

Controlling Legionella

Training and compliance for
air conditioning and water
systems maintenance



Develop Training Ltd | August 2015

About Develop Training

Develop Training Limited (DTL) is the UK's leading accredited provider of compliance, technical, and safety training, supporting thousands of firms with their training needs. Clients include some of the UK's largest and best-known organisations from utilities and construction to defence, healthcare, facilities management, and telecommunications sectors.

Training programmes cover water and environmental, gas and energy, safety, electrical and mechanical, apprenticeships and management development training delivered at one of Develop Training's five dedicated training centres in Linlithgow, York, Derby, Bolton and Swindon or onsite at clients' premises. It also provides bespoke options and training consultancy to provide training tailored to the requirements of individual clients.



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Executive summary

Potentially fatal Legionella bacteria and similar hazards in air conditioning and water systems present a health risk to employees and visitors of affected premises. Employers, managers and responsible persons face prosecution if they fail to comply with UK legislation on the subject.

Maintenance training is essential to control Legionella and other water-borne hazards in air conditioning and water systems. Many workplaces and public spaces are potentially at risk, and the health consequences, including the likelihood of fatalities, increase in facilities where people may have impaired immunity, such as hospitals and care homes. It is crucial

that facilities managers are aware of the dangers and have effective processes and training programmes in place to mitigate them.

Modern training techniques can ensure that responsible persons are trained more effectively in the maintenance of systems than with traditional, classroom-only training. This, coupled with new competency qualifications and compliance processes, gives management flexibility over how and where training is delivered as well as confidence that maintenance is carried out effectively and monitored properly to ensure the health and wellbeing of building users as well as compliance with legislation.

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Introduction: How artificial water systems allow bacteria to thrive

At the time of writing, 12 people are dead and more than 120 are sick from a 2015 outbreak of Legionnaires' disease in New York's South Bronx. While investigations focus on the Opera House Hotel, health officials have tested more than 135 other buildings, discovering the Legionella bacteria in the cooling towers of 20 of them (around one in seven).

Legionnaires' disease has an exotic reputation, but it is not uncommon. In England and Wales, cases number around 300 annually, including infections contracted abroad. The disease is not, as might be supposed, related to the French Foreign Legion but instead acquired its name from the first recorded outbreak in Philadelphia in 1976 at a convention of the American Legion, the US equivalent of the Royal British Legion. More than one in ten of the 2,000 delegates at that convention contracted the disease, and 34 died. Nor is Legionnaires' disease a mysterious or rare plague. It is, in fact, a common form of severe pneumonia, but may not be diagnosed in many cases due to a lack

of clinical awareness, so there are likely to be substantially more cases than are reported.

Legionnaires' disease is one of a number of infections, collectively named legionellosis, caused by Legionella pneumophila and related bacteria, legionellae. The severity of illnesses caused by these bacteria varies from mild fever to the potentially fatal Legionnaires' disease. Anyone may be affected, but age, illness, impaired immune system and risk factors, such as smoking, put certain people at particular risk.

The bacteria breeds in water and causes respiratory disease in humans when a susceptible host either inhales aerosolised water or, in rare cases, aspirates water containing the bacteria. Symptoms include fever, non-productive cough, headache, myalgia, rigors, dyspnoea, diarrhoea and delirium. As the 2015 Bronx case suggests, the causal bacteria are widespread in water systems. However, detection is not easy.

Any building with a water system can provide

the conditions the bacteria need to multiply, with numerous cases attributed to cooling towers and evaporative condensers, which allow the bacteria to take to the air in water droplets. Distributed water (including 13 to 17 per cent of mains water) is likely to contain some microorganisms, including legionellae, which find their way into buildings' water systems. Once they have penetrated the artificial environments of water systems in buildings and cooling towers, they may find the particular conditions they require for growth.

The bacterium Legionella pneumophila can withstand temperatures of 50 °C for several hours, but does not multiply below 20 °C. So the presence of Legionella in certain artificial aquatic environments, which can be assumed to be likely, combined with warm temperatures increases the risk of Legionnaires' disease. Biofilms, thin layers of microorganisms that cling to surfaces in water systems, also help the bacteria to thrive.

