Prevention of Legionnaires' Disease

Code of Practice

Preface

Hong Kong must have a healthy living environment to align with the world-class cities. Health is fundamental not only to individuals but also to the community as a whole when putting Hong Kong on the road to prosperity.

Despite the small number of reported Legionnaires' Disease cases in Hong Kong, effective protection of the community from this deadly disease called for the establishment of the Prevention of Legionnaires' Disease Committee in 1985 to formulate strategies in the prevention and management of the possible outbreak of Legionnaires' Disease.

The Committee first published in 1994 a Code of Practice for the Prevention of Legionnaires' Disease incorporating prudently the experience from other developed countries. This Code of Practice provides practical guidelines for the building owners and building services practitioners to join hands in the proper design, operation and maintenance of the related facilities to prevent the possible outbreak of Legionnaires' Disease.

On the threshold of the new century, the Committee has completed the revision of the Code of Practice, taking into account the experience and evolving knowledge of other countries in past years. The revised Code of Practice will surely safeguard our environment and enhance the quality of our lives. I am confident that with the co-operation of all those concerned to follow the Code of Practice, our health will be well protected from a spread of the Legionnaires' Disease in Hong Kong.

Lee Shing-see, JP
Secretary for Works
The Government of the Hong Kong
Special Administration Region

Introductory Notes

This Code of Practice recommends the good practices to be followed in the design, installation, operation and maintenance of air-conditioning and water systems, especially cooling towers and centralised hot water supply systems for the effective control and prevention of the Legionnaires' Disease.

The Code is prepared by the Prevention of Legionnaires' Disease Committee with reference to similar codes overseas, such as Australia, United Kingdom, Singapore, etc. It is intended that this Code of Practice should be read and followed by all architects, engineers, building owners and building managers, as well as Government authorities.

I would like to express my sincere gratitude for the effort paid by the former and current members of the Committee in preparing and revising this Code.

Uy Tat-ping
Chairman
Prevention of Legionnaires' Disease Committee
Hong Kong

CONTENT

1. Background

Legionnaires' Disease (L.D.) was first recognised in July 1976 when an outbreak occurred among delegates attending an American Legion Convention in Philadelphia in which more than two hundred cases were reported and 34 people died. After medical investigations, it was identified that the responsible bacterium of the disease was previously unknown, and was subsequently given the name Legionella pneumophila.

Since the identification of legionellae, cases ranging from sporadic infection to outbreak were subsequently reported in the USA, Australia, Singapore, etc. In Hong Kong, a few cases of Legionnaires' Disease had been recorded in recent years.

Based on past statistics, it has been found that Legionnaires' Disease is more active and serious in European countries, the USA and Australia than in Asia.

2. Medical Aspects

Legionnaires' disease typically manifests as severe pneumonia, with patients presenting symptoms of malaise, muscle pains, cough, breathlessness, headache and fever, often culminating in respiratory failure. The disease has an incubation period of 2 to 10 days.

The bacteria that causes L.D. are small coccobacilli measuring up to 0.5μm by 1-3μm, with occasional longer forms of 10-15μm or more, within the genus legionellae. Over 42 species of legionellae have been identified and the *Legionella pneumophila* serogroup 1 is most commonly responsible for L.D. outbreaks.

Legionellae survive and multiply in natural fresh water, including lakes, rivers, streams, ponds, mud and soil, as well as man-made water systems. The optimum temperature for proliferation of the bacteria is around 20 to 45°C, and particularly in the range of 35°C to 43°C. The proliferation ceases above 46°C and below 20°C, while the survival time decreases to a few minutes at above 60°C. At 70°C the organism is killed virtually instantaneously.

The organism appears to be insensitive to pH but requires as nutrition the presence of simple organic life (such as algae and microorganism in sludge, scale, biofilm, etc.), inorganic substances (such as nitrogen based substances, small concentration of iron, zinc, etc. in fresh water piping systems), and organic substances (such as certain types of rubber) for survival. Nevertheless the bacteria can hardly survive in salt water and domestic water supplies which are well chlorinated.

Transmission of the bacteria to the human bodies is mainly by inhalation of airborne droplets (i.e. aerosols) or particles in fine mist containing the bacteria into the lungs where they are deposited. According to the previous reported cases, the sources of the aerosols causing an outbreak were mainly traced to water systems in buildings including evaporative cooling towers and humidifiers of air-conditioning systems, hot and cold water services, whirlpool spa, industrial heating and cooling processes, etc. These systems are normally designed to operate at the favourable temperature for the growth of legionellae.

The correlation between the proliferation temperature of the bacteria and the operating temperature of commonly found water systems is shown in Figure 1.

There is no evidence that the disease is transmitted by eating or drinking or person to person contact.

The following types of people are more susceptible to the disease:-

(a) patients who have low resistance to infection, especially those with respiratory disease, or on renal dialysis or immuno-suppressant drugs;

(b) smokers;

(c) people of increasing age, particularly over 50 years old;

(d) males (3 times more susceptible than females);

(e) drinkers.

To summarise, the infection of L.D. is due to a combination of some of the following factors as shown in Figure 2 :-

(a) aerosols containing legionellae;

(b) inhalation of the aerosols; and

(c) susceptible person.

3. The Hong Kong Situation

Following the outbreak of L.D. in 1985 at Stafford District Hospital, UK, the Prevention of L.D. Committee was set up in Hong Kong. The Committee is chaired by the Electrical and Mechanical Services Department, and it comprises members from the Department of Health, Works Bureau, The University of Hong Kong, The Chinese University of Hong Kong, Architectural Services Department and Water Supplies Department.

Initially, the terms of reference of the Committee were confined to areas of immediate concern, especially on the preventive measures against L.D. in government hospitals. Starting from 1987 the recommendations of the Committee were gradually implemented in government hospitals. A set of the recommendations was also sent to all subverted hospitals and private hospitals in July, 1989. In January, 1990, a technical guideline was issued to the project design teams and operation and maintenance teams of Government buildings to ensure that they are aware of the issue and to adopt proper attitude and appropriate measures in handling the relevant design, operation and maintenance of engineering plants/ equipment.

To further arouse the awareness of the public on the disease, the Committee decided that some forms of publicity be launched so as to present guidelines to the public on prevention of L. D. and to allay unnecessary alarm and fear caused by the overwhelming publicity of the issue. The leaflet "Understanding Legionnaires' Disease and its Prevention" has been issued to the public and the L.D. Hotline (Tel. No. 2882 8011) has been in operation. The publication of this Code of Practice is also one of the publicity actions recommended by the Committee. Furthermore, the Publicity Subcommittee and Technical

Subcommittee are established under the Prevention of L.D. Committee to assist in the publicity launch and to advise the Prevention of L.D. Committee on technical matters such as preparation of publicity materials, drawing up investigation procedures and plans to handle an outbreak, collection and analysis of technical information, etc. The organizational relationship and membership of the Committee and Subcommittees are shown in Figure 3.

In March 1994, Legionnaires' Disease has been listed as a notifiable disease under the Quarantine and Prevention of Disease Ordinance (Cap. 141). Medical Practitioners are required by law to notify the Department of Health when he/she has reasons to suspect the existence of a case of the disease in accordance with 'FORM 2' of the said Ordinance. A copy of which is reproduced in Annex I.

There were 10 reported cases of Legionnaires' disease between 1994 and 1999. All were sporadic cases with no evidence of clustering. Apart from one elderly male patient who succumbed to the disease, all the others had recovered. Table 1 shows the summary of the cases.

Table 1: Summary of Notified Cases of Legionnaires' Disease 1994 - 1999

Year	No. of Cases	Outcome
1994	3	1 died & 2 recovered
1995	1	Recovered
1996	2	Both recovered
1997	2	Both recovered
1998	1	Recovered
1999	1	Recovered

Legionnaires' disease has been classified as a notifiable occupational disease under the Occupational Safety & Health Ordinance (Cap. 509) and Employees' Compensation Ordinance (Cap. 282) since 11 June, 1999. A copy of the notification form is attached in Annex II. Any occupation involving repair, maintenance or service of either cooling system that uses fresh water or hot water service system is considered at risk.

4. Guidelines on Prevention of Legionnaires' Disease

Under all circumstances, the first option to be examined is to avoid or abandon, where reasonably practicable, the use of equipment which can create a spray of contaminated water. Where the use of such equipment cannot be avoided, the risk should be prevented or controlled by measures to reduce exposure to contaminated water droplets and to prevent conditions which allow the proliferation of legionellae in water.

4.1 General Precautionary Measures

The precautionary measures should, in general, include the following:-

4.1.1 Design Precautions

(a) Minimize the release of water spray;

(b) Avoid dead-ends and stagnant corners in pipework;

(c) If possible, when selecting materials for jointing, valves and taps, ensure that the materials do not support the growth of legionellae;

(d) Design water holding tanks for easy cleaning and draining;

(e) Minimize number and length of spurs;

(f) Provide sufficient fall in pipework to avoid accumulation of water;

(g) Provide appropriate airduct cleaning points/access panels at airducts to facilitate inspection and cleaning;

(h) Provide good accessibility and maintainability for all parts of air/water systems requiring regular maintenance/cleaning;

(i) Make full use of the technical literature as stated in the references as much as possible;

(j) Provide drain valves at the lowest point of a pipework system to facilitate cleaning;

(k) Provide adequate sloping at the air handling unit/fan coil unit condensate collection pan and connect the drain pipe at the lowest position of the drip tray. Also provide an air break and U-trap before connection to the building drainage pipework;

(1) Where feasible, install a device for the removal of particulate matter (e.g. a filter) to minimize the build-up of sludge;

(m) Install a stirring or circulation pump to overcome the problem of stratification and stagnation of water in hot water storage tanks.

4.1.2 Operation and Maintenance Precautions

(a) When/if the pipework system is changed, remove unused sections, avoid dead-ends and stagnant corners;

(b) Clean and drain regularly any water holding tank to avoid contamination, sludge, slime, algae, fungi, rust, scale, dust, dirt and other foreign material;

(c) Purge regularly any spur, dead-ends or stagnant point in the pipework;

(d) Apply chemicals to fresh water cooling tower systems;

(e) Carry out periodic inspection and cleaning of airducts;

(f) Maintain proper records of testing, maintenance and precautionary measures carried out, and monitor results.

Some of the specific precautions for different systems are listed in subsequent paragraphs.

