline was developed by a working party comprising representatives from the following organisations:

- > Environmental Health Australia (SA Division)
- > Local Government Association of South Australia
- > The Australian Institute of Refrigeration Air Conditioning & Heating (Inc)
- > Institute of Medical & Veterinary Science
- > Institute of Plant Engineers
- > Queen Elizabeth Hospital
- > Flinders University of South Australia
- > SA Health, Communicable Disease Control Branch
- > SA Health, Health Protection Programs

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## Appendix A

### Resources and further reading

Department for Health and Ageing SA, Legionella Regulations website (for further information, factsheets and forms)  
<http://www.health.sa.gov.au/pehs/legionella-regulations-guidelines.htm>

South Australian Public Health (Legionella) Regulations 2013, available online at: <http://www.legislation.sa.gov.au>

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