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Water quality – Risk assessments for *Legionella* control – Code of practice

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Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 December 2010. It was prepared by Subcommittee EH/3/4, *Microbiological methods*, under the authority of Technical Committee EH/3, *Water quality*. A list of organizations represented on this committee can be obtained on request to its secretary.

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

The word “may” is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word “can” is used to express possibility, e.g. a consequence of an action or an event.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Introduction

Legionellosis is an infection caused by bacteria of the genus *Legionella*. The most serious is legionnaires' disease, a severe pneumonia with a relatively high fatality rate, which was first recognized in 1976. Outbreaks and sporadic infections occur throughout the world. At least 50 species of *Legionella* have been described and twenty have been associated with disease in humans, but the predominant cause of legionnaires' disease is *L. pneumophila*. *Legionella spp.* are opportunistic pathogens of humans and normally inhabit warm moist or aquatic environments where they grow in association with other organisms. In particular, they are known to grow in a range of protozoa. Their predilection for warm water means that they are capable of colonizing artificial water systems and equipment containing water. Legionnaires' disease is not transmitted from person to person, but is of environmental origin and usually contracted by inhaling the organism in an aerosol produced from water contaminated with the organism. Aspiration of water containing *Legionella spp.* can also cause infection, particularly in hospitalized individuals.

There is a chain of events leading to an individual becoming infected with legionnaires' disease:

- the water system needs to become contaminated (inoculated) with the bacteria;
- conditions have to exist within the system for the amplification of the bacteria to sufficient concentrations to cause infection;
- the contaminated water usually needs to be dispersed into droplets fine enough to form an aerosol for transmission to the victim(s);
- inhalation of contaminated aerosols or, in rare cases, aspiration of contaminated drinking water; and
- the exposed individual has to be susceptible to succumb to infection.

The ubiquitous occurrence of *Legionella spp.*, combined with their association with protozoa, means that all water systems are susceptible to contamination with legionellae via the water supply or dust entering the system. It is therefore normal practice to assume that a system can become contaminated. Whether the amplification of legionellae is likely within the equipment or system can be inferred from the conditions of the water; the design, construction and operating conditions of the equipment or system at the time of assessment; and records of treatment and monitoring of the equipment or system in the past. It is not usually necessary to demonstrate the presence of legionellae by laboratory analysis of samples.

The generation of aerosols can be observed in the operation of systems such as cooling towers, evaporative condensers, many industrial processes, spa pools/hot tubs, showers and taps. Many of these can produce substantial aerosols. Some systems, such as cooling towers, evaporative condensers and some industrial processes, can transmit the aerosol widely, exposing a large population over a wide area, up to several kilometres. Spa pools and hot tubs can expose many users and anyone in the immediate vicinity, while showers and taps are most likely to lead only to the exposure of individual users.

Finally, for an individual to become infected following exposure they have to be susceptible, usually having predisposing conditions. Only a very small proportion of those exposed develop disease, but increasing

age, particularly 50 years and over, smoking, being male and being immunosuppressed through disease or treatment increases susceptibility.

Suitable and sufficient assessment of risks allows appropriate control measures to be put in place to protect the health and safety of employees and members of the public who could be affected by work activities. *Legionella* risk assessment is no different, and is a legal requirement under the Health and Safety at Work etc Act 1974 [1]. The Management of Health and Safety at Work Regulations 1999 [2] and the Control of Substances Hazardous to Health Regulations 2002, as amended) [3], make specific requirements for risk assessment. These regulations apply to the control of *Legionella* and are embodied in the Approved Code of Practice and guidance document, "*Legionnaires' disease: The control of Legionella bacteria in water systems*", otherwise known as ACoP L8.

A risk assessment is a live document, not a one-off exercise, and needs to be reviewed regularly, ideally in anticipation of, rather than in response to, changes. For example, the risk assessment for a new construction ought to be performed before commissioning, but then reviewed when the system has been operating normally for several weeks or months.

It is the responsibility of the duty holder to ensure that an assessment is carried out to identify and assess the risk of exposure to *Legionella* from work activities and water systems and to put in place any necessary precautions. The duty holder appoints a person to take day-to-day responsibility for controlling any identified risk from *Legionella* bacteria. The appointed "responsible person" needs to have:

- a) sufficient standing and authority within the organization (e.g. a manager or director) and competence and knowledge of the system to ensure that all operational procedures are carried out in a timely and effective manner; and
- b) a clear understanding of their duties and the overall health and safety management structure and policy in the organization.