4.2 Air Conditioning System

4.2.1 Cooling Tower

Cooling towers are commonly used as heat rejection equipment for air conditioning and industrial cooling processes. The operation temperature of the coolant water is optimal to the growth of legionellae (Figure 1) and the generation of aerosol during the spray cooling process in the tower easily leads to the dispersion of aerosols to the surroundings. Improperly designed, operated and maintained cooling towers have been one of the main causative agent for outbreak of L.D,

Different types of cooling towers are shown in Figure 4.

4.2.1.1 Design Precautions

(a) Avoid using fresh water cooling tower in the design of air conditioning system as far as economically and technically feasible.

(b) If the use of fresh water cooling tower is unavoidable, then

  (i) Site the cooling tower sufficiently far away from the public thoroughfare and air intakes of ventilation and air conditioning systems;

  (ii) Provide dosing points for chemical treatment of the cooling tower;

  (iii) Provide effective drift eliminator for the cooling tower (Figure 5);

  (iv) Use non-porous and easy-to-clean surface material as tower construction material;

  (v) Provide easy access to internal surfaces of the tower for inspection and removal of components;

  (vi) Select eliminator and fill material that can withstand cleaning by water jet, and arrange eliminators and fill such that they can be easily removed for cleaning or replacement;

  (vii) Provide smooth, sloped tower basin which drains to an outlet of large bore at the lowest point for easy cleaning.

4.2.1.2 Operation and Maintenance Precautions

(a) Water Treatment - A comprehensive water treatment programme shall be adopted to continuously or intermittently filter and treat the water with corrosion inhibitors, surfactant, and anti-fouling chemicals. The water treatment programme shall aim at controlling the fouling of pipework and cooling tower due to slit, scale and microbial growth in order to maintain efficient heat transfer at metal surfaces, ensure free flow of water throughout the system.

  The selection of water treatment system for eliminating and controlling general biological growth shall be based on the following criteria :-

  (i) It shall preferably be a patented proprietary product:

  (ii) It shall be manufactured by the supplier to an international or national standard;

  (iii) It shall have already been in widespread use in the country of manufacture and others for a minimum of 3 years;

  (iv) It shall be proven to be effective when dosed in accordance with the manufacturers' recommendations (frequency, dose strength, preparation, etc.);

(v) Case studies shall be available covering the effectiveness of the product in the re-circulating system;

(vi) It shall be chemically and physically compatible with the processed water;

(vii) It shall be compatible and non-corrosive to piping materials;

(viii) It shall be safe and easy to use;

(ix) It and its subsequent end-products shall be environmental friendly and have no mammalian toxicity and be chemically and biologically degradable. They shall not cause any hazards or adverse impacts on the environment through drainage and meet all relevant requirements and regulations of the Environmental Protection Department;

(x) It shall be compatible with other water treatment chemicals, and shall remain effective under a wide range of temperature changes, varying flow velocities, pH, conductivity, total dissolved solids and suspended matters commonly found in cooling tower open-type recirculation water circuits. It shall also be capable of penetrating foam, sludge, slime and scale within the system without foaming.

Water treatment chemicals should be added to turbulent zones within the water system to assist in rapid dilution and mixing. Also, if there are possible interactions between the treatment chemicals used, separate dosing point should be used to ensure dilution of one potentially reactive chemical prior to adding a second chemical.

The method of dosing can either be. -

(i) continuous drip feed with automatic dosing rate and/or concentration control;

(ii) manual slug dosing on regular basis (e.g. daily, twice-weekly, weekly, biweekly, etc.);

(iii) automatic metered dosing controlled by devices such as timers, dosing chemical concentration sensors, make-up water flowmeters, etc.

The following strategies maybe considered :-

(i) use of two chemicals, each of which shall comply with the criteria aforementioned, alternatively at periodic intervals;

(ii) use a combination of 2 compatible chemicals to provide better control against a range of microorganisms;

(iii) carry out occasional slug dosing or intermittent shock dosing with a high level of chlorine.

The water treatment works should be carried out under the direction of suitably qualified and experienced persons. Chemicals should be handled with care by personnel wearing appropriate protective clothing, including goggles, gloves, face-shield and chemical-proof apron to prevent contact with these agents. Personnel involved in the work procedures should be trained in safety procedures, including the use and maintenance of protective equipment. Hands should be washed and thoroughly dried before eating, drinking and smoking

(b) Bleed-off - Water in the cooling tower circuit evaporates during normal tower operation, leaving the dissolved substances behind in the water circuit and thus increasing the total dissolved solids (TDS) in the cooling water. This increase in TDS will lead to metal corrosion, chemical sedimentation, as well as growth of those bacteria which depend on the dissolved solids as nutrients.

To overcome these problems, a small percentage of water should be bled off (i.e. discharged to the drain) and replaced with make-up water, thus limiting the concentration of the total dissolved solids.

Bleed-off can be effected by continuously draining to waste with flow rate controlled by water conductivity meter or by intermittent discharge. Intermittent discharge can be achieved by manually operated or conductivity meter controlled drain valves (figure 6).

(c) Routine Cleaning and Disinfection - Cooling towers shall be cleaned, desludged and disinfected regularly. The frequency of cleaning should be based on tower cleanliness and the particular site environment. As a guide, the frequency of cleaning should be half-yearly. Less frequent cleaning intervals, but not exceeding yearly, may be acceptable based on relevant performance data. On the other hand, more frequent cleaning may be required.

Cleaning, desludging and disinfection should also be carried out if the cooling tower has been:-

(i) contaminated during construction, or by dusts, inorganic or organic matters;

(ii) shut down for a prolonged time, say more than 4 months;

(iii) mechanically altered or disrupted in a manner which may lead to contamination;

(iv) infected or may have been infected by an adjacent cooling tower which has been confirmed as a source of LD outbreak.

Cleaning, desludging and disinfection shall be carried out as follows: -

(i) chlorinate the water and circulate for four hours, maintaining a minimum level of free residual chlorine at 5 ppm through the entire cooling tower water circuit;

(ii) drain the entire water circuit, including the make-up tank ;

(iii) manually clean the tower, sump, fill, eliminator, make-up tank and the water circuit system. Accessible areas of the towers and its pack shall be adequately washed. Cleaning methods which create excessive spray such as high pressure water jetting shall be avoided as far as possible. Staff involved in water jetting shall be adequately trained, wear suitable respiratory protective equipment such as a cartridge respirator containing a particulate filter of appropriate efficiency. The hands of these staff should be washed and thoroughly dried before eating, drinking and smoking;

(iv) refill with water, rechlorinate and recirculate for at least six hours, maintaining a minimum level of free residual chlorine at 5 ppm ;

(v) drain and flush the system. Refill with water and dose with the appropriate start-up level of treatment chemicals. Finally recommission the system.

4.2.2 Other Components of Air-conditioning System

Condensate drain trays of air handling unit/fan coil unit (AHU/FCU) should be properly drained. Such drain trays should have adequate slope and the drain pipework should be connected at the lowest point of the sloping drain trays (figure 7). Drain trays shall be regularly inspected, cleaned and disinfected.

An air break and U-trap should also be provided at the condensate drain pipework of the drain tray before connection of AHU/FCU condensate drain pipework to the drainage system of the building to prevent backflow of drain from other AHU/FCU. Please refer to figure 8 for details.

Horizontal drain pipe shall have adequate slope and shall be regularly inspected for possible clogging.

Airduct servicing access points or panels should be provided at airduct at intervals of around 3 metres between centres in accessible positions. Access points or panels shall also be provided at positions such as around duct bends, tees, branches, duct heaters/reheaters, air mixing boxes, variable air volume (VAV) boxes, duct humidifiers, in-line booster fans, dampers, silencers, etc. to facilitate cleaning and inspection.

Airduct servicing access panels should preferably be of-size not less than 250 mm x 250 mm. They shall not cause dripping or condensation at its surface even at the worst condition under the prevailing weather in Hong Kong. In this connection, adequate thermal insulation shall be provided between the cooling air flowing in the airduct and the metalwork of the servicing access panel against the hot and humid surrounding air around the access panels. Particularly all metalwork forming a bridge through the insulation from the hot surrounding air to the cooled metal parts shall be avoided or properly insulated and complete with an overall vapour barrier.

Airduct and AHU/FCU air filters should be regularly inspected, cleaned or replaced to minimize the collection of dust and micro-organisms, so as to ensure good indoor air quality and to prevent the spread of infectious diseases, including the LD.

Only steam humidifier shall be used for humidification. City water spray type humidifier and humidifier that operates on the principle of evaporation of cold water will generate fine mists and thus would become an infectious source of LD if water contains legionellae. Such humidifiers shaft be avoided in new installations, and shall be replaced in existing installations. Prior to the replacement, these humidifiers should be maintained in thoroughly clean condition and stored dry when not in use.

4.2.3 Proper Record Keeping

A formal record for every cooling tower with accurate and adequate information shall be kept and be made available for inspections if demanded by Government appointed officials.

The record shall include: -

(a) the name, contact phone and address of the person and/or company who is responsible for operation and maintenance of the cooling tower;

(b) a description of the cooling tower such as location, make, model, capacity and year of manufacture/ installation as well as details on the correct and safe operation;

(c) a schematic layout plan of the plant or system;

(d) a programme for routine chemical treatment, cleaning, desludging and disinfection of the cooling tower;

(e) details of maintenance such as :-

  (i) date and result of visual inspection;

  (ii) date of cleaning, desludging and disinfection;

  (iii) date of chemical treatment with details on the treatment carried out;

  (iv) remedial work (if required) and date executed;

(v) method of bleed-off and details of the automatic bleed-off controls, if any.

Each activity (i) to (v) shall be authenticated by the signature of the person who has carried out the task.

Record books shall be kept for at least 24 calendar months. The name, contact phone and address of the person or company who is holding the record book shall be indicated by a durable label attached to the cooling tower or painted on the tower.

4.3 Water System

Centralized hot water systems usually operate at 35°C to 50°C. These temperatures are ideal for the growth of *Legionella pneumophila*.

