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Non-automatic fire-fighting systems in buildings – Code of practice

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 18, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 January 2015. It was prepared by Technical Committee FSH/14, *Fire precautions in buildings*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 9990:2006, which is withdrawn.

Information about this document

This is a full revision of the standard. The principal changes are to update the recommendations for:

- flow tests and pressures;
- rising and falling mains;
- pumps;
- maintenance;
- shut-off pressures.

It is important for the fire protection of a building to be considered as a whole. The provision of fire mains is an essential element of the fire protection systems in large and complex buildings due to the difficulties in providing water supplies at the point of use for fire-fighting and search and rescue. It is essential that these systems be carefully maintained to ensure instant readiness when required.

Use of this document

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

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

Presentational conventions

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

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

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

Contractual and legal considerations

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

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

Particular attention is drawn to the Water Supply (Water Fittings) Regulations 1999 [1], the Water Supply (Water Fittings) (Scotland) Byelaws 2014 [2] and the Water Supply (Water Fittings) Regulations (Northern Ireland) 2009 [3] in respect of requirements for any fire suppression system which conveys, or is likely to convey, water supplied by a water undertaker or licensed water supplier.

Attention is also drawn to legal requirements in respect of planning and approval, and to the need to consult with the appropriate bodies, which might include the building control body, the water undertaker and the local fire and rescue service.

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1 Scope

This British Standard gives recommendations for non-automatic fire-fighting systems in buildings. It covers good practice in matters affecting the design, installation, testing and maintenance of such systems including wet and dry fire-fighting mains.

This British Standard does not cover hose reels, foam inlets, automatic foam systems and portable fire-fighting equipment. These systems are covered in BS EN 671-1, BS 5306-1, BS 5306-3, BS 5306-8 and BS EN 3-7.

2 Normative references

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

BS 750, *Specification for underground fire hydrants and surface box frames and covers*

BS 1710, *Specification for identification of pipelines and services*

BS 5041 (all parts), *Fire hydrant systems equipment*

BS 6391, *Specification for non-percolating layflat delivery hoses and hose assemblies for fire fighting purposes*

BS 7430, *Code of practice for protective earthing of electrical installations*

BS 7671, *Requirements for electrical installations – IET Wiring Regulations – Seventeenth edition*

BS 8519, *Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications – Code of practice*

BS 9991, *Fire safety in the design, management and use of residential buildings – Code of practice*

BS 9999, *Code of practice for fire safety in the design, management and use of buildings*

BS EN 1092 (all parts), *Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated*

BS EN 1515 (all parts), *Flanges and their joints – Bolting*

BS EN 14339, *Underground fire hydrants*

BS EN 14384, *Pillar fire hydrants*

BS EN ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

BS ISO 3864-1, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings*

3 Terms and definitions

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

3.1 authority having jurisdiction (AHJ)
organization, office or individual responsible for enforcing the requirements of legislation or standards, or for approving equipment, materials, an installation, or a procedure

3.2 bridgehead
part of a building, usually two floors below the fire (floors above in the case of basements), from which fire-fighting teams can be safely committed to attack a fire

3.3 competent person
person, suitably trained and qualified by knowledge and practical experience, and provided with the necessary instructions, to enable the required task(s) to be carried out correctly

3.4 coupling
device for connecting lengths of hose so as to secure continuity from the source of a water supply to the delivery point

3.5 depth
distance of the lowest point of the floor of the lowest storey of a building to the fire service access level, measured at the centre of that face of the building where the distance is greatest

3.6 fire-fighting lobby
protected lobby provided within a fire-fighting shaft giving access from a fire-fighting stair to an accommodation area, and normally to any associated fire-fighting lift and fire main

NOTE Common corridors serving residential accommodation can be regarded as fire-fighting lobbies.

