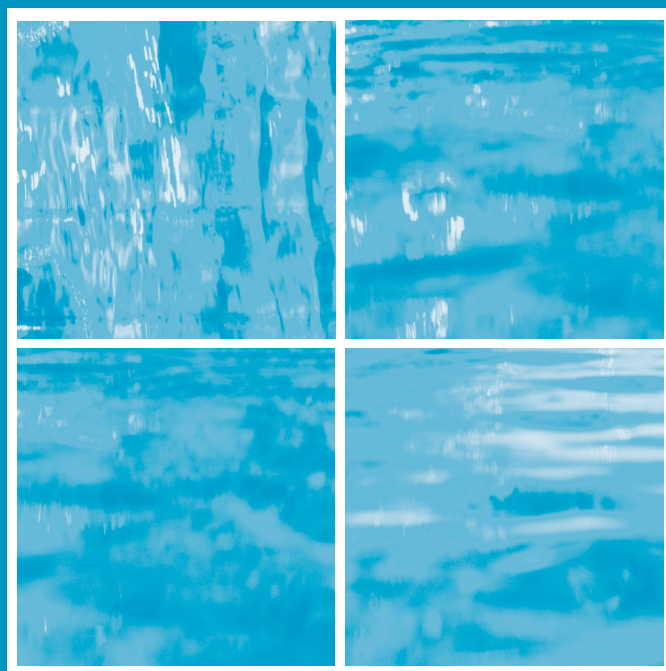


Please note that advice on cooling water systems provided in this *Code of Practice* has been rescinded and replaced by the *NSW Guidelines for Legionella Control in Cooling Water Systems*. Download the *Guidelines* at: www.health.nsw.gov.au/environment/legionellacontrol

NSW Code of Practice for the Control of Legionnaires' Disease

June 2004

2nd edition



NSW DEPARTMENT OF HEALTH

73 Miller Street
NORTH SYDNEY NSW 2060
Tel. (02) 9391 9000
Fax. (02) 9391 9101
TTY. (02) 391 9900
www.health.nsw.gov.au

This document represents a compendium of useful information. Every effort has been made to give reliable information. Readers should not act or rely upon this publication as the sole source of information without taking into consideration their particular circumstances.

This Code is not copyright and the NSW Department of Health is pleased to allow this material to be reproduced in whole or in part, provided the meaning is unchanged and its source, publisher and authorship is acknowledged.

© NSW Department of Health 2004

SHPN (EH) 040051
ISBN 0 7347 3657 6

For further copies of this document please contact:

Environmental Health Branch
PO Box 798
Gladesville NSW 1675
Tel. (02) 9816 0234
Fax. (02) 9816 0377

A full copy of this Code can be downloaded from the NSW Health website:
www.health.nsw.gov.au/public-health/ehb/general/microbial/microbial.html

NSW Health website: www.health.nsw.gov.au
Intranet: internal.health.nsw.gov.au/publications

June 2004

Foreword

Controlling Legionnaires' disease has been a priority of the NSW Department of Health since the first outbreak was identified.

The original *NSW Code of Practice for the Control of Legionnaires' Disease*, published in 1991, was prepared by the former Legionella Advisory Committee to complement recently introduced public health legislation. NSW was the first State to produce Guidelines for the management of the *Legionella* bacteria in health care buildings and subsequently developed an emergency management plan to investigate and control outbreaks.

Following the promulgation of the *Public Health (Microbial Control) Regulation 2000* there was a distinct need to update the *Code of Practice* to maintain it as suitable for the control of Legionella in buildings with air-handling systems, water-cooled systems, warm-water systems and hot-water systems. The review of the *Code* was conducted by the Environmental Health Branch of NSW Health.

Compliance with this *Code*, unlike its predecessor, cannot be used as a defence to prosecution and the document is therefore only advisory. Advice has been included on the requirements of the *Regulation* and AS 3666 which has been adopted by the *Regulation*. Discussion is included on some of the terms used, such as 'competent person' and a section has been included on consumer handling of organic potting mix.

This *Code* has been adopted as policy by the Department for implementation in all health care facilities in NSW.

Contents

Section 1. Introduction.....1	
1.1 Awareness.....1	
1.2 Purpose.....1	
1.3 Associated material.....1	
1.4 Who is involved?.....2	
1.5 The future.....2	
Section 2. Microbial aspects.....3	
2.1 Legionnaires' disease.....3	
2.2 Habitat and proliferation.....4	
2.3 Other sources of infection.....5	
Section 3. Minimising the hazards.....7	
3.1 The hazard.....7	
3.2 System design.....7	
3.3 Hazard minimisation.....7	
3.4 Rational chemical use.....8	
Section 4. Responsibilities.....9	
4.1 Introduction.....9	
4.2 Installation.....9	
4.3 Operation and maintenance.....9	
4.4 Registration.....9	
4.5 Owner.....9	
4.6 Occupier.....9	
4.7 Installer.....10	
4.8 Contractor.....10	
4.9 Prosecutions.....10	
Section 5. Public health legislation.....11	
5.1 Purpose.....11	
5.2 <i>Public Health Act 1991 Part 4,</i> Microbial Control.....11	
5.2.1 Systems.....11	
5.2.2 Definitions.....12	
5.2.3 Offences.....12	
5.3 <i>Public Health (Microbial Control)</i> <i>Regulation 2000</i> (amended July 2003).....13	
5.3.1 Interpretation.....13	
5.3.2 Regulated systems.....13	
5.3.3 Installation requirements.....14	
5.3.4 Operating requirements.....14	
5.3.5 Prescribed maintenance requirements.....15	
5.3.6 Legionnaires' disease investigations.....15	
5.3.7 Registration of water-cooling and warm-water systems.....15	
Section 6. Competent person.....17	
6.1 Introduction.....17	
6.2 Installation.....17	
6.3 Operation and/or maintenance.....17	
6.4 Process designed to control microbial growth.....18	
6.5 Maintenance of a water-cooling system using AS/NZS 3666.3:2000.....18	
Section 7. Air-handling systems.....19	
7.1 Introduction.....19	
7.2 Design and installation.....19	
7.3 Legal requirements.....19	
7.3.1 Installation.....19	
7.3.2 Operation and maintenance.....19	
7.3.3 Maintenance precautions.....19	
Section 8. Water-cooling systems.....21	
8.1 Introduction.....21	
8.2 Types of water-cooling systems.....21	
8.3 Cooling-tower equipment.....23	
8.3.1 Filters and separators.....23	
8.3.2 Drift eliminators.....23	
8.4 Water treatment.....23	
8.4.1 Dosing equipment.....24	
8.4.2 Bleed off.....24	
8.4.3 Biocides.....24	
8.4.4 Biocide types.....25	
8.4.5 Other water treatment systems.....25	
8.4.6 Operation of process designed to control microbial growth.....25	
8.4.7 Certification of process designed to control microbial growth.....25	
8.4.8 Compliance of process designed to control microbial growth.....26	
8.5 Water sampling and testing.....26	
8.6 Installation.....27	
8.7 Operation and maintenance.....27	
8.7.1 Routine cleaning.....28	
8.7.2 Notification to council.....28	
8.7.3 Emergency decontamination procedures.....28	
8.8 Cooling-tower replacement.....28	

Contents

8.9 Legal requirements.....	28
8.9.1 Installation	28
8.9.2 Operation and maintenance	29
8.9.3 Maintenance precautions	29

Section 9. Hot and warm water systems31

9.1 Introduction.....	31
9.2 Water temperature regulation	31
9.3 Cold water supply	32
9.4 Water treatment	32
9.5 Water filters	33
9.6 Routine cleaning	33
9.7 Hot-water systems.....	33
9.8 Warm-water systems	34
9.8.1 Types of warm-water systems	34
9.8.2 Approval of warm-water systems	35
9.8.3 Installation and maintenance	35
9.9 Plumbing issues.....	35
9.10 Emergency decontamination procedures	36
9.11 Legal requirements.....	36

Section 10. Evaporative air coolers.....37

10.1 Operation.....	37
10.2 Industry best practice	37
10.3 Minimising contamination.....	37

Section 11. Compost and potting mix.....39

11.1 Introduction.....	39
11.2 Manufacture.....	39
11.3 Precautions.....	39

Section 12. Manuals and records41

12.1 Manuals	41
12.2 Maintenance records	41
12.3 Report on maintenance work.....	41

Section 13. Training.....42

Section 14. Safe working practices.....45

Section 15. Building construction and modifications47

Section 16. Approvals and authorisation49

Section 17. Sampling procedure.....51

Section 18. The role of local authorities in NSW53

18.1 Basic knowledge.....	53
18.2 Management plan	53
18.3 Inspections by authorised officers	54
18.4 Registers.....	54

Section 19. Legionella monitoring55

Section 20. Emergency Management Plan.....57

Glossary.....59

Appendices

Appendix 1. Emergency decontamination procedure for water-cooling systems	61
Appendix 2. Certification by a 'competent person' of a process designed to control microbial growth in a water-cooling system.....	62
Appendix 3. Sample report on maintenance of a water-cooling system	63
Appendix 4. Procedure for routine cleaning of warm water storage tank systems	64
Appendix 5 Emergency decontamination procedure for warm water storage tank systems	66
Appendix 6 Reference documents	67

Tables

Table 1. Action recommended at various populations of total Legionella in water systems where a single sample has been taken	55
---	----

Figures

Figure 1. Relationship between proliferation of <i>Legionella</i> and typical water temperature of water handling systems.....	4
Figure 2. Schematic layout of an air-conditioning system which uses a cooling-tower for heat rejection	22
Figure 3. Examples of drift eliminators.....	23
Figure 4. Basic layout of a thermostatic mixing valve	34
Figure 5. Evaporative air cooler	37
Figure 6. Example of the Recommended Warning Label	40

Introduction

1

This section introduces the microbial control of Legionnaires' disease and explains the purpose of the Code of Practice. It lists those involved in microbial control and suggests associated material which is essential and other material which is advisory.

1.1 Awareness

Outbreaks of Legionnaires' disease have created national and worldwide public concern. This is due not necessarily to a large number of cases, but more to its insidious mode of transmission. Dramatic coverage of outbreaks, as well as some single sporadic cases, by the media has also fuelled public awareness.

The facts are such that managers of public buildings and high-risk health care facilities cannot afford to be apathetic; they must be aware of their obligations and the potential risks that their buildings present. Similarly, the public should be aware of the precautions which can be taken to minimise exposure through the use of potting mixes and other similar gardening products.

The responsibilities of maintenance staff include routine maintenance and record keeping. Maintenance staff should also be aware of decontamination procedures and systems of treatment for water-cooling systems and warm-water systems. This *Code of Practice* is appropriate for all premises.

Apart from the legal obligations there are, of course, moral obligations to ensure that all reasonable preventive action is taken to protect the public, as well as the workers in the industries associated with air-handling systems, water-cooling systems, warm-water systems and organic gardening products.

Compliance with this *Code* does not necessarily imply compliance with all relevant legislation.

1.2 Purpose

The purpose of this *Code of Practice (Code)* is to assist and provide guidance to all those concerned with various aspects of microbial control in various specific systems which may harbour *Legionella*, the organism which may cause Legionnaires' disease. In the past compliance with this *Code of Practice* could be used as a defence to prosecution but with the regulatory review of 2000 the *Code of Practice* can no longer be used in this way. This *Code* is not a legal document and is not enforceable.

This *Code* emphasises water and air systems of buildings but the contents are equally applicable to equivalent industrial processes, such as power stations and process heat rejection devices which use water.

The *Code* is based on the legal requirements of:

- the *Public Health Act 1991*, Part 4, Microbial Control
- the *Public Health (Microbial Control) Regulation 2000*.

The *Code* advises on the contents of the above legislation but cannot change or alter the contents of the legislation.

1.3 Associated material

This *Code of Practice* should be read in conjunction with:

- the *Public Health Act 1991* and the *Public Health (Microbial Control) Regulation 2000*
- AS/NZS 3666.1-2:2002 and AS/NZS 3666.3:2000 and subsequent Standards when adopted by the *Public Health (Microbial Control) Regulation*
- the Standards Australia Handbook SAA/SNZ HB32:1995
- *Guidance for the Control of Legionella*, National Environmental Health Forum Monographs, Water Series No 1, South Australian Health Commission.

A list of other publications which may be of assistance has been included in Appendix 6.

NSW Health publications on microbial control may be found at: <http://www.health.nsw.gov.au/public-health/ehb/general/microbial/microbial.html>

1.4 Who is involved?

Many people have a role in regard to microbial control in various systems and services. They include state government, local authorities, contractors, service agents, building occupiers, authorised officers, private certifiers acting as the principal certifying authority, architects, engineers, manufacturers, building owners and building managers. Their responsibilities include design, manufacture, location, supply, installation, operation, maintenance, inspection, and servicing of equipment. Other activities include record keeping, training of personnel, inspection and enforcement.

1.5 The future

There is no doubt the future will show that the benefits of improved system design, correct commissioning, more efficient operation and effective disinfection go hand in hand with easier, more economic maintenance and a greatly reduced risk of Legionnaires' disease.

This section discusses the diseases caused by *Legionella* bacteria and the type of people who may be susceptible. It also discusses suitable environments in which *Legionella* may grow, be sustained and how it may be transmitted to susceptible people.

2.1 Legionnaires' disease

The causative agent of Legionnaires' disease is a bacterium belonging to the genus *Legionella*. The pathogen most commonly isolated from cases of Legionnaires' disease associated with air-handling and water-cooling systems is *Legionella pneumophila* serogroup 1. However, *Legionella longbeachae* has been implicated with Legionnaires' disease associated with potting mix.

The term used to describe all forms of *Legionella* infections is Legionellosis – of which there are two distinct illnesses; Legionnaires' disease and Pontiac fever.

Legionnaires' disease, the more serious disease, is a pneumonic illness (ie pneumonia is present in all cases) often requiring hospitalisation. Typically, the illness is characterised by abrupt onset of high fever, non-productive cough, chills, headache and myalgia (muscle pain), and mental confusion. In reported outbreaks, a substantial proportion of cases of Legionnaires' disease (commonly more than 30%) have diarrhoea and abdominal pain. These symptoms can be important in the case of an epidemic for physicians requesting the proper laboratory test. The disease which has an incubation period (the time between infection and onset of symptoms) of 2 to 10 days is usually associated with a low attack rate (percentage of the population affected) up to 5%, but a high mortality rate (death rate) of 15 – 20% in hospitalised cases.

Prompt and appropriate antibiotic therapy is effective in reducing the mortality rate. Susceptibility to the disease is increased by age, underlying disease, particularly involving immunocompromised or

immunosuppressed conditions, heavy smoking and excessive alcohol consumption. Many outbreaks overseas have involved hospitalised patients and elderly tourists in hotels.

Pontiac fever, the less debilitating, non-pneumonic form of the disease, is a flu-like illness usually not requiring hospitalisation. It is self-limiting and non-fatal, with symptoms such as fever, chills, headache and myalgia subsiding commonly within 48 hours. Attack rates in reported outbreaks have been high, generally more than 96%. Sporadic and isolated cases generally remain undiagnosed.

Statistics contained in an epidemiological review of Legionnaires' Disease in NSW from 1991 to 2000 may be downloaded from the October 2001 issue, Volume 12, Number 10, of the *Public Health Bulletin* at: <http://www.health.nsw.gov.au/public-health/phb/2001.html#oct01>

Notification: Legionnaires' disease is notifiable, that is, known cases and laboratory isolations must be advised to the local Public Health Unit of the Area Health Service. Pontiac fever is not a notifiable disease.

Transmission: Legionellosis has, to date, not been documented to occur by transmission from person to person or other vectors. Epidemiological evidence points to the fact that all patients acquire the disease from environmental water habitats, particularly amplifiers of *Legionella* growth such as water-cooling systems (cooling-towers and evaporative condensers), warm-water systems and potting mix.

The route of infection of legionellosis is largely, if not exclusively, through inhalation of *Legionella* contaminated aerosols or perhaps very fine particles as in the case of potting mix. Certain other routes have been postulated, but these have either been lacking in evidence or of little epidemiological significance as occurrence has been restricted to a few isolated cases.

