The FSA Short Guide Series

Fire Detection and Alarm Systems

Guide to the Installation and Maintenance of Fire Alarm and Detection Systems to: BS 5839-1: 2002 + A2: 2008

FSA
Fire & Security Association

ECA The FSA is a specialist division of the ECA.

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Supporting the Profession to Safeguard the Client

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CONTENTS

1. INTRODUCTION

There have been many books published as detailed guides to BS 5839 and it's many parts, some of which extend to more than 200 pages. In this short guide, we are focussing on clarifying some of the more popular technical issues and questions, which are commonly asked by installers and maintenance personnel.

This guide is neither a substitute for BS 5839-1:2002 +A2: 2008 Fire detection and fire alarm systems for buildings - Part 1: Code of practice for system design, installation, commissioning and maintenance nor is it a definitive guidance document. Anyone who intends to design, install, commission and maintain Fire Detection and Alarm Systems, should have access to a current authorised copy of the British standard. They must also ensure that they are familiar with all the applicable standards, regulations and legislation

British Standard 5839-1:2002+A2: 2008 deals with commercial, industrial, including Houses of Multiple Occupation (HMO), fire detection and alarm systems. It is important to understand that British Standards are only codes of practice, which make recommendations as to how a fire detector and alarm system may be designed, installed, commissioned and maintained. This code of practice only becomes a requirement where a specification or contract determines that the installation element shall be undertaken in compliance with BS 5839.

The fire risk assessment requirements should determine the areas of the building that require fire detection and alarm system. This enables the designer of the fire detection and alarm system to decide where in the building the wiring, containment and equipment, need to be installed. This will depend on the Grade or Category of the system most suitable for the fire risk. It is therefore most important that the installer of the wiring, containment and equipment familiarises themselves with the content of the fire risk assessment of the building when quoting for, or contracting to carry out the electrical installation element of a fire detector and alarm system.

This document is a simple industry guide, and is not designed to replace the installation section of any BS 5839 part, the more detailed technical recommendations can be found in the actual standard.

This document is designed to explain the use of and interpret the recommendations of the British Standards BS 5839, as it applies to the organisations that carry out the installation and Maintenance of the equipment, containment and cables as they are described above, in accordance with BS 7671 Requirements for Electrical Installations. Please note that the requirements for Design & Commissioning are not dealt with in this document.

A previous FSA short guide has covered Design and Commissioning requirements

The possession of this guidance document is not a requirement for any third party certification scheme or inspection regime.

All British Standards carry a note in their forward stating that: Compliance with a British Standard does not of itself confer immunity from legal obligations

Though the installation clauses of BS 5839 are a relatively small part of the documents, there are some elements in the standards that are not covered within BS 7671. This guide uses the appropriate installation commentary clauses of BS 5839, to highlight these differences relating to the installing of fire detection and alarm systems.

The FSA/ECA recommends that association Members undertaking works on fire detection and alarm systems should be in possession of both BS 5839-1:2002+A2: 2008, BS 5839-6:2004 and BS 7671:2008.

2. CURRENT, NEW LEGISLATION and POLICES

Fire safety systems (fire detection and alarm systems) are controlled by various pieces of legislation, which are required by law, or policy to be complied with: -

1) **Electricity at work Regulation 1989 (Statutory)**
2) **Regulatory Reform Order (Fire Safety) 2005 (Statutory)**
3) **Scottish Fire Safety Regulations 2006 (Statutory)**
4) **Chief Fire Officers Association URN Policy 2008 (Policy)**

You should ensure you are familiar with these legislative documents and policy, before undertaking any work. These laws and policies require that those who undertake work within the areas they cover, are competent.