3.7 fire-fighting shaft
protected enclosure containing a fire-fighting stair, fire-fighting lobbies, a fire main and, if provided, a fire-fighting lift together with any machinery space

3.8 fire-fighting stair
protected stairway communicating with an accommodation area only through a fire-fighting lobby

3.9 fire hydrants

3.9.1 fire hydrant
assembly comprising a valve and outlet connection from a water supply

3.9.2 pillar fire hydrant
fire hydrant whose outlet connection is fitted to a vertical component projecting above ground level

3.9.3 underground fire hydrant
fire hydrant contained in a pit or box below ground level

3.10 fire mains

3.10.1 fire main
water supply pipe, fitted with an outlet and control valve at specified points, installed in a building for fire-fighting purposes

3.10.2 dry fire main
water supply pipe installed in a building for fire-fighting purposes, fitted with inlet connections at fire service access level and landing valves at specified points, which is normally dry but is capable of being charged with water usually by pumping from fire and rescue service appliances

3.10.3 ring system fire main
water main which encircles a building or series of buildings or other associated fire risks and which feeds fire hydrants, fire mains or other fire-fighting apparatus

3.10.4 wet fire main
water supply pipe installed in a building for fire-fighting purposes and permanently charged with water from a pressurized supply, and fitted with landing valves at specified points

3.11 fire service access level
level at which there is suitable entry to the building and to a fire-fighting shaft from an area to which fire and rescue service appliances have access

3.12 height
distance of the surface of the highest point of the floor of the highest storey (excluding any such storey consisting exclusively of plant rooms) to the fire service access level, measured at the centre of that face of the building where the distance is greatest

3.13 hydrant outlet
component of a fire hydrant to which a standpipe and/or hose is connected

3.14 inlet connection
assembly comprising a valve and inlet to enable supply of water to a fire main

3.15 K-value
coefficient of discharge that is related to flow rate and pressure at the branch/nozzle

NOTE The K-value is calculated from:

$Q = KP^{1/2}$

where:

Q is the flow rate through the branch, in litres per minute (L/min);

P is the pressure at the entry to the branch, in bar; [1)]

K is the branch constant.

3.16 landing valve
assembly comprising a valve and outlet to enable connection of fire-fighting hose to a fire main

3.17 mains water supply
permanent network of pipes that convey wholesome water from a public or private water supply system to a customer service connection or user draw-off point

3.18 suction tank
tank supplying inlet water to a fire pump

3.19 water undertaker
company licensed to provide a public water supply

3.20 wholesome water
water suitable for human consumption

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

4 Fire mains

4.1 Design considerations

4.1.1 General

The fire strategy for a building might necessitate some deviations from the recommendations in this British Standard. If this is the case then this should be discussed and agreed with the authority having jurisdiction and the local fire and rescue service.

Fire mains should have a minimum nominal bore of 100 mm and the system should be designed to withstand a pressure of one and half times its predicted maximum operating pressure.

Isolating valves should be incorporated in the system at intervals not exceeding 10 m on vertical pipework so that sections of the fire main can be isolated to enable repairs to be carried out. In addition, where there is more than one vertical main supplied from a horizontal wet main, valves should be installed on each vertical main below the first landing valve outlet. Such valves should be secured in the open position by a chain and padlock or incorporated within a monitoring system to indicate when the valve is not fully open.

Installed equipment should be protected against interference and attack by thieves and vandals as far as it is possible to do so without adversely affecting operational capability. This should be done in accordance with Annex A.

4.1.2 Materials

Fire mains and associated pipework and fittings should be of suitable heavy quality steel to meet the pressure, robustness and durability requirements of the system in question, including galvanizing where necessary.

Pipework should be jointed by screwing and socketing, or by any other means selected as suitable for use, except at valves or other fittings where appropriate flanges in accordance with the relevant parts of BS EN 1092 and BS EN 1515 may be used. Such means may be selected on the basis of practical tests and evidence of satisfactory performance in similar applications such as wet or dry system sprinkler installations.

All changes in the direction of the run of the piping should be made with standard bends, springs or long turn fittings. Elbows should not be used.

4.1.3 Dry fire mains

4.1.3.1 Design operating pressure

Dry fire mains should have an operating pressure of 12 bar.

4.1.3.2 Inlets

A dry fire main should be fitted with a two-way inlet breeching for 100 mm mains. Each breeching should conform to BS 5041-3. Such breeching should be accommodated in an inlet box conforming to BS 5041-5, the box being positioned with its lower edge between 400 mm and 600 mm above ground level.

Any proposed use of floor-mounted inlets, or inlet cabinet doors integrated into the building fabric, should be discussed and agreed with the local fire and rescue service.

NOTE Floor-mounted (horizontal) inlets are not suitable for the majority of fire main applications.

4.1.3.3 Drain valves

Inlet breechings should be fitted with a 25 mm drain valve, in accordance with BS 5041-3, to facilitate draining the rising main after use.