4.3.1 Design Precautions

The following precautions shall be attended to in the design of hot water systems :-

(a) The hot water storage device of the system (e.g. direct or indirect heated calorifier, storage vessel, etc.) shall be designed to operate at 60°C to effectively kill the bacteria and the water tap outlet temperature shall be at 50°C in all areas except for the supply to paediatric, geriatric and psychiatric wards of hospitals where the provisions as laid down in (e) should be observed instead ;

(b) The water supply system and the size of the hot water storage device shall be so designed that the water within the device shall have reached 60°C for at least 5 minutes prior to the discharge to the distribution system under normal loading conditions;

(c) Drain outlets shall be provided at the lowest point of hot water storage devices for flushing away settled sludge;

(d) Secondary pumped circulation shall be provided where possible and necessary to reduce temperature stratification within the hot water storage devices (Figure 9);

(e) In paediatric, geriatric and psychiatric wards of hospitals, the hot water supply temperature at outlets shall not exceed 43°C to prevent accidental scalding. Thermostatic mixing valves which mix hot and cold water automatically to provide water at a preset temperature shall be used (Figure 10). Typically such thermostatic mixing valves shall comply with the following :-

(i) the mixed water at the outlet of the tap shall be within +2°C of the preset outlet temperature while the hot water supply temperature changes from 50°C to 65°C,

(ii) the adjustable outlet temperature, if any, shall be resettable only with the aid of tools or else the mechanism for adjusting the temperature shall be concealed and inaccessible to the patient,

(iii) the valve shall be fail-safe such that in case the cold water supply fails, the valve shall automatically shut off the water supply within 4 seconds once the outlet water temperature is 10°C above the preset temperature,

(iv) the valve shall be of durable design and be able to react quickly to hot and cold water temperature changes, and to fluctuation in supply water pressure and back pressure from the final hot water outlets;

(v) the valve shall be installed as near to the tap outlets as possible and the manufacturer's recommendations regarding the maximum number of tap outlets to be supplied by each thermostatic valve shall be strictly followed;

(f) Deadlegs and stagnant corners in the hot water pipework shall be avoided. The number and length of spur-fed hot water tap outlets shall be minimized;

(g) All piping systems and associated hot water storage devices should be flushed clean upon commissioning prior to bringing them into operation;

(h) Avoid the use of natural rubber, porous and organic matters (e.g. leathers) as parts of the pipework (e.g. as materials for washers) since these materials provide nutrients and a favoured environment for the growth of micro-organisms. Materials such as neoprene and suitable synthetic materials which do not support microbial growth should be used instead ;

(i) Hot water storage devices should be well insulated to prevent heat losses to a temperature at which legionellae may survive ;

(j) Cold make up water should not be able to short circuit through the hot water storage device and the system should be designed to ensure that an water is adequately heat disinfected prior to leaving the storage devices.

4.3.2 Operation and Maintenance

The following operation and maintenance practices shall be observed :-

(a) Operate hot water storage devices at 60°C and maintain the tap outlet temperature at 50°C in all areas except those specified in 4.3.1 (a) above ;

(b) Drain and clean the hot water storage device regularly to avoid accumulation of oxides, rusts, scales and sludges. The frequency of cleaning shall depend on the accumulation rate of sediments and contamination in the device, which is primarily dependent on the quality of the inlet water. Under normal circumstances, the cleaning frequency shall be at least once per year ;

(c) Carry out the following modifications/improvements as necessary:-

  (i) remove redundant pipework containing stagnant water;

  (ii) retrofit existing hot water storage devices so as to provide drains at the lowest point of the devices;

  (iii) provide secondary pumped circulation where possible and necessary to reduce temperature stratification within the hot water storage devices (Figure 9);

(d) Hot water outlets which are infrequently used or are connected to stagnant water supply pipework shall be flushed at full flow for a minimum period of one minute at least on a monthly basis;

(e) When thermostatic mixing valves are used, the following maintenance practices are recommended: -

  (i) check the outlet water temperature with a thermometer monthly or at least quarterly to detect any drift in outlet temperature from the required setting;

  (ii) carry out comprehensive maintenance involving inspection, dismantling for cleaning, replacing faulty parts and other parts as recommended by the manufacturer yearly. In areas with poor water quality, more regular servicing may be required;

  (iii) perform fail-safe test on each valve after comprehensive servicing by shutting down the cold water supply to the valve. Water flow from the valve shall cease in accordance with 4.3. 1 (e)(iii);

(iv) record details of monthly temperature tests and yearly comprehensive servicing on a log sheet for future reference in the event of valve failure or inspection as demanded by designated Government appointed officials.

4.4 Other Water Systems

The following preventive measures on the design, operation and maintenance of fresh water systems shall also be observed for prevention of LD :-

(a) all cold water storage tanks should be fitted with a tight-fitting lid, and an appropriately sized drain valve and associated pipework to facilitate flushing, cleaning and decontamination. Overflow pipes and air vents should be fitted with a mesh to exclude vermin, dusts and other extraneous material;

(b) cold water storage tanks should be located and insulated, where necessary, to ensure that the bulk of water stored does not rise to temperatures where legionellae will proliferate. Sufficient space, access, cleaning and drainage facilities should be available to permit easy inspection and maintenance;

(c) on commissioning cold water storage tanks should be cleaned to remove rust, sludge and sediment. The tanks shall be regularly inspected, thoroughly cleaned and scrubbed with a solution of chloride of lime or bleaching powder containing not less than fifty parts of chlorine in one million parts of water. The frequency of cleaning may initially be on an annual basis, and then be altered to suit the level of corrosion, sludge and sediment experienced;

(d) corroded covers of cold water storage tanks should be replaced to remove possible nutrients for microbial growth;

(e) natural rubber, porous and organic plumbing washers (e.g. leather) will provide nutrients and a favoured environment for the growth of legionellae. All washers should therefore be of neoprene or other suitable synthetic material which does not support microbial growth;

(f) Spas (whirlpools) utilizes warm water at approximately 35°C to 40°C, with air and water jets producing turbulence and creating aerosols. These aerosols are in the breathing zone of spa users and therefore likely to be inhaled. The water should be continuously recirculated, filtered and disinfected, and with good pH control to minimize the proliferation of micro-organisms. Excessive use of spas can lead to accumulation of soluble matter in the water; therefore they should be drained and refilled regularly at intervals depending on the degree of usage. Spas should be adequately maintained and body fats removed from the sides of the spa regularly. Also, it is important that the filter for the circulation water shall be regularly cleaned.

FORM 2
QUARANTINE AND PREVENTION OF DISEASE ORDINANCE (CAP.141)

Notification of Infectious Diseases other than Tuberculosis
Particulars of Infected Person

Name in English:	Name in Chinese:	Age/Sex:	I.D. Card/Passport No.:
Address:			Telephone Number:
Place of Work/ School Attended:			Telephone Number:
Hospital(s) attended:			Hospital/A&E Number:

Disease[“✓”] below Suspected/Confirmed on ________ / ________ / ________

- ☐ Acute Poliomyelitis
- ☐ Amoebic Dysentery
- ☐ Bacillary Dysentery
- ☐ Chickenpox
- ☐ Cholera
- ☐ Dengue Fever
- ☐ Diphtheria
- ☐ Food Poisoning
- ☐ Legionnaires' Disease
- ☐ Leprosy
- ☐ Malaria
- ☐ Measles
- ☐ Meningococcal Infections
- ☐ Mumps
- ☐ Paratyphoid Fever
- ☐ Plague
- ☐ Rabies
- ☐ Relapsing Fever
- ☐ Rubella
- ☐ Scarlet Fever
- ☐ Tetanus
- ☐ Typhoid Fever
- ☐ Typhus
- ☐ Viral Hepatitis
- ☐ Whooping Cough
- ☐ Yellow Fever

Notified under the Prevention of the Spread of Infectious Diseases Regulations by

Dr. . . . . on . . . . / . . . . / . . . .
(Full Name in BLOCK Letters) (Date)

Telephone Number: . . . .
(Signature)

Remarks:

DH 1(s)(Rev.98)

Annex II

OCCUPATIONAL SAFETY AND HEALTH ORDINANCE (CAP. 509)
NOTIFICATION OF OCCUPATIONAL DISEASES

To: Commissioner for Labour

PARTICULARS OF PATIENT

Name: _____ HKID/Passport no.: _____

Male/Feamle* Date of birth _____ / _____ /_____ Occupation: _____

Home address: _____

_____

Telephone no. (Home) _____ (Office) _____ (Pager/Mobile)_____

Name and address of employer: _____

Telephone no. of employer: _____

For Internal use:

Code: _____

Code: _____

Code: _____

NOTIFIABLE OCCUPATIONAL DISEASES (Please put a tick in □)

□1	Radiation Illness	□18	Lead Poisoning	□35	Chrome Ulceration
□2	Heat Cataract	□19	Manganese Poisoning	□36	Urinary Tract Cancer
□3	Compressed Air Illness	□20	Phosphorus Poisoning	□37	Peripheral Polyneuropathy
□4	Cramp of Hand or Forearm	□21	Arsenic Poisoning	□38	Localised Papillomatous or Keratotic New Skin Growth
□5	Beat Hand	□22	Mercury Poisoning	□39	Occupational Vitiligo
□6	Beat Knee	□23	Carbon Bisulphide Poisoning	□40	Occupational Dermatitis
□7	Beat Elbow	□24	Benzene Poisoning	□41	Chemical Induced Upper Respiratory Tract Inflammation
□8	Tenosynovitis of Hand or Forearm	□25	Poisoning By Nitro-, Amino-, or Chloro- Derivatives of Benzene	□42	Nasal or Paranasal Sinus Cancer
□9	Anthrax	□26	Dinitrophenol Poisoning	□43	Byssinosis
□10	Glanders	□27	Poisoning by Halogen Derivatives of Hydrocarbons	□44	Occupational Asthma
□11	Leptospirosis	□28	Diethylene Dioxide Poisoning	□45	Silicosis
□12	Extrinsic Allergic Alveolitis	□29	Chlorinated Naphthalene Poisoning	□46	Asbestos-Related Diseases
□13	Brucellosis	□30	Poisoning by Oxides of Nitrogen	□47	Occupational Deafness
□14	Tuberculosis in health care workers	□31	Beryllium Poisoning	□48	Carpal Tunnel Syndrome
□15	Parenterally Contracted Viral Hepatitis in health care workers	□32	Cadmium Poisoning	□49	Legionnaires' Disease
□16	Streptococcus suis Infection	□33	Dystrophy of the Cornea		
□17	Avian Chlamydiosis	□34	Skin Cancer		

Diagnosis: Confirm/Suspect* Date of onset of illness: _____ / _____ / _____

Follow-up of patient: Treated/Referred to hospital/Others(specify)*: _____

Other relevant information: _____

Name of notifying medical practitioner: _____

Address of notifying medical practitioner: _____

_____

Telephone no. of notif.ying medical practitioner: _____

Date: _____ Signature: _____

**Delete whichever is inapplicable*

Please return this form by fax (no. 25812049) or by mail to Occupational Health Service, Labour Department, 15/F Harbour Building, 38 Pier Road, Central, Hong Kong.