There has been much debate on how individuals and companies can demonstrate that they are competent to carry out the maintenance of fire detection and alarm systems:

1) **Electricity at Work Regulation 1989 covers the issue of competence in Regulation 16.**
2) **Regulatory Reform (Fire Safety) Order 2005 covers the issue of competence in Clause 13.**
3) **Chief Fire Officers Association URN Policy 2008 covers the issue of competence in Clause 20 and sub-clause 28-10**

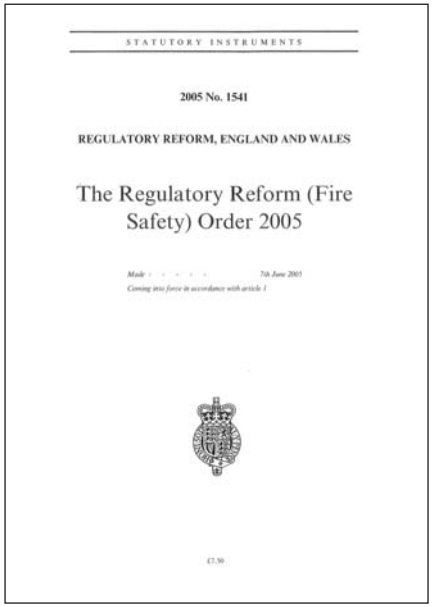
Individuals or organisations not covered by a recognised approval certification scheme. Will need to and be able and prepared to demonstrate competence, when asked to do so. The law places the onus on the proof of competence with the individual or organisation.

Guidance on fire risk assessment is available from the government website. These documents can be downloaded free of charge at. http://www.communities.gov.uk/publications/fire/firesafetyrisk2, along with guidance for many other types of premises.

The Building Regulations for Northern Ireland, Scotland, England and Wales

The Building Regulations relate to new and alterations to buildings. Guidance on the Building Regulations is provided in Technical Booklet E in Northern Ireland, Technical Handbooks are

available to view and download on the DFPNI (Department of Finance and Personnel Northern Ireland) website http://www.dfpni.gov.uk/fire_2.pdf. Guidance is provided in the Scottish Building Standards (SBS) Technical Handbooks (Domestic and Non-Domestic) in Scotland, and in the Approved Document B in England and Wales. The SBS Technical Handbooks are available to view and download on the SBSA (Scottish Building Standards Approval) website www.sbsa.gov.uk and The Approved documents for England and Wales can be downloaded free of charge at http://www.communities.gov.uk/planningandbuilding/buildingregulations/buildingregulationspublications/


STATUTORY INSTRUMENTS

2005 No. 1541

REGULATORY REFORM, ENGLAND AND WALES

The Regulatory Reform (Fire Safety) Order 2005

Fig 1 - Regulatory Reform (Fire Safety) Order 2005

Fig 2 - Part B of the Building Regulations

The above legislation and policy are available on the ECA member's website at www.eca.co.uk

3. OTHER BACKGROUND LEGISLATION

European legislation is gradually having a significant impact on all electro technical systems. The following section provides reference to some of this European legislation. These are mainly related to the manufacturer or importer of equipment. The description is included here to give the reader a basic understanding of the subject.

Electromagnetic Compatibility (EMC)

The EMC directive requires that all electrical and electronic equipment is able to co-exist and operate without interference.

Low Voltage Directive (LVD)

The Low Voltage Directive requires that all electrical equipment connected to low voltage supplies (up to 1000V) must be safe. Various standards are published relating to different types of equipment but the general standard EN 60950 is applied to fire detection and alarm system equipment. Particular items are fire alarm panels, mains rated relays, interface units and other items of equipment connected to the mains supply such as door closers, smoke ventilation security systems etc.

Construction Products Directive (CPD)

The Construction Products Directive relates to building materials and equipment fixed to the structure of the building.

CE MARKING

Currently CE marking is used to indicate that the equipment meets the EMC and LV directives.

The Restriction of Hazardous Substances directive (RoHS)

The Restriction of Hazardous Substances directive currently does not apply to fire detection and alarm system equipment. However it is likely that once alternative materials become available and reliable it will be brought under the scope of RoHS. Hazardous substances will have to be removed from the products (particularly in the case of lead solder) in the future.

4. MAINS POWER SUPPLIES

The following recommendations are applicable to the low voltage mains supply to the system.