Emergency management plan

Notification procedures, reporting requirements, management of cases and contacts are outlined in the NSW Department of Health's *Notifiable Diseases Manual*. The *Legionnaires' Disease Emergency Management Plan* referred to in the legislation is formally known as *Part 2.2 Legionnaires' Disease Public Health Emergency Management Plan of the Public Health Standing Operating Procedure of NSW Healthplan*. This plan, if activated by NSW Health, prescribes the protocols to be followed during an outbreak.

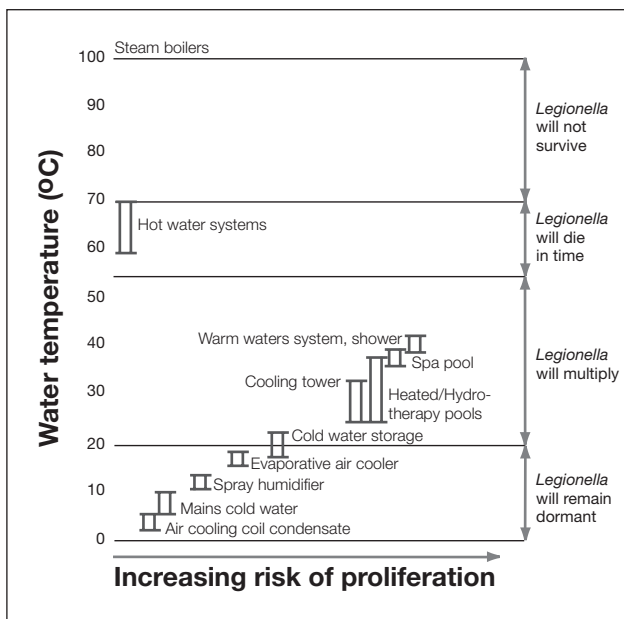
2.2 Habitat and proliferation

Legionella is found naturally in moist environments such as lakes, rivers, creeks, mud and other water sources at temperatures ranging from about 5°C to 55°C. However, no case of Legionnaires' disease has been proven to have been caused by *Legionella* present in the natural environment. Water contaminated with *Legionella* presents a risk when it is dispersed into the air as an aerosol.

The modern urban environment has provided many opportunities for human infection with *Legionella* species. The most significant are water-cooling systems of air-conditioners and industrial cooling processes, and warm-water systems.

The optimum temperature for multiplication of *Legionella* bacteria under laboratory conditions is 37°C. In the natural environment, the microorganism multiplies at temperatures ranging from 20°C to 45°C, with maximum growth occurring between 35°C and 43°C. At higher temperatures, the rate of multiplication of *Legionella* decreases dramatically (see Figure 1). Laboratory tests showed that the survival time for *Legionella* decreases from hours at 50°C to minutes at 60°C, while at 70°C the organism is destroyed almost immediately. Unlike other bacteria, *Legionella* can survive a wide range of pH values.

Figure 1. Relationship between proliferation of *Legionella* and typical water temperature of water handling systems



Overseas investigations into the corrosion products in water systems, for instance, iron and zinc, have suggested that low concentrations of such metals can enhance proliferation of *Legionella*. Conditions that promote the growth of algae, flavobacteria (which can supply essential nutrients) and protozoa (which can harbour *Legionella*) have also been suggested to enhance *Legionella* proliferation. Algae, protozoa and certain bacteria are all thought to provide the essential nutrients required by *Legionella* species for growth.

Investigations at the Department's Division of Analytical Laboratories found that no correlation existed between the concentrations of iron, zinc and manganese and *Legionella* counts. In addition, these investigations showed that there is little correlation, if any, between *Legionella* counts and Heterotrophic Plate Counts in water-cooling systems. This highlights the complexity and probably the overlap of the conditions of the micro-environment of *Legionella* which affect its growth and multiplication – none of which is fully understood so far.

It is of interest to note that *Legionella* were found to multiply within certain free-living water protozoa and that cysts produced from infected protozoa can actually protect *Legionella* from destruction by normal water chlorination processes. It would appear that protozoa may be a possible way by which *Legionella* evades disinfection and spreads to colonise new environments.

Little is known about the proliferation of *Legionella* in potting mix but it may be associated with the amount, source and treatment of pine bark in the mix and the moisture content before, during and after manufacture. *Legionella* has also been isolated from garden compost and soils.

2.3 Other sources of infection

Epidemiological investigations showed that apart from the water-cooling systems of air-conditioners and warm-water systems, many other sources may contain elevated populations of *Legionella* and other pathogens. These include potable water services and components such as water heaters, showers, taps, spa pools and nebulisers used in respiratory therapy. Humidifiers may also be involved.

Systems where water stagnates for some time and is then put back into service can provide conditions conducive to the proliferation of *Legionella*. Other sources, both known and potential, include cooling water systems for refrigeration equipment and air compressors, industrial heat exchangers when opened for cleaning, decorative fountains, water features, spray irrigation systems and industrial water-based cutting fluid systems.

Minimising the hazards

3

This section identifies the hazards associated with *Legionella* transmission in water-cooling systems and warm-water systems and how the hazards can be minimised. Chemicals used in hazard minimisation must be used carefully.

3.1 The hazard

There are three pre-conditions necessary for Legionnaires' disease to occur. There must be:

1. A source of *Legionella*, eg an infected water-cooling system.
2. A transmission pathway, eg aerosols emitted from the water-cooling system.
3. A susceptible host.

The hazards from *Legionella* arise mainly from systems in the built environment which allow the growth of these micro-organisms to numbers much greater than those normally encountered in the natural environment and thereby become a source of infection. Transmission of such micro-organisms in air occurs through minute contaminated water particles (aerosols) which, if inhaled, may cause Legionellosis.

Water supplies can contain very small levels of *Legionella*. Given the favourable conditions normally encountered in water handling systems, it is not practicable to eliminate *Legionella*.

3.2 System design

All systems should be designed, installed commissioned, operated and maintained by experienced professionals to not only maximise the system efficiency but also to minimise public health risk. Initially a decision should be made on the type of system to be installed. For example, it may be preferable to install an air cooled heat rejection system instead of a water-cooling system to save on maintenance costs and to eliminate the risk of Legionnaires' disease. Similarly, it may be preferable to install a series of thermostatic mixing valves instead of a tepid water storage system.

Once the system has been chosen engineering decisions need to be made to consider minimisation of risk factors such as those listed in Table 2.1 of AS/NZS 3666.3:2000.

3.3 Hazard minimisation

Certain measures can be taken to minimise the hazards posed by *Legionella*. These include:

- keeping water handling systems visually clean – that is, without sludge, slime, algae, fungi, rust, scale, dust and dirt, or any foreign material
- where feasible, installing a device for the suspension or removal of particulate matter (filter or centrifuge) to minimise the build-up of sludge
- minimising sections of pipework or any other part of a water handling system such as 'dead legs' which cause water stagnation, sludge accumulation or the creation of other favourable conditions for bacterial growth
- installing a stirring or circulation pump to overcome the problems of stratification and stagnation of stored water
- designing a water handling system that is easy to clean and constructed of materials that do not enhance the growth of *Legionella* (AS 2345 and AS 4020 may be used as a guide)
- designing a water-cooling system with ambient temperature cooler process water return to the cooling-tower
- installing drift eliminators
- renewing out-dated equipment
- replacing old and inefficient water-cooling systems
- ensuring easy access for maintenance and cleaning
- using a continuously operating disinfection process.

Note: It should be stressed that disinfection is complementary to keeping the system physically clean; the process may become ineffective if the system is dirty. Where chemicals are used, a sufficient amount of the active residual must be present at all times in all parts of the system.

3.4 Rational chemical use

The use of chemical disinfectants (biocides) should be applied rationally as the indiscriminate and excessive use of any product or process, particularly those of unsubstantiated or unknown toxic properties, may have harmful environmental and health implications when toxic materials are discharged into the atmosphere and also when treated water is discharged from the system.

Apart from a reliance on disinfection, there are engineering controls which may reduce the amount of chemical required such as:

- reducing the generation and spread of aerosols to a minimum level. Water-cooling systems must have well-designed drift eliminators (arrestors)

and be properly sited in relation to air intakes of buildings and prevailing wind conditions. Similarly, warm-water systems must have outlet fittings which create minimal aerosols. Persons with low immunity to bacterial infections, such as those with renal and other organ transplants, should not be exposed to any aerosols

- installing air cooled systems where practicable
- converting, where possible, an existing conventional open circuit water-cooling system to a closed circuit system. This type of system eliminates potential *Legionella* growth areas.

Responsibilities

4

This section generally outlines the responsibilities for installation, operation, maintenance and registration of regulated systems. The responsibilities of owners and occupiers of building where air-handling, water-cooling and warm-water systems are installed and the responsibilities of installers and other contractors in relation to these systems are summarised.

4.1 Introduction

The responsibility for a regulated system varies according to the circumstances. Generally, the prime responsibility for a regulated system rests with the owner and/or occupier of the premises where the regulated system is located unless a competent person is engaged. See 5.3.2 for a list of regulated systems. Responsibilities are generally specified in the Act.

4.2 Installation

If a regulated system is not installed as required, then both the installer and the occupier of that part of the building where the system is installed (whether the occupier is the owner or not) are both guilty of an offence. However, if the occupier can prove to a court that the installer might reasonably be expected to be competent to install the system, then the occupier is not guilty of an offence and the guilt rests with the installer alone.

4.3 Operation and maintenance

If the occupier fails to ensure that the regulated system is operated and maintained properly then the occupier is guilty of an offence. However, if the occupier engaged a contractor who would be reasonably expected by a court to be competent to operate and/or maintain the regulated system, then the occupier would not be guilty of an offence. The contractor would then be guilty of the offence.

4.4 Registration

Under clause 15 of the *Regulation* the occupier of the part of premises where a regulated system is installed must notify the local council of the following particulars:

- type of system
- the address of the premises on which the system is installed
- the name, and the residential and business addresses, of the owner of the premises and, if the operation area on the premises is occupied otherwise than by the owner, those particulars in relation to the occupier
- the telephone numbers at which, during business hours and after business hours, the person or persons referred to in the above point may be contacted.

These particulars must be notified to the council within one month after the person becomes the owner or occupier of the premises or if there is an alteration of the above details.

(Penalty: 10 penalty units.)

4.5 Owner

The owner has responsibilities only when the owner controls the part of premises (operation area) on which the regulated system is situated. See also occupier below.

4.6 Occupier

See Section 5.4.2 for the definition of 'occupier'. The occupier of the part of premises (operation area) on which the regulated system is situated is responsible for the proper installation, commissioning, operation and maintenance of the regulated system unless:

- the installation is carried out by an installer who might reasonably be expected to be competent to install and commission the system; or
- the operation and maintenance is carried out by a contractor who might reasonably be expected to be competent to operate and/or maintain the regulated system.

Responsibilities

The occupier is also required to register the regulated system with the local authority. See Section 4.4.

The building manager, if engaged by the occupier, is the agent of the occupier and the occupier still bears the legal responsibility for the regulated system.

4.7 Installer

The installer is guilty of an offence where the regulated system is not installed in accordance with the *Regulation* and/or Australian Standard.

4.8 Contractor

A contractor is guilty of an offence where the regulated system is not operated or maintained in accordance with the *Regulation* and/or Australian Standard. There may be separate contractors for operation and maintenance, or only a contractor for maintenance while the system is operated by the owner/occupier.

The situation may arise where a contractor advises the owner/occupier that the system does not comply with the prescribed operating requirements and the owner/occupier refuses to upgrade the system. This could include circumstances where the owner/occupier refuses to install an automatically controlled water treatment system to a water-cooling system. Under these circumstances the contractor may wish to seek separate legal and other advice in regard to their contract with the owner/occupier and advise the local authority of the system defects.

4.9 Prosecutions

Authorities such as the NSW Department of Health, Public Health Units and the local authority act on behalf of the community and therefore may institute legal proceedings in a court for a breach of the *Act*. Prosecutions may be conducted before either:

- a Local Court where the maximum penalty is 100 penalty units and/or 12 months imprisonment
- the Supreme Court where the maximum penalty is 500 penalty units and/or two years imprisonment.

Prosecutions may only be commenced within two years of the commission of the alleged offence.

Responsibility for the installation, commissioning, operation and maintenance of regulated systems rests with the occupier of the operation area and the contractor.

This section provides an overview of the microbial control requirements of the *Public Health Act 1991, Part 4, Microbial Control* and the *Public Health (Microbial Control) Regulation 2000*. More detailed information can be found in the sections on individual systems. The *Public Health Act* is currently under review and while the changes are not likely to be significant they may vary from the following discussion. Minor amendments to the *Regulation* are also proposed.

5.1 Purpose

Microbial Control public health legislation exists to “prevent or inhibit the growth in systems of micro-organisms, liable to cause Legionnaires’ and other diseases”. An overview of the legislative provisions is presented below, but to determine the precise content the *Public Health Act 1991* and *Public Health (Microbial Control) Regulation 2000* should be consulted. The legislation may be downloaded from: <http://www.health.nsw.gov.au/public-health/ehb/general/microbial/microbial.html>

The purpose of the *Public Health Act* and the *Public Health (Microbial Control) Regulation* is to regulate:

- the installation on premises of certain kinds of systems
- the operation and maintenance of those kinds of systems installed on premises, to minimise the growth of micro-organisms that are liable to cause Legionnaires’ disease and other diseases.

5.2 Public Health Act 1991, Part 4, Microbial Control

The microbial control provisions under the *Act* commenced in December 1991 and its provisions in regard to installation do not apply to a system installed before that date.

The operation and maintenance provisions under the Act and Regulation however, apply to all regulated systems including those installed before December 1991.

5.2.1 Systems

The *Act* specifies these certain kinds of systems to be:

- air-handling systems
- evaporative cooling systems (to be deleted from the *Act* when next amended)
- hot-water systems
- humidifying systems
- warm-water systems
- water-cooling systems and their associated equipment and fittings.

It should be noted that the *Public Health Act* only applies to these nominated systems. The *Act* also defines each of these systems and these definitions will be further explained under their separate headings in this *Code*. It should also be noted that the *Public Health (Microbial Control) Regulation 2000* further identifies the systems and premises to which the legislation applies.

5.2.2 Definitions

The *Act* defines important terms so that the meaning of those terms are clear and specific for the purposes of the legislation. It is important to understand some of these terms, which are listed alphabetically, before the legislation is read.

Authorised officer, in relation to any premises, means an Environmental Health Officer employed by the local authority or the Department of Health; or a person authorised by the Minister for Health or the Director-General of the NSW Department of Health.

Install includes construct.

Maintain includes repair, inspect, carry out preventive servicing and clean.

Occupier, in relation to premises or part of premises, means:

- a) a person who has the right to occupy the premises or part to the exclusion of the owner
- b) the person who is the owner of the premises or part if there is no person with a right to occupy the premises or part to the exclusion of the owner.

Prescribed installation requirements means design and installation requirements specified in the *Regulation*.

Prescribed maintenance requirements means maintenance requirements specified in the *Regulation*.

Prescribed operating requirements means operating requirements specified in the *Regulation*.

Regulated premises means any premises other than premises declared by the Regulation not to be regulated premises for the purposes of this Part (see also exemptions under 5.3.2 below). All premises are regulated premises except a dwelling (unless the dwelling has a water-cooling system).

Regulated system simply means a system listed in the *Act* (see above for a list), and any system that is declared by the regulations to be a regulated system (see also exemptions under 5.3.2 below). Of the above listed systems only an evaporative cooler is not a regulated system.

5.2.3 Offences

The *Act* sets out the main offences under which a prosecution may be taken. These may be summarised as follows:

Installation: When a system is not installed in accordance with the Regulation the **installer is guilty** of an offence. If the occupier can demonstrate to the court that the installation was done by a person who would reasonably be expected to be competent then the occupier has not committed an offence. Where the occupier cannot demonstrate that the installation was done by a person who would reasonably be expected to be competent then the occupier has also committed an offence.

Operation and maintenance: If the occupier fails to ensure compliance with the operating or maintenance requirements of the Regulation then the **occupier is guilty** of an offence. The occupier has a defence to prosecution if the court is satisfied that the occupier engaged a person, who might reasonably have been expected to be competent, to carry out the operation and maintenance requirements. If a contractor is engaged by the occupier to operate and/or maintain a regulated system, and fails to do this then the **contractor is guilty** of an offence.