For details of Notifiable Occupational Diseases and their related occupations, Please refer to Schedule 2 of the Occupational Safety & Health Ordinance and to the Labour Department publicatiion "Guidance Notes on the Diagnosis of Notifiable Occupational Diseases". Enquiry telephone no.: 2852 4041.

LD483(Rev.11.6.1999)

Figure 1

Relationship between Proliferation of Legionella and Temperature of Water Systems when in Use and when Other Growth Factors are Present

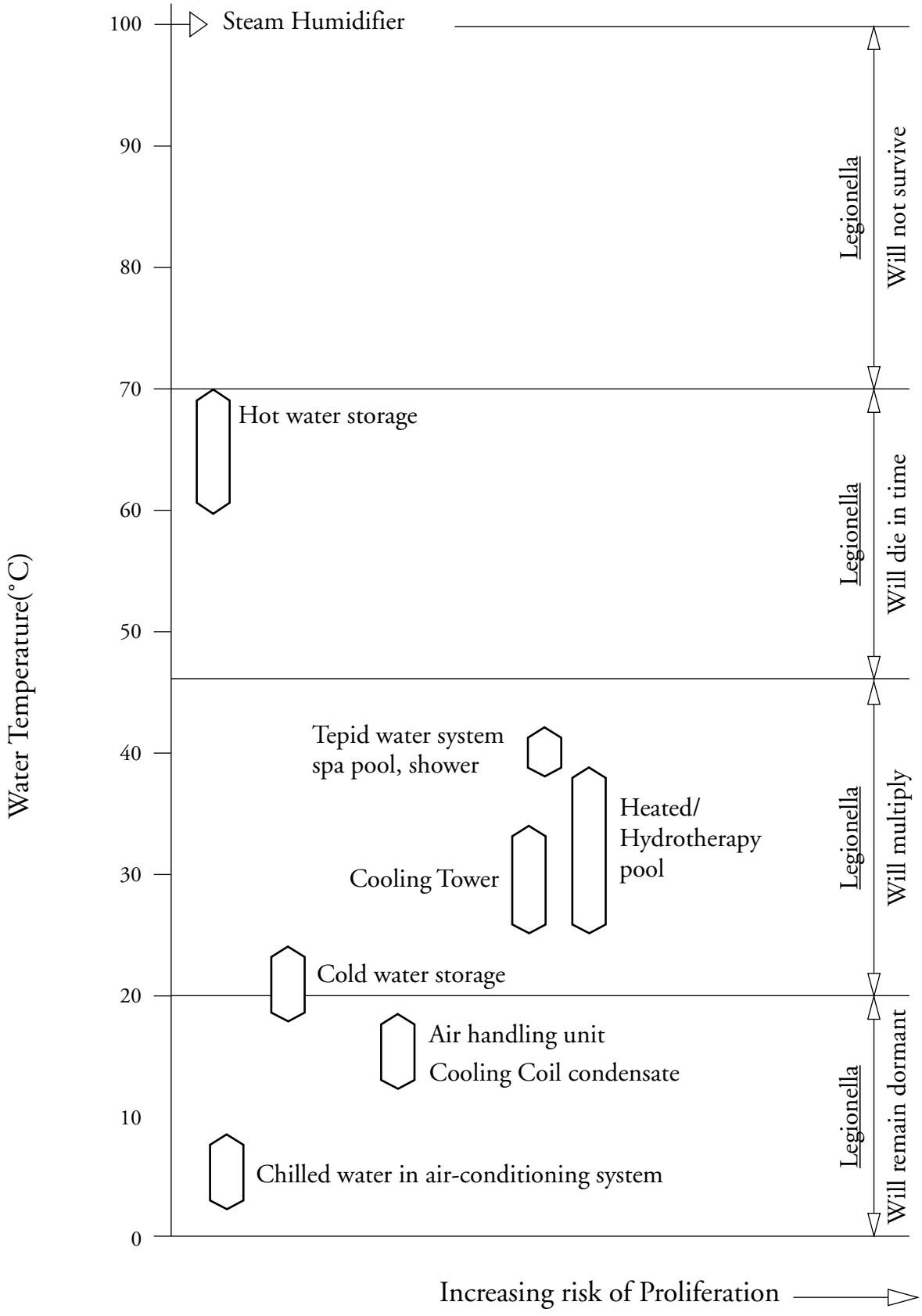


Figure 2

Transmission of Legionnaires' Disease

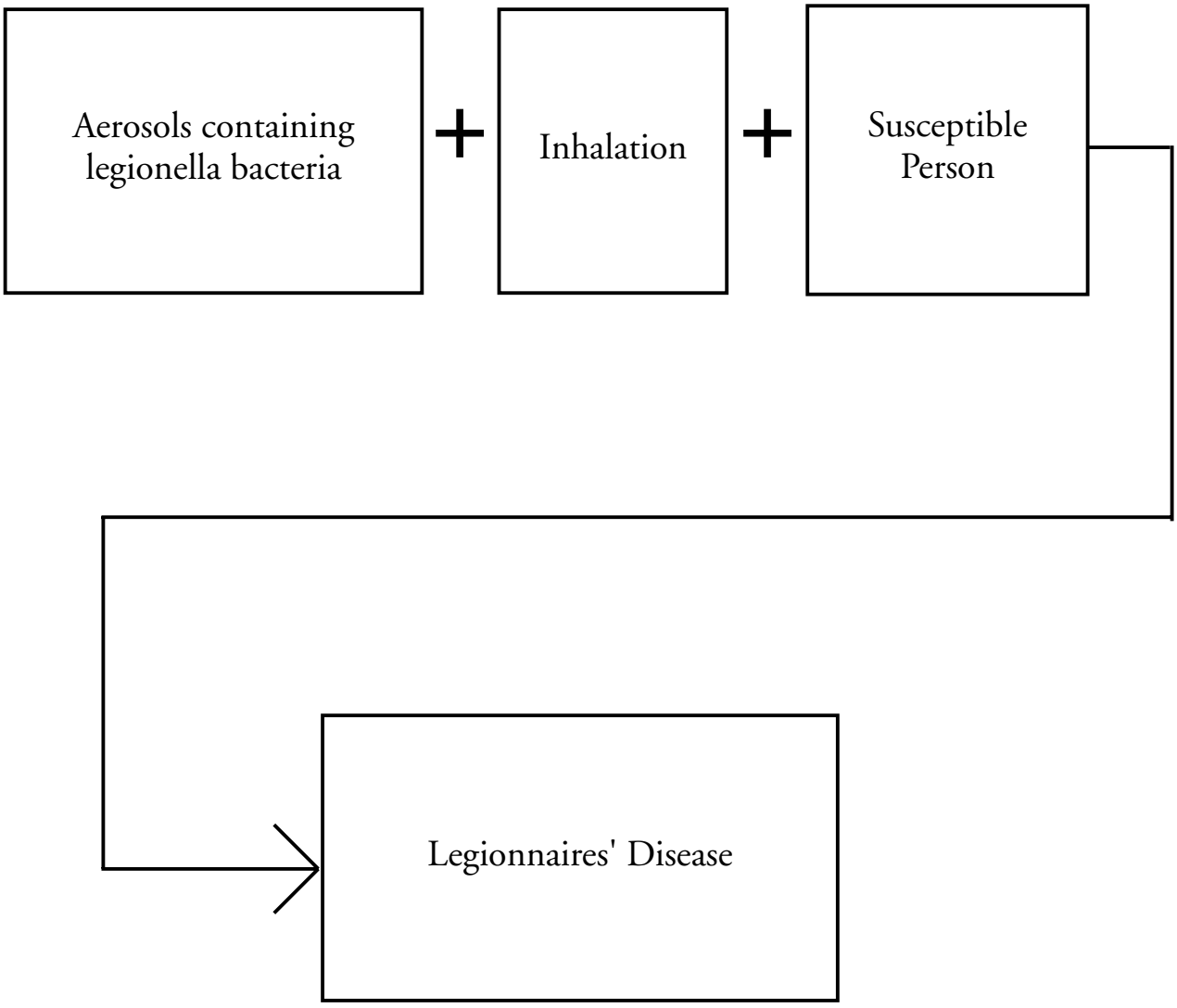
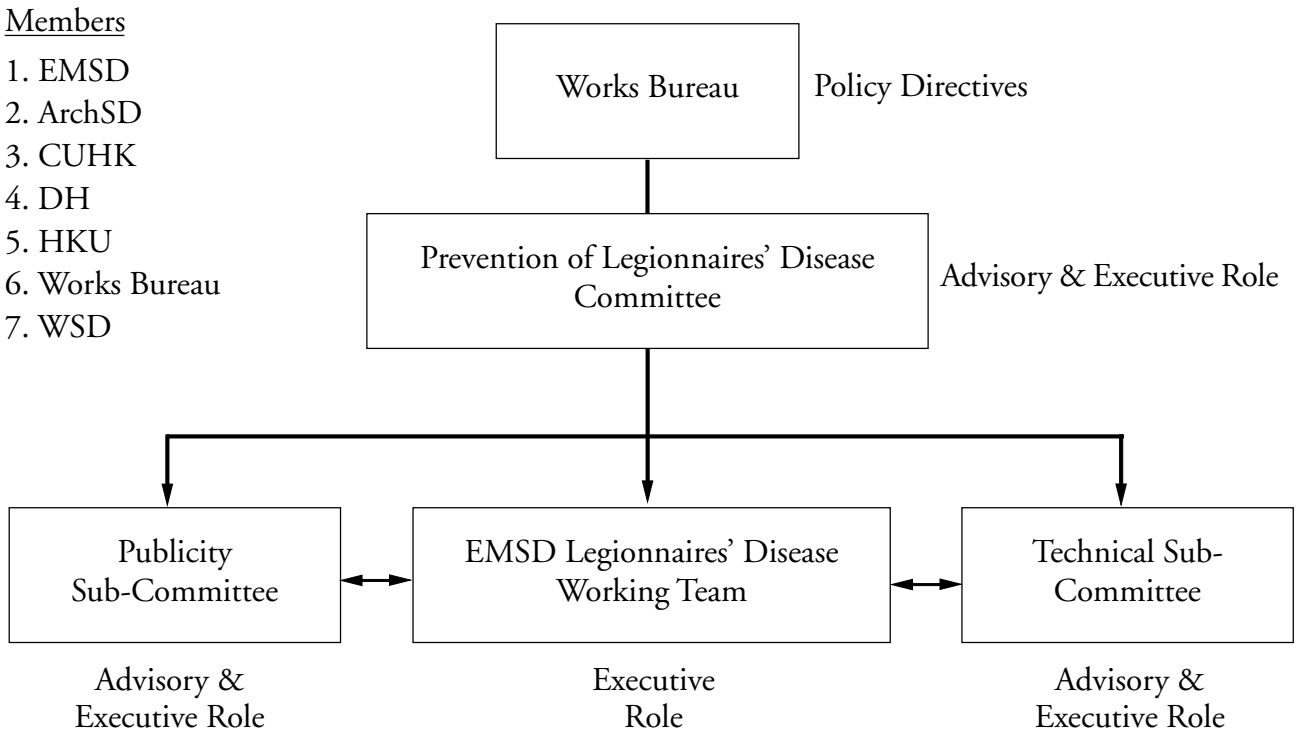


