Fire Industry Association

Code of Practice for the Design and Installation of Commercial and Industrial Watermist Systems

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Fire Industry Association

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Issue 1 – first published March 2008

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Foreword

We welcome the lead which FIA continues to provide in the responsible use of new and emerging technologies such as watermist. The FIA Code of Practice for Commercial and Industrial Watermist Systems fulfils an urgent need in the fire safety community. It provides the first definitive guidelines on the safe and effective use of watermist technology which will enable clear guidance to be given by fire safety decision makers. The Code covers both frangible bulb as well as open nozzle systems for protection within buildings from hotels to food industry fryers and power generators. CFOA and FIA will continue to work closely together in safeguarding lives and livelihoods in UK and beyond.

Iain Cox - Chief Fire Officer, Royal Berkshire Fire & Rescue Service and Chair of CFOA National Fire Safety Committee

Introduction

Fixed watermist systems for the fire protection of commercial and industrial hazards comprise specially designed nozzles mounted in pipework, secured within a commercial/industrial building, and connected via control valves to a dedicated water supply. The watermist nozzles produce a mist of small droplets with sufficient momentum to penetrate a fire plume. Both single fluid and twin fluid watermist systems deliver small droplets which control, suppress or extinguish fire by:

- absorbing heat from the fire and its surroundings;
- smothering the flames by evaporation to steam;
- blocking radiant heat transfer to adjacent combustible materials.

The watermist droplets are lightweight and thus:

- remain airborne for longer periods;
- swirl around obstructions (but not to the same extent as a gas);
- are drawn into a fire's combustion air stream and thus into the fire.

High heat output fires, such as those involving flammable liquids (class B fires), can be extinguished using watermist. Low heat output fires, such as those involving ordinary combustible materials (class A fires), can be controlled and suppressed using watermist. Watermist can also prevent flash-over. With the high surface area of the droplets produced, watermist is able to absorb relatively large amounts of heat and thus provide efficient cooling. Watermist droplets can also partially wash out particles from the smoke produced by combustion. Currently, the majority of applications for watermist relate to property and asset protection. However, under certain circumstances, watermist can improve tenability within the protected space and thus increase the chances of survival for personnel inside the protected areas. It can also enhance life safety in more general applications by protecting facilities upon which the safety of people depends. Typical watermist applications can include, but are not limited to:

- general plant and equipment such as gas turbines and diesel generators, automotive test facilities, process and printing machinery;
- public spaces such as circulation areas, shops and offices;
- food industry applications;
- IT facilities.

1 Scope

This Code of Practice gives recommendations for the design, installation, commissioning and maintenance of watermist systems, and gives performance criteria for fixed watermist systems for specific commercial and industrial hazards. Annex A of this Code provides a template for the testing and validation of watermist system applications by qualified fire testing laboratories.

The Code of Practice does not cover watermist systems on ships, in aircraft, on vehicles and mobile fire appliances or for below ground systems in the mining industry. It does not cover the use of watermist for explosion protection.

2 Normative references

The following referenced documents are indispensable for the application of this document.

BS 5839-1, *Fire detection and fire alarm systems for buildings*

BS 7273-3, *Code of practice for the operation of fire protection measures – Part 3: Electrical actuation of pre-action watermist and sprinkler systems*

BS 7273-5, *Code of practice for the operation of fire protection measures – Part 5: Electrical actuation of watermist systems* [1)]

BS 7671, *Requirements for electrical installations – IEE Wiring Regulations – Sixteenth edition*

BS EN 1057, *Copper and copper alloys – Seamless, round copper tubes for water and gas in sanitary and heating applications*

BS EN 1968, *Transportable gas cylinders – Periodic inspection and testing of seamless steel gas cylinders*

BS EN 12094 (all parts), *Fixed firefighting systems – Components for gas extinguishing systems*

BS EN 12259 (all parts), *Fixed firefighting systems – Components for sprinkler and water spray systems*

BS EN 12845:2004, *Fixed firefighting systems – Automatic sprinkler systems – Design, installation and maintenance*

BS EN 13445-5, *Unfired pressure vessels – Part 5: Inspection and testing*

BS EN 60079 (all parts), *Electrical apparatus for explosive gas atmospheres*

BS EN 60947-1:2004, *Specification for low-voltage switchgear and control gear – Part 1: General rules*

BS EN 60947-4-1:2001, *Low-voltage switchgear and control gear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

BS EN ISO 14847, *Rotary positive displacement pumps – Technical requirements*

BS ISO 14520-1, *Gaseous fire-extinguishing systems – Physical properties and system design – Part 1: General requirements*

ISO 6182-11, *Fire protection – Automatic sprinkler systems – Part 11: Requirements and test methods for pipe hangers*

IEC 61241 (all parts), *Electrical apparatus for use in the presence of combustible dust*

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1) In preparation.

3 Terms and definitions

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

3.1 additive
chemical or mixture of chemicals or gases, intentionally introduced into a watermist system for one or more of the following purposes:

- enhancement of or compliance with fire protection requirements;
- corrosion protection;
- frost protection

3.2 authority having jurisdiction
organization, office, or individual responsible for approving equipment, installations, and/or procedures

3.3 automatic nozzle
watermist nozzle (see **3.26**) held closed by an integral thermal release element

3.4 competent person
individual or organization that has the requisite training and experience, access to the requisite tools, equipment and information, and is capable of carrying out a defined task

3.5 working pressure
maximum developed pressure expected to be applied to a system component at maximum operating ambient temperature.

Note This not the hydrotest pressure.

3.6 discharge duration
sum of all the times that watermist discharges throughout one firefighting event

3.7 dry pipe system
watermist system in which the pipework is charged with air or inert gas under pressure

NOTE the water flows into the piping system and out through any activated nozzles.

3.8 fire control
prevention of fire spread beyond a defined fire zone

3.9 fire extinguishment
complete elimination of any flaming or smouldering fire

3.10 fire suppression
reduction in the heat release rate and prevention of re-growth of a fire over the discharge duration

3.11 flash-over
simultaneous ignition of all combustible products in a building or part of a building

3.12 local application system
watermist system designed to provide object protection within a larger overall space

3.13 maintenance
combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function

3.14 manufacturer
organization responsible for manufacturing watermist equipment, including nozzles, and for producing the watermist system design manual and the fire test programmes to which it is linked

3.15 manufacturer's design and installation manual
document containing design and installation rules for all details of a watermist system

3.16 monitored systems
systems where the operational status is electrically monitored

NOTE for example, valve position and liquid level.

3.17 pre-action systems

3.17.1 Type A pre-action system
otherwise normal dry pipe system in which:

- the air/inert gas pressure in the installation is monitored at all times;
- the control valve set is activated by an automatic fire detection system but not by the operation of the automatic nozzles;
- at least one quick opening manually operated valve is installed in an appropriate position to enable the pre-action valve to be activated in an emergency

3.17.2 Type B pre-action system
otherwise normal dry pipe system in which:

- the control valve set is activated either by an automatic fire detection system or by the operation of the automatic nozzles;
- independently of the response of the detectors, a pressure drop in the pipework causes the opening of the system control valve

NOTE see also BS 7273-3.

3.18 responsible person
person(s) responsible for or having effective control over fire safety provisions adopted in or appropriate to the premises or the building

3.19 single fluid system
system that generates watermist by the passage of water, or water with additive, through a nozzle

3.20 supplier
company fully trained and authorized by a manufacturer for the design, installation, commissioning and maintenance of its fixed watermist systems

3.21 system duration
total of discharge times plus any interspersed non-discharge times

3.22 twin fluid system
system that generates watermist at a nozzle by mixing water with inert gas fed from a separate pipe(s) from the water supply

3.23 user's operation and maintenance manual
document provided by the watermist design and installation company to the user's responsible person which sets out the procedures to be followed to ensure the ongoing satisfactory operation of the watermist system(s), and the frequency of such procedures

3.24 volume protection system
watermist system designed to protect an enclosed volumetric space

3.25 watermist
water spray for which the $D_{v0,90}$ measured in a plane 1 m from the nozzle at its minimum operating pressure is less than 1 mm

NOTE $D_{v0,90}$ *is the drop diameter such that the cumulative volume, from zero diameter, to the respective diameter, is nine tenths of the corresponding sum of the total distribution.*

3.26 watermist nozzle
component with one or more orifices, which is designed to produce and discharge watermist

3.27 watermist system
distribution system connected to a water supply, or water and atomizing media supplies, that is equipped with one or more nozzles capable of delivering watermist intended to control, suppress, or extinguish fires

NOTE Watermist systems can discharge water or a mixture of water and some other agent or agents, i.e. inert gases or additives.