Powers of authorised officers: Where an authorised officer believes that a regulated system has been installed on any regulated premises the officer may:

- **enter the premises** at any reasonable time to find out whether a system is a regulated system
- **inspect and test** any system on the premises
- **investigate** compliance with the operating and/or maintenance requirements
- **require the production of** any records required to be kept on site about the operation and maintenance of the system.

Authorised officers must carry their local authority or NSW Department of Health authorisation and identification with them and be able to produce them when requested.

Directions to carry out maintenance

requirements: Where the NSW Department of Health or the local authority believes that a maintenance requirement is not being complied with, it may **direct in writing** the occupier of the premises to do specified maintenance requirements before a certain date. If appropriate, the authority may direct that the system not be used until it is satisfied that there is compliance with the direction. Service of a written direction does not necessarily prevent prosecution.

Failure to comply with directions: If a direction to carry out a maintenance requirement (as above) is not complied with then the NSW Department of Health or the local authority may make arrangements to do the work at any reasonable time. The cost of carrying out work may be recovered from the occupier of the premises. The occupier is also guilty of an offence if a regulated system on the premises is used in contravention of the written direction.

5.3 Public Health (Microbial Control) Regulation 2000 (amended July 2003)

5.3.1 Interpretation

The *Public Health (Microbial Control) Regulation 2000* commenced on 31 August 2000. Like the *Public Health Act*, the *Regulation* defines terms to have specific meanings for the purposes of the *Regulation*.

Operation area, in relation to any regulated premises, means the part of the premises on which a regulated system is installed.

Where the *Regulation* references a publication, not being a Departmental publication, it means the publication as in force at the date the *Regulation* was made (31 August 2000) except where a later version of the publication is specifically cited in the most recently amended *Regulation*.

Unless otherwise defined in the *Act* or *Regulation*, an expression used in the *Regulation* and in any of the following publications has the same meaning as in that publication (there are definitions in the following standards):

- AS/NZS 3666.1:2002
- AS/NZS 3666.2:2002
- AS/NZS 3666.3 2000.

Further, in any of the publications listed above, annually means taking action at intervals not greater than one year of the previous event and monthly and six-monthly have corresponding meanings.

5.3.2 Regulated systems

The following are regulated systems, that is, systems controlled by the *Regulation*:

- **air-handling systems (including humidifying systems)**
- **water-cooling systems and their associated equipment**
- **warm-water systems**
- **hot-water systems.**

Exemptions:

- i A dwelling is exempt, unless it has a water-cooling system. A dwelling has been defined as a single occupancy dwelling that does not have common property and is not controlled by an owners corporation within the meaning of the *Strata Schemes Management Act 1996*.
- ii The *Regulation* does not apply to evaporative cooling systems. Due to the design of the evaporative cooling system, there is minimal risk of legionellosis being transmitted. It was therefore decided not to regulate these systems so that resources could be concentrated on the control of higher risk systems. While control of evaporative cooling systems has been removed from the *Regulation*, the *Public Health Act* has not yet been amended to reflect this change.

5.3.3 Installation requirements

Air-handling systems (which includes humidifying systems)

- The air-handling system must **be installed and commissioned** in accordance with AS/NZS 3666.1:2002.
- The occupier must be given both **operation and maintenance manuals** for the system by the installer, each of which must comply with the requirements for manuals set out in AS/NZS 3666.2:2002.
- **Supply air filters** must be fitted to the air-handling system.

Hot-water systems and warm-water systems:

- The system must be **installed** in accordance with AS/NZS 3666.1:2002.
- If the system **automatically produces warm water** for ablution purposes the system must not be installed in a defined health care facility (public hospital, private hospital, day procedure centre and aged care service, unless it is of a kind **approved in writing by the NSW Department of Health**. Applications for approval must be accompanied by a fee (see Section 9.8.2).

Water-cooling systems:

- The system must be **installed** in accordance with AS/NZS 3666.1:2002.
- The occupier must be given both an **operation manual and a maintenance manual** for the system by the installer, each of which must comply with the requirements for such manuals set out in AS/NZS 3666.2:2002.

5.3.4 Operating requirements

Any regulated system must be operated in accordance with AS/NZS 3666.2:2002.

An additional operating requirement for a **water-cooling system** is that the system must be equipped with a process designed to control microbial growth. The process:

- must be in operation at all times independently of the water-cooling system. The water-cooling system must still be effectively disinfected even though the water-cooling system may not be operating continuously. Further, the biocide does not have to be added at all times but rather the process must be in operation; and
- **must be certified by a competent person** (a tertiary qualified chemist, chemical engineer, engineer or microbiologist and who has expertise in the relevant field) **annually** as being an effective process of disinfection under the range of conditions that could ordinarily be expected (see Appendix 2 for a certificate format containing the minimum detail). The competent person is certifying the process, not its performance under installed field conditions
- must be sufficiently effective so that no sample taken from any part of the system subjected to a test in accordance with the relevant Australian Standard has:
 - (i) a level of *Legionella* of more than 10 colony-forming units per millilitre; or
 - (ii) a Heterotrophic Plate Count of more than 100,000 colony-forming units per millilitre
- must be supplemented by remedial action taken by a **competent person** after any test where the levels set out above are exceeded. Remedial action could include recommendations regarding the disinfection process which could then be implemented by the competent operator.

5.3.5 Prescribed maintenance requirements

Maintenance precautions: The contractor, or any other person carrying out the maintenance (other than an employee) must ensure that contamination of adjoining areas and the ambient environment by aerosols, dust, particulate matter or effluent is minimised. Public access to the maintenance area must be prevented. (Maximum penalty: 20 penalty units.)

Maintenance requirements: The prescribed maintenance requirements for any regulated system are that the system must be maintained in accordance with AS/NZS 3666.2:2002.

Alternatively, a **water-cooling system** may be maintained in accordance with AS/NZS 3666.3:2000. The local authority must be notified of this choice in writing. This standard requires a risk assessment to be performed to determine the monitoring and treatment parameters. A reference in AS/NZS 3666.3:2000 to a person competent to evaluate a cooling water system is a reference to an engineer who is:

- a corporate member of the Institution of Engineers and
- registered on the National Professional Register for Engineers in the general area of practice of building services (see www.nper.isa.net.au).

All tests must be performed in a laboratory accredited by the National Association of Testing Authorities (NATA) for that purpose.

A **hot-water system** must be maintained to ensure that it delivers water at each outlet at not less than 60°C once any standing water in the pipe has been expelled.

The maintenance requirements for a **warm-water system** are those set out in the document entitled *Requirements for the Provision of Cold and Heated Water* also known as *Circular 2002/10* published by the NSW Department of Health. It may be downloaded from <http://www.health.nsw.gov.au/fcsd/rmc/cib/circulars/2002/cir2002-10.pdf>

5.3.6 Legionnaires' disease investigations

The *Legionnaires' Disease Emergency Management Plan* referred to in the legislation has been incorporated into the *Legionnaires' Disease Public Health Emergency Management Plan* of the NSW Department of Health. This plan, if activated by NSW Health, prescribes the protocols to be taken during an outbreak. Any investigation of an outbreak of Legionnaires' disease should be carried out in accordance with the *Legionnaires' Disease Emergency Management Plan* and each local authority is to keep the necessary contact lists as required by that plan.

An authorised officer when investigating an occurrence of Legionnaires' disease may, by order served on the occupier of premises, direct that a regulated system be maintained in a particular way. The directions given in an order become 'prescribed maintenance requirements'. Where the directions given in the order are inconsistent with any other provision of the *Regulation*, the order prevails.

5.3.7 Registration of water-cooling and warm-water systems

Each local authority is to maintain a register of water-cooling systems and warm-water systems installed on regulated premises in its area. The register relating to a system is to show the following:

- the type of system
- the address of the premises on which the system is installed
- the name, and the residential and business addresses of the owner of the premises and, if the operation area on the premises is occupied otherwise than by the owner, those particulars in relation to the occupier
- the telephone numbers at which, during business hours and after business hours, the person or persons referred to above may be contacted
- details of any inspections carried out by the local authority.

Public health legislation

The register is to be maintained in such a way that the entries may be quickly retrieved and is to be organised in alphabetical order according to the name of the suburb or city. An electronic database or spreadsheet can easily be established to fulfil this function.

A person who is the owner or occupier of premises where a system is installed must provide the local authority the above particulars (other than those relating to inspections):

- within one month after the person becomes the owner or occupier of the premises, or
- within one month after the alteration to particulars previously provided.

A breach of this requirement carries a maximum of 10 penalty units.

Competent person

6

This section considers the concept of 'competent person' in the context of its various uses in the legislation.

6.1 Introduction

The terms 'competent', 'competent person' and 'person competent' are used in the microbial control legislation. On each occasion it has a different application and interpretation. There are four circumstances of use and these are:

- installation of a regulated system must be performed by a competent person under Section 45 of the *Public Health Act*
- operation and/or maintenance of a regulated system must be performed by a competent person under Section 46 of the *Public Health Act*
- certification of a process of disinfection for a water-cooling system must be by a competent person under clause 9(2) of the *Regulation*
- maintenance of the water-cooling system using the performance based requirements of AS/NZS 3666.3:2000 where the performance based requirement requires a risk assessment to be performed by a competent person under clause 11(2) of the *Regulation*.

NOTE: AS/NZS 3666.1 defines a competent person as 'a person who has had the appropriate training or practical experience (or both) in the subject, sufficient to provide safe and satisfactory performance'.

The following sub-sections deal with the four circumstances of the use of 'competent person'.

6.2 Installation

It is stated in Section 4.2 of the *Code* that the legislation provides that both the occupier and installer would be guilty of an offence where a regulated system is not properly installed. However, under the *Act*, where the occupier can satisfy the court that the installation of the regulated system was carried out by a person who might reasonably be **expected to be competent** then the occupier is not guilty of an offence.

Similarly, where the occupier can demonstrate to an authorised officer that the regulated system was installed by a person who might reasonably be expected to be competent to do so, then it is unlikely that legal proceedings would be taken against the occupier. In such a case a competent person would be likely to be a qualified trades person, licensed by the Department of Fair Trading, and experienced, or under the direct control of someone who is qualified, licensed, and experienced to install the type of regulated system in accordance with the prescribed installation requirements (Australian/New Zealand Standard).

6.3 Operation and/or maintenance

Also in Section 5.3 of the *Code*, where a regulated system was not properly operated and/or maintained both the occupier of the premises and the contractor would be guilty of an offence. However, under Section 46 of the *Act*, where the occupier can satisfy the court that the operation and/or maintenance of the regulated system was carried out by a person who might reasonably be **expected to be competent** then the occupier is not guilty of an offence.

Similarly, where the occupier can demonstrate to an authorised officer that the regulated system was operated and/or maintained by a person who might reasonably be expected to be competent then it is unlikely that legal proceedings would be taken against the occupier. In such a case a competent person would be likely to be a qualified trades person, licensed by the Department of Fair Trading and experienced, or under the direct control of someone who is qualified, licensed, and experienced to operate and/or maintain the type of regulated system in accordance with the prescribed operating and/or maintenance requirements (Australian/New Zealand Standard).

6.4 Process designed to control microbial growth

Clause 9(2) of the *Regulation* requires that a water-cooling system be equipped with a process designed to control microbial growth and, among other things, the process must be **certified by a competent person** annually as being an effective process of disinfection under the range of operating conditions that could ordinarily be expected. The annual certification of the process designed to control microbial growth is not expected to cover extraordinary circumstances which may occur, for example due to the dust created by the demolition of a nearby building, but would include the normal climatic conditions which could be experienced at the site.

It should be noted that the competent person is not certifying the process to comply with the microbial standard of clause 9(2)(c) for *Legionella* or heterotrophic plate count.

In this case the competent person is defined in clause 9(3) as a person who is a tertiary qualified chemist, chemical engineer, engineer or microbiologist and who has expertise in the relevant field of processes of disinfection and their application to water-cooling systems.

Where the process of disinfection does not perform to the prescribed standard then the competent person must supplement the process by remedial action. Remedial action could include recommendations regarding the disinfection process which could then be implemented by the competent operator.

Because the requirement to equip a water-cooling system with a process designed to control microbial growth is a prescribed operating requirement then the comments of Section 6.3 above in regard to operating and/or maintenance requirements also apply to the process of disinfection.

6.5 Maintenance of a water-cooling system using AS/NZS 3666.3:2000

Under clause 11(2) of the *Regulation*, the owner/occupier of the premises has the option to maintain the water-cooling system using the performance based requirements of AS/NZS 3666.3:2000 instead of the prescriptive requirements of AS/NZS 3666.2:2002. The performance based requirement of AS/NZS 3666.3:2000 requires a risk assessment to be performed by a person competent to evaluate the condition of the water-cooling system. In this case the reference to a 'person competent' is a reference to an engineer who is:

- a corporate member of the Institution of Engineers and
- registered on the National Professional Register for Engineers in the general area of practice of building services (see www.nper.isa.net.au).

An engineer is considered to be the only appropriate person competent to perform the risk assessment due to their knowledge in not only the chemical, but the engineering components and options available to respond to the risk analysis. Such options include not only processes of disinfection, but also eliminating or minimising risk factors caused by, for example: dead legs; open systems; and high levels of particulate matter or suspended solids.

Air-handling systems

7

This section gives guidance on the design, installation, operation and maintenance requirements of air-handling systems.

7.1 Introduction

The *Public Health Act* defines an air-handling system to mean a system designed for the purpose of directing air in a positive and controlled manner to and from specific enclosures by means of air-handling plants, ducts, plenums, air distribution devices and automatic controls. An air-handling system does not therefore include a simple exhaust fan or system, a window mounted air conditioner or split system air conditioner but refers to a system where air is recirculated through ducts.

An air-handling system may incorporate either an air-cooling system or a water-cooling system to remove heat from the air-handling system. Where a water-cooling system is installed there are separate requirements (see Section 8).

The legislation controlling an air-handling system applies to all types of premises, except a dwelling unless a water-cooling system is installed to serve the air-handling system.

The owner and/or occupier of the premises is not required to register an air-handling system with the local Council.

7.2 Design and installation

Prior to the design and installation of an air-handling system a site survey to identify potential transmission and contamination pathways must be done in accordance with AS/NZS 3666.1:2002, Section 2.1.4. The site survey should also consider the location of openable windows, air intakes, exhausts and cooling-towers on the site and adjoining sites. The site survey is required to be submitted together with building plans for local authority approval.

Consideration should also be given to access for maintenance of all components of the air-handling system including cleaning of filters, ducts and fire dampers.

Materials used need to have been tested to AS 1157 to assist in avoiding problems of fungal growth.

7.3 Legal requirements

In order to comply with the legislation in respect of the installation, commissioning, operation and maintenance of air-handling systems, the following requirements must be met.

7.3.1 Installation

The air-handling system must be installed in accordance with AS/NZS 3666.1:2002.

Supply **air filters** must be fitted to the air-handling system.

The installation must also be in accordance with any drawings approved by the local authority under separate development or building approvals.

7.3.2 Operation and maintenance

The system must be operated and maintained in accordance with AS/NZS 3666.2:2002.

Both an operation manual and a maintenance manual shall be provided for the system, each of which must comply with the requirements for such manuals set out in AS/NZS 3666.2:2002, Section 2.6.

7.3.3 Maintenance precautions

When maintenance of an air-handling system is being carried out contamination of adjoining areas and the ambient environment by aerosols, dust, particulate matter or effluent must be minimised and it must be ensured that public access to the area in which the maintenance is being carried out is prevented.

Water-cooling systems

8

This section gives guidance on the design, installation, operation and maintenance requirements of water-cooling systems.

8.1 Introduction

The heat energy extracted from a building or an industrial process by an air-conditioning system may be released into the atmosphere by a cooling-tower or evaporative condenser. Because of the temperature of the water and the presence of sludge, algae and other matter, the water-cooling system may aid the proliferation of *Legionella* and other microbes.

The *Public Health Act* defines **water-cooling system** to mean a cooling-tower and its associated equipment and pipework. A **cooling-tower** includes a device for lowering the temperature of water or other liquid by evaporative cooling, or an evaporative condenser which incorporates a circuit containing a refrigerant.

The aerosol drift from a contaminated cooling-tower may cause an infection in nearby susceptible people. The correct operation and regular routine maintenance including cleaning are important to ensure the desired heat transfer efficiency, prolong the life of the cooling-tower and associated equipment and ensure acceptable hygienic conditions of all components of the water-cooling system.