Figure 3

Organisation of the Prevention of Legionnaires' Disease Committee



Note :-

ArchSD	=	Architectural Services Department
BD	=	Buildings Department
CUHK	=	The Chinese University of Hong Kong
DH	=	Department of Health
EMSD	=	Electrical & Mechanical Services Department
FEHD	=	Food and Environmental Hygiene Department
HKU	=	The Hong Kong University
ISD	=	Information Services Department
LD	=	Labour Department
WSD	=	Water Supplies Department

Figure 4A

Induced Draught Counter Flow Cooling Tower

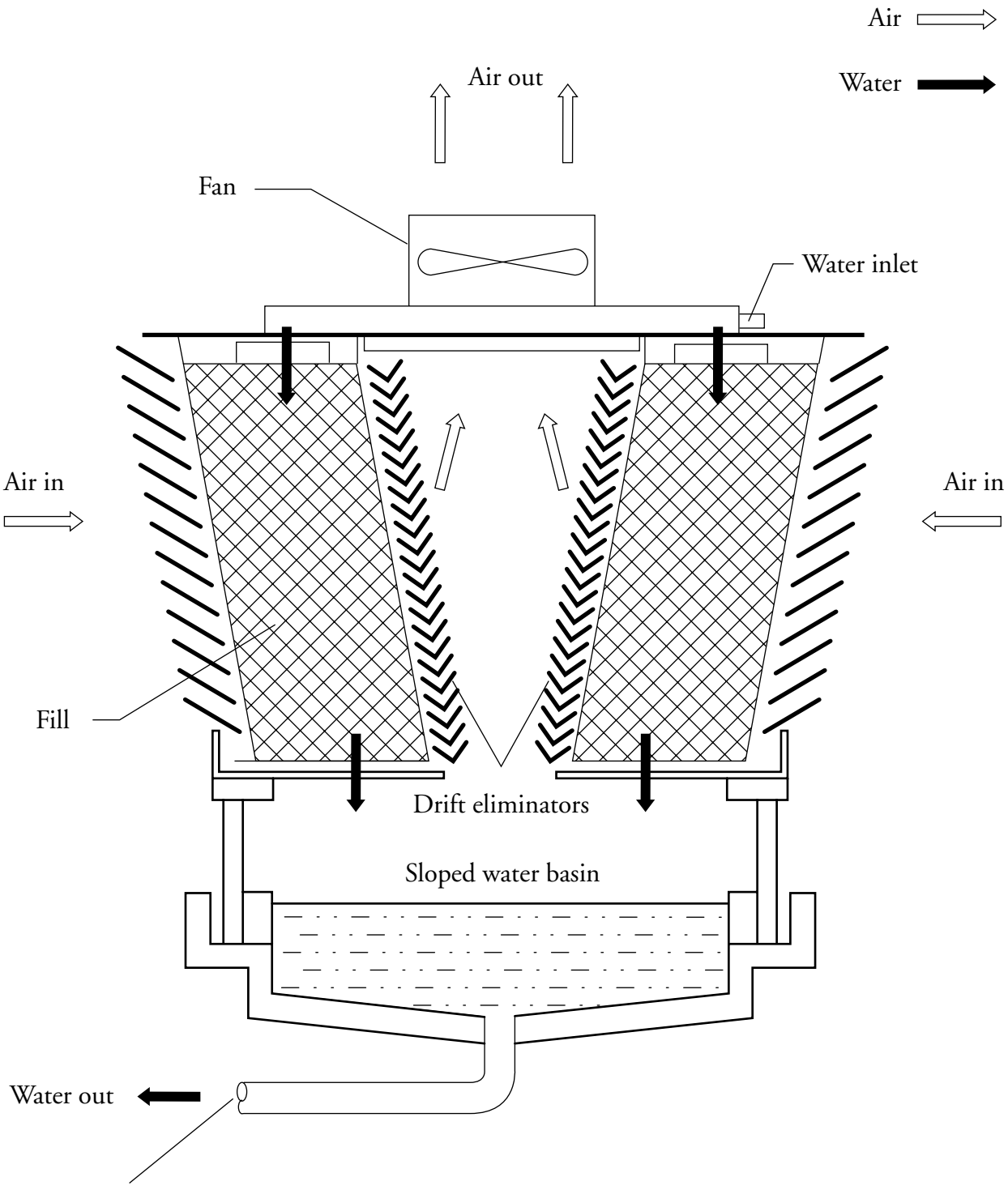


Figure 4B

Induced Draught Counter Flow Cooling Tower, Fibreglass Type

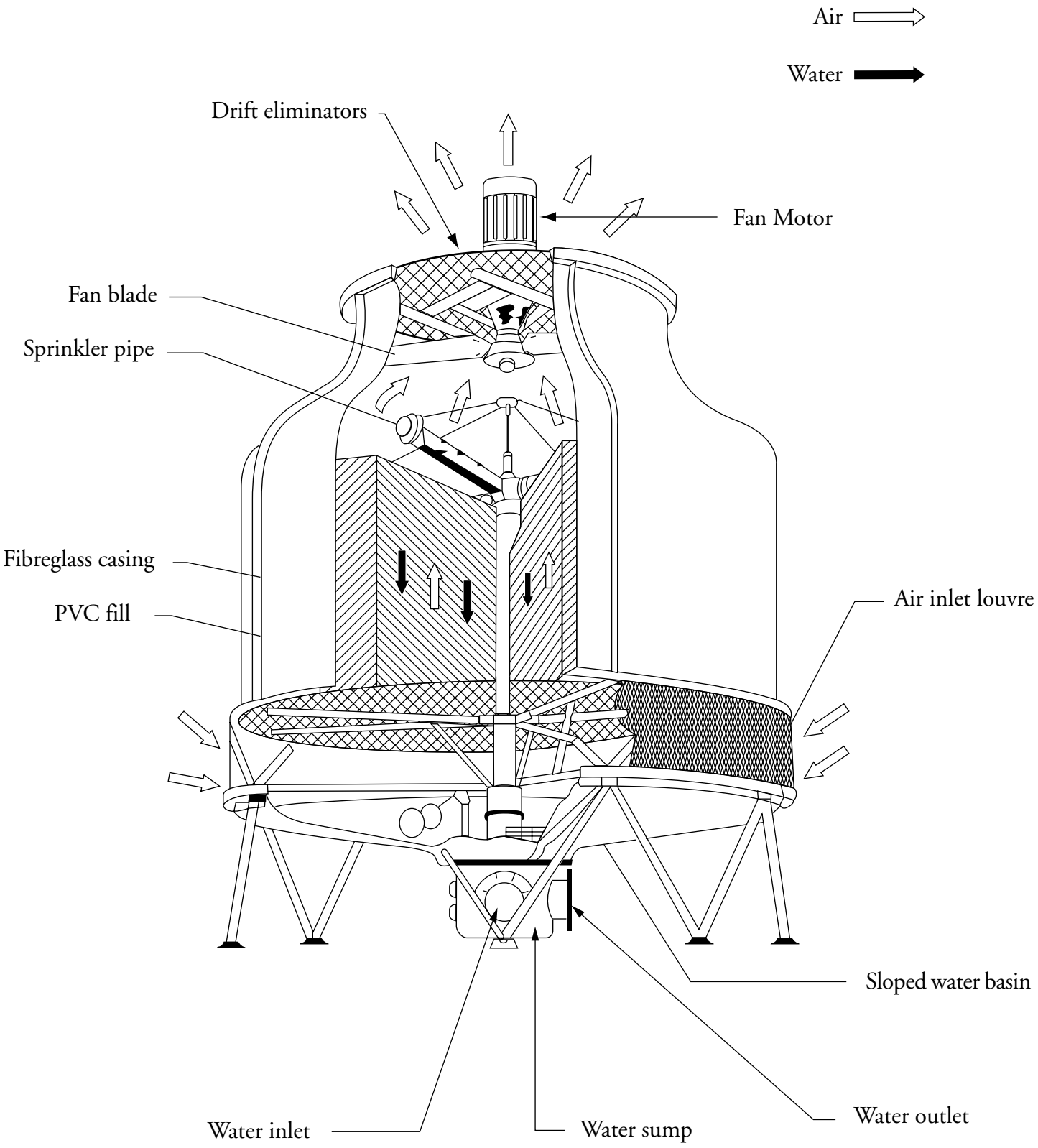


Figure 4C

Forced Draught Counter Flow Cooling Tower

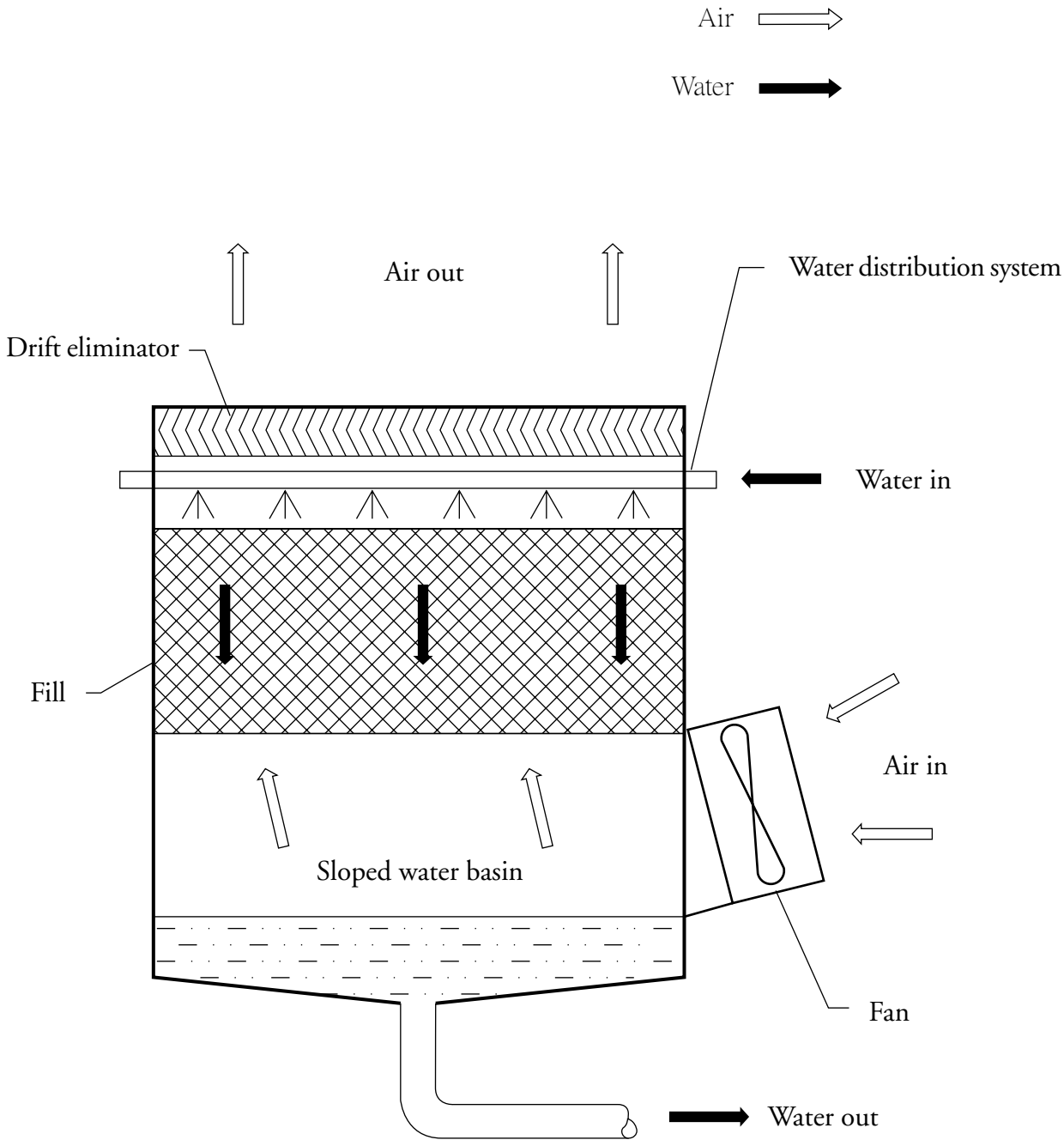


Figure 4D

Crossflow Cooling Tower

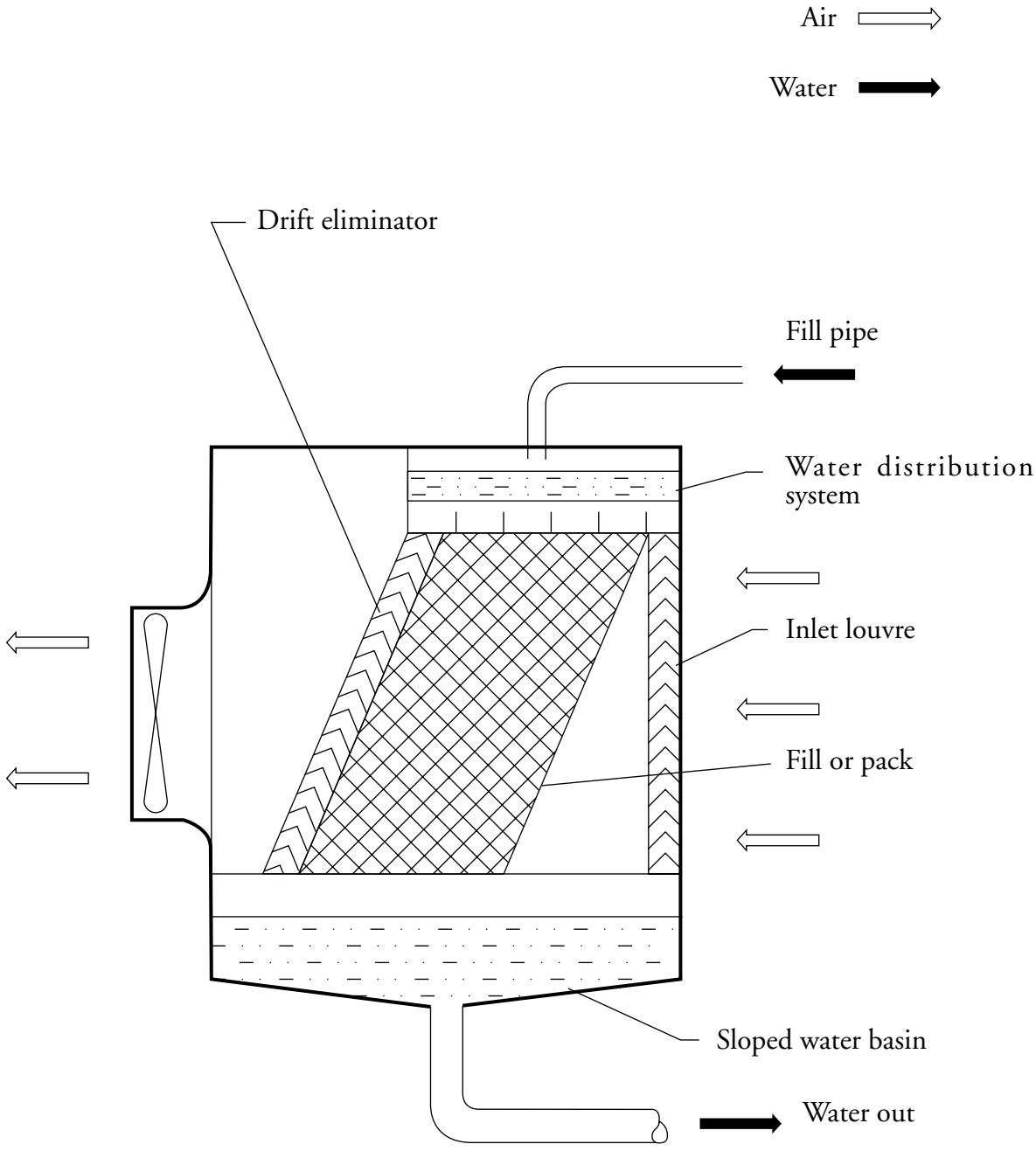
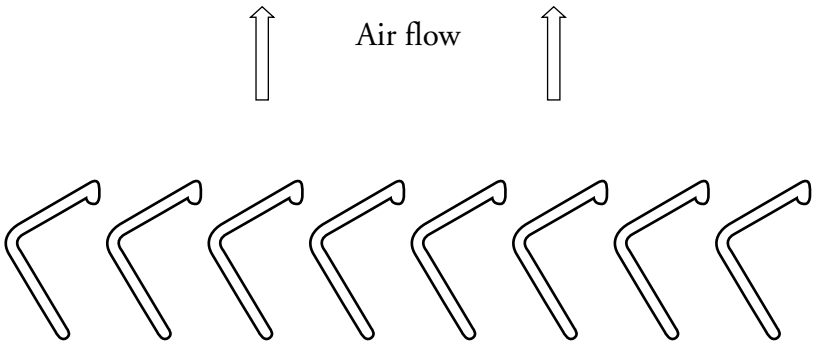
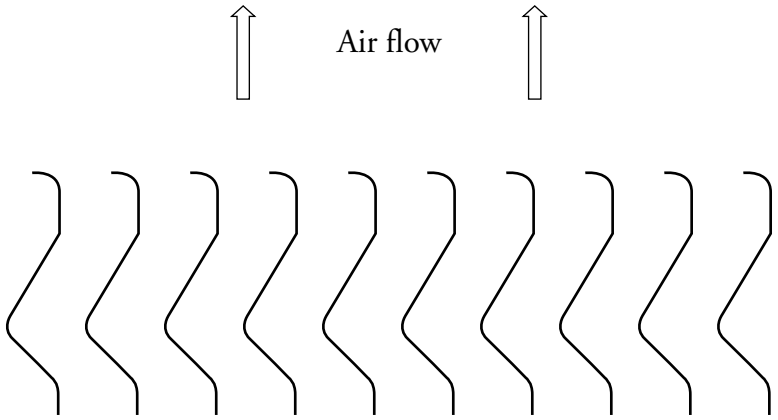