3.28 wet pipe system
watermist system in which the pipework is always charged with water

4 General recommendations

4.1 Consultation

Where a watermist system or an extension or alteration to a watermist system is being considered within new or existing buildings, the following parties should be consulted and, where necessary, their approval sought at an early stage:

a) the water supply authority;

b) the fire authority;

c) the building control body;

d) the insurer(s) of the building and building contents.

4.2 Exclusions

Watermist systems should be designed and installed to ensure that contact between water and the following materials or substances is avoided.

a) **Materials which react with water**

   Watermist systems should not be used for direct application to materials that react with water to produce violent reactions or significant amounts of hazardous products. These materials include:

   1) reactive metals, such as lithium, sodium, potassium, magnesium, titanium, zirconium, uranium and plutonium;

   2) metal alkoxides, such as sodium methoxide;

   3) metal amides, such as sodium amide;

   4) carbides, such as calcium carbide;

   5) halides, such as benzoyl chloride and aluminium chloride;

6) hydrides, such as lithium aluminium hydride;

7) oxyhalides, such as phosphorus oxybromide;

8) silanes, such as trichloromethylsilane;

9) sulfides, such as phosphorus pentasulfide;

10) cyanates, such as methylisocyanate.

b) **Liquefied gases**
Watermist systems should not be used for direct application to liquefied gases at cryogenic temperatures (such as liquefied natural gas), which boil violently when heated by water.

c) **Live electrical equipment**
Watermist systems should not be installed in the presence of live electrical equipment, except where a risk assessment has been carried out and determined it is safe to do so.

NOTE It is preferable that electrical equipment be de-energized prior to discharge of the watermist.

4.3 Local application

Local application systems should be designed and installed for the object being protected, together with its associated hazards, in accordance with the design parameters established through representative fire tests (see **6.1** and Annex A).

Where a risk assessment shows that the spread of fire could involve two or more objects of local application, the watermist system should be designed for the combined hazard.

4.4 Volume protection

Volume protection systems should be designed and installed for the volume being protected, together with its associated hazards, in accordance with the design parameters established through representative fire tests (see **6.1** and Annex A).

Where the spread of fire is likely to involve two or more enclosed volumetric spaces, account should be taken of adjacent fire hazards, and the watermist system should be designed for the combined hazard.

NOTE The installation of an automatic door closing mechanism is expected to improve the effectiveness of the system by ensuring that any doors to the volume being protected are kept shut.

4.5 Oxygen depletion

Systems using an inert gas as a form of propellant for the watermist should conform to the safety requirements specified in BS ISO 14520-1.

4.6 Foam additives

The extinguishing properties of foam, including the ability to spread readily over pool fires, can contribute to the effectiveness of a watermist system. The use of water/foam mixtures can improve the effectiveness of the system and minimize re-ignition potential.

Foam may be used in applications where:

- there are obstructions between the mist source and the fire (e.g. pool fires under open floors); and/or
- the system is required to extinguish rather than suppress the fire.

If a system is designed to be used with a foam additive, any testing should be carried out in combination with this additive.

NOTE 1 Foam extinguishing media are specified in BS EN 1568.

*NOTE 2 See also **8.3**.*

5 Detection, actuation and control

5.1 Detection

The detection system is of paramount importance for correct and efficient system functioning. Only detection systems should be used which ensure response characteristics similar to the conditions under which the watermist system was tested (see **6.1** and Annex A).

The detection system should conform to BS 5839-1.

5.2 Actuation and control

5.2.1 General

System actuation can be mechanical, hydraulic, pneumatic or electrical, initiated by smoke, flame or heat.

NOTE Requirements for pneumatic heat actuated systems are specified in prEN 14816. [2)]

Watermist systems that use intermittent misting may be used provided that they are designed and installed in accordance with this document, but details of modes of control associated with intermittent misting systems are not given.

Alarms or indicators or both should be used to indicate the operation of the system or failure of any supervised device. The type (audible/visual), number, and location of the devices should be as specified in BS 5839-1.

5.2.2 Electrical actuation

Electrical actuation should be in accordance with BS 7273-3 or BS 7273-5 as appropriate.

5.2.3 Non-electrical actuation

Where pneumatic, hydraulic or mechanic control equipment is used, the lines should be protected against crimping and other possible damage. Where installations could be exposed to adverse conditions that could affect the integrity of the installation (electrical cable, pipework, key parts, etc.), appropriate precautions should be taken to counteract such occurrence.

5.2.4 Manual actuation

If a watermist system is equipped with a manual triggering device, the device should actuate in accordance with BS 7273-3 and BS 7273-5 and should be located outside the protected space or adjacent to the main exit from the protected space.

6 Design and installation

Watermist is a relatively new technology, and systems are still under development. At present watermist systems can vary considerably between manufacturers, and each system works in a different way, so a standardized test for a complete system is not possible. Instead of a

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[2)] In preparation.

standardized test, a template is provided in Annex A which the system designer can use to create a test tailored for the volume or object to be protected, based on a risk assessment that will have determined the types of fire that are likely to occur. It is hoped that in time a series of more standardized tests will be made available, which will be added to this document.

Watermist systems are designed to control, suppress or extinguish fire, and each system is designed for a specific fire scenario. The watermist system design parameters are established by testing, using the test template in Annex A with the appropriate ventilation conditions and fire load. The tests are used to establish for each manufacturer's equipment the necessary type and number of nozzles and their flows, operating pressures and spacing.

6.1 General

Before designing a watermist system, the volume or object to be protected should be identified and a risk assessment carried out to establish the exact nature of the potential fire hazard affecting that volume or object.

A test should then be carried out, simulating the volume or object to be protected in conjunction with the identified hazard. If a test has already been carried out for this application, and verified as being reliable, then that test should be used. If no test has previously been carried out, then the template given in Annex A should be used to identify and conduct an appropriate test.

When a successful set of test results is obtained (see **6.2.1** and **A.7**), those results should be used to determine the design parameters. The system should then be designed using those parameters, in accordance with this Code of Practice.

All design and installation parameters and any other system constraints crucial to the operation should be specified in the manufacturer's design and installation manual(s). Sufficient and relevant design and installation information should be provided to enable the replication of the system as tested. The manufacturer should describe and/or specify the procedure for the installation of the system.

6.2 System design

6.2.1 General

Watermist systems should meet the following criteria.

a) Nozzles should be positioned and orientated in accordance with the manufacturer's design and installation manual and should meet at least the established design parameters (see **6.1**). These should address, but are not limited to:

    1) minimum and maximum heights;

    2) minimum and maximum distances between nozzles;

    3) minimum and maximum distances from nozzles to walls;

    4) the location of nozzles with regard to obstructions;

    5) positioning of nozzles with regard to ceiling (flat, pitched or curved);

    6) nozzle protection;

    7) nozzle ceiling plates used with flush, recessed or concealed nozzles;

    8) minimum and maximum flow rates and pressures;

    9) additive requirements, where applicable.

b) Thermally activated nozzles should have heat-responsive elements in accordance with BS EN 12845 in terms of temperature ratings and selection of the temperature rating for installed maximum ambient conditions.

c) The system duration should be as follows.

   1) For extinguishing systems, the duration should be at least twice the time taken to extinguish the fire and to prevent re-ignition as established in the test (see **6.1**).

      NOTE Other factors such as the run-down time of a turbine and the time necessary to secure fuel lines to rotating equipment might also need to be taken into account, depending on the application.

   2) For suppression and control systems using automatic nozzles, the duration should be not less than 30 min.

d) The water supply should be as follows.

   1) For extinguishing systems, the water supply should be based on the minimum discharge duration and the maximum number of nozzles established in the test (see **6.1**).

   2) For suppression and control systems using automatic nozzles, the water supply should be based on the minimum discharge duration and twice the maximum number of nozzles established in the test (see **6.1**).

e) Where watermist systems are provided for life safety, they should be monitored.