4.1.3.4 Air release valve

An air release valve should be installed at the top of all vertical mains in order to vent air from the main and to act as a vacuum break to allow drainage to take place.

4.1.4 Wet fire mains

4.1.4.1 Design operating pressure

Systems should be designed such that maximum system pressures serving a fire main outlet do not exceed 20 bar.

4.1.4.2 Location

Wet rising mains should not be located against or near external walls unless they are adequately insulated or otherwise satisfactorily protected against frost (see BS EN 806-2).

4.1.5 Landing valves

A landing valve should be provided at each floor level, including the ground floor level, where personnel can connect and fill hose lines in relative safety before entering the fire compartment. When selecting the position of landing valves, account should also be taken of: ease of access; exposure to fire from the accommodation if a door is open; obstruction of fire doors by the hose line; and the risk of unintentional discharge of water coming into contact with the lift doors or controls.

Each landing valve should be sited:

a) within a ventilated lobby of a lobby approach stairway, where this is provided; or

b) in a stairway enclosure; or

c) in any other position as agreed with the appropriate authority.

NOTE 1 For residential blocks of flats, where fire mains are proposed to be provided it is expected that the landing valves are located within the staircase enclosure on the full landings.

On dry mains, landing valves should be provided at roof level for test purposes if practicable.

*NOTE 2 For tests on fire mains see **7.3.1**.*

In all cases a landing valve should be installed with its lowest point about 750 mm above floor level.

Landing valves for fire mains should preferably be protected by, and installed within, a box in accordance with BS 5041-4 (see Annex A).

Landing valves for dry mains should conform to BS 5041-2 and those for wet mains should conform to BS 5041-1.

Outlets should be flanged rather than directly threaded to allow for ease of maintenance.

4.2 Provision and siting

4.2.1 General

Where fire mains are installed and there are no floors higher than 50 m above fire service access level, wet or dry fire mains may be installed. Where there are floors higher than 50 m above fire service access level, wet fire mains should be installed owing to the pressures required to provide adequate fire-fighting water supplies at the landing valves at upper floors, and also to ensure that water is immediately available at all floor levels.

NOTE 1 This height is based upon using 51 mm hose and a fire-fighting branch having hydraulic characteristics of K-value = 230.

NOTE 2 Guidance on when a fire main should be installed is given in BS 9991 and BS 9999.

Any proposed use of horizontal fire mains should be discussed and agreed with the local fire and rescue service.

NOTE 3 Horizontal dry fire mains (no vertical pipework) are typically not a practical design solution.

4.2.2 Position of inlets

Inlet connections for a fire main should be installed in an external wall or in a boundary wall of a building as close as possible to the position of the main which they serve, ideally on the exterior face of the fire-fighting shaft and adjacent to the access point. Any run of connecting pipe between the inlet and the vertical run of the main should be kept to a minimum and should be given a fall towards the drain valve.

NOTE For typical building applications, the run of horizontal connecting pipe is a maximum of 18 m in length.

Where the fire-fighting shaft or fire-fighting stair is not adjacent to a perimeter wall, an assessment should be made as to whether more than one inlet needs to be provided. If two or more inlets are provided, they should be sufficiently remote from one another to provide viable alternative locations from which to charge the fire main.

The need to provide more than one fire main inlet for an installation should be discussed and agreed with relevant approving authorities and the local fire and rescue service.

Access to the inlet connections should be in accordance with BS 9991 or BS 9999 as appropriate.

In selecting positions for inlet connections, account should be taken of the positions of fire hydrants, the parking locations for fire appliances, and the effect that falling debris and other possible occurrences during a fire might have on the continuing viability of the location (see BS 9991 and BS 9999).

Inlets should be flanged rather than directly threaded to allow for ease of maintenance.

4.2.3 Number of rising/falling mains

The number and disposition of rising/falling mains should be in accordance with BS 9991 or BS 9999 as appropriate.

For large buildings or sites comprising multiple buildings, multiple horizontal or vertical fire main pipework runs should not be served from the same inlet connection.

4.3 Electrical earthing

Fire mains should be electrically earthed in accordance with BS 7671 and BS 7430. Those joints which do not provide electrical continuity should be bonded.

5 Private fire hydrants

5.1 Design considerations

The design and installation of hydrant systems should be closely correlated with all other services being provided in the building, and ducts may be shared. The water supply to hydrants should be kept entirely independent from other water supplies including those for other fire-fighting systems.