8.2 Types of water-cooling systems

A cooling-tower is part of a water-cooling system. A typical air conditioning system of which a cooling-tower is a component is shown in Figure 2. The purpose of a cooling-tower is to transfer heat from the cooling water to the atmosphere air. In a water-cooling system water flows in a circuit from a

source of heat as warm water to the cooling-tower. The water is sprayed onto a fill material in the cooling-tower and exposed to a draught of air. This removes the heat from the water because some of the water evaporates and this is known as evaporative cooling. The cooled water is collected in a basin before its return to the heat generating source.

Sometimes the cooling-tower can become infected by low levels of *Legionella* from wind blown infected soil where the water spray removes the contaminated soil from the air draught. *Legionella* may also be introduced from the water supply. The *Legionella* is then in an ideal environment in which to multiply unless it is controlled by physical and chemical intervention in the cooling-tower. Under rare ideal weather conditions and if a cooling-tower is infected and dirty, the exhaust air can become contaminated with aerosols containing *Legionella* which can be released into the atmosphere.

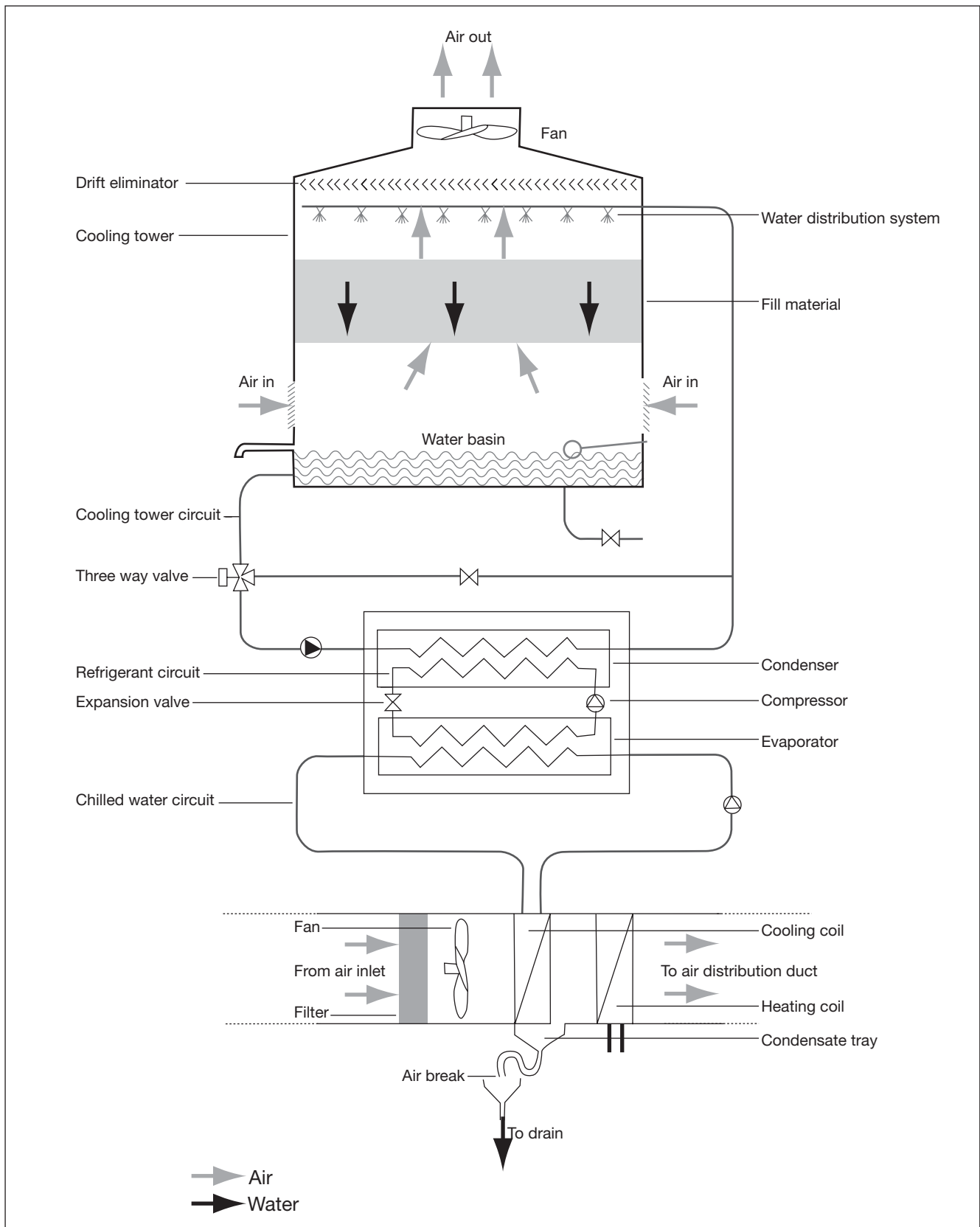
There are some attributes which can be designed out of a water-cooling system and these are considered in Sections 8.3 and 8.4.

There are other various types of water-cooling-towers which are known as:

- induced draught counter flow cooling-tower
- forced draught counter flow cooling-tower
- cross flow cooling-tower
- closed circuit cooler
- natural draught cooling-tower
- induced draught evaporative condenser
- forced draught evaporative condenser.

AIRAH DA 17 Cooling Towers (See Appendix 6) provides useful information regarding cooling-towers.

Figure 2. Schematic layout of an air-conditioning system which uses a cooling-tower for heat rejection



8.3 Cooling-tower equipment

8.3.1 Filters and separators

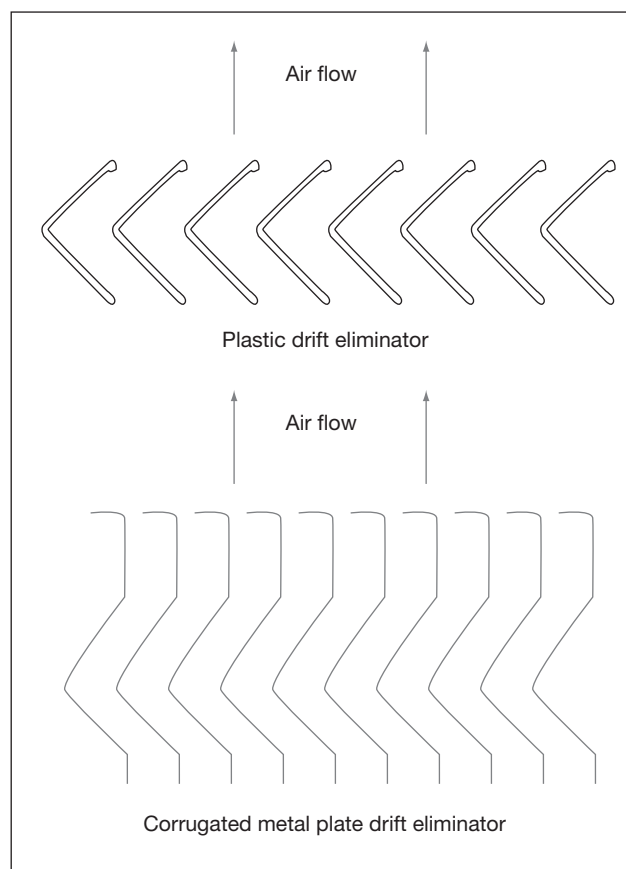
The use of a correctly designed system of either mainstream or sidestream filtration and/or centrifugal separation can significantly reduce fouling of water-cooling systems with particulate matter. Filtered water should be reintroduced into the tower basin in such a way as to ensure that particulate matter remains suspended in the water for easier removal when the water passes through the filter. This cleansing process allows the biocide or other treatment process to be much more effective and improves the efficiency and life of the cooling-tower. Water filtration in areas of dirty ambient air is considered essential.

8.3.2 Drift eliminators

When the cooling-tower water leaves the hot water distribution system and splashes onto the internal fill and the basin aerosols can be produced. The aerosols may contain *Legionella* and water treatment chemical contaminants. When the aerosols leave the cooling-tower it is called 'drift'. To minimise drift from leaving the cooling-tower 'drift eliminators' (arrestors) are fitted near the top of the cooling-tower. Their shape causes a sudden change of direction in the air flow to catch most of the small water droplets and aerosols. It is impossible to prevent the escape of all drift, however usually any uncaught aerosols quickly evaporate.

Figure 3 opposite shows two different types of drift eliminators. Modern drift eliminators can provide a drift ratio of better than 0.002% at the maximum design water circulation rate. The eliminator must cover the full air stream so there is no air by-pass.

Figure 3. Examples of drift eliminators



8.4 Water treatment

A water treatment program is essential to inhibit corrosion, the build-up of scale and bio-fouling, and the development of any microbial contamination. Corrosion, scale and bio-film development can cause fouling of the condenser tubes and the pipework distribution system resulting in poor system efficiency and premature failure. These factors can also provide a favourable environment which promotes the colonisation and growth of microbes such as *Legionella*.

Water treatment should not be used to overcome any deficiencies in the design of the water-cooling system.

Specialist water treatment companies will be able to advise on the appropriate water treatment regimen, whether it is a chemical or non-chemical process or a combination of water treatment processes. These companies should also be familiar with any legislation applicable to the particular products or processes they offer.

Water cooling systems

There is no longer a requirement that processes of disinfection be approved by the NSW Department of Health. Instead it is a requirement that all water-cooling systems be equipped with a process designed to control microbial growth which must be certified, annually, by a competent person. Also see 8.4.7 below.

AIRAH DA 18 Water Treatment provides useful information regarding water treatment for water-cooling systems. Suppliers should have a quality system to AS 3905.1 in operation which is also applicable to work in the field.

8.4.1 Dosing equipment

Care needs to be taken with the dosing of chemicals when added to the cooling-tower as some chemicals may react adversely if dosed or used at the same time. Chemicals should be added to turbulent areas to assist with rapid mixing.

*It should be noted that AS/NZS 3666.1:2002, Section 4.1.3 and AS/NZS 3666.3:2000, Clause 2.4 require that **automatically controlled water treatment systems** be installed in all water-cooling systems. This requirement commenced with the Public Health (Microbial Control) Regulation 2000 on 31 August 2000 when it adopted AS/NZS 3666.1:1995 as a prescribed installation requirement which continued with the updated standards.*

An automatically controlled water treatment system is a device such as metered dosing with or without sensor feedback.

Various methods, which are not automatically controlled water treatment systems, have been used to dose chemicals and these have included:

- manual or hand dosing
- continuous drip feed
- capillary or syphon feed
- drop in cartridge or canister
- tablet capsule or briquette feeder.

8.4.2 Bleed off

The longer a cooling-tower operates the more various chemicals become concentrated in the cooling-tower water. These dissolved chemicals are known as dissolved solids and their measure known as 'Total Dissolved Solids' or TDS. The chemicals become even more concentrated as the water evaporates in the cooling process. Increasing TDS increases the potential for corrosion and may lead to scaling of equipment, heat exchangers and sensors. These dissolved inorganic solids are not oxidised. A small quantity of the water is therefore continuously bled off and replaced with clean water to dilute the concentration of dissolved solids in the cooling-tower. Care must be taken to ensure that not too much water is bled off or there will be an overall loss of beneficial chemicals. Bleed off can be a continuous or intermittent pre-set process, or automated and controlled through a conductivity sensor.

8.4.3 Biocides

Water treatment biocides should be used to control the growth of microbes in the condenser water. These microbes may provide nutrients for the growth of *Legionella*. The effectiveness of biocides may be reduced by the presence of organic and inorganic materials such as sand, dirt and other particulate matter. Biocides must never be allowed to discharge into surface draining systems or other water courses. Approval for discharge of treated water into sewage reticulation systems must be obtained from the relevant local water supply and sewage authority. A problem with many biocides is that their concentration cannot be measured in a simple field test. Biocide manufacturers should consider this matter in their product development. Biocide based water treatment systems should not necessarily be relied on as the sole process of microbial control. Effective water treatment practices also include the use of scale and corrosion inhibitors.

Biocides should be checked for conformity to ASTM E645 and ASTM E1427 as a guide (see Appendix 6 of this Code for reference details).

Section 2.6 of Appendix V of the *HMSO 1989 Report of the Expert Advisory Committee on Biocides* details information about biocides that should be available from the supplier.

8.4.4 Biocide types

Biocides may be classified in two different ways:

- They may be classified according to whether they are oxidising (such as chlorine and bromine) or non-oxidising (such as quaternary ammonium compounds).
- They may also be classified according to their ability to kill microorganisms (these are known as biocides, bactericides, or algaecides) or to only prevent the growth of microorganisms without killing them (these are known as biostats, bacteristats, etc).

Both of these types of biocides leave a residual in the water to control bacteria as they enter the water.

The advantages of oxidising biocides (such as chlorine and bromine) are that they rapidly kill bacteria and are easy to measure with a test kit at the cooling-tower. Oxidising biocides may be readily and accurately dosed using automated sensing equipment but react by oxidising organic materials and therefore dissipate more quickly. They require a higher amount to be added to overcome the oxidation demand. This demand will be lowered if filtration equipment is used to keep the system clean.

Non-oxidising biocides are slower to kill bacteria but are not dissipated by oxidation of organic materials. They persist in the cooling-tower water longer. Their concentration cannot be readily measured on site and are dosed at a calculated rate in volume per unit time (eg mL/min) based on the system volume.

More recently ozone and UV light have gained some popularity as disinfection agents. Neither ozone nor UV light leave a residual in the water and their effectiveness has to be boosted by the addition of a residual oxidising or non-oxidising biocide. Additionally, the housing of the UV light may become fouled or the water too turbid to allow the efficient transmission of the UV light unless a high efficiency filtration system is installed.

An effective water treatment program will alternate the use of at least two biocides to minimise the development of resistant strains of bacteria.

8.4.5 Other water treatment systems

There are many water treatment processes on the market that are reported to be effective in controlling the growth of micro-organisms by direct or indirect means. Some factors to consider when choosing an appropriate process include the merits of the respective claims, case study details and independent field test data verifying such claims. The proponent of each process should be able to explain a plausible scientific killing mechanism at the molecular level and the time taken to achieve a kill.

Cathodic protection systems need to be installed and maintained in accordance with AS/NZS 2832.4.

8.4.6 Operation of process designed to control microbial growth

The legislation now requires that a water-cooling system must be equipped with a process designed to control microbial growth and that process **must be in operation at all times**. The disinfection process must therefore operate independently of the water-cooling system. There are some processes of disinfection which rely on the water-cooling system to operate for their activation. In some seasons the water-cooling system may not operate for some days and therefore no addition of disinfectant occurs. Any remaining disinfectant will be consumed allowing *Legionella* to proliferate and, under the right conditions, an outbreak could occur before the disinfectant can return to normal concentrations.

8.4.7 Certification of process designed to control microbial growth

This requirement replaces the previous approval of the process of disinfection scheme operated by the NSW Department of Health. Instead of Departmental approval being required, responsibility for the performance of a process designed to control microbial growth is now vested in a 'competent person'. The process of disinfection must be certified by a **competent person** (a tertiary qualified chemist, chemical engineer, engineer or microbiologist and who has expertise in the relevant field) annually (preferably at the start of each year) as being an **effective** process to control microbial growth under the range of operating conditions that could ordinarily be expected.

It is not appropriate for a company or firm to certify a process of disinfection as it can only be certified by a competent person. See Appendix 2 for a suggested certification format.

8.4.8 Compliance of process designed to control microbial growth

Once the process of disinfection has been installed it then must be sufficiently effective such that it complies with the following microbial standard:

- any sample taken from the system to be analysed for total *Legionella* must be less than 10 cfu (colony forming units) per mL, or
- any sample taken from the system to be analysed for Heterotrophic Plate Count must be less than 100,000 cfu per mL.

Where a sample is taken for both total *Legionella* and Heterotrophic Plate Count it must comply with each standard respectively.