If the duty holder is competent, they may appoint themselves responsible person. Further guidance is given in HSG65: *Successful health and safety management* [4].

A person is identified to carry out the risk assessment. This person can be an employee of the duty holder or an external contractor. This British Standard gives recommendations for how such a person conducts a risk assessment for *Legionella*, though the duty holder remains accountable for implementing the recommendations.

1 Scope

This British Standard gives recommendations and guidance on the assessment of the risk of legionellosis presented by artificial water systems. It is applicable to any undertaking involving a work activity or premises controlled in connection with a trade, business or other undertaking where water is used or stored in circumstances that could cause a reasonably foreseeable risk of exposure to legionellae and contracting legionellosis.

The standard is applicable to risk assessments being undertaken on premises, plant and systems for the first time, and to review and audit

where a previous assessment has been undertaken and where control measures might have been implemented.

This British Standard does not give recommendations for:

- a) the assessment of the risk presented by natural waters, including rivers, lakes, ponds, waterfalls, caves, dew ponds or natural recreational facilities, such as boating lakes; or
- b) the preparation of the scheme of control for the risk systems identified.

Annex A gives general guidance on the assessment of systems, while Annex B to Annex E give guidance on the assessment of specific types of system. Annex F gives an example checklist for the assessment of a particular system (spa pool). A list of equipment that might be used by a risk assessor is given in Annex G, and Annex H gives guidance on the production of schematics.

NOTE The guidance in Annex A to Annex E is not intended to be exhaustive; merely to highlight some of the more common issues associated with particular systems to be considered as part of a Legionella risk assessment. Where appropriate, these annexes contain references to publications that give more detailed information about these systems.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 7592, *Sampling for Legionella bacteria in water systems – Code of practice*

Approved Code of Practice (ACoP) and guidance L8, *Legionnaires' disease – The control of Legionella bacteria in water systems* (third edition), HSE: 2000

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

- 3.1 aerosol**
suspension in a gaseous medium of solid particles, liquid particles or solid and liquid particles having negligible falling velocity
- 3.2 calorifier**
apparatus used for the transfer of heat to water in a vessel by indirect means and incorporating a source of heat
- 3.3 guidance for control**
findings from the risk assessment that can be used in producing a scheme of control
- 3.4 hazard**
biological, chemical or physical agents or water conditions with potential to cause adverse health effects

3.5 key roles

3.5.1 duty holder

individual(s) with the legal responsibility to ensure that health and safety is managed effectively

NOTE 1 The duty holder is the employer where the risk is from their undertakings to their staff or others, the self-employed person where the risk is from their undertaking to themselves or others, or the person in control of the premises where the risk is from systems in the building (e.g. a landlord who remains responsible for the maintenance of the systems). See ACoP L8, para. 23.

NOTE 2 In most cases there will only be one duty holder, but in cases of shared accommodation there could be a shared responsibility. The duty holder cannot delegate this duty, but can delegate managerial responsibility to the responsible person (see 3.6).

3.5.2 responsible person

individual appointed with, and who has accepted, responsibility under the authority of the duty holder for ensuring that the organization's responsibilities for the control of *Legionella* are met and that all individuals and organizations assigned to carry out tasks in the scheme of *Legionella* control are competent to do so

NOTE 1 Also referred to as the "nominated responsible person".

NOTE 2 In a large undertaking there may be more than one responsible person, each responsible for a part of the undertaking, e.g. each block of a large teaching hospital.

3.6 risk

3.6.1 inherent risk

risk associated with the system before any action has been taken to control it

NOTE In the context of Legionella risk assessment (LRA) there is an assumption that the system is or will be inoculated at some point with Legionella.

3.6.2 risk (general)

likelihood of a hazardous event occurring and its consequences

NOTE In the context of this standard, amplification and dissemination of Legionella spp, and exposure to an aerosol of such, are hazards and legionellosis is a consequence.

3.7 risk appetite

amount and type of risk that an organization is prepared to seek, accept or tolerate

[PD ISO/IEC Guide 73, modified]

NOTE For the purposes of Legionella risk assessment, the appetite is for as low as reasonably practicable (ALARP).

3.8 risk assessments

3.8.1 risk assessment (general)

overall process of risk identification, risk analysis and risk evaluation

[BS 31100]

NOTE Includes hazard identification.