Hydrant systems should be afforded all possible protection against frost (see BS EN 806-2).

5.2 Provision and siting

When they are considered to be necessary, private fire hydrants should be provided within the confines of the site after consultation with the water undertaker and the local fire and rescue service. Their installation should be in accordance generally with this British Standard and also with any specific requirements of these bodies or the insurance company.

Fire hydrants should be positioned in such a way that the parking, loading and unloading of vehicles is unlikely to obstruct them. In choosing locations for them, the availability of statutory hydrants in public thoroughfares nearby should be taken into account.

Where fire hydrants are to be installed, they should be included as part of a ring fire main system (see **6.6**) and be positioned not more than 90 m from an entry to any building on the site and not more than 90 m apart. They should preferably be sited immediately adjacent to roadways or hard-standing facilities suitable for fire and rescue service appliances. To ensure that they remain usable during a fire, they should be sited to take into account the effect that falling debris and other possible occurrences during a fire might have on the continuing viability of the location, and should be not less than 6 m from the building or other risk.

*NOTE The positioning of hydrants can have an effect on the positioning of inlets; see **4.2.2**.*

Siting of underground fire hydrants in roadways should be avoided where possible. Where such siting is necessary, the frame and cover should be in accordance with BS 750 and capable of bearing the heaviest vehicle anticipated to use the roadway.

Underground fire hydrants should be in accordance with BS 750 and BS EN 14339. The provision of signage indicating the location of hydrants, or any other proposed methods of identifying hydrant covers, should be discussed and agreed with the water undertaker and the local fire and rescue service.

Pillar hydrants should be in accordance with BS EN 14384. Where pillar hydrants are installed, care should be taken to protect them from mechanical damage and from damage by frost.

6 Water supplies and pumping arrangements

*COMMENTARY ON CLAUSE **6***

For wet fire mains it is essential that pressures and flows are at all times adequate to serve two fire-fighting jets. This is irrespective of the source of water supply.

For dry fire mains a high pressure supply is not essential as the pressure can be controlled by fire and rescue service pumps. Dry fire mains can be supplied from static or open water supplies, although it is normal in built-up areas to rely upon mains water supplies.

External hydrants usually depend on connections available from mains water supplies.

6.1 Adequacy of basic supply

In all cases where a mains water supply is involved, the capacity of the mains is important and should be checked.

*NOTE Generally a water supply capable of providing a minimum of 1 500 L/min at all times is required (see **6.3.1**).*

6.2 Supplementing the basic supply for wet fire mains

Where the mains water supply does not provide sufficient pressure and capacity (see **6.1**) to provide the necessary supply, each fire main should be fed from two interconnected tanks of nominal equal capacity and having a total minimum capacity of 45 000 L. The tanks should be automatically supplied from a mains water supply controlled by ballvalve(s). The capacity of these mains together with the contents of the tanks should be such as to maintain a flow of water capable of supplying two fire-fighting jets for 45 min when water is being used at a total rate of 1 500 L/min. Each tank should be fitted with isolating valves to enable one tank to be taken out of service for maintenance or repair.

Where more than one fire main is installed in a building, the potential need for additional water storage and/or pumping capacity should be taken into account.

Tanks supplying water for domestic purposes should not be used as suction tanks for wet rising mains, unless arrangements have been made for these domestic supplies to be drawn off in such a manner that the requisite reserve of water for the rising main is always preserved.

6.3 Pumps for wet fire mains

6.3.1 General

Two automatic pumps should be installed to feed the wet fire main, one of which should act as duty pump and the other as standby. The standby pump should be configured to operate automatically on failure of the duty pump.

Wherever possible, horizontal centrifugal pumps should be used, installed with a positive suction head, i.e. in accordance with the following:

a) at least two thirds of the effective capacity of the suction tank should be above the level of the pump centre line;

b) the pump centre line should be no more than 2 m above the low water level of the suction tank.

If this is not feasible, either the pump should be installed under suction lift conditions or vertical turbine pumps should be used.

The pumps should be driven by either electric motors or diesel engines. Where both pumps are electrically driven they should be either:

1) separately driven by independent supplies (see **6.3.2.3**); or

2) driven from the same supply with an automatic changeover to a completely independent secondary supply (see **6.3.2.3**) in the event of failure of the primary supply.

All pumps should be capable of being started and stopped manually.