Table 1: Risk factors identified by the WHO that can promote the proliferation of legionellae

• TEMPERATURE	• MATERIAL USED IN CONSTRUCTION
• WATER QUALITY	• PRESENCE OF BIOFILMS
• DESIGN	

“The major risk factor for legionellae proliferation appears to be neglect or insufficient maintenance.”
- World Health Organisation



Table 2: High risk facilities

- **Healthcare facilities:** Pre-existing medical conditions increase the chances of contracting, and dying from, Legionnaires' disease with up to 40 per cent mortality. Piped hot and cold water systems have been responsible for many incidents, as well as cooling towers.

- **Hotels:** Large, complex and subject to seasonal use, the piped water systems of hotels are prone to legionellae.

- **Ships:** With the same problems as hotels, ships are also self-contained systems where airborne infections may spread. Cruise ships also often include spas and pools (see below).

- **Natural spas, hot tubs and swimming pools:** With their warm water and concentrated numbers of human users, hot tubs are fertile breeding grounds for legionellae and, along with natural spas, have been responsible for numerous outbreaks. Showers near pools also present a risk.



Table 3: Confirmed Cases of Legionnaires' disease in England and Wales

2010 ~ 357
2011 ~ 235
2012 ~ 306
2013 ~ 285
2014 ~ 331

For business owners and managers as well as responsible individuals, failing to comply with health and safety legislation related to the control of legionella could result in substantial penalties, including unlimited fines, court costs, compensation claims, disqualification and up to two years' in prison. Basildon and Thurrock University Hospitals NHS Foundation Trust was ordered to pay £350,000 in fines and costs for safety failings, including an incident in which seven patients were infected with legionella from the hospital's water system. One man died as a direct result of Legionnaires' disease, and it contributed to the death of another man. Another five patients and a hospital visitor were infected between 2006 and 2010.

Even if poor housekeeping has not resulted in an infection, organisations face prosecution if they fail to adequately maintain systems to prevent the risk. Fines and costs totalling nearly £250,000 were imposed on two firms in the West Midlands after workers and members of the public were put at risk of

exposure to the bacteria. So it is clear legionellae and other bacteria in the water systems of buildings present a potentially serious risk to health, lives, businesses and reputations. Since proper maintenance has been identified as the single most effective action to negate the risk, why do cases continue to occur?



Legionella: The problem with air conditioning and water systems maintenance

Left alone in their natural freshwater environments, the legionellae group of bacteria would present little risk to humans. However, in artificial aquatic environments where the water temperature rises above ambient, it is a different story. Legionnaires' disease is considered preventable by controlling the causal bacteria in the locations where they could otherwise thrive. The opportunity to impact on health and the risk of culpability for an outbreak heightens its significance for public health professionals and anyone involved in, or responsible for, maintaining water systems in buildings. Internationally, the World Health Organisation (WHO) has published guidelines, as have the Health and Safety Executive in the UK.

Nevertheless, it is still uncertain exactly how outbreaks occur. The known factors are:

- The bacteria are present in an aquatic environment
- They grow to a level that is infectious (though it is not known what that level is)
- They are carried via aerosol to a human host that is susceptible to infection.

The World Health Organisation recommends focusing on preventing both proliferation and exposure with control measures.

Table 4: Major outbreaks of legionellosis

- April 1985, Stafford, England: 175 people admitted to hospital with chest infection or pneumonia. 28 die. Source traced to air-conditioning cooling tower on roof of Stafford District Hospital.

- March 1999, Bovenkarspel, Netherlands: 318 people become ill at Westfriese Flora flower exhibition. At least 32 confirmed dead.

- July 2001, Murcia, Spain: The world's largest outbreak. More than 800 suspected cases. At least 16,000 people exposed to the bacterium. Six die.

- September 2005, Canada: 127 nursing home residents become ill. 21 die in first week. Source traced to air-conditioning cooling towers on the nursing home's roof.