Figure 5

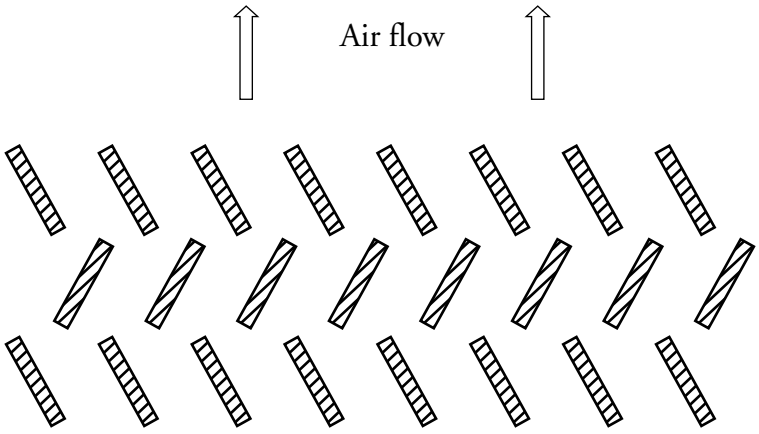
Types of Drift Eliminators



Plastic drift eliminators



Corrugated metal plate drift eliminators



3-pass wooden drift eliminators

Figure 6

Cooling Tower Automatic Bleed-off Control

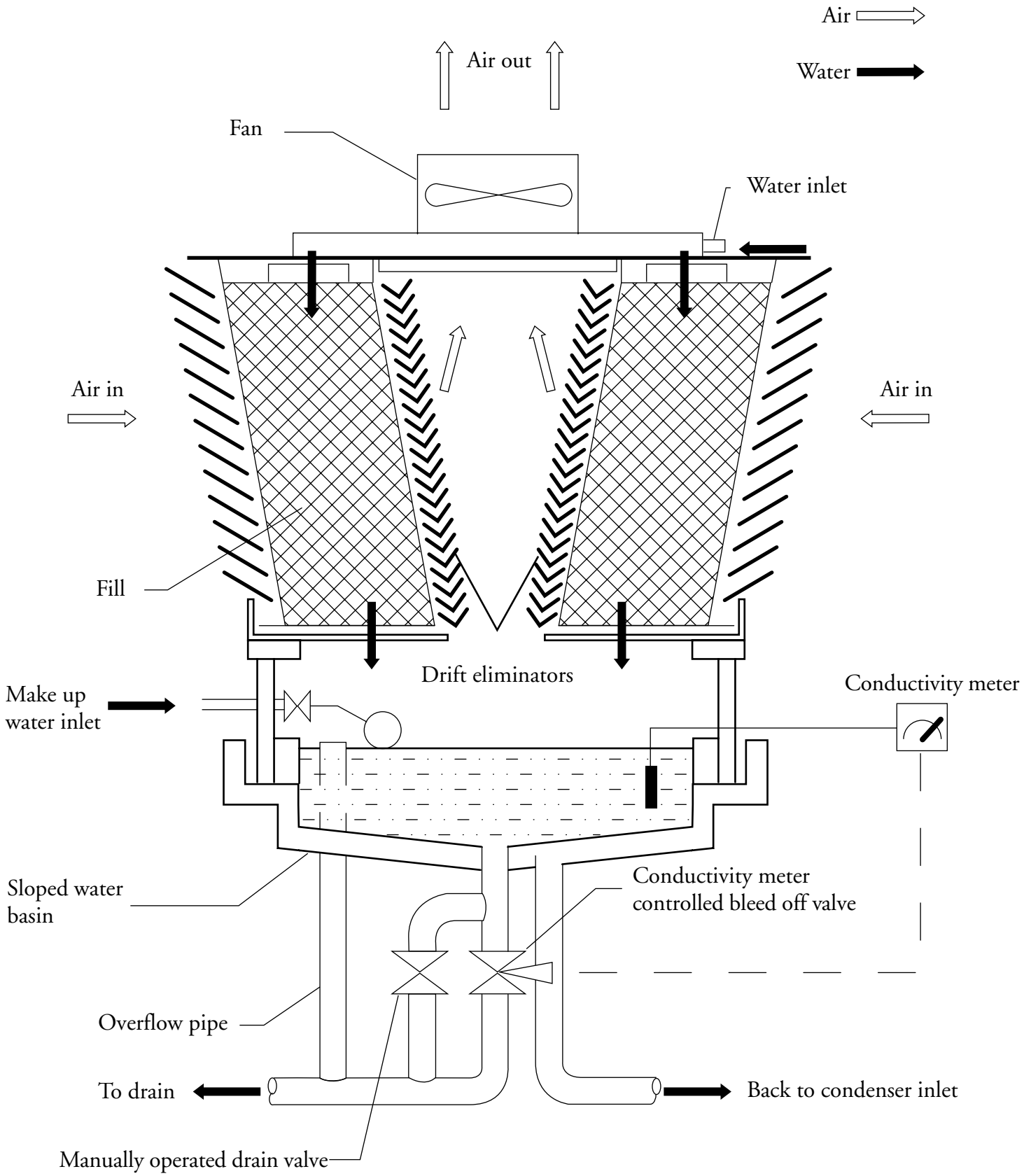


Figure 7

AHU/FCU Drain Tray

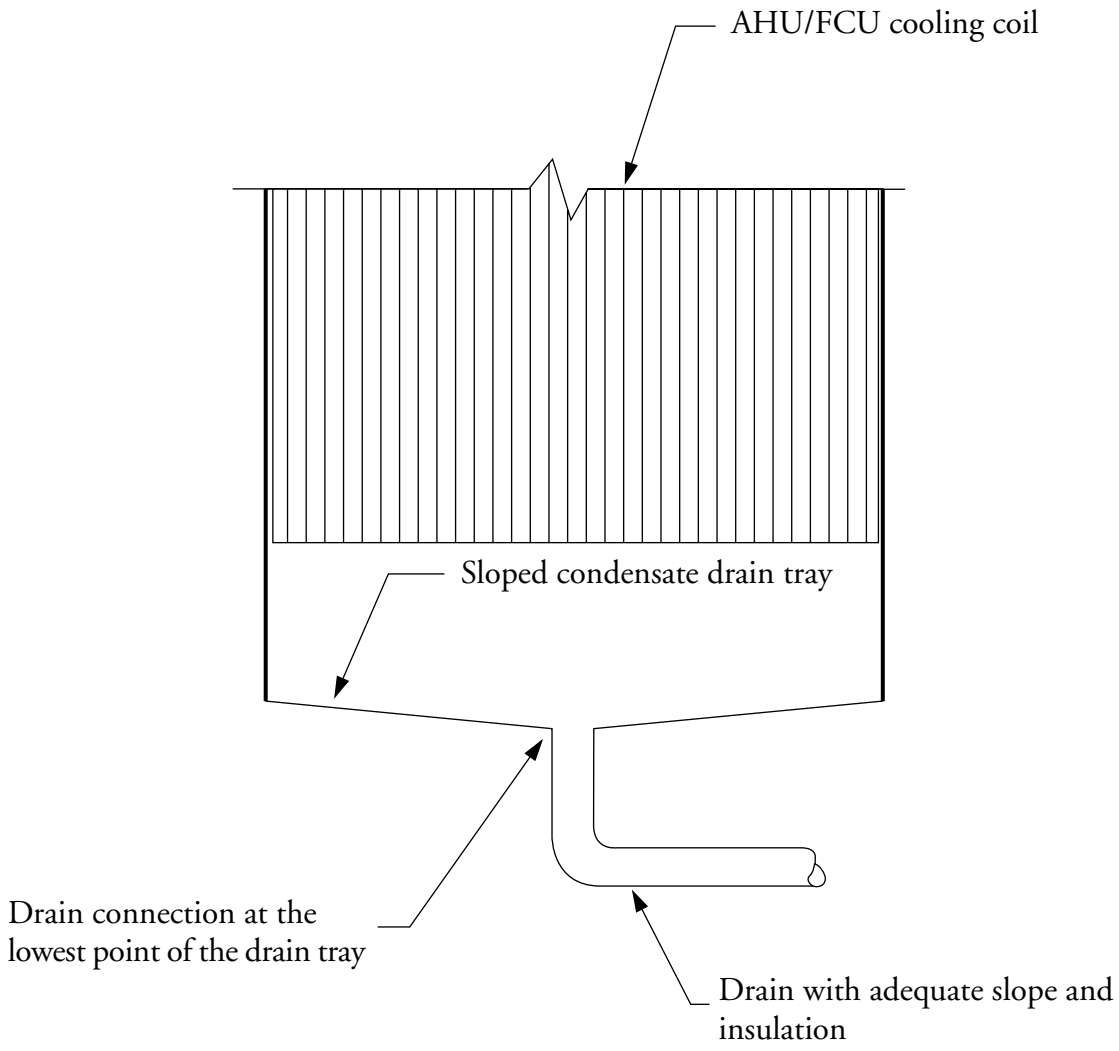
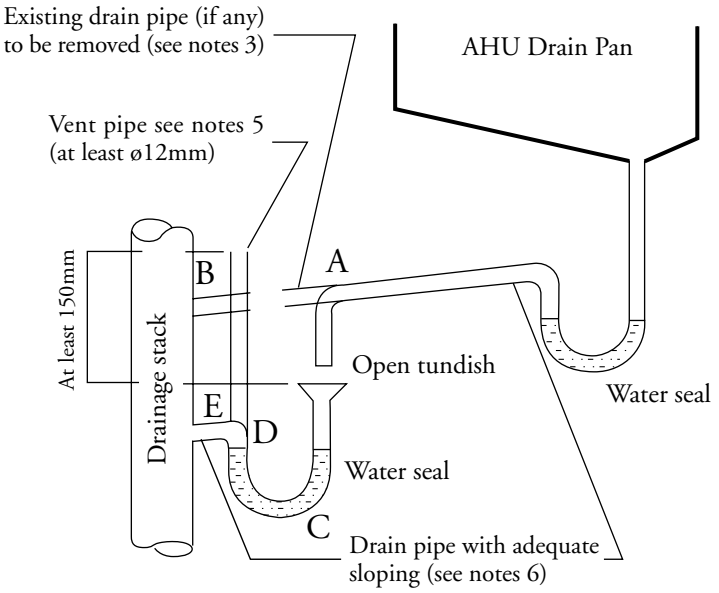
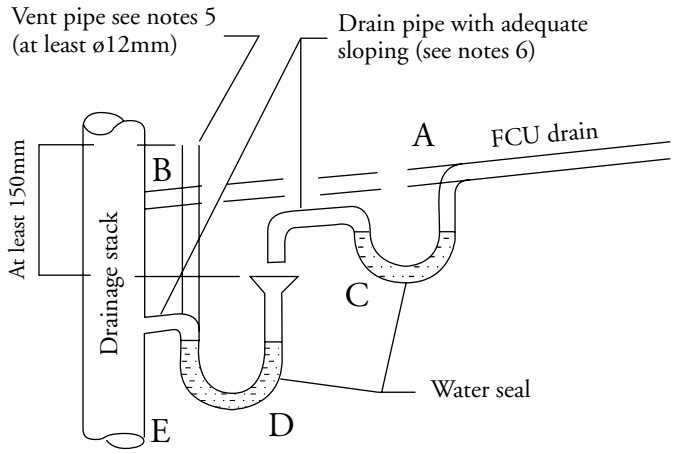