This supply should be regarded as an integral part of the fire alarm system. Particularly for the purpose of certification of the system, regardless of whether the electrical installation within the building is provided by the organisation responsible for installation of the fire alarm system. It therefore needs to be wired in the same grade fire resistant cable as the fire alarm system. On large systems with remote power supplies for modules or sounders the supply cable to these power supplies, should be also wired in fire rated cable of the same grade as the fire alarm system. In the case of a radio system the power supply to all parts of the system (panel, radio range extenders etc) still needs to be in fire resistant cable.

Fig 3 - Typical Power supply unit

For reasons of electrical safety, the mains supply to all parts of the fire alarm system should be supplied, via an isolating protective device (such as a circuit-breaker), from the load ("dead") side

of the main isolating device for the building. Where the user requires isolating of the building during closed hours, a separate supply should be provided for the fire alarm system that should not normally be isolated during closed hours.

The mains supply final circuit(s) to all parts of the fire alarm system should be dedicated solely to the fire alarm system, and should serve no other systems or equipment. The circuit(s) should be derived from a point in the building's electrical distribution system close to the main isolating device for the building. It is not acceptable for the electricity supply to be connected via a card or coin operated meter or similar device.

To facilitate local isolation during maintenance, suitable means should be provided for double pole isolation of the low voltage supply circuit that serves the power supply and control equipment. This should be located in the vicinity of the control equipment supplied and be lockable in both normal and isolated positions.

Every isolator and protective device that can isolate the supply to the fire alarm system, other than the main isolator for the building, should be labelled either:

"FIRE ALARM"

In the case of a protective device that serves only the fire alarm circuit, but incorporates no switch;

"FIRE ALARM. DO NOT SWITCH OFF"

In the case of a switch (whether incorporating a protective device or not) that serves only the fire alarm circuit;

"WARNING. THIS SWITCH ALSO CONTROLS THE SUPPLY TO THE FIRE ALARM SYSTEM",

In the case of any switch that disconnects the mains supply to both the fire alarm system and to other circuits.

Labels should be clear and in durable fade resistant

5. CABLES, WIRING AND OTHER INTERCONNECTIONS

The components of most fire alarm systems are connected by cables and wiring, but it is possible to connect them by other means, such as radio or fibre optics. Recommendations for radio-linked systems are given in BS 5839-1: 2002+A2: 2008 Clause 27. Radio-linked systems have both advantages and disadvantages. In the context of a dwelling, the major advantage is the ease of installation and the avoidance of the need to damage or disfigure décor in order to install wiring. The latter advantage is of particular benefit in historic buildings and buildings with ornate finishes; the use of radio-linked systems in historic buildings is now relatively common. Where fibre optic connections are used, they need to provide at least equivalent integrity and reliability to other cables that are recommended for the same purpose.

It is essential that all interconnections operate correctly at the time of a fire. This is particularly important in the case of cables that link control equipment to manual call points, automatic fire detectors and fire alarm devices, door releases, fire shutters, and that transmit signals to an alarm-receiving centre. It is only less important in the case of interconnections between the fire alarm system and other equipment that are so arranged that failure of interconnecting cables during a fire would not lead to a dangerous condition (e.g. because the failure causes the other equipment to change state to that appropriate to the fire condition).

Fig 4 - Typical soft skin standard fire resistant

It is normally possible to predict, with some accuracy, those areas of a building in which fire can or cannot occur. At the design stage, the exact routes that cables will follow may also be unknown. Therefore to ensure that cables used for critical signal paths remain operational for an adequate duration, cables with an inherent ability to resist attack by fire need to be used throughout such critical signal paths.

The critical signal paths can be defined as all interconnections between every fire alarm initiation point (manual call point or automatic fire detector) and the control and indicating equipment. It also includes the interconnections from the control and indicating equipment to the fire alarm warning devices (bells, sounders, flashing beacons, & PA/VA equipment etc.)

The integrity of the mains supply to the system is also regarded as essential, even though the system has a standby supply. Accordingly, mains supply circuits need to be adequately protected against the effects of fire.