- November 2014, Vila France, Portugal: 302 people hospitalised. Seven related deaths. Cooling towers of fertiliser plant are suspected source.

- Source water quality
- Treatment of source water
- Design of systems to prevent stagnation
- Control of temperature to minimise proliferation.

Cooling towers and evaporative condensers, as used in air conditioning and refrigeration systems, have been the origin of serious outbreaks of Legionnaires' disease.

Many of these have been attributed to systems that had fallen stagnant, presumably during the winter when air conditioning was not required, and where water in the systems had not been adequately treated to control legionellae. Maintenance and proper treatment are clearly essential ingredients to control and prevent proliferation of the bacteria. Those responsible for potential "safe haven" systems for legionellae and those whose services connect with these systems must fully understand the importance of an effective water treatment programme in controlling legionellae.

Technical training has to address a variety of scenarios

In distribution systems, particularly complex ones such as those found in hotels and on ships, the best way to prevent colonisation is to keep temperatures outside the 20–50°C range. The World Health Organisation advice is to remove dead and blind ends, maintain elevated temperatures in the hot-water system, and periodically disinfect and permanently chlorinate the cold-water system. Because hot tubs and spas are a particular risk, design, installation, management and maintenance of systems should take this into account. Disinfection, cleaning and monitoring as well as regular service and maintenance must be carried out.

In the West Midlands case (see Introduction), neither company that was prosecuted had a comprehensive, up-to-date risk assessment in place for legionellae, nor had they taken

reasonable steps to control the potential spread by assessing the risk or properly cleaning and maintaining the water cooling system. Employees had not been properly supervised.

Human error

Imperfect procedures, carelessness and a lack of appreciation of the real risk presented may all contribute to a failed maintenance programme. Where systems are complex or where they are a peripheral responsibility for individuals, a lack of knowledge of the risks and the causal processes involved would also appear to be a likely cause of problems. For example, individuals may form the opinion that cleaning a system once a year may be sufficient to eliminate risk, without realising that other factors such as water temperature and system design can also be very significant contributors to the proliferation of the bacteria.

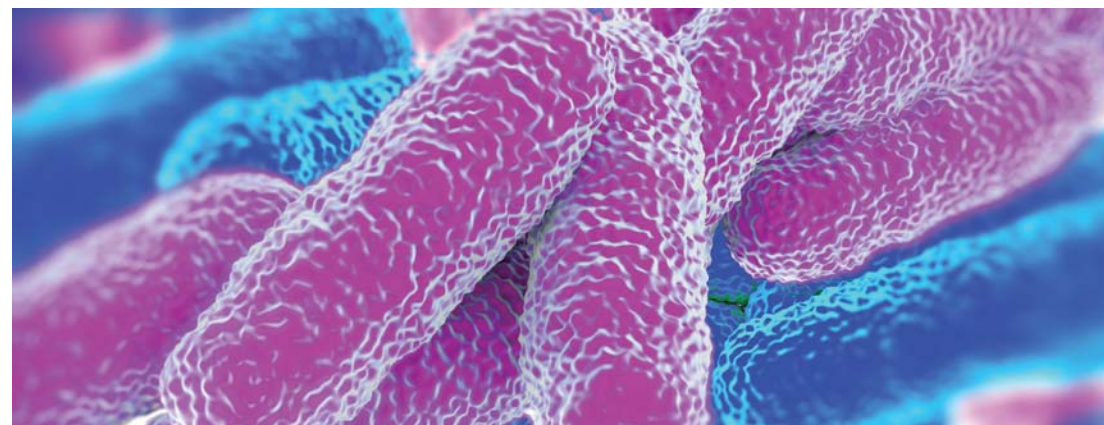
Because outbreaks are commonly associated with systems for heat control, there is a risk from a disconnect between those responsible for the maintenance of thermal systems and their counterparts responsible for maintaining water systems. A lack of appreciation of the problem, or experience in control measures, on either side could lead to an issue developing, as could a breakdown in communication or lack of clear division of responsibilities.