6.2.2 System type and size

The protected area in wet pipe and pre-action systems, served by a single control valve, should be not more than 10 000 m^2.

Type A pre-action systems should only be installed in areas where considerable damage could occur if there was an accidental discharge of water.

Type B pre-action systems may be installed wherever a dry pipe system is called for and the spread of fire is expected to be rapid.

The net volume of a dry system, served by a single control valve, should be $<0.15\ m^3$ for intermediate and high pressure systems and $<0.28\ m^3$ for low pressure systems.

6.2.3 Pipework

6.2.3.1 Pressure loss

System piping should be hydraulically designed to deliver the required water flow in accordance with the manufacturer's design manual and **8.1**.

Only appropriate and validated calculation procedures should be applied, e.g. the Darcy-Weisbach formula for liquid flow systems.

6.2.3.2 Air venting

Vent valves should be provided where air pockets can accumulate in normally water-filled pipework.

6.2.3.3 Installation

The pipework should be installed in accordance with the manufacturer's design and installation manual and should be protected against internal corrosion. Pipes and fittings should be installed in such a way that the pipework is not exposed to damage, e.g. by fire, by passing vehicles, by frost, or by contact with dissimilar metals. Where systems are installed in corrosive environments, suitably corrosion-resistant materials and components should be used. The possibility of thermal expansion in very long straight pipe runs should be addressed where applicable.

Bonding should be carried out in accordance with BS 7671.

Systems within electrical sub-stations or switch rooms should be effectively bonded and earthed to prevent metalwork becoming electrically charged.

All pipework should be checked for electrical earthing connections. Pipework should not be used for earthing electrical equipment. Any earthing connections from electrical equipment should be removed and alternative arrangements made.

6.2.3.4 Drainage

All systems should be installed in such a way that the entire pipework system can be drained.

6.3 Electrical design

6.3.1 General

Electrical installations should conform to BS 7671.

Special attention should be paid to the use of equipment in hazardous classified areas and the appropriate ingress protection grade. Electrical apparatus in explosive gas atmospheres should conform to BS EN 60079. Electrical apparatus in the presence of combustible dust should conform to IEC 61241.

6.3.2 Transmission of alarms

Alarms should be connected to an alarm panel in the watermist control room or pump room and be transmitted onwards depending on the nature of the alarm (e.g. fault or fire condition). Alarms should be transmitted to a permanently attended location, on or off the premises, or to a responsible person in such a way that appropriate action can be taken immediately.

Signals such as water flow indication, which could be indicative of a fire, should be shown as fire alarms (alarm level A in Table 1). Technical faults such as a power failure, which could prevent the system operating correctly in case of fire, should be shown as fault (trouble) alarms (alarm level B in Table 1).

Table 1 – Types of alarm for transmission

Fault	Alarm type
Low pressure in town main	B
Fire in pump room	A
Electric pumpset:	
• power not available	B
• on demand (initiation device operated)	B
• start failure	B
• running	A
Diesel pumpset:	
• fault in controller	B
• automatic mode off	B
• on demand (initiation device operated)	B
• start failure	B
• running	A
Trace heating circuits	B
Low pressure:	
• pre-action Type A system	B
• dry pipe and pre-action systems	B
Control valves:	
• water flow	A
Monitored watermist systems:	
• partially closed stop valves	B
• liquid levels	B
• low pressure	B
• power failure	B
• low temperature in pump room	B

NOTE Table reproduced from BS EN 12845:2004, Table I.1.

6.4 Air velocity, openings and ventilation

Air velocity, openings and ventilation should be taken into account, in accordance with the manufacturer’s instructions, based on test results.

Wherever possible, the ventilation system should be shut down automatically before the system operates. In those cases where this is not possible or desirable, the air velocity and/or total leakage area should be within the limits specified by the manufacturer on the basis of tests.

6.5 Volume protection for enclosures

Fire resistance, pressure relief openings, and the positioning of nozzles in relation to obstructions should be in accordance with the manufacturer’s design and installation manual.

7 Components

7.1 General

Gaseous components should conform to the relevant part(s) of BS EN 12094.

NOTE: Requirements for water components is currently under consideration

7.2 Piping and fittings

7.2.1 General

The pipework and fittings should be suitable for the working pressure. Distribution pipework and fittings, including hoses, within the hazard area should be suitable for their intended use.

7.2.2 Pipe

Pipework materials should be of 316 grade stainless steel or of at least equivalent quality in respect to both corrosion and fire resistance. Alternative solutions (e.g. copper conforming to BS EN 1057, zinc-coated steel or synthetic materials) are acceptable if the same level of performance can be proven with respect to clogging of the chosen nozzle and filters due to corrosion, and if the alternative material can be proven to be equally fire-resistant. The materials (and any protective coating) should have adequate corrosion resistance taking into account its possible use in wet pipe systems and should not be adversely affected by any system additives. Care should be taken in the choice of dissimilar metals in contact in order to reduce the effects of galvanic corrosion.

7.2.3 Pipe supports

Pipe supports should either be in accordance with ISO 6182-11 or have at least equivalent performance in terms of load, vibration and heat resistance.

Pipe supports should be suitable for the environmental conditions and for the expected temperature, including the stresses induced in the pipe work by temperature variations, and should be able to withstand the anticipated dynamic and static forces.

Pipe supports should be designed and spaced according to the manufacturer's design and installation manual, but with spacing no greater than the intervals given in Table 2, Table 3 and Table 4 for the appropriate type of steelwork.

Pipe supports should be located not more than 300 mm either side of any fitting or connection.

Table 2 – Maximum spacing of fixings for copper and stainless steel pipework

Nominal diameter Mm	**Horizontal run** M	**Vertical run** M
12	1.2	1.8
16	1.5	2.1
22	1.8	2.4
28	1.8	2.4
35	2.4	3.0
42	2.4	3.0
54	2.7	3.0

Table 3 – Maximum spacing of fixings for steel pipework

Nominal diameter mm	Horizontal run M	Vertical run M
15	1.8	2.4
20	2.4	3.0
25	2.4	3.0
32	2.7	3.0
40	3.0	3.6
50	3.0	3.6
80	3.6	4.5

Table 4 – Maximum spacing of fixings for CPVC pipework

Nominal diameter mm	Horizontal run M	Vertical run M
12	0.6	1.2
15	0.8	1.6
22	0.8	1.6
28	0.9	1.8
32	1.0	2.0
40	1.05	2.1
50	1.2	2.4
65	1.35	2.7
80	1.5	3.0

7.2.4 Flexible hoses

The length of the hose should be limited to the minimum necessary taking into account the installation guidelines and restrictions of the hose manufacturer.

Where flexible hoses connect to metal pipes the hose end fittings should be of galvanically compatible materials

7.3 Valves

7.3.1 Control valves

In systems operating below 12.5 bar[3)], wet pipe control valves should conform to BS EN 12259-2 and should operate correctly with nozzle flows of less than 80 l/min.

Control valves for systems operating above 12.5 bar should be suitable for the pressures, temperatures and environment imposed on them. They should be in accordance with the acceptance criteria of the essential features of the tests for strength, fatigue resistance of springs and diaphragms, resistance to damage of sealing assemblies, resistance to aging of non-metallic parts, endurance, reverse flow and corrosion resistance, as listed in BS EN 12259-2. The valve

[3)] 1 bar = 10^5 N/m^2 = 100 kPa.

should be made of corrosion-resistant material or should have corrosion resistant finishing. Valves are expected to have a clear mark to indicate the correct way of installation.

For control valves with actuator mechanisms, such as pneumatic type, hydraulic type, or electrical type, the specifications of the actuator should match the valve operation criteria.

Means should be provided to enable the correct functioning to be checked and maintenance to be carried out in situ.

7.3.2 Pressure regulating valves

Pressure regulating valves, where used, should be capable of providing a regulated output at the rated flow capacity and design setting, over the full range of pressures that will be experienced over the course of the discharge period. Pressure set, point-adjusting mechanisms on the pressure regulating valve should be tamper-resistant, and a permanent marking should indicate the adjustment. A means to indicate evidence of tampering should be provided. The pressure regulating valve's set point is expected to have been set by the manufacturer. Permanent markings should indicate the inlet and outlet connections of the pressure regulating valve.