An audible and visual alarm should be provided at an agreed position to indicate that the equipment and the pumping plant have operated.

Each pump should be capable of providing a flow of water of at least 1 500 L/min in the fire main, i.e. sufficient to serve lines of hose from two separate landing valves simultaneously. A running pressure of (8 ±0.5) bar should be maintained at each landing valve when fully opened.

A test facility, including permanently installed devices for measuring pressure and flow, should be provided at the pump delivery branch downstream of each outlet check valve to permit a running pressure test of each pump at full load condition.

6.3.2 Electrical supplies

6.3.2.1 General

The electrical power supply to wet fire main pumps should be separate from all other circuits in the building so that the failure of other equipment does not render the installation inoperative.

Each connection to the power supply should be via an isolating protective device reserved solely for the pumps and independent of any other main or sub-main circuit. Such isolating protective devices (with high-rupturing safety devices) should be clearly labelled and identified as to their purpose. They should be secured against unauthorized operation and should, except for maintenance, be kept locked-on.

The supply to these isolating protective devices should be independent of the main switch for the building and be appropriately labelled.

6.3.2.2 Electrical power supplies for wet fire mains pumps

Wiring systems for the power supplies to the wet fire mains pumps should conform to the following recommendations.

a) The wiring system should, as a minimum, either:

   1) meet the category 3 requirement given in BS 8519; or

      NOTE Cables selected from BS 7846, BS 7629-1 or BS EN 60702-1 that meet relevant levels of performance are suitable.

   2) be protected against exposure to the fire by separation from any significant fire risk by a wall, partition or floor with a fire resistance of not less than that required for the building.

b) The wiring system should be separate from any circuit provided for any other purpose.

6.3.2.3 Power supplies for dual pumps

Where both pumps are electrically powered, a secondary electrical power supply independent of the primary supply to the building, e.g. an automatically started generator or a supply from another substation, should be provided which, independently of the primary supply, is of sufficient capacity to maintain the pumps for wet fire mains in operation for at least 3 h.

The power supplies should conform to the following specific recommendations.

a) The secondary power supply should be capable of providing the power supply within 15 s of the failure of the primary electrical supply. Where the alternative power supply source is a generator, it should be capable of providing the power necessary for at least 3 h without replenishment of fuel.

b) Where the secondary electricity supply is taken from a separate substation to that supplying the primary electrical supply, the following criteria should be met.

   1) The electrical supplies to the two independent substations should be taken from two separate high-voltage supplies, and not originate from the same substation.

   2) The failure of one substation should not lead to the failure of the other.

   3) The two independent substations should be adequately separated. Where the substations are located within the building they serve, the following criteria should be met:

      i) each substation should be enclosed within a fire-resisting structure having a minimum of 2 h fire resistance;

      ii) the two substations should be located in separate parts of the building.

   4) Supply cables from the high-voltage substations should enter directly the high-voltage/low-voltage switch rooms and not pass through the building.

   5) The two sets of supply cables should be adequately separated from each other to avoid a single fault affecting both supplies.

c) Whichever secondary power source is provided, the distribution should be organized such that the secondary supply remains live when the remainder of the supplies in the building are isolated in an emergency.

d) The primary and secondary power supply cables should be terminated in change-over devices located in the room housing the wet mains pumps. The change-over devices should automatically effect the transition from the primary to the secondary power supply if the primary supply to the pumps fails.

e) Any electrical substation or enclosures containing any distribution board, generator and any other equipment associated with the wet fire mains pumps, should be separated from the building by construction having a fire resistance of not less than 2 h.

6.4 Additional precautions for wet fire mains

Arrangements for draining a wet fire main should be incorporated to enable any necessary repairs to be carried out.

To reduce the risk of hose bursting, arrangements should be made in accordance with BS 5041-1 and BS 6391 so that when the water is shut off at the nozzle the static pressure in any line of hose connected to a landing valve does not exceed 12 bar.

Pressure-reducing valves should be provided to regulate the flow and pressure to (750 ±75) L/min at (8 ±0.5) bar per outlet. Arrangements for the disposal of water during flow tests, commissioning and maintenance should be made via a permanent return facility to the tank(s) or to drain. These arrangements should be on all floors.

The drain should be of a sufficient size and design to avoid back siphonage and/or back pressure building up within the drain and affecting the performance of the pressure-reducing valve.