Regular Heterotrophic Plate Count testing (eg monthly) on system water should be undertaken to assess the efficacy of the biocidal treatment and general cleanliness of the system. If the acceptable level of the Heterotrophic Plate Count of bacteria is exceeded, the frequency of testing should be increased to weekly while control is re-established. A Heterotrophic Plate Count of 10^5 colony forming units per millilitre (CFU/mL) of sample is generally regarded as an acceptable upper limit. Concentrations above this level indicate that conditions in the system are favouring multiplication.¹

Where the process designed to control microbial growth is not found to be sufficiently effective the process of disinfection must be supplemented by remedial action taken by the competent person (a tertiary qualified chemist, chemical engineer, engineer or microbiologist and who has expertise in the relevant field) after any test where either the total *Legionella* or Heterotrophic Plate Count level set out above is exceeded. Where the process of disinfection does not perform to the prescribed standard then the

competent person must supplement the process by remedial action. Remedial action could include recommendations regarding the disinfection process which could then be implemented by the competent operator.

8.5 Water sampling and testing

On-site testing

The following tests on water may be performed on-site:

- oxidising biocide (chlorine, bromine)
- pH
- conductivity
- turbidity
- temperature
- chloride
- alkalinity
- water balance.

Some tests such as chlorine, bromine and temperature may only be reliably performed on-site because their concentrations or measurement value rapidly change over time.

Off-site testing

The following tests may only be performed off-site:

- non-oxidising biocide
- corrosion rate
- Heterotrophic Plate Count (HPC)
- *Legionella* bacteria.

Testing of water samples for HPC and *Legionella* shall only be performed at a National Association of Testing Authority (NATA) registered laboratory and performed strategically as part of a performance based maintenance system such as AS/NZS 3666.3:2000. Individual tests usually have little relevance unless being used as an outbreak investigation tool or to build up a database history of performance or to test the performance of a process of disinfection. Microbial sampling therefore, should only be performed by a competent person and as part of a strategy. See Section 19 for further information.

¹ Broadbent, C 1996, *Guidance for the Control of Legionella*, National Environmental Health Forum Monographs, Water Series No. 1, South Australian Health Commission.

8.6 Installation

AS/NZS 3666.1:2002 must be used in the design, siting, installation and commissioning of water-cooling systems.

From the outset it is important to properly design and locate the cooling-tower. There should be easy and safe access to and about the tower and within the tower for maintenance activities such as safe inspection, adjustment and cleaning. Hosing down facilities must be available. It must be possible to shut down the cooling-tower during cleaning or during an emergency if suspected of being a source of *Legionella*.

Air intakes of air-handling systems should prevent the entry of birds and rodents, and windblown debris such as newspapers, leaves and rubbish. Exhaust air outlets should be located as far away from building air-handling system air intakes as possible. An assessment of the location of air intakes and exhausts must also include adjoining buildings. Exhaust air outlets must not discharge where people may be directly exposed.

Provision should be made to ensure that maintenance of a water-cooling system can be carried out without contamination of adjoining areas and the ambient environment by aerosols, dust, particulate matter or effluent. It must be ensured that public access to the area in which the maintenance is being carried out is prevented.

The installation requirements prescribe that installation of a water-cooling system includes the installation, certification and assessment of a process of disinfection. Clause 8, *Public Health (Microbial Control) Regulation* requires that, from 31 August 2000, water-cooling systems be installed in accordance with AS/NZS 3666.1:2002. Section 4.2.3 of this Australian/New Zealand Standard requires that **automatically controlled water treatment systems** be installed in all water-cooling systems. It is also a requirement that the process of disinfection operate continuously and independently of the water-cooling system. See Sections 8.4.6 to 8.4.8 above.

The maximum penalty for non-compliance may be either:

- 100 penalty units and/or 12 months imprisonment if imposed at a Local Court; or
- 500 penalty units and/or two years imprisonment if imposed at the Supreme Court.

Piping needs to be labelled to AS 1345 for identification purposes and, together with tagging for valves and controls, should relate to the operating instructions for the system.

AIRAH DA16 provides useful information about the design, installation and commissioning of piping for water-cooling systems.

8.7 Operation and maintenance

The legislation now provides a choice between two methods of maintenance. These are:

- AS/NZS 3666.2:2002 which is a **prescriptive approach** to operation and maintenance. Essentially the prescriptive approach requires monthly inspection and cleaning at six monthly intervals; or
- AS/NZS 3666.3:2000 but only where the local authority has been notified. **Performance based monitoring** relies on a risk assessment and risk management approach based on monthly bacteriological sampling, water quality management and operating water temperature.

Both an **operation manual and a maintenance manual** for the system must be provided, each of which must comply with the requirements for such manuals set out in AS/NZS 3666.2:2002, Section 2.6. A suggested report on maintenance of a water-cooling system is attached as Appendix 3.

Both Section 8.9 below and the *Regulation* should be consulted regarding the exact legal requirements.

AIRAH DA 19 provides useful information regarding maintenance of HVAC&R systems and plant.

8.7.1 Routine cleaning

The regular cleaning of cooling-towers and any associated condenser water system is important in a well-maintained system. Such cleaning also reduces the nutrients and microbial populations which may aid in the growth of *Legionella*. Stagnation of water must be avoided as this can be conducive to the growth of *Legionella*. Cleaning is therefore particularly important before a tower is commissioned, or started up after a shut down of a week or more.

8.7.2 Notification to Council

Where it has been decided that a water-cooling system is to be maintained using a risk assessment and performance based monitoring approach the Council must be notified in writing.

8.7.3 Emergency decontamination procedures

When a water-cooling system is known or suspected on epidemiological evidence to be contaminated with a high population of *Legionella*, the system should be shut down promptly. Decontamination procedures should begin after water samples have been collected by an appropriately trained person for microbiological testing by a National Association of Testing Authorities (NATA) accredited laboratory. The decontamination procedure involves a chlorination process. Details of the procedure are set out in Appendix 1.

8.8 Cooling-tower replacement

There are many cooling-towers which due to their deteriorated condition or obsolete design are impossible to maintain in a state of complete cleanliness. Consideration should be given to the planned replacement of these cooling-towers with air cooled heat rejection devices or with towers which are easier to access, maintain and clean. Replacement often leads to a reduction in maintenance costs. Retro-fitted cooling-towers or any upgrade should meet all the legislative requirements.

8.9 Legal requirements

The *Public Health Act* defines water-cooling system to mean a cooling-tower and its associated equipment and pipework. A cooling-tower means:

- a device for lowering the temperature of water or other liquid by evaporative cooling; or
- an evaporative condenser which incorporates a device containing a refrigerant or heat exchanger.

It should be noted that the water-cooling system is not just the cooling-tower or evaporative condenser but includes all associated equipment and pipework.

The legislation **applies to all premises** where a water-cooling system is installed.

The owner and/or occupier of the premises is **required to register** the water-cooling system with the local Council by providing the following details:

- type of system
- address of premises
- name, residential address, business address and telephone number of the owner
- where the operation area of the water-cooling system is occupied other than by the owner, the name, residential address and business address and telephone number of the occupier.

In order to comply with the legislation in respect of the installation, commissioning, operation and maintenance of water-cooling systems, the following requirements must be met.

8.9.1 Installation

- The system must be installed in accordance with AS/NZS 3666.1:2002.
- The occupier must be given both an **operation manual and a maintenance manual** for the system by the installer, each of which must comply with the requirements for such manuals set out in AS/NZS 3666.2:2002. In the case of a water-cooling system, a separate set of operation and maintenance manuals is usually provided.

8.9.2. Operation and maintenance

- The system must be operated and maintained in accordance with AS/NZS 3666.2:2002. Alternatively and **only where the local authority has been notified** in writing, the water-cooling system may be maintained in accordance with AS/NZS 3666.3:2000. A reference in AS/NZS 3666.3:2000 to a person competent to evaluate the condition of a cooling water system is a reference to an engineer who is:
 - a corporate member of the Institution of Engineers and
 - registered on the National Professional Register for Engineers in the general area of practice of building services (see www.nper.isa.net.au).
- All tests required under AS/NZS 3666.3:2000 must be carried out in a laboratory accredited by the National Association of Testing Authorities (NATA) for that purpose.
- The water-cooling system must be equipped with a **process designed to control microbial growth** and that process:
 - **must be in operation at all times** and
 - **must be certified by a competent person** (a tertiary qualified chemist, chemical engineer, engineer or microbiologist and who has expertise in the relevant field) annually as being an effective process of disinfection under the range of operating conditions that could ordinarily be expected; and

- **must be sufficiently effective** so that no sample taken from the system subjected to a test in accordance with the relevant Australian Standard has:
 - (i) a level of *Legionella* of more than 10 colony-forming units per millilitre; or
 - (ii) a Heterotrophic Plate Count of more than 100,000 colony-forming units per millilitre; and
- **must be supplemented by remedial action** taken by a competent person after any test where the levels set out above are exceeded. Remedial action could include recommendations regarding the disinfection process which could then be implemented by the competent operator.

All water-cooling systems must be equipped with a continually operating, automatic process designed to control microbial growth under the range of conditions that could ordinarily be expected which is certified annually by a competent person.

See Sections 8.4.6, 8.4.7 and 8.4.8 for commentary on the process designed to control microbial growth.

8.9.3 Maintenance precautions

When maintenance of a water-cooling system is being carried out contamination of adjoining areas and the ambient environment by aerosols, dust, particulate matter or effluent must be minimised and it must be ensured that public access to the area in which the maintenance is being carried out is prevented.

Hot and warm water systems

9

This section gives guidance on the design, installation, operation and maintenance requirements of hot-water and warm-water systems.

9.1 Introduction

Under the *Public Health Act* a hot-water system is defined as a system which is designed to heat and deliver water at a temperature of at least 60°C at each outlet point. A warm-water system is defined as a system designed to heat and deliver water at a temperature of less than 60°C at each outlet point. Hot and warm water systems if not designed, installed, commissioned, operated, maintained or site managed properly are capable of supporting *Legionella* to the extent that there may be a risk to public health in certain types of premises.

Because both hot and warm water systems are fed by cold water systems some aspects of the cold water supply will also be considered.

Pipelines should be identified in accordance with AS 1345:1995.

9.2 Water temperature regulation

The *Public Health Act* and *Regulation* does not prescribe where warm-water systems will be installed nor does it prescribe water temperatures for particular locations. In public and private health care facilities water systems are prescribed in the *NSW Code of Practice – Plumbing and Drainage 2nd Edition* (1999) and specific legislation related to specific premises. The *NSW Code of Practice – Plumbing and Drainage 2nd Edition* (1999) requires:

Clause 1.10.2*

All new hot water installations shall deliver hot water at the outlet of all sanitary fixtures used primarily for personal hygiene purposes at a temperature not exceeding:

- (a) 43.5°C for childhood centres, primary and secondary schools, and nursing homes or similar facilities for the aged, sick or disabled persons
- (b) 50°C in all other classes of buildings.

Existing installations

- (c) An existing hot water temperature limiting device shall not be removed except when:
 - (i) moved to an alternate location
 - (ii) replaced by an alternate mechanism.
- (d) An existing hot water temperature limiting device shall be adequately maintained or replaced when defective.
- (e) Where hot water is being delivered to an outlet of a sanitary fixture, used primarily for personal hygiene purposes on commercial premises or by the public, at a temperature exceeding 50°C, such fixture shall have a sign, using symbol and red writing on a white background in appropriate languages, displayed adjacent to the sanitary fixture which states 'Warning – this fixture may deliver hot water which will scald'.

Note (1) In clause 1.10 the interpretation of the term 'installation' is important. In accordance with the Glossary of Terms (of the *NSW Code of Practice – Plumbing and Drainage*) 'installation' applies to:

- the construction of pipeworks and fixtures in position for service and use
- the network of pipework and fixtures.

In this context clause 1.10 does not apply to the replacement of water heater units if there is no significant change in existing pipework.

Note (2) The *NSW Code of Practice – Plumbing and Drainage 2nd Edition* (1999) overrides AS/NZS 3500.4.3:1997.

* The *NSW Code of Practice – Plumbing and Drainage 2nd Edition* (1999) is currently in the process of being updated and republished. The information above will remain consistent, but the internal referencing of the document may alter (ie clause numbers may be different).

Hot and warm water systems

The requirement to reduce temperature does not apply to laundry and kitchen fixtures. The requirement to reduce temperature does not apply where a hot water heater is replaced with another one in the same location because this is not a 'new hot water installation'.

However, the requirement to reduce temperature does apply where a hot water heater is replaced with another heater and it involves the construction of (rather than the minor alteration of existing) pipeworks. This may be because the hot water heater is moved to another location and requires the construction of pipeworks. The construction of an en-suite would require 50°C maximum temperature water to be supplied to the en-suite. The additionally constructed pipeworks to the relocated water heater or the constructed en-suite is a 'new hot water installation' and it shall be temperature regulated. In some cases the only practical way to provide the 'new hot water installation' with 50°C maximum temperature water is to control the whole hot-water system and use a booster heater or separate water heater to provide water at a temperature greater than 50°C for purposes other than personal hygiene.

An existing hot water temperature limiting device shall not be removed. However, it may be relocated or be replaced with an alternate mechanism which effectively controls the temperature to the bathroom fittings so that it does not exceed 50°C.

Where hot water at greater than 50°C is already supplied to a personal hygiene sanitary fixture in a commercial premises (eg hotel, motel, squash courts, gymnasium, office, etc) or where the fixture is used by the public (eg public or community hall) then a sign must be displayed adjacent to the shower, bath or hand basin stating in **red writing** on a white background 'Warning – this fixture may deliver hot water which will scald'.

Automatic warm-water bathing systems are designed to operate at a set temperature of less than 43.5°C. These temperatures are conducive to the growth of *Legionella*. Various systems may be designed to control *Legionella* and other micro-organisms. Although these systems which automatically produce warm water must be approved by the NSW Department of Health it is not required (although advisable) to install the approved systems into a dwelling.

Stratification of water temperature can occur in water heaters and warm and hot water storage tanks. The low temperature within the vessels can result in *Legionella* proliferating.

Recommended water temperatures for health care facilities are contained in *Requirements for the Provision of Cold and Heated Water* published by the NSW Department of Health.

9.3 Cold water supply

One of the most important points with cold water is that it must be 'potable' (fit for drinking) and this is the responsibility of the water supply authority and/or the owner/occupier of the premises. Any storage vessel in use for cold water must be treated in accordance with Appendix 1 of AS 3500.1:1992 and maintained in accordance with Section 2.2.13 of the mandatory *NSW Code of Practice – Plumbing and Drainage 2nd Edition* (1999). Any new or altered cold water supply lines from the mains to any building must also be treated in accordance with Appendix J of AS 3500.1:1992.

9.4 Water treatment

Because hot, warm and cold water are classified as potable water (fit for drinking), there are limits to the water treatment that can be applied to control any growth of *Legionella* so that the water remains safe to drink. Routine disinfection by chlorination to maintain a low level of residual chlorine is one of the few proven and acceptable methods. The method must be accurate, automatic and filtration may be a prerequisite.

Microbial growth in warm-water systems can be controlled by various non-chemical treatments. However, the efficacy of these treatments has not been fully determined in the field under varying conditions such as water quality, temperature of storage, volume of water use and system design.

Two other methods, apart from chlorine, of microbial control of warm-water systems have potential application by heat (pasteurisation to 70°C for five minutes) and ultra-violet irradiation. Ultra-violet light treatment of warm water appears at this stage to have limited application. The overall microbial quality of the water appears to be

dependent on a number of factors, such as the properties of the supply water and the re-growth potential in the plumbing system. The latter factor can be a major problem as the treatment process does not attain a '100% kill' of *Legionella* and other micro-organisms. In addition, unlike chlorination, no anti-microbial residual is present in the system for inhibiting microbial growth.

9.5 Water filters

Filter systems are designed to filter out most particulate matter that is suspended in the water and this increases the effectiveness of a disinfection process. The efficacy of filters vary, depending on the type. The filter media needs to be replaced or cleaned periodically. A filtration system which collects the backwash for disposal or discharge to the sewer may be used. Such automatic systems still need periodic maintenance for optimum performance.

9.6 Routine cleaning

Routine internal cleaning of hot water and warm water storage vessels (tanks, cylinders or calorifiers) is very important to remove any sludge, slime and other pollutants. Lids, inspection openings and sludge drains should be provided on new vessels to aid cleaning. Existing vessels may need to be modified, replaced or operated under conditions that do not support the growth of *Legionella*.

The recommended routine procedure for cleaning of warm water storage tanks is attached as Appendix 4 and the emergency decontamination procedure is attached as Appendix 5.