7.3.3 Stop valves

All stop valves controlling the flow of water to watermist systems should have an open/shut indicator and should be securely fastened in the correct mode. This should include the stop valves on all water supplies, at the control valve(s) and all zone or other subsidiary stop valves.

Stop valves in watermist systems used for life safety should be monitored.

7.3.4 Check valves

Check valves should be suitable for the applicable pressure class.

Check valves should be installed in accordance with the manufacturer's design and installation manual, if more than one section is fed by a common supply. Check valves should also be installed to prevent backflow, e.g. into the town mains or as a separation between pumps/water sources.

7.3.5 Safety valves

Pressure relief valves should be designed to operate no higher than the hydrostatic test pressure and no lower than the working pressure.

Pumps capable of over pressurising the system should be provided with a means of pressure relief to prevent over pressurisation.

7.4 Strainers

Strainers should be made of corrosion-resistant materials. For pressure-bearing parts and for the sieve, metallic materials should be used. The flow direction should be given on the body of system strainers.

System strainers should be installed in each water supply connection. It should be possible to take out the sieve and the dirt particles of system strainers without having to remove the strainer housing.

All parts should be constructed in such a way that incorrect mounting will be obvious. Strainers should be designed in such a way that spheres with a diameter of more than 0.8 times the minimum nozzle waterway dimension cannot pass through the strainer.

The free flow through the distribution pipes should not be obstructed, i.e. no part of the strainer should protrude into that pipe waterway.

If the nozzle strainer is projecting from the nozzle inlet into the pipe fitting, the design should be such that a sphere with a diameter of 3 mm can pass between the inner surface of the pipe fitting and the outer surface of the strainer.

The pressure loss of the strainer should be taken into account during hydraulic calculation.

7.5 Pressure measuring equipment

Pressure measuring equipment should be installed according to the manufacturer's design and installation manual.

7.6 Water supply components

NOTE Attention is drawn to the Pressure Equipment Regulations 1999 [1] with regard to the ability to withstand design pressure.

The components of low pressure systems should be in accordance with the relevant part of BS EN 12259. The components of systems with higher pressure should fulfil the same safety level as given in BS EN 12259.

Pressure vessels, vessels with external expelling gas, and pumps should be:

a) of suitable metal alloy or composite material to provide adequate protection against corrosion and sludge development;

b) compatible with the specific watermist system tested (see **6.1**).

8 Water supply, including additives

8.1 General

The water supply should be capable of supplying both the hydraulically most remote and the hydraulically most favourable operating areas. The hydraulically most remote area is that which determines the design pressure requirements. The hydraulically most favourable is that which determines the design flow requirements.

The water supply can be based on either potable or non-potable water. If non-potable water is used, provision should be made to allow a thorough flushing of the system piping with potable water after operation of the system. If non-potable water is used for a closed head system, provision should be made to pre-charge the system with potable water.

The water supply should be taken from one of the following:

- a connection with the public water distribution system, taking into account the requirements and restrictions from the local water authority;
- one or more automatic starting fire pumps;
- one or more pressurized containers.

8.2 Water quality

The water used in watermist systems should be demineralised water, deionised water, potable or sweet industrial water.

Watermist systems, with and without additives, may be used in combination with inert gas(es) which are used primarily to atomize the water and/or to reduce the oxygen concentration at the fire.

The water quality should be specified in the manufacturer's design and installation manual.

The water should be free from fibrous or other matter in suspension liable to cause accumulations in the system piping. Non-potable water should not be retained in installation pipework.

8.3 Additives

8.3.1 General

WARNING. Watermist systems using additives should not be used in normally occupied areas unless they have been evaluated to be safe for human exposure at the maximum concentration of the additive that can be reached upon system discharge. The user's operation and maintenance manual should state any limitations in areas where the watermist system can be used safely, taking into account the potential for at least skin irritation, eye irritation, inhalation toxicity and toxicity on human beings.

NOTE 1 For information on Legionella and fire-fighting systems, see Legionella and fire-fighting systems – A technical briefing note *[2].*

A watermist system is deemed to include additives when constituents other than those normally present in potable water are added to the water in percentages as specified by the manufacturer. Systems using non-potable water as emergency supply are not considered to include additives.

Notre: With regard to material compatibility see clause 7.2.2.

Additives can be used in watermist systems for various reasons including the following:

- maintain system operability under freezing conditions (wet systems);
- preventing water/container deterioration;
- preventing corrosion;
- fire suppression capabilities.

NOTE 2 Where additives are specified by the manufacturer as part of the system these are deemed to be essential to the performance of the system.

Additives that can be used with a specific watermist system should be listed in both the manufacturer's design and installation manual, and the user's operation and maintenance manual. The listing should at least include:

- specific type of additive;
- specific concentration;
- method of mixing the additive with water;
- method of test to confirm concentration delivered and efficacy of the mixture.

Systems using additives should have a supply of additive sufficient for the discharge duration.

8.3.2 Identification

Watermist systems containing additives should be clearly identified on the system identification label. Warning labels should also be attached at all fill and flushing points. Material safety data sheets for each additive should be included in both the manufacturer's design and installation manual, and the user's operation and maintenance manual.

8.4 Duration

Designed quantities of water and additives (if used) should be capable of supplying the system in accordance with **6.2.1**c).

The durations should be based on the hydraulically most favourable operating areas, i.e. those areas where the maximum flow would be delivered.

Intermittent discharge systems should repeat the operating sequence throughout the required system duration.

The water supply should be capable of maintaining the necessary minimum pressure and the minimum water flow of the system during the system discharge time.

8.5 Continuity

8.5.1 General

All practical steps should be taken to ensure the continuity and reliability of water supplies. Where used, reduced capacity tanks should be not less than 30% full capacity and the infill rate should be sufficient to ensure discharge durations in accordance with **6.2.1**.

Water supplies should be protected against the effects of frost and installed under secure conditions, to prevent tampering.

Water supplies should preferably be under the control of the user, or else the reliability and right of use should be guaranteed by the designated organization having control.

8.5.2 Frost protection

The stored water and the feed pipe and the control valve set should be maintained at a minimum temperature of 4 °C. If this is not possible, measures should be taken to ensure that the frost has no adverse effects on the system reliability, e.g. via additives.

The pump compartment should be maintained at or above the following temperature:

- 4 °C for electric motor driven pumps;
- 10 °C for diesel engine driven pumps.

8.5.3 Housing of equipment for water supplies

Water supply equipment, such as pumps, pressure tanks and gravity tanks, should not be housed in buildings or sections of premises in which there are hazardous processes or explosion hazards. The water supplies, stop valves and control valves should be installed such that they are safely accessible even in a fire situation.

8.6 Maximum and minimum water pressure

The maximum and minimum pressure of the water supply should be within the approved limits for the nozzles specified by the manufacturer in consideration of the static pressure difference and the pipe hydraulic pressure loss.

8.7 Test devices

8.7.1 Self-contained systems

Self-contained systems should be equipped with a means to permanently check the pressure or weight of pressurized cylinders. They should be equipped with means to check the water content, as applicable.

8.7.2 Pump and town main supplied systems

Watermist systems should be provided with permanent means for measuring maximum pressures and flows. Each supply to the system should be tested independently with all other supplies isolated.

For pump systems, means should be provided to establish pump flow and pressure performance, and clear strainer where fitted.

Means should be provided to measure the inflow to a non-full capacity tank of the watermist system.

8.8 Type of water supply

The choice of the water supply depends on the risk assessment for the hazard.

Acceptable sources of supply are:

- direct town mains with a single or duplicate feed;
- pressurized gas/water storage containers with single or duplicate sources of gas purge;
- pumps and tanks with single or multiple pumps and with single or duplicate tanks.

Single sources of supply should not be used for critical/life safety applications. Dual sources should be used to provide redundancy and improve availability.

9 Pressurization systems

9.1 Cylinders and storage tanks

NOTE Attention is drawn to the Pressure Equipment Regulations 1999 [1] in respect of the construction, testing and marking of pressure containers and cylinders.

Cylinder systems should be in accordance with the relevant part(s) of BS EN 12094.

Cylinders should be supported and secured to prevent cylinder movement and possible physical damage. Facilities should be provided for servicing or verification of the contents of each cylinder. When any cylinder in a system, that has a manifold, is removed for maintenance a means should be provided to prevent leakage from the manifold if the system is operated.