It is worth noting that the bacteria and the disease present difficulties to scientists and medical professionals as well as those involved in, or responsible for, buildings and water systems maintenance. In the Canadian nursing home incident, first culture results were negative, which is not unusual, as Legionella pneumophila is a fastidious bacterium and cannot grow without specific nutrients and living conditions. As noted earlier, it is believed there are many more cases of Legionnaire's disease because of its similarities to common pneumonia while other forms of legionellosis may not be diagnosed without appropriate tests for the bacterium responsible.

“Maintenance of properly treated cooling systems is an essential element in reducing legionellae risks in these environments.”
- World Health Organisation

Table 5: 20 ways organisations let Legionella develop in air conditioning and water systems

- 1. Inadequate maintenance
- 2. Neglect and poorly motivated workforce
- 3. Overly-complex distribution systems with dead ends etc.
- 4. Failure to keep temperatures in water systems outside the 20-50°C range
- 5. Failure to periodically disinfect cold water systems
- 6. Cold water systems not chlorinated
- 7. In new installations, poor design or installation
- 8. Bad management
- 9. Inadequate cleaning and monitoring
- 10. Lack of regular servicing of equipment
- 11. No comprehensive, up-to-date risk assessment
- 12. Employees not properly supervised
- 13. Imperfect procedures or failure to implement
- 14. Carelessness
- 15. Lack of appreciation of the genuine risk
- 16. Seen as a peripheral instead of a core responsibility
- 17. Lack of knowledge of the causes and treatment
- 18. Disconnect between those responsible for individual systems
- 19. Inexperience, poor training and staff shortages
- 20. Lack of clear division of responsibilities or poor internal communications



It has been established that there are complex reasons for outbreaks of legionellosis, including the potentially deadly Legionnaire's Disease. However, it is also clearly understood that the single most effective strategy to prevent bacteria developing is a programme of proper maintenance of water systems. To quote the World Health Organisation: "The major risk factor for legionellae proliferation appears to be neglect or insufficient maintenance."

Periodic major eruptions of the disease, such as the NYC 2015 outbreak, gain worldwide publicity, so it might be expected that building managers would be fully aware of the threat and have programmes in place to deal with them. This is especially true in the health sector where there is heightened awareness of hygiene risks following high profile incidences of MRSA and other bacterial infections.

Nevertheless, perhaps because it is some years since a major incident in the UK, it seems reasonable to suggest that management in many organisations are less aware of the risk and the steps required to mitigate it than

Table 6: Modern training methods

- CASE STUDY
- GAMES-BASED TRAINING
- INTERNSHIP
- JOB ROTATION
- JOB SHADOWING
- LECTURE
- MENTORING & APPRENTICESHIP
- PROGRAMMED INSTRUCTION
- ROLE-MODELING
- ROLE PLAY
- SIMULATION
- STIMULUS-BASED TRAINING
- TEAM-TRAINING

Strategies to prevent legionella in air conditioning and water systems

they should be. In smaller organisations where there is no dedicated health and safety officer, that possibility is increased since premises management and health and safety as a whole will both be peripheral to the main management function of running the business. Under financial pressure, there is an increased likelihood for corner cutting.

Education is therefore important, and to this end the UK government Health & Safety Executive publishes guidance for businesses and landlords on the subject and also publicises cases where it has brought prosecutions in both the private and public sector.

In organisations where management are ignorant or wilfully neglectful, there will be little appetite for solutions to the problem. In organisations that are concerned about the issue and wish to be sure that they take adequate steps to prevent an occurrence in their premises, training is vital. Studies of the causes of accidents have highlighted inappropriate systems of work, poor maintenance, use of defective materials, and poor supervision and training as key contributors. Inadequately trained operators have also been identified as a major reason for the prevalence of water quality incidents and disease outbreaks. Error management techniques put forward as solutions to the problem include selection, training, licensing and certification.

It is clear that addressing these issues with appropriate management and technician training is imperative for building managers and anyone with a duty of care for at-risk premises.