9.7 Hot-water systems

Hot-water systems typically heat water to about 70°C prior to distribution through the system to outlets. A hot-water system is required to produce water at a temperature of at least 60°C measured at the outlet or the point of temperature regulation. This is to ensure that *Legionella* which may be in the cold water supply are killed rapidly before being able to multiply at fixture outlets such as shower risers and heads.

The water temperature regulation however, in Section 9 above which referred to the *NSW Code of Practice – Plumbing and Drainage 2nd Edition* (1999) does apply to all premises.

The *Public Health Act and Regulation* do not apply to a dwelling where a hot-water system is installed. The owner and/or occupier of the dwelling is therefore not required to register a hot-water system with the local Council.

In premises other than single dwellings, in order to comply with the *Act* in respect of the installation, commissioning, operation and maintenance of the hot-water system, the following requirements must be met:

Installation

- The system must be installed and commissioned in accordance with AS/NZS 3666.1:2002 as applicable to the specific system.
- A hot-water system needs to comply with AS 3500.4:1994 and the mandatory *NSW Code of Practice – Plumbing and Drainage 2nd Edition* (1999) administered by the Department of Land and Water Conservation.
- Storage calorifiers and cylinders shall be designed, installed and commissioned to minimise stratification of temperature.

Operating and maintenance requirements

- The regulated system must be operated and maintained as required by AS/NZS 3666.2:2002.
- Sufficient maintenance must be carried out on a hot-water system so as to ensure that at any time when the system is in operation it delivers water at each outlet (prior to temperature regulation) each time the outlet is turned on at not less than 60°C, once any water standing in the pipe to that outlet before it was turned on has been expelled.

Maintenance precautions

When maintenance of a hot-water system is being carried out contamination of adjoining areas and the ambient environment by aerosols, dust, particulate matter or effluent must be minimised and it must be ensured that public access to the area in which the maintenance is being carried out is prevented. Care should be exercised to minimise the risk of accidental scalding when operating or maintaining the hot-water system.

9.8 Warm-water systems

Automatic warm-water systems for ablation purposes are designed to minimise scalding in health care facilities and childhood centres, and they operate at a temperature of 38°C or 43.5°C measured at the outlet for direct ablation purposes. These temperatures are conducive to the growth of *Legionella*. The warm water may be:

- generated and maintained at the desired temperature and contained in storage vessels (tepid system)
- mixed from hot and cold water and generated instantaneously with the aid of thermostatically controlled mixing valves
- generated instantaneously but not stored in a water heating unit.

Those systems which automatically produce warm water for ablation or bathing purposes must be approved by the NSW Department of Health before they are installed in a defined health care facility (public hospital, private hospital, day procedure centre and aged care service).

The owner and/or occupier of any premises where a warm-water system is installed is required to register the warm-water system with the local Council and provide the following details:

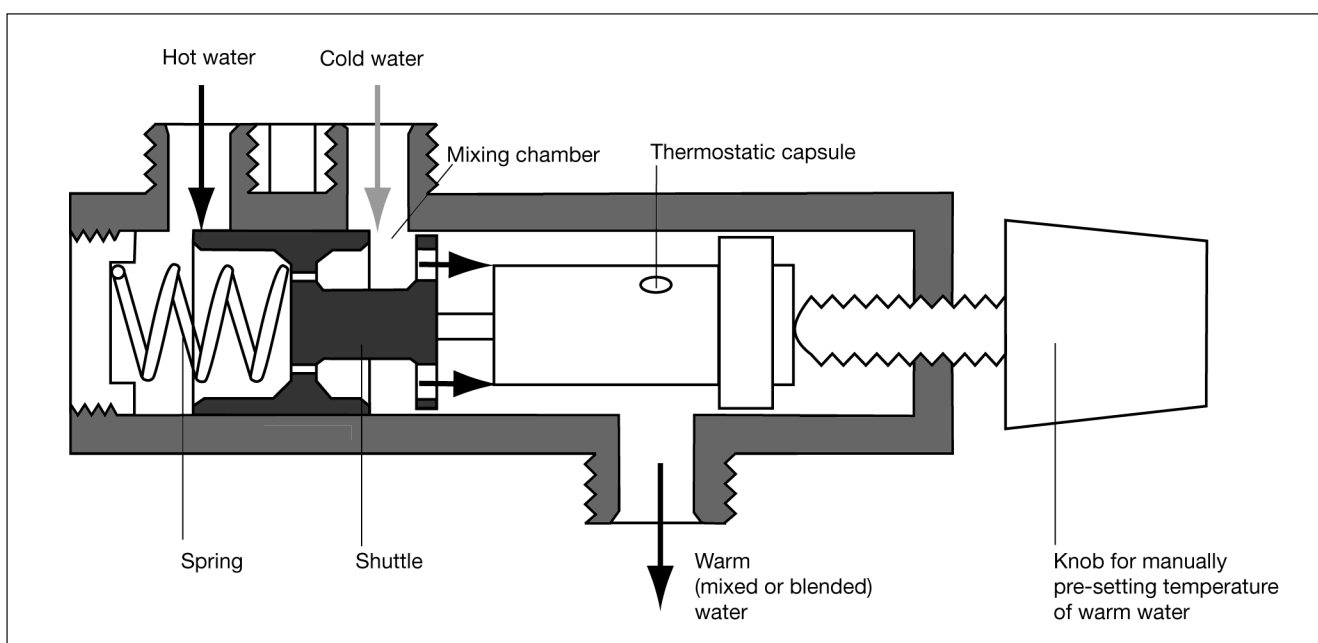
- a list of the number and type of each system(s)
- address of premises
- name, residential address, business address and telephone number of the owner
- where the operation area of the warm-water system is otherwise occupied, the name, residential address and business address and telephone number of the occupier.

9.8.1 Types of warm-water systems

Thermostatic mixing valves (see Figure 4) are generally used to blend hot and cold water to provide water to a preset temperature, usually between 38°C and 43.5°C to prevent scalding. They do not provide microbial control and can, in fact, promote the growth of *Legionella* and other micro-organisms.

Warm-water systems have many applications in the health care and hospitality industries, for instance in hospitals, nursing homes, hostels, retirement villages, hotels, motels, hairdressing salons, benevolent organisations and homes for people with disabilities.

Figure 4. Basic layout of a thermostatic mixing valve



Details of warm-water systems and those systems incorporating thermostatic mixing valves that have been approved for use in NSW health care facilities are available from the NSW Department of Health or may be downloaded from <http://www.health.nsw.gov.au/public-health/ehb/general/microbial/microbial.html>.

A comprehensive, useful and important *Code of Practice* covering the supply, siting, sizing, selection, installation, commissioning, operation, maintenance and servicing of thermostatic mixing valves is only available from the NSW Department of Health. This *Code* details the decontamination (pasteurisation) procedure to be applied when the mixing valve is being serviced.

Boiler warm-water systems (also called tepid water systems) may also be used to automatically produce warm water for ablution and bathing purposes. Cold water may be passed through a heat exchanger on its way to the heater unit and heated to 70°C for pasteurisation. After heating the hot water again passes through the heat exchanger to warm the incoming water. The warm water is then maintained in a storage tank. Alternatively, the water may be heated to the required temperature in the storage tank or heated instantaneously at the point of use. The stored warm water is either piped directly to the outlet points or circulated through a ring main to the outlet points.

9.8.2 Approval of warm-water systems

A warm-water system which automatically produces warm water for ablution purposes, ie less than 60°C at the outlet, must not be installed (except in a dwelling) unless it is of a kind approved in writing by the NSW Department of Health.

A procedure document *Requirements for the Provision of Cold and Heated Water* is available from the Department together with approval lists and other material from the Environmental Health Branch web site: <http://www.health.nsw.gov.au/public-health/ehb/general/microbial/microbial.html>.

Applications for approval must be accompanied by an administrative fee.

9.8.3 Installation and maintenance

In order to comply with the public health legislation in respect of the installation, operation and maintenance of the warm-water system the following requirements must be met:

Installation

- The system must be designed, installed and commissioned in accordance with AS/NZS 3666.1:2002 as applicable to the specific system, except to the extent that this *Regulation* provides otherwise.

Operating and maintenance requirements

- The regulated system must be operated and maintained as required by AS/NZS 3666.2:2002.
- Both an **operation manual and a maintenance manual** for the system must be provided, each of which must comply with the requirements for such manuals set out in AS/NZS 3666.2:2002, Section 2.6.
- The prescribed maintenance requirements for a warm-water system are those set out in the most recent version of the document entitled *Requirements for the Provision of Cold and Heated Water* published by the NSW Department of Health from time to time.

Maintenance precautions

When maintenance of a warm-water system is being carried out contamination of adjoining areas and the ambient environment by aerosols, dust, particulate matter or effluent must be minimised and it must be ensured that public access to the area in which the maintenance is being carried out is prevented.

9.9 Plumbing issues

Leather, natural rubber and other materials that support the localisation and subsequent growth of *Legionella* shall be avoided in plumbing systems. Pipelines need to be identified in compliance with AS 1345:1995.

9.10 Emergency decontamination procedures

When a warm-water system is known or suspected to be contaminated with a high population of *Legionella*, the system must be shut down promptly. Decontamination procedures must begin after samples have been collected for microbiological testing at a qualified laboratory. The decontamination procedures usually employed are heat treatment at a minimum of 70°C for at least five minutes or super-chlorination. Details of this latter procedure are set out in Appendix 5.

9.11 Legal requirements

The *Public Health Act* defines hot-water system to mean a system designed to heat and deliver water at a temperature of at least 60°C at each outlet point and warm-water system means a system designed to heat and deliver water at a temperature of less than 60°C at each outlet point.

The *Public Health Act* and *Regulation* does not apply to a dwelling where only a hot-water system or warm-water system is installed.

The owner and/or occupier of the premises is **required to register** the warm-water system (but not a hot-water system) with the local Council and provide the following details:

- a list of the type and number of each system(s)
- address of premises
- name, residential address, business address and telephone number of the owner
- where the operation area of the water-cooling system is otherwise occupied, the name, residential address and business address and telephone number of the occupier.

In order to comply with the *Act* in respect of the installation, operation and maintenance of the hot-water system and warm-water system the following requirements must be met:

Installation

- The system must be installed in accordance with AS/NZS 3666.1:2002 as applicable to the specific system, except to the extent that this Regulation provides otherwise.
- If the system automatically produces warm water for ablution purposes the system must not be installed (see Section 9.8) unless it is of a kind approved in writing by the Director-General of the NSW Department of Health (fee applies).

Operating and maintenance requirements

- The regulated system must be operated and maintained as required by AS/NZS 3666.2:2002.
- Sufficient maintenance must be carried out on a hot-water system so as to ensure that at any time when the system is in operation it delivers water at each outlet each time the outlet is turned on at not less than 60°C, once any water standing in the pipe to that outlet before it was turned on has been expelled.
- The prescribed maintenance requirements for a warm-water system are those set out in the most recent version of the document entitled *Requirements for the Provision of Cold and Heated Water* published by the NSW Department of Health from time to time.

Maintenance precautions

When maintenance of a hot-water system or warm-water system is being carried out contamination of adjoining areas and the ambient environment by aerosols, dust, particulate matter or effluent must be minimised and it must be ensured that public access to the area in which the maintenance is being carried out is prevented.

Evaporative air coolers

10

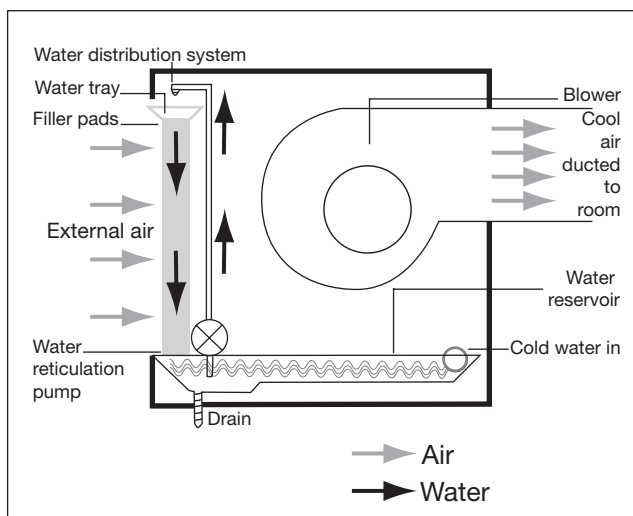
Evaporative air coolers are not a regulated system. That is, the *Regulation* does not apply to them. This section however, still gives guidance on the design, installation, operation and maintenance requirements of evaporative air coolers. Due to the design of the evaporative cooling system, there is minimal risk of legionellosis being transmitted. It was therefore decided not to regulate these systems so that resources could be concentrated on the control of higher risk systems. While control of evaporative cooling systems has been removed from the *Regulation*, the *Public Health Act* has not yet been amended to reflect this change.

10.1 Operation

Evaporative air coolers operate by utilising the physical phenomenon of cooling air entering the building by evaporation of water (see Figure 5). These systems will only work satisfactorily in dry climates as a high level of humidity prohibits an adequate rate of evaporation. They are used in large numbers in areas remote from the coast, for instance in western NSW. They have not been implicated in any outbreak or case of Legionnaires' disease, although *Legionella* bacteria have been found in such systems.

Evaporative air coolers require regular attention and the manufacturer's instructions for operation and maintenance must be followed.

Figure 5. Evaporative air cooler



10.2 Industry best practice

Evaporative air coolers should be designed, installed and commissioned in accordance with AS/NZS 3666.1:2002. Evaporative air coolers should be operated and maintained in accordance with AS/NZS 3666.2:2002.

10.3 Minimising contamination

Before switching the unit off, the fan should be allowed to run for a few minutes to dry the filter pads. Evaporative coolers should be fitted with a bleed-off system. This is essential to prevent excessive accumulations of dissolved solids and other impurities within the unit.

Compost and potting mix

11

This section gives guidance on precautions when handling compost, garden soils and potting mix as cases of Legionnaires' disease have occurred through contact with potting mix.

11.1 Introduction

There are a significant number of sporadic and single cases of Legionnaires' disease caused by a different *Legionella* organism known as *Legionella longbeachae* serogroup 1. This organism has, in contrast to cooling-towers and warm-water systems, been isolated from composts, soil conditioners and mulches, soils for landscaping and garden use and potting mixes. Composted materials also may contain other *Legionella* species which have not been implicated in these infections.

11.2 Manufacture

In Australia, potting mixes are generally made from mixing sand with composted wood products, such as pine bark, sawdust and wood shavings. Composting of wood products requires adequate moisture and nitrogen to be effective. The process generates heat over a number of weeks. This can be an optimal environment for the multiplication of *Legionella*.

It has been reported that *Legionella* has been found in more than 50% of commercial potting products in Australia. Several *Legionella* species have been detected in both commercial potting mixes and in the composted organic matter used in such media. *Legionella* are also commonly present in composted vegetable matter prepared by home gardeners.

The route of infection has not been established. However, it may be that aerosols containing *Legionella* are formed during the handling of potting mixes or during watering. Alternatively, *Legionella* infection could result from the ingestion of organisms, which form colonies in the area of the throat, and are then aspirated into the lower respiratory tract.

11.3 Precautions

There is no statutory requirement in NSW that potting mixes must have warning labels attached. This is because most manufacturers have volunteered to use an industry agreed warning label, a copy of which follows as Figure 6.

A number of precautions can be taken by gardeners to minimise the risk of infection from potting mixes, such as avoiding the inhalation of airborne potting mix, wearing gloves, washing hands after handling potting mix, and moistening the contents to avoid creating dust. It is also important to keep the bags cool by storing in the shade to minimise the growth and survival of *Legionella*.

Figure 6. Example of the Recommended Warning Label

RECOMMENDED LABELLING OF BAGGED PRODUCTS, SALES DOCUMENTATION AND BULK HANDLING AREAS

To be displayed in one line in clearly visible type and colour at the front top of the bag:

WARNING: This product may affect your health. For your personal safety ensure you first read the warning on the reverse side of this bag.

To be displayed in clearly visible type and colour, consistent with other information on the packaging, elsewhere on the packaging:

Warning

This product is made from organic materials which may contain living micro-organisms, including bacteria, fungi and protoza.