Either cylinders should be installed in an area maintained within the temperature range specified by the manufacturer, or external heating/cooling should be provided to keep the temperature of the storage container within the specified ranges.

When the storage container(s) is placed in the hazard area being protected, provision should be made to ensure that the system operation is not adversely affected by its location.

Water storage tanks and cylinders should be internally protected against corrosion.

9.2 Pump systems

9.2.1 General

Pumps supplying watermist systems should be designed to start both automatically and manually. Pumps supplying watermist systems should be of sufficient capacity (flow and pressure) to achieve the necessary pressure and duration (see **8.4**). The prime mover should be rated at 110% of the rated power demand of the pump.

Pumps capable of pressurizing the system above its design pressure should be provided with a suitably sized pressure relief valve. The system pressure should not exceed the design pressure of any component that might be in contact with water.

A stop valve should be fitted in the pump suction pipe, and a non-return and a stop valve should be fitted in the delivery pipe.

Valves on the delivery side should be fitted after any taper pipe.

Means for venting all cavities of the pump casing should be provided unless the pump is made self-venting by arrangement of its branches.

Arrangements should be made to ensure a continuous flow of water through the pump sufficient to prevent overheating when it is operating against a closed valve. This flow should be taken into account in the system hydraulic calculation and pump selection. The outlet should be clearly visible, and where there is more than one pump the outlets should be separate. To prevent overheating of the water, water flow through the pressure relief valve should not be directed back to the pump suction line. Flow may be directed back to the tank or to the drainage line of the system.

The pump inlet should be provided with a vacuum/pressure pressure gauge and the pump outlet should be provided with a pressure gauge.

Except in the case of submersible pumps, the pumpset controller should be situated in the same compartment as the electric motor and pump. In the case of submersible pumps, a plate stating its hydraulic and power characteristics should be affixed to the pumpset controller.

9.2.2 Centrifugal pumpsets

Centrifugal pumpsets should be designed and installed in accordance with BS EN 12845 and BS EN 12259-12.

9.2.3 Positive displacement pumpsets

Positive displacement pumps should either meet the requirements of BS EN ISO 14847 or have technically equivalent system performance.

Pumpsets should be fitted with pressure relief valves and flow bypass arrangements in order to avoid damage to the pump and system.

NOTE 1 Positive displacement pumps, e.g. piston pumps and, hence, the flow and pressure characteristics are quite different than those of a centrifugal pump. In contrast to the centrifugal pump, the flow rate of a positive displacement pump does not depend on system back pressure but is proportional only to pump speed.

NOTE 2 Certain system features, such as the electrical power supply connections, location and sizing of circuit breakers, and supervision, are similar to conventional fire pump installations.

9.2.4 Electrically driven pumpsets

9.2.4.1 General

The electric supply system should be available at all times.

Up to date documentation should be kept available in the watermist valve or pump compartment. Examples include installation drawings, main supply and transformer diagrams, connections for supplying the pump controller panel and motor, and control alarm circuits and signals.

9.2.4.2 Electricity supply

The supply to the pump controller should be solely for use of the watermist pumpset and separate from all other connections. Where permitted by the electrical utility, the electrical supply to the pump controller should be taken from the input side of the main switch on the incoming supply to the premises. Where this is not permitted, the supply should be taken from a connection from the main switch. The fuses in the pump controller should be of high rupturing capacity, capable of carrying the start current for a period of no less than 20 s.

9.2.4.3 Main switchboard

The main switchboard for the premises should be situated in a fire compartment used for no other purpose than for electrical power supplies.

The electrical connections in the main switchboard should be such that the supply to the pump controller is not isolated when isolating other services.

Each switch on the dedicated power feed to the watermist pump should be labelled:

FIREFIGHTING SYSTEM PUMP MOTOR SUPPLY –
NOT TO BE SWITCHED OFF IN THE EVENT OF FIRE

The letters on the notice should be at least 10 mm high and should be white on a red background. The switch should be locked to protect it against tampering. The label should be non-detachable, non-flammable, permanent and legible.

When connecting the main switchboard and the pump controller, the current for calculating the correct dimension for the cable should be determined by taking 150% of the largest possible full load current.

9.2.4.4 Pumpset controller

The pumpset controller should be able to:

a) start the pumpset automatically on receiving an initiating signal;

b) start the pumpset on manual actuation.

It should be possible to shut down the pumpset only manually; monitoring devices should not cause the pumpset to stop.

The controller should be equipped with a means of establishing deterioration in motor condition, for example, an ammeter.

Contacts should conform to utilization category AC-4 as specified in BS EN 60947-1:2004 and BS EN 60947-4-1:2001.

9.2.4.5 Monitoring of pump operation

The following equipment should be monitored continuously:

a) electric pumpsets with:
   1) pump running;
   2) loss of power, e.g. one or more phases;
   3) phase reversal;
   4) controller not in automatic position;
b) diesel-driven pumps with:
   1) pump running;
   2) power failure;
   3) controller not in automatic position;
   4) low oil pressure;
   5) high water temperature;
   6) failure to start/over crank;
   7) over speed;
   8) fuel level (set at 75% capacity).

The following conditions should be monitored:

- power available to the motor and, where A.C., on all three phases;
- pump on demand;
- pump running;
- start failure.

All monitored conditions should be visually indicated individually in the pump room. They should also be visually indicated at a location permanently attended by responsible personnel. Pump running and fault alarms should also be audibly indicated at the same place.

The visual fault indication should be yellow. The audible signals should have a signal strength of at least 75 dB and should be able to be silenced.

A lamp test for checking the signal lamps should be provided.

9.2.5 Diesel driven pumpsets

Diesel driven pumpsets should be in accordance with BS EN 12845:2004, **10.9**, with the exception of the fuel tank size, which should be sufficient for not less than 3 h running at full load. Diesel engine cooling circuits usually use the same water. However, if additional water is used, this should also be taken into account.

9.3 Tanks

9.3.1 General

Water tanks should be supervised for the following conditions:

- water level;
- risk of freezing (for tanks located in unheated areas).

Tanks should be provided with a drain valve, access to inflow valves for inspection, a readable water level indicator, and an overflow outlet.

The water inflow should be positioned so as not to influence the pump suction.

A valve should be placed at the outlet of the tank, between tank and pumps, for maintenance purposes.

Tanks (except for pressurized tanks) should be provided with some form of venting to atmosphere to avoid over/under pressure. This venting should include a screen to avoid particles from entering the vents/or and contaminating the water.

The tank should include a name plate indicating the volume of the tank and the liquid contained therein.

9.3.2 Connections to water networks

Connection to water networks should be provided with a strainer.

The connection to the water network should have a capacity to provide the maximum system demand at the minimum design pressure. It should also include a flow and pressure verification facility.

9.3.3 Jockey pumps

A jockey pump should be able to supply the system with sufficient pressure to open an automatically activated nozzle or valve. It should not have sufficient flow capacity to sustain the pressure in the system above the pressure required to initiate the main watermist pump(s) when the smallest and/or most remote nozzle is operating.

A valve should be provided for test purposes at the jockey pump outlet. Some protection devices, e.g. a check valve, should be installed between the jockey pump and the pipe system to avoid breakage of the jockey pump due to the main pump operation.

Pumps should start automatically upon system actuation. Manual activation system should be provided.

10 Commissioning

10.1 Pre-commissioning tests

10.1.1 General

The following checks should be made prior to commissioning of a watermist system.

- The completed system should be checked against the approved documentation. This check should comprise a physical verification of protected risk system design, site conditions and risk limitations, which should include flow calculations of the as-built system.
- A system inspection should be carried out. This should consist of a component review where the condition, connection and installation of components are confirmed to be in accordance with the system requirements.

10.1.2 Pipework

10.1.2.1 Dry pipework

Dry pipework should be tested pneumatically to a pressure of no less than 2.5 bar[4)] for no less than 24 h. Any leakage that results in a loss of pressure greater than 0.15 bar for the 24 h should be corrected.

10.1.2.2 All pipework

All pipework should be cleaned internally after preparation and before assembly and be free of particulate matter and oil residue

Water supply pipework upstream of watermist pumps should be flushed for a suitable time to ensure thorough cleaning at the system design flow rate or maximum flow available under fire conditions- whichever is the greater.