Where a fire main is supplied direct from a mains water supply and a shut-off valve is incorporated in the fire main, the valve should be kept secured in the open position by a chain and padlock.

Where a fire main is bifurcated, valves should be provided to enable either branch to be isolated for repair without adversely affecting the other one.

6.5 Emergency arrangements for filling suction tanks

Arrangements should be provided for the remote filling of suction tanks. Where the tanks are no higher than 60 m above ground level, pipes of not less than 100 mm nominal size should be installed. Each infill pipe should enter the tank(s) above the maximum water level and should be connected to an appropriately sized inlet breeching, provided within an inlet box in a conspicuous position on the face of the building. In selecting positions for the inlets, account should be taken of the effect that falling debris and other possible occurrences during a fire might have on the continuing viability of the location. The local fire and rescue service should be consulted.

Arrangements should be made to monitor the water supply and inform the fire and rescue service if there is a need to supplement it.

Provision should be made for either:

a) an alarm to indicate at the inlet breeching when the tank has been sufficiently replenished; or

b) a means of automatic shut-off to prevent the tank(s) overflowing.

6.6 Ring main supply

Where a number of fire hydrants or wet fire mains are required because of the area of the premises to be covered, the mains supplying these systems should be in the form of a ring main to form a complete circuit of the site. Materials for these mains should be in accordance with **4.1.2**.

Water should be supplied to the ring at a minimum of two positions, preferably from supplies obtained from different sources.

Isolating valves should be incorporated in the system so that sections of the ring main can be isolated to enable repairs to be carried out. Branches to mains water supplies should also have an isolating valve and a non-return valve to suit the water undertaker's requirement.

7 Installation, commissioning and maintenance

7.1 Work on site

Adequate provision should be made by the responsible contractor to protect materials and components on site from deterioration or damage.

Unloading, stacking and storage should be carried out with care to prevent damage to pipes and pipe threads, hydrants, fittings, couplings and other components used in the system.

Pipes should be securely anchored before any pressure or flow tests are carried out.

7.2 Protection of buildings under construction

In order that a fire occurring during the construction of a building can be dealt with effectively, especially in high or extensive buildings where large quantities of combustible materials might be stored, mains should be in an operational condition as soon as any floor of the building reaches 11 m above fire service access level. These mains should be extended and commissioned progressively as work on the building proceeds to provide fire-fighting facilities at all stages of construction.

Where wet mains are provided, installation initially can be as a dry main. When construction reaches 50 m, the system should be commissioned as a wet main in accordance with the relevant recommendations of this British Standard.

NOTE This height is based upon using 51 mm hose and a fire-fighting branch having hydraulic characteristics of K-value = 230.

From the time that the wet fire main is first commissioned, the running pressure at each outlet should be in accordance with **6.3.1**.

7.3 Initial inspections and acceptance tests

7.3.1 Tests on fire mains

7.3.1.1 General

Fire mains should be tested at appropriate stages during installation, as work progresses, and upon final completion. Records should be kept of the tests and their results.

7.3.1.2 Pre-test procedures

Prior to conducting tests, water should be allowed to flow through the fire main and be discharged via the topmost outlet to flush out any debris that might be present.

NOTE This procedure is of particular importance at acceptance test as there is a possibility of quantities of foreign matter being lodged in the pipework.

Facilities should be provided for flushing out at the base of the main debris which is too large to be flushed to the top of the building.

7.3.1.3 Static pressure test

The system should be completely charged with water to a pressure equal to its design operating pressure (see **4.1.3.1** and **4.1.4.1**) measured at the inlet for a period of at least 15 min. During this period, an inspection of the system should be made to check whether there is any leakage of water at any of the joints or landing valves. If any leaks are identified, appropriate remedial action should be taken and the system should be retested.

For dry fire mains, upon completion of the static pressure test, when the pressure has been released at the pumping appliance the coupling to the fire main inlet should be disconnected and the action of the non-return valves checked. The system should then be drained and left ready for use.

7.3.1.4 Flow and pressure test for wet mains

After the static pressure test (see **7.3.1.3**) is completed successfully, a flow and pressure test should be carried out.

For this test, water should be passed through the system under pressure and readings taken of flows and pressures. The flow and pressure test should be carried out at the highest or furthest landing valve and at a minimum of two intermediate valves, using the system pumps. Built-in test facilities should be provided for each wet fire main as recommended in **6.4**.