3.8.2 Legionella risk assessment (LRA)

process of identifying and assessing the risk of exposure to *Legionella* bacteria from work activities and from water systems or equipment

3.8.3 risk review

reassessment of both the current risk assessment and control scheme to ensure they are valid and up-to-date

3.9 schematic diagram

simple but accurate illustration of the configuration of the water system, including parts that are out of use

NOTE An example of a computer-drawn and a hand-drawn schematic are given in Figure 1 and Figure 2, respectively. These figures are monochrome, but colour might be useful for schematics of more complex systems.

3.10 scheme of control

procedures and checks intended to control the risk of legionellosis

NOTE The scheme can be in either hard copy or electronic formats.

3.11 WRAS

Water Regulations Advisory Scheme

4 Factors to be considered in the risk assessment

There is a chain of events leading to the infection of a human by *Legionella* spp. which should be considered in any risk assessment process:

- a) contamination;
- b) amplification;
- c) transmission;
- d) exposure;
- e) host susceptibility.

NOTE Further information on each of these is given in Annex A.

5 Preparations for risk assessment

5.1 Competence of the risk assessor

The person appointed to carry out the risk assessment may be the duty holder or an employee of the duty holder, but in many cases it is an external contractor. In each case, they should be able to demonstrate that they have specialist knowledge of *Legionella* bacteria, relevant water treatment and the water system(s) to be assessed, and are competent to carry out any necessary surveys, measurements and sampling (see Clause 7).

NOTE 1 Competence may be demonstrated by, for example, a CV indicating the assessor's experience.

NOTE 2 A complex site might require input from more than one assessor of different expertise.

5.2 Agreeing the terms of reference

The risk assessor should, before conducting the risk assessment, agree the following with the responsible person or/and duty holder.

- a) The scope of the risk assessment, including identifying the systems that are to be assessed and those that are not to be assessed. This is important as certain aspects of the risk assessment could require specialist knowledge or equipment (including PPE) to which the assessor would require access.
- b) Whether a schematic has to be prepared or redrawn as part of the assessment and, if so, its form and its coverage.
- c) The person to whom the risk assessment is communicated and reported.
- d) Time frames for key milestones and the completion of the risk assessment report.
- e) The necessary access to the site to be surveyed and the need for a competent escort, as necessary, who is familiar with the system(s) to be assessed and who will be responsible for the assessor's health and safety (see Clause 7). The assessor has a duty to not put themselves or others at risk during the visit.
- f) That the assessor will be made aware of any factors which could compromise the validity of the risk assessment process, such as planned treatment or maintenance.
- g) Any "permit to work" or access clearance necessary for access to the site of the assessment.
- h) Where a large number of essentially identical units/premises are to be assessed and it would be uneconomical to assess each individual unit/premise, what proportion of these would constitute a representative sample (see 7.3).

While there will inevitably be common factors associated with the many and varied types of premises being assessed such that a proportion of these may be treated as a representative sample (see 7.3), the individual nature of each site should be taken into account.

5.3 Independence

The risk assessor should be able to demonstrate impartiality and integrity when carrying out surveys of legionellae in premises. The risk assessor or assessing organization should also demonstrate valid reasons for any proposed course of action. It should be clear, for example, why a certain number of samples were taken for a premises survey or why a particular recommendation was made.

Where an organization provides risk assessment and other services, then it should have in place safeguards to ensure adequate segregation of responsibilities and accountabilities through appropriate reporting structures.

6 Desktop appraisal of documentation

6.1 Preparation

If a current risk assessment is available, it should be appraised by the risk assessor to determine if it is still valid and to identify any changes.

NOTE 1 Appraising the current risk assessment can give the assessor valuable information about the water systems being assessed and the attitude of the management on site.

NOTE 2 The appraisal of the validity of the existing risk assessment cannot be performed adequately without a site survey (see Clause 7).

An appraisal of the current risk assessment, together with the logbook or other records, e.g. monitoring records, should be carried out to determine whether the system is under control and is continuing to be adequately managed. However, recommendations should still be made in the report to keep these successful controls in place. If the current controls, etc., are found to be insufficient or not to have been fully implemented, or if there has been a change in process or management, then the risk assessor should request/obtain and appraise the following.

- a) Up-to-date logbooks and schematic diagram(s) of the water system(s). This will allow the assessor to determine inherent risk arising from design and construction.

NOTE 3 In the absence of an up-to-date schematic diagram, the risk assessor has to make a value judgement as to whether they have sufficient information to complete and issue a risk assessment.