All pipework should be hydrostatically tested for no less than 2 h, to a pressure of 1.5 times the maximum pressure to which the system will be subjected (measured at the installation control valves). For dry pipework, this test should be carried out immediately after the pneumatic test, or as soon afterwards as climatic conditions permit.

Any faults disclosed, such as permanent distortion, rupture or leakage, should be corrected and the test repeated.

Care should be taken not to subject any system components to pressure higher than those recommended by the supplier.

10.2 Commissioning tests

10.2.1 Electrical detection and actuation

Electrical detection and actuation should be in accordance with BS 5839-1, BS 7273-3 and BS 7273-5.

10.2.2 Mechanical equipment

Where systems are fitted with mechanical actuation, a functional check of the actuation system should be carried out.

All gas cylinders and water storage vessels should be fully charged.

The function of all resettable valves and actuators should be checked, unless testing of the valves would result in water discharge from the nozzles.

The system should then be tested once in accordance with **11.3.2** and **11.3.3**.

Full system discharge tests may be carried out where appropriate.

10.3 Handover documentation

The installer of the system should provide the user with the following:

a) a completion certificate stating that the system conforms to all the appropriate recommendations of this Code of Practice[5)], or giving details of any deviation from the recommendations;

[4)] 1 bar = 10^5 N/m^2 = 100 kPa.

b) results of the hydrostatic testing;

c) confirmation that the necessary flushing and cleaning operations have been conducted so that pipe work are free of swarf and debris that could cause the nozzles to block;

d) results of the functional tests;

e) a complete set of operating instructions and as-built drawings, including identification of all valves and instruments used for testing and operation;

f) the user's operation and maintenance manual (see Clause **11**).

11 Inspection and maintenance

11.1 User's operation and maintenance manual

The installer should provide the user with an operation and maintenance manual which should include, but is not limited to:

- any limitations in areas where the watermist system can be used safely (see **4.2**);
- a listing of additives that can be safely used with the system (see **8.3.1**), including material safety data sheets (see **8.3.2**);
- instructions to the user to notify interested parties of the intent to carry out tests and/or of the results, as appropriate;
- a monitoring programme for the system and components in accordance with the manufacturer's design and installation manual, including instruction on the action to be taken in respect of faults;
- general maintenance instructions (see **11.2**);
- a user's programme for inspection and checking (see **11.3**). This is intended to detect faults at an early stage to allow rectification before the system might have to operate;
- a user's programme for service and maintenance (see **11.4**);
- instructions to the user to have the test, service and maintenance schedule carried out by a competent person;
- instructions to the user to keep records, including a logbook which should be held on the premises;
- instructions to the user to return the system, together with any automatic pumps, pressure tanks and gravity tanks, to its proper operational condition, with all faults corrected, after any inspection, check, test, service or maintenance procedure.

11.2 General maintenance instructions

The user's operation and maintenance manual should include the following general maintenance instructions.

a) **Suppliers**
Watermist systems should be maintained by qualified suppliers.

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[5] Such a certificate represents an installer's declaration of conformity, i.e. a claim by or on behalf of the installer that the product meets the recommendations of this Code of Practice. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

b) **Precautions while carrying out work**

Alternative fire precautions should be taken by the user while the system is not operational or after system operation.

c) **Replacement watermist nozzles and additives**

A stock of spare watermist nozzles should be kept on the premises as replacements for operated or damaged nozzles. Spare watermist nozzles, together with watermist nozzle spanners as supplied by the system supplier, should be housed in a cabinet or cabinets located in a prominent and easily accessible position where the ambient temperature does not exceed 27 °C.

The number and type of spare watermist nozzles per system should be not less than the number required to reinstate the system to operational status.

NOTE For automatic nozzles this quantity will be based on the largest design area of operation.

The stock should be replenished promptly after spares are used.

Where systems contain high-temperature automatic nozzles, sidewall or other variations, an adequate number of these spares should also be maintained. The quantity should be based on the largest area of operation for each nozzle type.

Where appropriate, a supply of additive sufficient for one recharge should be held on site unless it can be made available within 24 h.

11.3 User's programme for inspection and checking

11.3.1 General

The installer should provide the user with a documented inspection and checking procedure for the system.

The programme should include instruction on the action to be taken in respect of faults and operation of the system, with particular mention of the procedure for emergency manual starting of pumps, and details of the weekly routine recommended in **11.3.2** and the monthly routine recommended in **11.3.3**.

Electrical detection and actuation systems should be inspected in accordance with BS 5839-1.

Water additives (where used) should be tested/replaced in accordance with the user's operation and maintenance manual.

11.3.2 Weekly routine

11.3.2.1 General

Each part of the weekly routine should be carried out at intervals of no more than 7 days.

11.3.2.2 Checks

The following should be checked and recorded:

a) all water and air pressure gauge readings on systems, trunk mains and pressure vessels;

NOTE The pressure in the pipework in dry and pre-action installations should not fall at a rate of more than 1.0 bar per week.

b) all water levels in water storage tanks (including pump priming water tanks and pressure vessels);

c) the correct position of all main stop valves unless fitted with remote monitoring.

11.3.2.3 Automatic pump starting test

Tests on automatic pumps should include the following;

a) water pressure on the starting device should be reduced, or means of simulating the condition of automatic starting;

b) when the pump starts, the starting pressure should be checked and recorded;

c) fuel and engine lubricating oil levels in diesel engines should be checked;

d) the oil pressure on diesel pumps should be checked, as well as the flow of cooling water through open circuit cooling systems.

11.3.2.4 Diesel engine restarting test

Immediately after the pump start test recommended in **11.3.2.3**, diesel engines should be tested as follows:

a) the engine should be run for 20 min, or for the time recommended by the supplier. The engine should then be stopped and immediately restarted using the manual start test button;

b) the water level in the primary circuit of closed circuit cooling systems should be checked.

Oil pressure (where gauges are fitted), engine temperatures and coolant flow should be monitored throughout the test. Oil hoses should be checked and a general inspection made for leakage of fuel, coolant or exhaust fumes.

11.3.2.5 Trace heating and localized heating systems

Heating systems to prevent freezing in the system should be checked for correct function.

11.3.3 Monthly routine

The electrolyte level and density of all non sealed lead acid cells (including diesel engine starter batteries and those for control panel power supplies) should be checked. If the density is low, the battery charger should be checked and, if this is working normally, the battery or batteries affected should be replaced.

11.4 User’s programme for service and maintenance

11.4.1 General

The installer should provide the user with a documented service and maintenance procedure for the system. The programme should include the routines recommended in **11.4.2** to **11.4.6**, together with an instruction for any additional procedures to be carried out by a competent supplier.

Electrical detection and actuation systems should be serviced and maintained in accordance with BS 5839-1.

Whenever an inspection is carried out, a signed, dated report of each inspection should be provided to the user and should include advice of any rectification carried out or needed, and details of any external factors, e.g. weather conditions, which might have affected the results.

11.4.2 Quarterly routine

11.4.2.1 General

The following checks and inspections should be made at intervals of no more than 13 weeks.

11.4.2.2 Review of hazard

The effect of any changes of structure, occupancy, storage configuration, heating, lighting or equipment etc. of a building on hazard classification or installation design should be identified in order that the appropriate modifications can be carried out.

11.4.2.3 Watermist nozzles

Watermist nozzles affected by deposits should be changed.

NOTE Watermist nozzles in deep fat fryers and spray booths will require more frequent cleaning and/or protective measures.

11.4.2.4 Pipework and pipe supports

Pipework and hangers should be checked for corrosion and mechanical damage, and remedial action taken as necessary.

The pipework should be checked for electrical earthing connections. System pipework should not be used for earthing electrical equipment and any earthing connections from electrical equipment should be removed and alternative arrangements made.

11.4.2.5 Water supplies and their alarms

Each water supply should be tested with each control valve set in the system. The pump(s), if fitted, in the supply should start automatically and the supply pressure should be no less than the appropriate value recommended in **9.2**, recognizing any changes identified in **11.4.2.2**.

11.4.2.6 Electrical supplies

Any secondary electrical supplies from diesel generators should be checked for satisfactory operation.

11.4.2.7 Stop valves

All stop valves controlling the flow of water to the system should be operated to ensure that they are in working order, and securely refastened in the correct mode. This should include the stop valves on all water supplies, at the alarm valve(s) and all zone or other subsidiary stop valves.