Inability to achieve the performance criteria recommended in **6.4** is deemed a failure of the test. Appropriate remedial action should be taken and the system should be retested.

7.3.1.5 Tests on pumps

Pumps, including any standby pumps, should be tested individually to determine whether each one will operate satisfactorily and meet the appropriate performance criteria. Any standby pump should be tested to determine whether it will operate satisfactorily in the event of failure of the duty pump.

7.3.2 Tests on private fire hydrants

Where the local fire and rescue service provides a private hydrant inspection and test service, inspection of and, where practicable, a wet test of private underground fire hydrants should be made in conjunction with the owner or occupier of the premises or their representative. Where the local fire and rescue service does not provide a private hydrant inspection and test service, the activity should be undertaken by a suitable contractor. Where private fire hydrants are supplied from mains, arrangements should also be made with the water undertaker before tests are carried out.

During these inspections and tests the condition of the following should be checked and noted for remedial action if necessary:

a) pits;

b) frames;

c) covers;

d) surface paving round edges of frames;

e) depth of outlet below the frame, which should be no more than 300 mm below ground level;

f) method of indication by means of hydrant indicator plate or sticker.

The test should include flushing out the outlet and checking the outlet connection. The flow and pressure at the outlet should also be measured and noted.

On completion of the test, the operation of the frost valve (where fitted) should be checked, and the pit should be left empty and clean.

7.3.3 Indemnities

Before testing any system a signed indemnity should be sought from the person at that time responsible for the work site or premises.

NOTE This might be required by the appropriate authority in respect of liability for damage caused to persons or property arising out of, or in connection with, any test.

7.3.4 Test records

A permanent record of all initial inspections and acceptance tests should be kept by the responsible person.

This should record:

a) date and time of inspection or test;

b) person carrying out the test;

c) test results noted;

d) any external factors significantly affecting the results (e.g. weather conditions);

e) follow-up action required;

f) work carried out as a result of e) with date, time and result of retest.

7.4 Maintenance of systems and rectification of defects

7.4.1 General

Maintenance frequency and procedures should be in accordance with BS 9991 or BS 9999 as appropriate.

7.4.2 Competence of maintenance personnel

The services of a competent person should be obtained to carry out maintenance and repairs.

7.4.3 Fire mains

7.4.3.1 General

Inlets, landing valves, drain valves, door hinges and locking arrangements to the inlet and landing valve boxes should be inspected every six months. Particular attention should be given to all valves, spindles, glands and washers to ensure that they are in satisfactory condition, so that all equipment is ready for immediate use.

7.4.3.2 Dry fire mains

For dry fire mains, the tests in **7.3.1.3** and **7.4.3.1** should be carried out annually.

7.4.3.3 Wet fire mains

For wet fire mains, the tests in **7.3.1.3**, **7.3.1.4**, **7.3.1.5** and **7.4.3.1**, and the following checks, should be carried out annually:

a) internal cleanliness, condition and water level of storage tanks, including the operation of float valves and any water level alarms;

b) booster pumps and their associated mechanical and electrical equipment;

c) electrical supplies and equipment to prevent freezing;

d) operation of system monitoring and alarms.

Where pressure regulating valves are installed, the manufacturer's maintenance recommendations should be followed.

7.4.4 Fire hydrants

Arrangements should be made by the owners or the occupiers to ensure that, at least once a year, maintenance is carried out on all private fire hydrants by a competent person.

NOTE In most cases these arrangements, subject to suitable financial provisions, can be made with the water undertaker or the local fire and rescue service. The former might also be prepared to carry out any necessary repair work.

Periodical inspections of the vicinity of all hydrants should be made to ensure that there are no obstructions impeding accessibility and that hydrant indicator plates are in position.

Periodical inspections should be made to ensure that all isolating valves for systems are kept locked in an open position. Also flow and pressure should be checked to ensure that supplies have not deteriorated.

7.4.5 Procedures for defective non-automatic fire-fighting systems

Where systems are found to be defective the faulty component should be replaced immediately if possible. Where a replacement is not immediately available or possible an "Out of order" notice should be attached to the faulty component. The premises' responsible person should be informed and arrangements made as soon as possible to reinstate operation of the fire main. The responsible person should also inform the fire and rescue service immediately in order that alternative arrangements can be made to cover this deficiency if the need arises. Where the entire fire main is defective a notice should be placed in the appropriate inlet box. When the installation is reinstated, the fire and rescue service should again be informed so that any alternative arrangements can be cancelled.