Figure 8

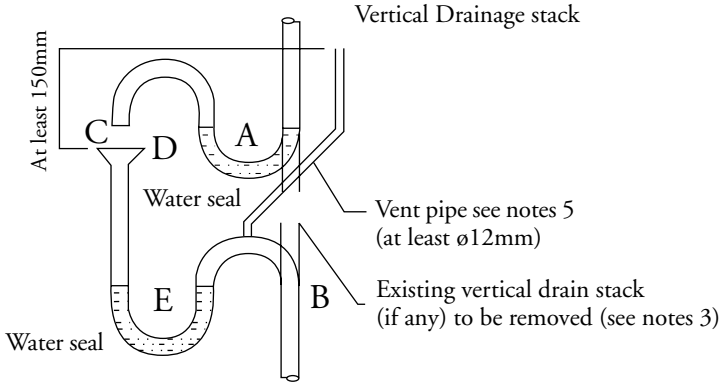
Air Break and U-trap (Water Seal) at AHU/FCU Condensate Drain Pipework



i) AHU drain connection



ii) FCU drain connection



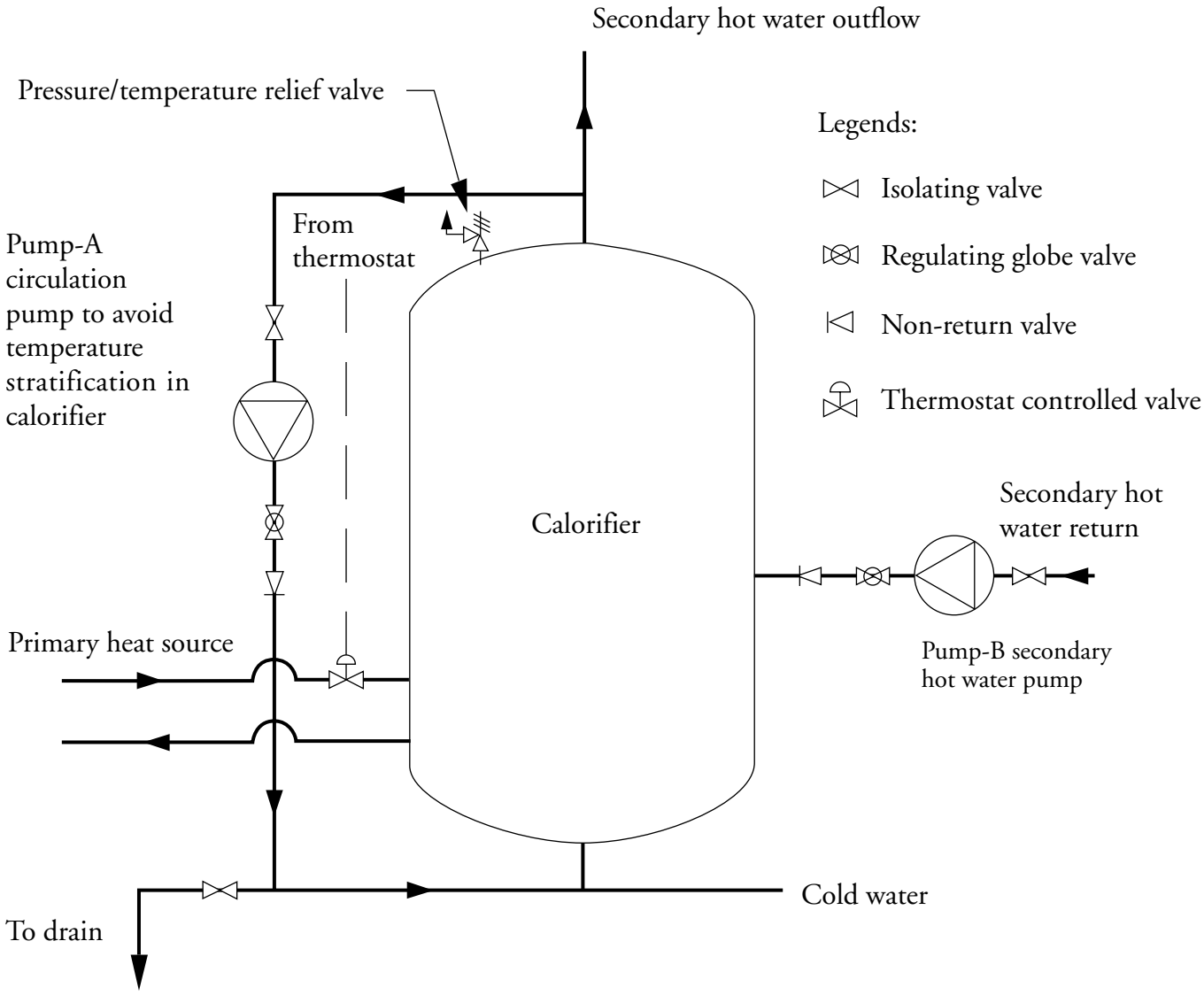
iii) Alternative design at vertical drain stack

Notes:

1. Depend on the site condition, the design of the water seal should be of type i), ii), or iii).
2. Drain pipes & open tundish should be insulated.
3. The existing drain pipe (if any) from A to B shall be removed. All damaged insulation should be made good.
4. Water seal shall be of sufficient depth to withstand maximum surge in drain pipe pressure.
5. The additional vent pipe shown in the drawings should be required as and when necessary.
6. Recommended drain pipe sloping is at least 1 in 5; pipe size should match that of existing drain.

Figure 9

Pumped Circulation in Calorifier to Reduce or Eliminate Temperature Stratification



Note:

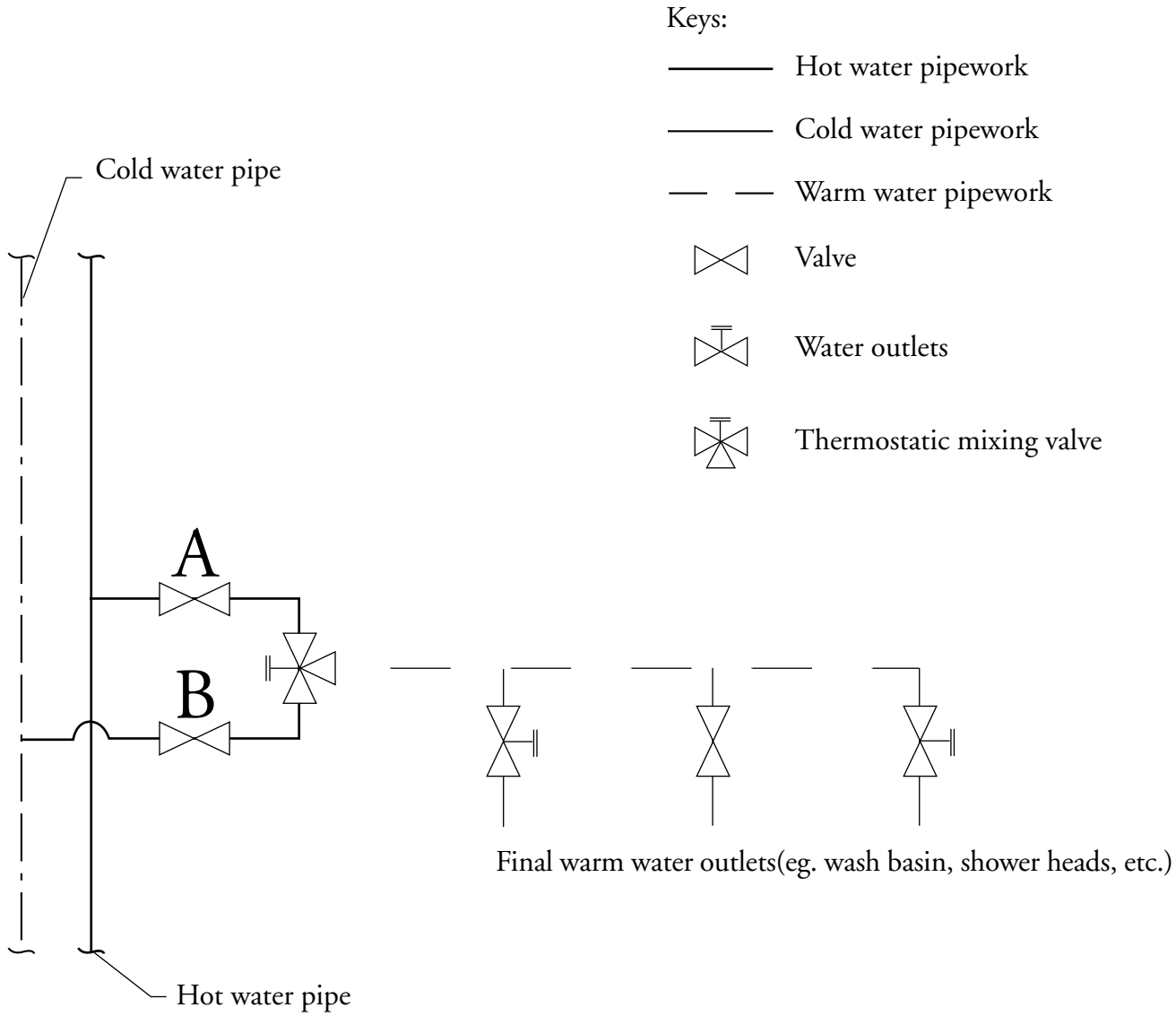
1. The flowrate of the low head, high flowrate circulation pump-A should be determined on site. As a guideline, the flowrate could first be set at the calculated peak hourly demand of the hot water system divided by the total no. of operating calorifiers in the system.

2. The circulation pump-A may be timer controlled or continuously operated. The total run time and frequency of operation shall be so selected to reduce or eliminate the temperature gradient within the calorifier.

3. It was not considered necessary to take any action to reduce or eliminate temperature stratification in calorifiers unless it was recognised that the hot water supply system could provide an environment suitable for the proliferation of legionella.

Figure 10

Thermostatic Mixing Valve



Notes:

1. Valve A and B shall be turned on normally. Valve B should be shut off for routine fail-safe test of the thermostatic mixing valve.

2. Maximum no. of final warm water outlets to be supplied by each thermostatic mixing valve shall follow the recommendation of the manufacturer.

3. Thermostatic mixing valve should be installed as near to the final warm water outlets as possible.

References

(a) Guidelines for the Control of Legionnaires' Disease, Health Department Victoria, Australia, 1999.

(b) Code of Practice for the Control of Legionnaires' Disease, New South Wales Health Department, Australia, 1992.

(c) Code of Practice for the Control of Legionella Bacteria in Cooling Towers in Singapore, Institute of Environmental Epidemiology, Ministry of Environment, Singapore, June 1998.

(d) Approved Code of Practice for the Prevention or Control of Legionellosis (including Legionnaires' Disease), Health and Safety Commission, UK, 1994.

Members of the Prevention of Legionnaires' Disease Committee

Chairman :	Mr. Uy Tat-ping	Electrical & Mechanical Services Department
Secretary :	Mr. Ho Hon-ying	Electrical & Mechanical Services Department
Members :	Mr. Lau Kwok-fan	Architectural Services Department
	Dr. Cindy Lai	Department of Health
	Dr. Kam Kai-man	Department of Health
	Dr. D.J. Lyon	The Chinese University of Hong Kong
	Dr. Ho Pak-leung	The University of Hong Kong
	Mr. Chou Wing-ping	Works Bureau
	Mr. Cheung Tze-leung	Water Supplies Department
	Mr. Lam Ching-man	Water Supplies Department