11.4.2.8 Flow switches

Flow switches should be checked for correct function.

11.4.2.9 Replacement

The number and condition of replacement parts held as spare should be checked and replenished as necessary.

11.4.3 Half-yearly routine

11.4.3.1 General

The following checks and inspections should be made at intervals of no more than 6 months.

11.4.3.2 Dry and open head control valves

The moving parts of dry and open-head control valves in dry pipe installations and subsidiary extensions should be exercised in accordance with the supplier’s instructions.

11.4.3.3 Examination of cylinders and vessels

Cylinders and water storage vessels should be examined externally for signs of damage or unauthorized modification, and for damage to system hoses. The contents should be checked and confirmed that they are within 5% of correct charge pressure. Any showing a greater loss should be replaced or refilled.

11.4.3.4 Valves

The function of all resettable valves and actuators should be checked, unless testing of the valves would result in water discharge from the nozzles.

11.4.3.5 Fire brigade and remote central station alarm

The electrical transmission and receipt should be checked.

11.4.3.6 Test of fire detection and alarm system

The fire detection and alarm system should be tested and serviced in accordance with BS 5839-1. All auxiliary functions, e.g. plant shut-down, should be checked at this time.

11.4.4 Yearly routine

11.4.4.1 General

The following checks and inspection should be made at intervals of no more than 12 months.

At least annually, or more frequently as required, all systems should be thoroughly inspected and tested for correct operation by competent personnel.

11.4.4.2 Automatic pump flow test

Each water supply pump in the installation should be tested at the full load condition (by means of the test line connection coupled to the pump delivery branch downstream of the pump outlet check valve) and should give the pressure/flow values stated on the nameplate.

Appropriate allowances should be made for pressure losses in the supply pipe and valves between the source and each control valve set.

11.4.4.3 Diesel engine failed-to-start test

The failed-to-start alarm should function correctly when tested in accordance with BS EN 12845:2004, **10.9.7.2**.

Immediately after this test the engine should be started using the manual starting system.

11.4.4.4 Infill valves on water storage tanks

Infill valves on water storage tanks should be functionally tested to determine whether they operate correctly. Appropriate remedial action should be taken if necessary.

11.4.4.5 Pump strainers

Pump strainers should be inspected at least annually and cleaned as necessary.

11.4.5 Three-yearly routine

11.4.5.1 General

The following checks and inspections should be made at intervals of no more than 3 years.

11.4.5.2 Storage tanks

All tanks should be examined externally for corrosion. They should be drained, cleaned as necessary and examined internally for corrosion.

All tanks should be repainted and/or have the corrosion protection refurbished, as necessary.

11.4.5.3 Water supply stop valves, control and check valves

All water supply stop valves, control and check valves should be examined and replaced or overhauled as necessary.

11.4.6 Ten-yearly routine

At intervals of no more than 10 years, all storage tanks should be cleaned and examined internally and the fabric attended to as necessary.

All pressure vessels should be re-pressure tested in accordance with BS EN 13445-5 or BS EN 1968 as appropriate.

Annex A (normative)

Template for developing representative fire test procedures for watermist systems

A.1 General

The basic design and installation parameters of all watermist systems should be obtained from performance tests.

Performance test procedures may be generic to a certain fire hazard, in which case first principles can be applied, or they may be particular to a specific application within a fire hazard.

Examples of applications include:

- general office accommodation;
- storage areas;
- plant and machinery;
- electrical equipment;
- industrial fryers and ovens;
- retail premises;
- leisure facilities;
- public spaces.

This annex provides a template for developing, carrying out, and documenting a fire performance test procedure for an application.

The design of a test procedure should be in accordance with the established scientific and engineering principles of fire protection.

The intent of these guidelines is to encourage the development of repeatable fire test procedures that:

a) are based on a fire protection engineering evaluation of the fire hazard, the compartment conditions and size, and the performance objectives/pass-fail criteria for the watermist system;

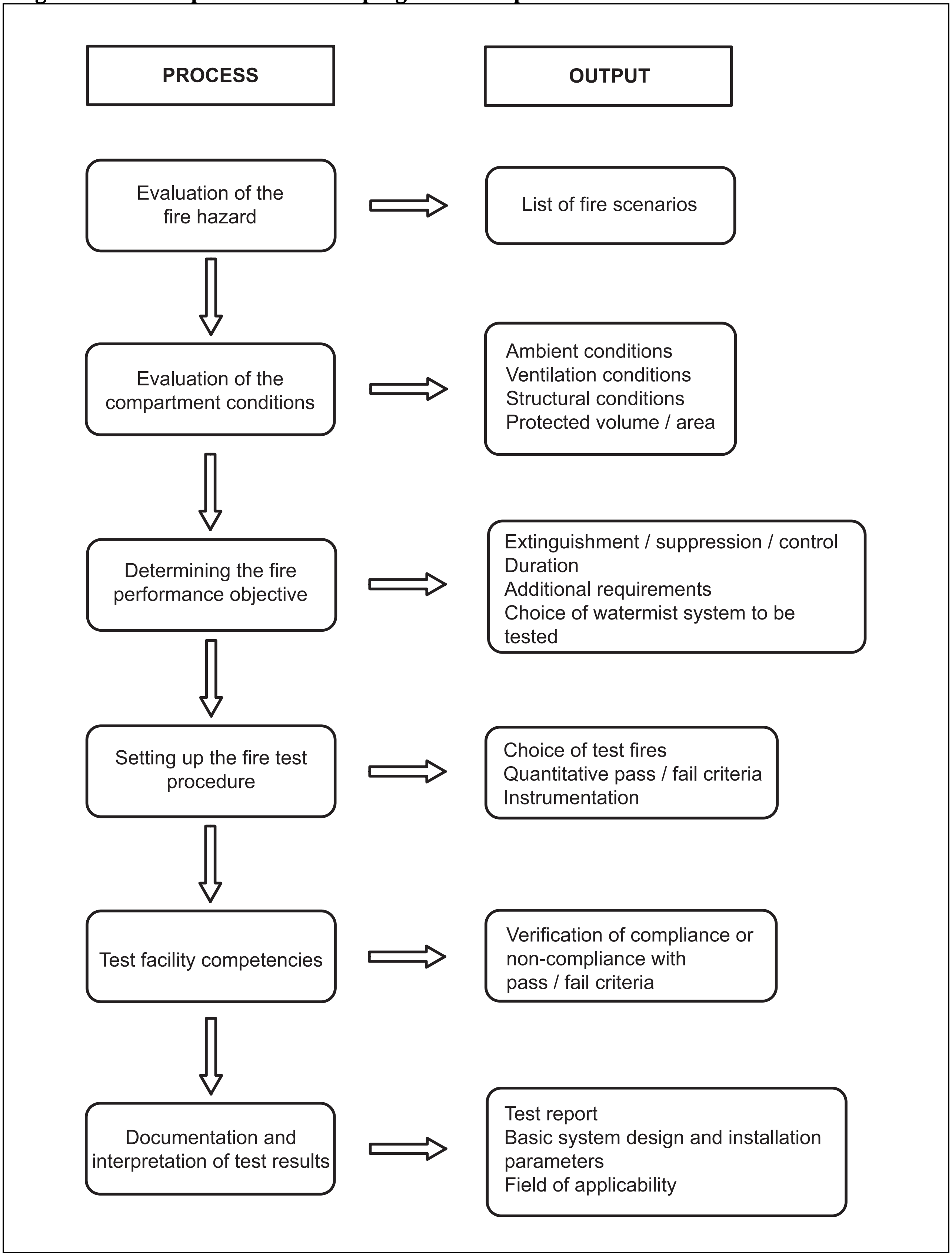
b) are developed, carried out, and interpreted by qualified fire testing laboratories;

c) identify the underlying assumptions on which the test is based;

d) define the product and the product parameters that have been tested.

Figure A.1 shows the process as a simple flowchart. The chart identifies the steps of the process, as well as the main output from each step. The steps are discussed in more detail in **A.2** to **A.7**.