7.4.6 Inspection/test records

There should be a signed and dated log of periodic inspections, maintenance and rectification of any defects, which should record:

a) date and time of inspection or test;

b) person carrying out the test;

c) installation being inspected or tested;

d) result of the inspection or test;

e) any rectifications carried out or needed.

8 Signage

8.1 Identification of equipment

Fire mains and associated equipment should be identified in accordance with BS 1710.

The following notices should be rectangular with white wording on a red background. Letter height should be not less than 25 mm and should be lower case except for the principal initial letters, which should be upper case and in accordance with BS ISO 3864-1 and BS EN ISO 7010.

a) A notice reading either "Dry fire main" or "Wet fire main" as appropriate should be displayed either on the door of the box or recess in which the landing valve is mounted or in an adjacent prominent position if a door is not provided.

b) A notice reading "Dry riser – drain valve" should be displayed in a prominent position adjacent to the valve. A notice approximately 100 mm × 75 mm should also be displayed in the inlet box reading "Low level drain valve in (here state location)".

c) A notice reading "Fire main pump motor supply – not to be switched off in the event of fire" should be displayed adjacent to all switches in the electrical power supply to pumps.

d) Where any isolating valves are installed a notice reading "Fire main control valve" should be displayed adjacent to the valve.

e) A notice reading "Wet riser tank fill" should be displayed on the relevant tank fill inlet box.

The position of any inlets should be clearly indicated using the appropriate notice in accordance with BS ISO 3864-1 and BS EN ISO 7010 and using a letter height of 50 mm.

8.2 System information

Information should be provided, in a position available to the fire and rescue service, to indicate the type of system (i.e. wet or dry fire main) and the parts of the building served by fire main outlets. For dry fire mains, information should also be provided indicating the maximum elevation and/or fall in relation to the riser inlet, and each floor level should have an indication of its elevation in respect to the fire main inlet.

Where multiple inlet points exist for an installation, or for a number of installations at one location, permanent durable signage should be provided clearly indicating which inlet connection serves which fire main. The format of this signage should be discussed and agreed with the local fire and rescue service.

Where reliance is being placed on the operation of fire-fighting systems or appliances during the construction period, temporary notices (to the satisfaction of the fire and rescue service) giving essential information for their protection from damage and for their efficient operation should be set up and remain until the installation becomes fully operative.

All system information signage should be designed in accordance with BS ISO 3864-1 and BS EN ISO 7010.

Annex A (normative) Protecting installed equipment from theft and vandalism

COMMENTARY ON ANNEX A

Equipment stolen or damaged can be expensive to replace, but it is even more important to recognize that the effect of the lack of even a small part of any fire-fighting installation can seriously delay the attack on a fire and in consequence cause unnecessary loss of life and damage to property. In any situation where installed equipment is at risk from thieves and vandals, special measures to protect all parts of the installation are essential, provided that these measures do not inhibit the primary purpose for which the equipment is installed. Precautions of any kind in these circumstances are however of little use unless the installation is kept under adequate surveillance.

This annex details measures designed to discourage persons from removing or damaging equipment, particularly related to landing valves and inlet breeching.

The responsible person for the premises should complete routine periodic visual inspections of all fire main inlet and landing valves to ensure that they have not been subjected to vandalism or damage, and to ensure that all inlet and landing valve boxes and/or riser cupboards are suitably secure and clear of storage or debris.

The frequency of this visual inspection should be determined by the responsible person as part of the building fire safety management strategy and/or fire risk assessment.

For inlet and landing valves, security nuts or bolts should be used where practicable. Where these are not used, all exposed screw threads or heads of nuts should be spot welded or similarly secured.

If it is proposed to use inlet or outlet box covers that do not conform to the relevant part of BS 5041 to address security concerns, this should be discussed and agreed with the local fire and rescue service.

As soon as loss or damage is noticed, the local fire and rescue service, the owners and the police should be informed and the procedures in **7.4.5** followed.

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.

BS 5306-1, *Code of practice for fire extinguishing installations and equipment on premises – Part 1: Hose reels and foam inlets*

BS 5306-3, *Fire extinguishing installations and equipment on premises – Part 3: Commissioning and maintenance of portable fire extinguishers – Code of practice*

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