Risk	Direct contact with this material or its dust or moisture may cause skin irritation (dermatitis), skin infection or eye irritation. Inhalation of dust or moisture droplets may irritate, inflame or sensitise the nose, throat and lungs resulting in illness ranging from hayfever, asthma to pneumonia (Legionella) or pneumonia-like illnesses.
Safety	Avoid contact with eyes and skin. Avoid breathing dust or moisture droplets. Wear suitable protective clothing and gloves (AS 2161). If exposed to dust or moisture droplets, also wear eye protection (AS/NZS 1337) and respirator (AS/NZS 1715 and 1718). Wash thoroughly after handling. Wash work clothes separately from other clothes. Clean up by wet sweeping or vacuuming.
First-aid	Irrigate eyes with plenty of water for 10 minutes. Wash skin with soap and water. Seek medical attention for any persistent skin, eye or respiratory symptoms.

For further information refer to the Material Safety Data Sheet for this product which is available from Company Details (THIS PART OPTIONAL).

The following disclaimer is recommended but optional:

Disclaimer:
Nothing stated in this warning can guarantee against the catching of skin irritation, illness or disease, including Legionella. However, on the scientific evidence available your risk of injury will be substantially reduced by following these precautions.

This section outlines the necessity for operation and maintenance manuals and keeping accurate records of inspections and maintenance.

12.1 Manuals

All systems are required to have operation and maintenance manuals which should be either published by the manufacturer of the system, the supplier of the system or by a competent person. A separate set of manuals is usually provided for the water treatment process. The manuals should reflect all of the operation and maintenance requirements of the legislation, Australian/New Zealand Standards, the manufacturer, the contractor, guidelines, handbooks and common sense. Specifically an operating manual must include, but need not be limited to, physical details (with drawings) of the system, and operating and shut down procedures.

The person who installs a regulated system on any premises is guilty of an offence if, before the system is handed over for operation, the occupier of the operation area on the premises is not provided with a copy of the operating manual for the system.

All systems are to be operated and maintained in accordance with the manuals. A copy of the manuals are to be kept at all times in a readily accessible position on the premises on which the system is installed. A copy of the manuals are to be made available so that they may be used on the premises by a maintenance contractor or scrutinised by an authorised officer.

The operation and maintenance manuals need to be periodically reviewed and revised, as necessary, to incorporate the requirements of amended legislation, standards, codes and industry practice.

12.2 Maintenance records

The prescribed maintenance requirements of the *Public Health (Microbial Control) Regulation* adopt AS/NZS 3666.2:2002. The standard requires, in Section 2.6, that records of maintenance be kept. Whenever a maintenance inspection of a regulated system is carried out, the occupier or maintenance contractor responsible for that plant must make a written record of the date and details of the inspection.

Whenever maintenance work is carried out on a regulated system, the occupier or maintenance contractor responsible for that plant shall make a written record of the date and nature of the work performed, and the name of the employer. The maintenance record is to be signed by the person who actually performs the work. An authorised officer may enter any regulated premises and inspect the records and should make a record of the inspection in the maintenance record.

12.3 Report on maintenance work

Any person who carries out an inspection or maintenance work on any water-cooling or warm-water system shall complete a maintenance report. Failure to do so is a breach of the Act. All maintenance reports must be kept on the premises. The maintenance report may be in the form as contained in Appendix 3.

This section emphasises training, as a most important part of microbial control of water-cooling systems and warm-water systems is a thorough understanding of the principles involved by all stakeholders.

This applies equally to maintenance staff, engineers, building owners and managers, equipment manufacturers and officers representing the various authorities. These persons must ensure that they attain an adequate level of knowledge about the subject and they must keep up-to-date with the latest developments and findings.

In order to achieve a better standard of equipment, more efficient systems and more effective maintenance a number of training courses are available. The NSW Department of Health works closely with recognised training institutions to develop and update appropriate courses. Two identical courses are conducted by NSW Technical and Further

Education (TAFE) both called *Microbial Control for Air Handling and Water Cooling* and given the course numbers 4249 by TAFE and 22582 by TAFE PLUS. Inquiries should be directed to TAFE OTEN on 1300 362 346 and TAFE PLUS on 8234 2778. The TAFE website URL is <http://www.tafensw.edu.au>. It is strongly recommended that Environmental Health Officers attend.

The Department of Fair Trading restricts air-conditioning work and refrigeration work to holders of an endorsed licence or appropriate certificate or by a person under the supervision of such a person.

Only competent persons should be employed to maintain or decontaminate a regulated system. Such persons should at least have successfully completed an appropriate course.

Safe working practices

14

This section emphasises the necessity for safe working practices as chemicals used in operating, maintenance and cleaning procedures must be treated with caution. Legionellosis is, of course, also a potential health hazard for people who work around systems harbouring the bacteria. Safe working practices are vital and it is important that safety measures are instituted as soon as possible.

Safety measures must be observed by all, whether they are a maintenance worker, a building inspector or someone taking a sample from the system. The risk is from contaminated aerosols and spray mists, as well as the obvious hazards of working with chemicals and around structures with difficult or inadequate access.

All stakeholders particularly the site owner, occupier, manager, all contractors and visitors to the site have a role under occupational health and safety legislation. It is paramount that new installations be designed and constructed to provide safe access, while existing installations must be made safe without delay. The requirements of the *Occupational Health and Safety Act 2000* should be determined and observed. The requirements of AS 1470 and AS 1657 need to be applied.

Protective measures must be taken during maintenance and inspections of air-handling and water-cooling systems to reduce the risk of inhalation of spray mists or exposure to toxic chemicals. Respirators must comply with and be used in accordance with appropriate Australian Standards. Table A1 of Appendix A of AS/NZS 3666.2:2002 can be considered as the minimum requirement for personal protective equipment during maintenance of, and indeed for any activity associated with air-handling and water-cooling systems.

The location of the system must be taken into consideration to ensure that maintenance and cleaning activities do not put any persons or adjoining premises at risk. AS 2865 gives guidance as to precautions to be observed when working in confined spaces such as cooling-towers or storage tanks.

Anyone taking a sample from a system, particularly during a suspected outbreak, must also take protective measures. Safety signs to AS 1319 need to be exhibited in the respective work areas. The handling and storage of water treatment chemicals needs to conform to AS 2714, AS/NZS 3666.2, AS 3780 and AS/NZS 4452 as applicable.

Building construction and modifications

15

This section addresses aspects of microbial control which need to be considered during building construction and modification.

Designers and Environmental Health Officers need to be aware of the principles of *Legionella* control when dealing with modifications and renovations to air-handling or water-cooling systems in existing buildings. To reduce the risk of *Legionella* proliferation in buildings which are being constructed, upgraded or modified, certain work practices must be applied. They include:

- ensuring that clearly marked, detailed plans of any proposed building work affecting an air-handling system or water-cooling system are obtained and approved before work begins on-site
- ensuring that ductwork, fresh air intakes, exhaust outlets and cooling-towers or evaporative condensers are positioned or repositioned in a way that is not conducive to the growth of *Legionella*
- as required by AS/NZS 3666.1.

Fresh air intakes must be located away from cooling-towers and exhaust discharges from air-handling systems to avoid cross contamination from the same or nearby buildings. Prevailing wind directions should also be considered. Air intakes must be designed and installed to minimise the entry of rainwater and prevent the entry of birds, rodents and windblown material such as leaves and paper.

Cooling-towers must not be located near exhaust discharges from kitchens or other areas where nutrients conveyed in these systems could assist in the growth of *Legionella*.

When considering the relocation or repositioning of ductwork in a building, care should be taken to ensure that the ductwork is designed and installed to minimise the ingress and accumulation of moisture. This includes grading ductwork to prevent water collection. As an added precaution, all ductwork must be cleaned before the air-handling system is commissioned.

Location of cooling-towers near occupied areas, pedestrian thoroughfares, air intakes and building openings should be avoided.

Approvals and authorisation

16

This section summarises specific approvals or authorisations required.

The *Public Health (Microbial Control) Regulation* requires that a type of warm-water system which automatically produces warm water for ablution purposes must be approved by the Director-General of the NSW Department of Health before it may be installed. Any approval given by the Director-General may be given subject to conditions specified in the approval. An administrative fee is required to accompany an application for approval.

The requirements for approval are provided in the most recent version of the document *Requirements for the Provision of Cold and Heated Water* published

by the NSW Department of Health from time to time. This document is available from any Public Health Unit or may be downloaded from the Environmental Health Branch Web Site at:
<http://www.health.nsw.gov.au/public-health/ehb/general/microbial/microbial.html>.

All plumbing and drainage products must be authorised by Quality Assurance Services, Australia to SAA MP 52.

The local authority should be contacted prior to the installation, replacement, renovation or modification of any regulated system to determine if any approval is required under the provisions of the *Environmental, Planning and Assessment Act, 1979*.

Sampling procedure

17

In this section sampling procedure essentials are explained to ensure that samples are of good quality and represent the system under examination.

In the collection of samples for microbiological examination, scrupulous care is necessary to ensure that the sample is representative of the water being examined. Accidental contamination of the sample must be avoided. Sampling personnel must be properly trained in the way in which samples are collected as this has an important bearing on the results.

Where samples are being collected for chemical and microbiological examination on the same occasion from the same source, the sample for microbiological examination must be collected first. This is to avoid the danger of contaminating the sampling point during the collection of the other samples. The sampling procedure of Appendix A of AS/NZS 3666.3 should be followed.

In cooling-towers, samples must be collected from the circulating water. Care must be taken to avoid the collection of sludge and other material. Samples should not be taken adjacent to water inlets, dosing points or bleed off locations. Where possible sampling taps should be installed so that they may be run for at least 30 seconds to drainage before a sample is taken.

In warm-water systems, samples must be collected from the circulating water outlet fixtures as well as the water contained in the storage vessel. Again, care must be taken to avoid collecting any sludge or other material.

During collection the sample containers must be clearly and permanently labelled to prevent confusion of samples. Following collection, samples must be transported to the laboratory in a cooler with ice bricks or portable refrigerated container to cool the sample to a temperature between 2°C and 6°C.

The volume of the sample is usually determined by the analysing laboratory, but the NSW Department of Health's Division of Analytical Laboratories requires a minimum 250 mL for *Legionella* testing. The sample container must be pre-sterilised and have added sodium thiosulphate to neutralise any chlorine or bromine which may be in the water. It is desirable to determine the level of residual disinfectant at the sampling point at the time of collection.

Microbiological examination of the sample should preferably be started within six hours of collection of the sample, but the interval between collection and the beginning of examination should not exceed 24 hours even if stored at the refrigerated temperature.

Contractors should contact their chosen laboratory to ensure that they are National Association of Testing Authorities (NATA) accredited for the analysis to be performed and that the laboratory performed satisfactorily on any quality assurance performance testing by NATA .

The role of local authorities in NSW

18

In this section the strategic importance of local authorities is highlighted and some guidance is given for the development of a management plan to ensure registration and legislative compliance of systems. Authorised officers need to be specifically authorised under the Act.

18.1 Basic knowledge

Local authorities have a significant role in the control of *Legionella* in NSW. Local authority officers involved in the control measures must have a clear understanding of how air-handling and water systems work and be aware of the principles of microbial control and problems that can be encountered. They must be able to supervise the decontamination of systems. It is not anticipated that local authorities will routinely collect samples to detect *Legionella* bacteria. However, it is important that they, due to their local knowledge and resources, ensure compliance with any relevant regulations and standards.

Local councils have the ability to charge a fee for service for registration of water-cooling and warm-water systems. They also have the ability to charge fees for inspections of cooling-towers and other systems provided the fee establishment procedure under the *Local Government Act* is followed. This is despite the service being carried out under the *Public Health Act*. A recent survey indicated that very few councils charge a fee for service for microbial control activities.

18.2 Management plan

Local councils should develop a *Microbial Control Management Plan* or *Strategy* as part of their overall environmental health planning strategy in consultation with neighbouring councils and the Public Health Unit.

The *Management Plan* could include issues such as:

- developing mechanisms to ensure registration of all water-cooling and warm-water systems in a database such that details may be recalled easily in the event of an outbreak or a random selection as part of a monitoring program
- developing a monitoring program based on community public health risk
- monitoring activities to ensure system maintenance in accordance with manuals and equipment and in accordance with the manufacturer's and contractor's specifications
- ensuring new installations comply in all respects with the legislation and appropriate Australian Standards
- ensuring older installations are improved and updated as soon as possible with emphasis on safe and effective microbial control
- during random inspections of premises keeping a look out for poorly maintained and defective systems as many are only found during random inspections. Glaring defects must be remedied immediately. Building owners and occupiers should be advised that, in the long term, upgrading or renewing the system will be more economical, effective and enable easier compliance with regulations and standard
- ensuring the satisfactory operation of all systems, old and new
- developing a reporting mechanism to measure legislative compliance
- allocating sufficient resources and cost recovery mechanisms to ensure an efficient management plan
- educating building owners and managers so that they realise their responsibilities and legal obligations
- where compliance cannot be obtained by other means or for blatant and deliberate breaches, conducting prosecutions to enforce the law.

18.3 Inspections by authorised officers

Environmental Health Officers are specifically defined as 'authorised officers' under Section 44 of the *Public Health Act 1991*. Councils should therefore ensure that its Environmental Health Officers are specifically authorised (through the provisions of Part 3, Chapter 12, *Local Government Act 1993*) to perform the regulatory role under the *Public Health Act* and *Public Health (Microbial Control) Regulation*.

If an authorised officer believes on reasonable grounds that a regulated system on a particular premises does not comply with the *Act* or *Regulation* the authorised officer may enter the premises and inspect the system. The provisions of the *Public Health Act* 'Powers of Entry' relate to authorised officers and must be observed.

Authorised officers should be well equipped and receive specific specialist training in microbial control issues. See Section 13 Training.

18.4 Registers

Each local authority must maintain a register in relation to water-cooling and warm-water systems installed on premises in its area. An entry into the register is to be made for a water-cooling or warm-water system when the local authority becomes aware of the particulars relating to the system. The local council should also ensure that new building or development applications are cross checked (see Appendix 7) to ensure new registrations.

All entries in the register must include:

- the type of system or a list of the number and type in the case of thermostatic mixing valves
- the address of the premises on which the system is installed
- the name, and the residential and business addresses of the owner of the premises and, if the operation area on the premises is occupied other than by the owner, those particulars in relation to the occupier
- the telephone numbers at which, during business hours and after business hours, the persons referred to above may be contacted
- details of any inspections carried out by the local authority for the purposes of the *Act*.

The entries in the register are to be arranged so as to allow rapid identification of premises and the occupant in case of an outbreak investigation.

A person who is the owner or occupier of premises in respect of which particulars in relation to a water-cooling or warm-water system are required to be kept, is guilty of an offence if the particulars are not retained on the premises. Council should take appropriate action against those persons who deliberately withhold registration details.

Legionella monitoring

19

The Department frequently receives inquiries about monitoring of *Legionella* populations in water-cooling and warm-water systems. *Legionella* are known to be ubiquitous in aquatic environments and members of the community are inevitably exposed to these bacteria. However, infections do not necessarily follow. These depend on the virulence of the *Legionella* strains and host associated conditions such as age, smoking, alcohol consumption, organ transplantation, immunosuppressive therapy, chronic lung disease, cancer and other underlying illnesses.

Consequently, special care must be exercised in buildings such as hospitals and nursing homes where there are people with a high risk of infection.

It must be noted however, that:

- generally, routine laboratory monitoring of *Legionella* populations in water-cooling and warm-water systems of non-health care buildings is not necessary unless part of a performance based maintenance program
- monitoring of *Legionella* populations in the above mentioned aquatic environments of high-risk buildings is essential if nosocomial infections in NSW are to be reduced or eliminated. This monitoring serves to determine whether

unusually high populations of *Legionella* are present. Area Health Services routinely monitor their own health care facilities

- high populations in poorly maintained systems may rapidly proliferate, so immediate action must be taken to reduce potential health hazards. Monitoring will indicate whether the maintenance program adopted is appropriate and whether such a program is applied effectively (eg biocide dosing and control).

The frequency of monitoring should be determined by the record of performance of individual systems. Once efficient systems and procedures have been established, regular monitoring may be reduced to less frequent intervals.

An intensive *Legionella* testing program by the Division of Analytical Laboratories of water samples from high-risk buildings has shown that there is no correlation between the Heterotrophic (Total) Plate Counts and total *Legionella* populations. Therefore, the reliance on the 'dip-slide' for Heterotrophic Plate Count as an indirect measure of *Legionella* contamination is not recommended.