Figure A.1 – The process of developing a fire test procedure



A.2 Evaluation of the fire hazard

The evaluation of the fire hazard should result in a list of possible fire scenarios, which are grouped to determine the test fires that are required. The test fires should be defined at least in terms of:

a) fuels – type and quantity (wood, plastics, cable, flammable liquid, gas, etc.);

b) arrangement (crib, pile, shelved storage, pool, flowing fire, spray, etc.);

c) size (dimension of the fuel array, area of the pool, or flow rate of a flowing or a spray fire, and degree of enclosure);

d) obstructions to watermist;

e) ignition source/procedure;

f) ventilation and air movement.

A.3 Evaluation of the compartment conditions

From fire dynamics point of view, the term "compartment conditions" is primarily related to whether the fire is freely-ventilated (fuel controlled) or ventilation-controlled (an enclosed fire). These conditions should be replicated in the test enclosure.

The key enclosure parameters are:

a) enclosure dimensions, particularly height, and configuration;

b) air exchange rate;

c) vent dimensions, position, and orientation.

For freely-ventilated and ventilation-controlled fires, the ambient conditions (temperature, moisture, air flow) surrounding the hazard, and the fire resistance and tightness of structures close to the hazard, should be evaluated.

NOTE 1 The case of freely-ventilated fires can apply either to area protection applications, or dedicated local application protection systems.

NOTE 2 The case of ventilation-controlled fire applies to fires inside enclosures that are fully closed or that have restricted ventilation openings.

A.4 Determining the fire performance objective

The main fire performance objective of a watermist system should be evaluated in terms of fire extinguishment, fire suppression or fire control (as defined in Clause **3**), as appropriate for the volume or object to be protected.

Other parameters that may be used to evaluate fire performance include:

- structural integrity;
- damage to sensitive equipment or systems;
- smoke damage;
- water damage;
- visibility;
- tenability.

When a watermist system is tested for the purpose of fire extinguishment, particular attention should be given to maximizing the probability of fire extinguishment in real applications. One way of doing this is to test against a number of fire and ignition scenarios, and to use a large range of watermist system assessment parameters to find out the optimum choice of parameters to be measured and recorded.

The performance objective for the watermist system undergoing the tests should be recorded.

A.5 Setting up the fire test procedure

The fire test procedure should make use of the list of possible test fires, and be instrumented so as to quantitatively verify system performance. All relevant aspects of the preceding evaluation steps should be taken into account when setting up the fire test procedure. Where similar test data is available, this may be used to inform the procedure being set up.

The set of test fires should include:

a) the worst-case fires with respect to possible consequences;

b) fires of greatest challenge to the tested watermist system.

Fires falling under item a) will not necessarily be the same fires that will fall under item b). An example is provided by a large fire in an enclosure of limited volume, which could be severe with respect to the enclosure, but quite easy to extinguish with a suitable watermist system. The purpose of item b) is to find the performance limits of the tested system, and thereby to give guidance on how to interpret the test results and possible field of applicability of the results.

A fire test procedure may therefore include several different fire scenarios. Using several different test fires will ensure that a watermist system is not optimized to perform well in one fire scenario.

Where possible, a free-burn test should be included in the fire test procedure. The free-burn test serves to determine the challenge that the fire load provides to the tested watermist system, and it will also provide a baseline for evaluating the effectiveness of the watermist system.

The fire test procedure should also take into account the possibility of different ignition scenarios. Normally, a fire test procedure involves one standard way of igniting the test fires. However, the fire development can be significantly affected by the ignition source, or even the number of ignition sources. Such considerations are particularly important, for example, where arson is an issue.

Care should be taken to take into account all aspects of the evaluations in the fire test procedure. For example, if the test fires are freely-ventilated fires, the test should be carried out in a sufficiently large enclosure to prevent oxygen depletion from favourably affecting the performance of the tested system, and the test should be appropriately instrumented to verify this.

The watermist system should be operated in the tests using:

- maximum nozzle spacing;
- maximum ceiling height, or maximum distance of nozzles to hazard;
- minimum design pressure at nozzles;
- additives, as intended to be used in real installation;
- relevant obstructions close to nozzles [such as a simulated false ceiling, joists, beams, or heating, ventilation or air-conditioning (HVAC) ducts].

To fully determine the limits of the installation parameters, fire tests should also be conducted using:

- minimum nozzle spacing;
- minimum ceiling height, or minimum distance from nozzles to hazard;
- maximum design pressure at nozzles.

For tests designed to control and/or suppress fire, the water supply (with additives where used) and discharge duration should be in accordance with the recommendations given in **6.2.1**.

Additional tests should be carried out for special conditions, such as sloped or curved ceilings.

It is important that the same model nozzle is subjected to all tests included in the series. There should be no tailoring of nozzle design to particular scenarios within a test series.

Where applicable (such as in open space fire tests), fire tests should be conducted with the ignition point located under one nozzle, between two nozzles, and between four nozzles, to test for a possible weak point in the water distribution.

Where a deluge watermist system is activated automatically, watermist system specifications should include the shortest and the longest detection times within which the system can control, suppress or extinguish the fires in accordance with the fire performance objective. These time limits should be derived from fire performance tests conducted using different pre-burn times. The design of the fire detection system should ensure that appropriate nozzles are activated, and that the detection times are in accordance with the limits found in a fire test.

NOTE It is not the intent of this Code of Practice to test fire detection systems.

As an option to increase the reliability of the system, failure mode testing can be considered. The most common failure mode test is a disabled nozzle test, where it is assumed that one nozzle closest to the fire source fails to effectively deliver watermist, e.g. due to clogging of the nozzle, or by physical obstructions close to the nozzle. In a failure mode test, criteria developed for normal mode tests should be significantly relaxed; however, the test should demonstrate whether the fire will be controlled.

A.6 Test facility competencies

The facility carrying out the tests should demonstrate that it operates a quality system, and that it is technically competent and able to generate technically valid results. Relevant requirements can be found in ISO/IEC 17025.

Of particular importance with respect to testing of watermist fire suppression systems are:

a) comprehensive understanding of watermist technology;

b) ability to properly condition and characterize the fuels;

c) the use of appropriate instrumentation and methodology to verify the compliance or non-compliance with the pass/fail criteria (see **A.7**) and repeatability.

A.7 Documentation and interpretation of test results

A test is deemed to be successful if the performance objectives are met, i.e. the fire is successfully controlled, suppressed or extinguished, within 30 min.

The results of the fire test series should be documented in a test report prepared in accordance with ISO/IEC 17025:2005, **5.10**. The test report should contain at least the following information:

a) a title;

b) the name and address of the laboratory, and the location where the tests were carried out, if different from the address of the laboratory;

c) unique identification of the test report (such as the serial number), and on each page an identification in order to ensure that the page is recognized as a part of the test report, and a clear identification of the end of the test report;

d) the name and address of the client;

e) a description of the method used;

f) a description of, the condition of, and unambiguous identification of the item(s) tested;

g) the date of receipt of the test item(s) where this is critical to the validity and application of the results, and the date(s) of performance of the test;

h) reference to the sampling plan and procedures used by the laboratory or other bodies where these are relevant to the validity or application of the results;

i) the test results with, where appropriate, the units of measurement;

j) a statement of compliance/non-compliance with the performance objective determined in **A.4**;

k) confirmation of system design parameters relevant to the specific application, including, but not limited to, the following:

    1) extinguishing or suppression system;

    2) for extinguishing systems, the extinguishing time and water supply duration;

    3) nozzle designation;

    4) permitted location in the protected volume;

    5) minimum and maximum installation height limitation;

    6) maximum dimensional and area coverage, including spacing between the nozzles;

    7) operating flow rates of the nozzle;

    8) distance between the ceiling and nozzle orifice;

    9) design pressure;

    10) type of detection/actuation method;

l) the name(s), function(s) and signature(s) or equivalent identification of person(s) authorizing the test report;

m) where relevant, a statement to the effect that the results relate only to the items tested.

NOTE Item e) contains the word "description" instead of "identification", as these guidelines are intended to be used for developing new fire test procedures. Also, item j) is considered essential in this context, whereas ISO/IEC 17025 lists statement of compliance or non-compliance as an optional item.

In addition, test reports should, where necessary for the interpretation of the test results, include the following:

n) information on specific test conditions, such as environmental conditions.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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[2] LOSS PREVENTION COUNCIL. *Legionella and fire-fighting systems – A technical briefing note*. Watford: Building Research Establishment, 1999.

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