There are many areas of training that could potentially impact on an organisation's performance in combating legionellae and other bacterial hazards in air conditioning and water systems. These are listed below. However, as has been well documented, training someone in an aspect of work does not in itself guarantee that work will be carried out effectively. So duty holders are well advised to ensure that they not only identify where training is required but that

they commission training that will be transferred to the workplace effectively. Outdated views of training as education and a classroom mentality have been replaced by forward thinking training managers and providers, such as Develop Training Limited (DTL), with new learning strategies that are more effective in instilling skills and knowledge that remain in the arsenal of the learner longer term in the workplace. In the quest for a more effective approach to workplace training, new techniques have been added to conventional study formats.

In addition, new communications technology and digital channels have widened the opportunity for both classroom-type and workplace training. For example, DTL now allows learners to video evidence of workplace training and upload the recorded files to an e portfolio, replacing cumbersome paper-based evidence systems.

To ensure adequate systems for maintenance and monitoring are in place, and to ensure compliance with legal responsibilities, it is necessary to implement procedures and documentation, which may include compliance with international standards. Again, it is self-evident that these procedures will not produce the desired outcome unless individuals with appropriate skills are available, tasked and motivated to implement them.

In order for management to be confident that the issue is fully addressed, they will need to ensure that they have effectively communicated with, motivated and delegated to their workforce, and that the workforce is reliable and capable. In the latter instance, qualifications, ideally endorsed by an appropriate authority, can be used to evidence that the responsible person has completed the necessary training, increasing management confidence levels. For technicians who will be tasked with carrying out maintenance, practical training is shown to be more effective than classroom training alone.



Providing training in a setting that is convenient for both the organisation and the learner is important so management should seek flexibility from an external training

provider when commissioning training. Management also need systems to track training and highlight when refreshers are required.

Table 7: Training categories that can impact on preventing legionellae in water systems and air conditioning

MANAGEMENT TRAINING	HEALTH & SAFETY TRAINING
• BUSINESS STRUCTURE	• HOW TO CONDUCT A RISK ASSESSMENT
• DELEGATION SKILLS	• IMPLEMENTING COMPLIANCE PROCESSES AND STANDARDS
• INTERNAL COMMUNICATION – TO ENSURE THE ISSUE IS UNDERSTOOD WITHIN THE ORGANISATION AND TO ENSURE THAT INDIVIDUALS AND TEAMS WITH DIFFERENT ROLES UNDERSTAND WHICH AREAS OF THE ISSUE ARE THEIR RESPONSIBILITY	MAINTENANCE TRAINING
• MOTIVATION	• AIR CON MAINTENANCE
• DISCIPLINE	• WATER SYSTEMS MAINTENANCE
• SUPERVISING PEOPLE	• MONITORING SYSTEMS
• RECRUITMENT – TO ENSURE ENOUGH PEOPLE WITH THE RIGHT SKILLS	INSTALLATION TRAINING
	• INSTALLING DISTRIBUTION SYSTEMS
	• INSTALLING EQUIPMENT



Legionella: Accredited, flexible training solutions from DTL

Develop Training Limited (DTL) has developed a range of training courses, created in partnership with The Chartered Institute of Environmental Health (CIEH). Its Legionella awareness qualification provides learners with an understanding of the risk, how to control it and the warning signs to look for in areas where the bacteria can replicate, providing employers with employee vigilance as the first line of Legionella defence. The training covers steps that maintenance teams can take to keep their systems safe.

- Avoiding water temperatures and conditions that favour the growth of legionella and other micro-organisms

- Ensuring water cannot stagnate anywhere in the system by keeping pipe lengths as short as possible or removing redundant pipework
- Keeping the system and the water in it clean
- Treating water to either control the growth of legionella (and other microorganisms) or limit their ability to grow

As specialists in training for the utilities, construction industry and facilities management organisations, DTL places special emphasis on creating learning environments that are vocational, hands on and practical in nature.