The remedial action recommended at various populations of *Legionella* in water systems for single grab samples is listed in Table 2. Where a performance based program established through a risk management approach is used then AS/NZS 3666.3 must be used.

Table 1. Action recommended at various populations of total *Legionella* in water systems where a single sample has been taken

<i>Legionella</i> population (colony forming units per mL)	Indication/Action
Less than 10	Effective maintenance practices.
Up to 100	Maintenance practices may not be satisfactory. Rectify. Monitor and perform follow up testing.
100 to 1,000	Potentially hazardous situation. Re-evaluate maintenance procedures including current disinfection process. Rectify and perform follow up testing.
Greater than 1,000	Serious situation. Shut down the system promptly and decontaminate (see Appendix 1). Return to service and perform follow up testing.

Note: Heterotrophic (Total) Plate Counts in excess of 100,000 cfu/mL for water-cooling systems and 100 cfu/mL for warm-water systems may indicate that maintenance practices are not satisfactory.

Emergency management plan

20

The outbreak of Legionnaires' disease in Wollongong in 1987 which resulted in 44 cases and 10 deaths clearly established the need for an *Emergency Management Plan*. The plan was completed and subsequently released in October 1989.

The *Emergency Management Plan* is being revised and currently includes:

- an action plan for a single case
- an action plan for numerous cases
- an outline of the disease
- interview proforma
- medical information and case definitions
- field coordinating centre details
- sampling procedures for environmental samples
- clinical specimen details
- requirements for bacteriological, chemical and spa pool sampling.

The Legionnaires' disease *Emergency Management Plan* referred to in the legislation has been incorporated into the *Legionnaires' Disease Public Health Emergency Management Plan* of the NSW Department of Health. Any investigation of an outbreak of Legionnaires' disease must be carried out in accordance with the *Legionnaires' Disease Emergency Management Plan* of the NSW Department of Health if activated.

An essential component of the *Emergency Management Plan* is the role definition where Area Health Services personnel are mainly associated with case investigation and local authorities perform the environmental investigations of likely infection sources.

Each local authority must keep the necessary contact lists as required by the plan. An authorised officer investigating an occurrence of Legionnaires' disease may, by order served on the occupier of premises, direct that a regulated system that is on the premises and is described in the order be maintained as directed by the order while it is in force. Directions given in an order in force are prescribed maintenance requirements.

To the extent to which directions given in an order in force under the *Act* are inconsistent with any other legal provision then the directions prevail.

Glossary

Act – means the *Public Health Act 1991*.

air-handling system – means a system designed for the purpose of directing air in a positive and controlled manner to and from specific enclosures by means of air-handling plant, ducts, plenums, air distribution devices and automatic controls.

annually – in relation to an action to be taken with respect to a regulated system, or part of a regulated system, means taking the action before the expiration of each period of 12 months that next succeeds the latter of:

- the installation of the system or part; or
- the commencement of the provision in which the expression occurs.

AS/NZS 3666 – means the publication of Standards Australia called *Air Handling and Water Systems of Buildings – Microbial Control*, Parts 1 and 2 of 2002 and Part 3 of 2000.

biocide – a chemical capable of killing micro-organisms (microbes).

clean – visually free of sludge, slime, algae, fungi, rust, scale, dust and dirt or any foreign material.

Code – means this *Code of Practice* known as the *NSW Code of Practice for the Control of Legionnaires' Disease*, 2nd Edition 2004.

cooling-tower means:

- (a) a device for lowering the temperature of water or other liquid by evaporative cooling; or
- (b) an evaporative condenser which incorporates a device containing a refrigerant or heat exchanger.

cooling water system – for the purposes of this *Code*, a cooling water system as defined in AS/NZS 3666.1 is the same as water-cooling system as defined in the *Act*.

competent person – has varying applications in the *Regulation* – see Section 6.

disinfection – significant reduction of the population of micro-organisms using chemical or physical means.

evaporative cooling system – means a system that effects a reduction of dry bulb temperature by evaporating water into the air being treated.

Heterotrophic (Total) Plate Count – is a measure of the aerobic and oxygen-tolerant bacterial populations present in a water sample.

hot-water system – means a system designed to heat and deliver water at a temperature of at least 60°C at each outlet point.

Legionellosis – is the term which denotes clinical diseases (pneumonic and non-pneumonic) caused by *Legionella* species of bacteria.

Legionnaires' disease – is defined as any pulmonary (lung) infection in patients caused by *Legionella* species.

local authority – includes council or local council.

monthly – in relation to an action to be taken with respect to a regulated system, or part of a regulated system, means taking the action before the expiration of each named month that next succeeds the latter of:

- the installation of the system or part; or
- the commencement of the provision in which the expression occurs.

'Three monthly' has a corresponding meaning.

mg/L – milligram per litre, equivalent to parts per million.

NHMRC – National Health and Medical Research Council.

nosocomial infection – hospital or health care facility acquired infection.

Glossary

operation area – in relation to any regulated premises means that part of the premises on which a regulated system is installed.

outbreak – usually means two or more disease cases linked by time and place.

penalty unit – Penalties in all legislation are now described in terms of 'penalty units' where the value of the penalty unit may be periodically increased in line with cost indexing. One penalty unit is currently \$110. A person convicted by a Local Court is liable to a penalty not exceeding 100 penalty units (currently \$11,000) and/or imprisonment for a term not exceeding 12 months. A person convicted by the Supreme Court is liable to a penalty not exceeding 500 penalty units (currently \$55,000) and/or imprisonment for a term not exceeding two years.

Prosecution for an offence may be commenced at any time within, but not later than, two years after the time at which the offence is alleged to have been committed.

pH – a measure of the degree of acidity or alkalinity in an aqueous medium; a pH below 7 represents acidity and above 7 represents alkalinity.

pontiac fever – a form of legionellosis which is characterised by influenza-like illness.

ppm – parts per million, equivalent to milligrams per litre (mg/L).

product and/or process for disinfection – means a product or process designed to control microbial growth in systems.

regulated system – a system to which the *Regulation* applies (see Section 5.1).

Regulation – means the *Public Health (Microbial Control) Regulation 2000* as amended.

thermostatic mixing valve – (a type of warm-water system) means a mixing valve in which the temperature from the mixed water outlet fixture is automatically controlled by a thermostat to a pre-selected temperature.

water-cooling system – means a cooling-tower (and evaporative condenser) and its associated equipment and pipe work.

warm-water system – means a system designed to heat and deliver water at a temperature of less than 60°C at each outlet point.

Appendix 1 – Emergency decontamination procedure for water-cooling systems

- Circulate a dispersant.
- Dose with sodium hypochlorite to maintain 25-50 mg/L (ppm) of free residual chlorine at pH 7.0-7.6 for 30 minutes. (Check concentration at 15 minute intervals.)
- Drain to either (a) sewer, or (b) where sewer is not available, disposal shall be in accordance with the requirements of the local authority or other relevant authority.
- Thoroughly scrub all wetted surfaces of the water-cooling system as practicable.
- Refill.
- Re-dose with sodium hypochlorite to maintain 5 mg/L (ppm) of free residual chlorine at pH 7.0 to 7.6 for one hour. (Check concentration at 15 minute intervals.)
- Drain and refill.
- Re-commission and reinstate full water treatment program.

NOTE: ASTM D1253 provides particular advice on checking for free residual chlorine.

Appendix 2 – Certification by a ‘competent person’ of a process designed to control microbial growth in a water-cooling system

Clause 9(2)(b) Public Health (Microbial Control) Regulation, 2000

I _____

of the firm _____

hereby certify that the following process designed to control microbial growth known as the _____

and marked with the unique identification model _____

and serial numbers _____

and supplied by _____

is an effective process under the range of operating conditions that could be expected for the water-cooling system

identified as _____ installed at _____.

Details and drawings of the process designed to control microbial growth are located at _____

I am a competent person within the meaning of *Clause 9(3), Public Health (Microbial Control) Regulation, 2000*, being a tertiary qualified *chemist / chemical engineer / engineer / microbiologist with my qualification being _____

I have expertise and have been working in the water-cooling system industry specifically with water-cooling systems for _____ years.

I am prepared to provide supplementary remedial *advice / action / co-ordination should any microbiological test of the above water-cooling system exceed the prescribed microbial standard in *clause 9(2)(c) Public Health (Microbial Control) Regulation, 2000*.

Signature _____ Date: ____/ ____/ ____

* delete as applicable

This certificate expires in one (1) year from the above date.

Appendix 3 – Sample report on maintenance of a water-cooling system

Name of owner/occupier	
Address of premises	
Location of water-cooling system	
Name and address of contractor company	
Contractor license no _____ Employee license no _____	
Tower identity	
Make and model	
Type of treatment	
Type and brand of chemicals used	
Sample taken for Heterotrophic Plate Count?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Sample taken for Total Legionella?	<input type="checkbox"/> Yes <input type="checkbox"/> No
General condition of tower?	<input type="checkbox"/> Clean <input type="checkbox"/> Mildly dirty <input type="checkbox"/> Dirty
Process to control microbial growth Certified?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Defects found:	
Description of rectification and other work carried out:	
Date of last routine maintenance: ____/____/____	
System maintained in accordance with maintenance manual?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Signature of Contractor: _____ Date: ____/____/____	
Signature of Site Manager / Owner: _____ Date: ____/____/____	

Appendix 4 – Procedure for routine cleaning of warm water storage tank systems

- The requirements of AS 1470 and AS 2865 shall be complied with.
- Determine the capacity of the warm water storage tank and the cold water feed tank.
- Shut off the isolation valves on the hot water heating coil serving the warm water storage tank. Close the inlet valve on the cold water storage tank.
- Ensure that the warm water circulation and stirring pumps (where provided) are operating.
- Check pH and adjust to within the range 7.0-7.6. Dose the warm water storage tank with sodium hypochlorite to maintain a free chlorine residual of 5-10 mg/L (ppm). Activate reticulation system by progressively opening all warm water outlet fittings until chlorinated water is discharged. Close all outlets and allow chlorine contact for at least 30 minutes. Measure free residual chlorine at 5 minute intervals.
- Switch off the stirring and circulation pumps and shut the isolation valves (where provided) in both the warm water flow and return lines adjacent to the warm water storage tank.
- Close the valve on the cold water supply line to the warm water storage tank. Open the valve fully on the drain line from the warm water storage tank and discharge the entire contents of the tank to either: (a) the sewer, or (b) where sewer is not available, disposal shall be in accordance with the requirements of the local authority or other relevant authority.
- After this operation is completed, open the valve fully on the cold water supply line to the warm water storage tank and allow the cold water storage tank to flush through the feed line to the warm water storage tank and to discharge to either: (a) the sewer, or (b) where sewer is not available, disposal shall be in accordance with the requirements of the local authority or other relevant authority. Use a hose to help clean the feed line.
- Open the valve fully on the drain line from the cold water storage tank and allow any remaining water to drain to waste.
- Close all outlet fittings and thoroughly clean all internal surfaces of both the warm water and the cold water storage tanks.
- After the cold water feed tank has been cleaned out and the associated drain line flushed, close the isolation valve on the cold water feed line to the warm water tank and then open the valve on the cold water inlet to the cold water feed tank and allow the cold water feed tank to refill while the warm water storage tank is being desludged and cleaned.
- When the warm water tank has been cleaned out and the associated drain line flushed, allow hot water to flow temporarily through the heating coil to aid in identification of any leaks in the coil. All such leaks are to be repaired.
- Close the drain valve on the warm water storage tank and open the valve on the cold feed line to the warm water storage tank. Allow both tanks to refill.
- Dose all tanks with sodium hypochlorite to maintain a free chlorine residual of at least 5.0 mg/L (ppm). Turn on the stirring pump and open the isolation valves (where provided) on the warm water flow and return lines adjacent to the warm water storage tank.
- Temporarily disconnect the hand showers, shower head rosettes and aerators to aid in the discharge of debris contained in the treated water. Open fully each associated warm water outlet in the building in turn until clean chlorinated water is discharged.
- Thoroughly clean all fittings internally and then disinfect by submerging in water containing 5 mg/L (ppm) of free chlorine residual for at least one hour, and it is recommended that all aerators be replaced with directional nozzles to minimise aerosol formation.

Appendix 4 – Procedure for routine cleaning of warm water storage tank systems

- Flush all outlet fittings for a minimum of three minutes or until clean. Close all outlets and refill warm water storage tank to design level, adjust free chlorine residual to at least 5.0 mg/L (ppm) and allow to stand for a minimum period of six hours. Measure free residual chlorine at 15 minute intervals.
- Drain contents of system to either: (a) the sewer, or (b) where sewer is not available, disposal shall be in accordance with the requirements of the local authority or other relevant authority. Refill and reheat to the required operating temperature.

* *Aerators should be thoroughly cleaned.*

NOTE: ASTM D1253 provides particular advice regarding checking for free residual chlorine.

Appendix 5 – Emergency decontamination procedure for warm water storage tank systems

- Dose with sodium hypochlorite to maintain 25-50 mg/L (ppm) of free residual chlorine at pH 7.0-7.6 for 30 minutes. Measure free residual chlorine at 15 minute intervals.
- Drain to either (a) sewer, or (b) where sewer is not available, disposal shall be in accordance with the requirements of the local authority or other relevant authority.
- Refill.
- Re-dose with sodium hypochlorite to maintain 5 mg/L (ppm) of free residual chlorine at pH 7.0- 7.6 for one hour. Measure free residual chlorine at 15 minute intervals.
- Drain and refill.
- Re-commission and reinstate full water treatment program.

NOTE: ASTM D1253 provides particular advice regarding checking for free residual chlorine.

Appendix 6 – Reference documents

Where there is any conflict with legislation, the requirements of legislation will apply. The following documents provide further important and useful information.

Australian and New Zealand standards

Available through Standards Australia
Tel. 1300 65 46 46 Fax. 1300 65 49 49

- AS 1157 Methods of testing materials for resistance to fungal growth.
- AS 1319 Safety signs for the occupational environment.
- AS 1345 Identification of the contents of pipes, conduits and ducts.
- AS 1470 Health and safety at work – Principles and practice.
- AS 1657 Fixed platforms, walkways, stairways and ladders – Design, construction and installation.
- AS 1668.2 The use of mechanical ventilation and air-conditioning in buildings, Part 2: Mechanical ventilation for acceptable indoor air quality.
- AS 2345 Dezincification resistance of copper alloys.
- AS 2714 The storage and handling of hazardous chemicals – organic peroxides.
- AS/NZS 2832.4 Cathodic protection of metals, Part 4: Internal surfaces.
- AS/NZS 2865 Safe working in a confined space.
- AS 3500.1 National Plumbing and Drainage Code, Part 1: Water supply.
- AS 3500.4 National Plumbing and Drainage Code, Part 4: Hot water supply systems.
- AS 3743 Potting mixes.
- AS 3780 The storage and handling of corrosive substances.
- AS 3806 Compliance programs.
- AS 3909.1 Quality system guidelines, Part 1: Guidelines for the chemical and allied industries.
- AS/NZS 4020 Products for use in contact with drinking water.
- AS 4419 Soils for landscaping and garden use.
- AS/NZS 4452 The storage and handling of toxic substances.
- AS 4454 Composts, soil conditioners and mulches.

Australian standards handbook

SAA MP 52 Manual of authorisation procedures for plumbing and drainage products.

American Standards

American Society for Testing and Materials Standards
Available through Standards Australia
Tel. 1300 65 46 46 Fax. 1300 65 49 49

ASTM D1253 Standard test method for residual chlorine in water.

ASTM D2688 Standard test methods for corrosivity of water in the absence of heat transfer.

ASTM E645 Standard test method for efficacy of microbicides used in cooling systems.

ASTM E1427 Standard guide for selecting test methods to determine the effectiveness of antimicrobial agents and other chemicals for the prevention, inactivation and removal of biofilm.

Industry reference publications

The Australian Institute of Refrigeration, Air-conditioning and Heating (Inc), Melbourne (AIRAH)
Tel. (03) 9614 8868 Fax. (03) 9614 8949

Application manuals

DA16 Air-conditioning water piping.

DA17 Cooling towers.

DA18 Water treatment.

DA19 HVAC&R Maintenance.