- b) Any current audits.
- c) The current written scheme of control, including:
 - 1) the maintenance history of the water system(s) to be assessed;
 - 2) training records of, and records of competence checks on, site personnel;
 - 3) monitoring and inspection records; and
 - 4) the scheme for the safe operation of the systems.

6.2 Appraisal of the current scheme of control

6.2.1 General

Where a scheme of control is in place, the risk assessor should undertake a detailed appraisal and audit of the scheme and report on its adequacy. If there is no scheme of control in place, a high priority in the risk assessment recommendations should be that one needs to be produced, unless the risk assessor considers that there is no reasonably foreseeable risk, in which case they should document that this is their assessment.

6.2.2 Appraisal of the maintenance and testing records within the scheme of control

The risk assessor should appraise any records of the scheme of maintenance and control that have been implemented for the water systems, ensuring that there is a signature or electronic identification

against each record, depending on whether the records are stored in hard copy or electronically.

NOTE 1 Study of the maintenance records can help the assessor derive information about the continued success of any control measures that are already in place.

The risk assessor should note the relevance and success of the scheme which has been implemented. Evidence should be sought to confirm that work was completed competently and within a reasonable time, and the identity of those who carried out the work.

For actions taken after adverse results have been found in the past the following should be considered.

- a) Were the correct actions taken and the correct communication chain invoked?
- b) Were the actions taken within a reasonable time?
- c) Were the results rechecked (after the action) to confirm conditions were back under control?
- d) If the actions did not result in better control, was an escalation procedure invoked to help and ensure conditions were eventually controlled? If not, is there an escalation procedure in place?
- e) Were there lessons learned or a new procedure put in place to prevent recurrence?

NOTE 2 The answers to all these questions, and the review in general, might also help the assessor gain some insight into the overall management of the site.

The scope of tests can vary according to the plant on each site, but a check should be made to ensure that all the control items or tests outlined within the ACoP L8 for each type of system are being considered.

If these records are not being kept, or cannot be found, the assessor should recommend that a system is put in place as a matter of priority in the final report.

6.2.3 Appraisal of management responsibilities

The risk assessor should check that:

- a) the duty holder, the responsible person and any deputies are clearly identified in the written scheme;
- b) the roles of all responsible persons and parties (e.g. consultants, facilities management companies and water treatment companies) are clearly defined and contact details for these persons and parties are readily available;
- c) lines of communication and the reporting structure are clearly stated in the scheme; and
- d) the tasks to be undertaken by each individual or party are outlined clearly with the necessary frequency of the tasks.

6.2.4 Appraisal of training records and competence checks of site and service provider personnel

The assessor should review the training records of those personnel with an involvement in the scheme of control and make comments as to their relevance and validity. In addition to the formal training records,

the assessor should derive an indication of the level of competence of the staff by studying the site records.

NOTE 1 For example, looking at actions taken after adverse results have been found in the past to ensure that suitable corrective actions were taken in a timely manner.

Records may also be checked to verify, as far as reasonably practicable, that staff are competent to take measurements (see 7.4).

Similarly, the assessor might be concerned that the checks on competence are inadequate, in which case they should make recommendations to improve the procedure for confirming competence.

If the assessor considers the training and/or competence of one or more of the parties to be inadequate, they should state this as part of the report and include the need for training or refresher training as a priority in the recommendations of the final assessment report.

NOTE 2 Common faults or shortfalls might include the following.

- a) *No records of checks of competence in place.*
- b) *Records are in place, but there is no indication of how competence was assessed.*
- c) *Records in place, but refer to training rather than employees' ability to work safely and effectively.*
- d) *No checks on contractor, subcontractor and service provider competence.*
- e) *No review to confirm continued and up-to-date competence.*

6.2.5 Appraisal of the safe operation of the systems

The risk assessor should check that there is a scheme for the safe operation and maintenance of all risk systems which:

- a) includes a description of the correct operation of the plant and any precautions to be taken;
- b) details any start-up and shut-down procedures, and plant rotation and flushing requirements for little-used outlets;
- c) includes, where appropriate, method statements, e.g. for major tasks such as cleaning operations;
- d) outlines any tests that are to be completed on the systems, along with the required frequency of the tests and the acceptable control parameters;
- e) details defects or out-of-parameter results; and
- f) logs appropriate corrective actions.

6.2.6 Appraisal of the monitoring and inspection records

The assessor should appraise the records of monitoring and inspections that have been carried out on the systems being assessed, which may be found within the written scheme or a separate document (possibly cross-referenced with the maintenance history reports).