Table 8:
Develop Training Limited (DTL) Legionella training courses

Recognising that organisations differ, DTL offers a great deal of flexibility in the way it delivers training, from set courses at one of its five UK locations to bespoke training packages delivered at a client's own premises.

To enable managers to manage their organisation's training requirements, DTL has created a dedicated online portal, which

includes a range of features from booking and managing training to the control of purchase orders and invoicing as well as identifying refresher training needs...

www.developtraining.co.uk/news/new-online-portal-helps-clients-track-and-manage-training.aspx

- LEGIONELLA AWARENESS AND ACOP L8 (BS6)**
A one day course incorporating City and Guilds assessment and accreditation.
- LEGIONELLA RISK ASSESSMENT OF WATER SYSTEMS (BS4)**
A three day course incorporating City and Guilds assessment and accreditation. Designed for those responsible for carrying out risk assessments on water systems, air conditioning and cooling towers.
- LEGIONELLA: COOLING TOWERS AND AIR CONDITIONING EQUIPMENT (BS3)**
A four day course incorporating City and Guilds assessment and accreditation. The legal and technical knowledge required to operate cooling towers and air conditioning systems safely.
- LEGIONELLA: HEALTHCARE PREMISES HOT AND COLD WATER SYSTEMS (BS2/H)**
A four day training course incorporating City and Guilds assessment and accreditation. The legal and technical requirements for the control of Legionella in hot and cold water systems, aligned to HTM04-01 and the healthcare sector.
- LEGIONELLA: HOT AND COLD WATER SYSTEMS (BS2)**
A four day training course incorporating City and Guilds assessment and accreditation. The legal and technical requirements for the control of Legionella in hot and cold water systems (includes disinfection module).
- LEGIONELLA: HOT AND COLD WATER SYSTEMS, COOLING TOWERS AND AIR CONDITIONING SYSTEMS INCLUDING DISINFECTION (BS23)**
A five day course incorporating City and Guilds assessment and accreditation. Provides delegates with current legal and technical requirements for the control of Legionella bacteria in water systems within buildings.
- LEGIONELLA: ROLE OF THE RESPONSIBLE PERSON/DUTY HOLDER/LANDLORD (BS1)**
A one day training course incorporating City and Guilds assessment and accreditation. The duties and responsibilities of the 'Responsible Person' for supervision, effective implementation and control of risk assessments, and remedial works.
- LEGIONELLA: WATER SYSTEMS REFRESHER (BS8)**
A one day course incorporating City and Guilds assessment and accreditation. For delegates who have successfully completed our Legionella City & Guilds courses BS2, BS3 or BS23 and wish to update their skills.
- MANGEMENT TRAINING • IOSH MANAGING SAFELY (SHE2)**
A four day IOSH managing safely training course designed to deliver better management of health and safety to control risks and keep employees safe.

Business benefits of legionella training with DTL

Legionellosis is a real risk to health in any premises with water systems and air conditioning. Additionally, organisations in the UK that fail to have appropriate risk management and maintenance procedures in place are at risk of prosecution. So it is imperative that a fully trained and properly supervised maintenance team is in place to ensure safe operation of air conditioning and water systems.

Effective maintenance has been shown to substantially reduce the risk of legionellosis in premises and equipment. Effective maintenance also delivers real and measurable business benefits with more efficient operation and

longer system life of systems and equipment. It also protects organisations and individuals with a duty of care from prosecution or civil claims.

DTL's flexible water systems and air conditioning maintenance training can be tailored to the organisation and individual learner, and delivered when and where it is required. This allows organisations to tailor training delivery in a way that is highly cost effective.

Because it is crucial that learners not only experience training but leave the training environment with the skills and knowledge to carry out the work, the DTL learning experience is enhanced by the use of modern training techniques. Qualifications from appropriate external bodies, including the Chartered Institute of Environmental Health and City & Guilds, give management a level of assurance, and provide proof, that the workforce has been properly trained.

DTL's online portal allows managers to track training and highlight when and where, and for whom, refresher courses are required.

Table 9: Key business benefits of legionella training and qualifications

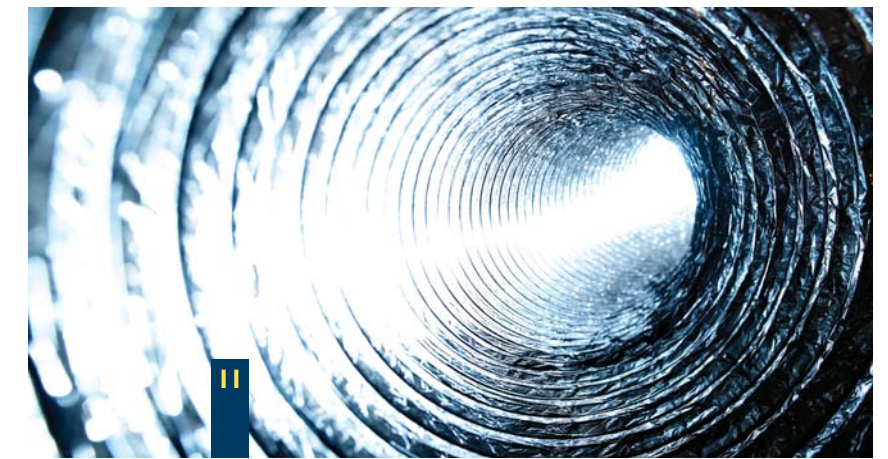
<ul style="list-style-type: none"> • Health and safety of staff and visitors 	<ul style="list-style-type: none"> • Compliance with health and safety legislation 	<ul style="list-style-type: none"> • Avoidance of prosecution and/or civil claims
<ul style="list-style-type: none"> • More efficient operation of systems and equipment 	<ul style="list-style-type: none"> • Longer system life 	<ul style="list-style-type: none"> • Flexibility of delivery and location for cost effectiveness
<ul style="list-style-type: none"> • Modern training techniques for more cost effective learning 	<ul style="list-style-type: none"> • Quality assurance 	<ul style="list-style-type: none"> • Online tracking for effective ongoing training delivery

Summary

Legionnaire's disease is a potentially deadly condition caused by bacteria that commonly breed in poorly-maintained water systems and are dispersed by air conditioning systems in a form where they threaten human life. This threat can be prevented by effective maintenance, which relies on responsible individuals having the skills and motivation to carry out the work, good management and appropriate systems. Apposite training, potentially coupled with formal standards and qualifications, is crucial. However, training will only have the desired effect if it impacts on the learner. So organisations should take advantage of the latest training techniques and ways of working with training providers to

ensure maximum effectiveness and allow duty holders to feel confident that necessary maintenance and monitoring is being carried out properly.

DTL provides a flexible range of state-of-the-art training and qualifications with the Chartered Institute of Environmental Health and City & Guilds that can be delivered at any of DTL's five UK centres or in clients' own premises. DTL also provides bespoke training and an online portal to allow managers to monitor and track training, ensuring that it is delivered when, where and to whom it is needed.



Appendix: Terminology

aerosol – a colloid (a solution with evenly-distributed particles ranging between 1 and 1,000 nanometres in diameter) of liquid droplets in air

Legionella: Find out more about training solutions from DTL

To discuss your training requirements for legionella prevention:

Call DTL free on **0800 876 6708**
Email enquiries@developtraining.co.uk
Alternatively, to search for available courses, visit www.developtraining.co.uk where you can also download training brochures and other resources.

evaporative condenser – a device which facilitates the condensation, or return to a liquid state, of a hot gas or vapor in a tube system using the evaporation of water flowing over the tubes. All refrigeration and air conditioning processes use a gas to facilitate the transfer of heat between the air-conditioned area and the outside atmosphere.

Legionnaires' disease – a pneumonia-type

illness caused by Legionella pneumophila

Legionella(e) – a pathogenic group of bacteria including Legionella pneumophila, causing legionellosis

legionellosis – illnesses caused by Legionella pneumophila including a pneumonia-type illness called Legionnaires' disease and a mild flu-like illness called Pontiac fever.

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