The assessor should identify the control parameters that have been set (both chemical and physical) and check whether these have been set correctly before deciding if the existing control measures are adequate.

NOTE 1 The assessor will not necessarily have the knowledge or experience to determine whether the control parameters are appropriate,

so it might be necessary for the assessor to check this with the system manufacturer or the representative of the water treatment company.

The assessor should note the relevance and success of the monitoring and inspection work that has been carried out as these will indicate whether the correct actions have been taken based on the monitoring results obtained.

The results of inspections should be checked to see whether these indicate whether the control scheme is sufficient.

To obtain an indication of what to expect during the survey, the assessor should consider the following.

- a) Has the work been completed competently and in a timely manner?
- b) Has the work been completed at the correct frequency?
- c) Do the records indicate who carried out the work?

If these records are not being kept, or cannot be found, the assessor should recommend in the final report that such a system be put in place as a matter of priority.

NOTE 2 Common faults found include:

- 1) *no records in place;*
- 2) *records in place, but incomplete due to all actions going unrecorded;*
- 3) *inadequate or no escalation procedures;*
- 4) *records are kept, but corrective actions have not been performed (or recorded as having being performed) following results which are out of specification;*
- 5) *no preventative maintenance in place;*
- 6) *no, or inadequate, records of maintenance in place;*
- 7) *records not kept for appropriate periods, such as the five years required by COSHH [3];*
- 8) *work not completed in a timely manner.*

7 Site visit/survey

7.1 General

As part of the risk assessment, the assessor should conduct a site survey, with reference to the schematic diagrams and logbooks [see 6.1a)]. The assessor should use the survey to check that the diagrams are still valid and up-to-date. They should also familiarize themselves with the processes taking place on site, including how these could place limitations upon measures to control *Legionella* risks. If sufficient information is not available, the assessor should determine whether, in the absence of the schematic diagrams (or any other critical information), they have enough information available to successfully assess the risk. If they conclude that there is not enough information, they may decline to issue the assessment or decide to issue it in draft format.

When carrying out an assessment, be it on a familiar or previously unknown site, the assessor should consider their own personal safety and ensure that they are safe from all other inter-related health risks while undertaking the risk assessment, including those arising from working at height or in confined spaces [6],[7]. The assessor should ensure that

all appropriate personal protective equipment (PPE) is available and suitable, and prepare their own equipment list (see Annex G).

Before commencing a site visit, the assessor should undertake an assessment of the risks of the site survey. All hazards, their assessment and the precautions planned and taken should be recorded (for example, if plant is operating, history of positive *Legionella* testing results).

7.2 Site inspection

While there will be common factors associated with the types of premises being assessed such that a proportion of these may be treated as a representative sample (see 7.3), the individual nature of each site should be taken into account.

If the assessor identifies an imminent danger of exposure to *Legionella*, e.g. failure of a biocide dosing system or a previously unidentified water system, or one which falls outside the scope of their brief, they should report this immediately to the responsible person or their site representative, and not keep this for the written report.

NOTE Attention is drawn to the Health and Safety at Work Act 1974 [1].

The site inspection should include speaking to management and staff to allow the assessor to judge the effects of the management culture and work practices of the organization in adding to (or reducing) the risk.

The suitability of sentinel/sampling points identified in the current control scheme should be reviewed as part of the survey.

The risk assessor should ensure that measurements of, for example, temperature, taken on site are accurate/reliable by checking the equipment and, as appropriate, taking their own measurements. Performance of equipment installed on site may be assessed by checking records.

7.3 Visual inspection of utilities/location for possible sources of contamination

The assessor should examine sentinel points and any discrete plant or component. The assessor should inspect the water systems to confirm that the configuration is as illustrated in the schematic diagram (see Figure 1 and Figure 2 for examples) and to determine the operation and condition of each system and its components to the extent that they could affect the proliferation and dissemination of *Legionella*.

Where the system being assessed consists of several repeated units, such as multiple storeys or pods in a commercial building, the assessor should decide on representative examples to be inspected. A rolling programme should be employed to ensure that the same premises are not assessed in successive cycles. Where there are many individual self-contained units, such as flats or houses, the *Legionella* risk assessment may be scheduled to coincide with mandatory visits, such as those for gas safety checks. This type of approach may be appropriate in situations where access to housing units for *Legionella* risk assessment is problematic for whatever reason.

Where possible, the assessor should check that the materials are WRAS-approved and conform to the Water Fittings Regulations [5].