In order to ensure satisfactory performance of cables when exposed to fire, cables conforming to the fire test requirements given in BS 5839, need to be used throughout the critical signal paths. These types of cable are ready available in the market place.

The standard makes recommendations for two levels of fire resisting cable systems, termed "standard" also called "PH30" and "enhanced" also called "PH120". Standard cable has to maintain circuit integrity for 30 minutes when exposed to fire. Enhanced cable has to maintain circuit integrity for 120 minutes when exposed to fire, according to the type of building and fire alarm system installed, the designer of the system would, normally specify the specific type of cable.

- The use of cables with "standard PH30" fire resistance is recommended for general use;
- The use of cables with "enhanced PH120" fire resistance is recommended for systems, in particular building types, in which cables might need to operate correctly during a fire, for periods in excess of those normally required for single-phase evacuation of a building. Examples are un-sprinklered high-rise buildings with phased evacuation arrangements and premises of such a nature or size (buildings in excess of 30m tall) that areas remote from the fire could continue to be occupied for a prolonged duration, during a fire that might then damage cables serving parts of the fire alarm system in occupied areas.

The distinction between the two levels of performance is, therefore, made in BS 5839 to enable designers and specifiers to specify, “enhanced” performance cables in situations in which it is considered that a higher level of fire resistance is desired.

Cables capable of complying with the recommendations for “standard PH30” fire resistance include some that have been commonly used for many years for circuits in fire alarm systems. It is recognised, however, that the level of fire resistance described, as “enhanced PH120” is desirable in certain systems in particular building types, although unnecessary for most systems. Cables complying with the recommendations for “enhanced” fire resistance are expected to include, amongst other types, some mineral insulated copper sheathed cables, as well as some soft skinned cables, specially developed by manufacturers to meet the enhanced recommendations.

The probability of disablement of any part of the fire alarm system as a result of mechanical damage to cables can be reduced by the use of sufficiently robust cables, careful selection of cable routes and by the provision of protection against mechanical damage. Monitoring of circuits does not ensure that cable faults will not occur, but is essential to minimize the time between, occurrence and identification (and hence repair) of the fault. Monitoring of circuits and protection of cables against damage are, therefore, complementary precautions, rather than alternatives. It is recommended that cables should have a cross-sectional area of at least 1mm^2.

It is the responsibility of the designer to ensure that the electrical characteristics of the cables, including current carrying capacity and voltage drop, and compatibility with the characteristics of the data transmission e.g. speed and waveform are suitable for the system. The choice of cable routes selected might not be suitable. As the designer may not have all the information (i.e. site specific conditions) when the design was carried out. Therefore the installer needs to take into account the likely hood of damage by fire and mechanical damage. Also the need to avoid electromagnetic interference from other cables and sources, particularly in the case of systems in which cables are used for transmission of data (such as addressable device circuits). The circuits of fire alarm systems need to be segregated from the cables of other circuits to minimize any potential for other circuits to cause malfunction of the fire alarm system arising from:

- Breakdown of cable insulation of other circuits and/or fire alarm circuits;
- A fire caused by a fault on another circuit;
- Electromagnetic interference to any fire alarm circuit as a result of the proximity of another circuit;
- Damage resulting from the need for other circuits to be installed in, or removed from, ducts or Trunking containing a fire alarm circuit.

In order to facilitate identification of fire alarm circuits, cables should preferably be red in colour, unless another form of colour coding is appropriate. By this means, the possible need for appropriate segregation can be identified, and there will be less likelihood of

inadvertent manual interference with the circuits of fire alarm systems (e.g. during work on other electrical circuits).

The containment and fixings of standard or enhanced fire resistant cable needs to be properly addressed.

Fixings and support containment should be of equal fire resistance to the cable type, selected by the designer, in order to meet the required level of fire resistance, which is appropriate for the particular risk along the length, and size of the cable.

This means that the use of nylon cable ties is not acceptable. The cables will need to be fixed using metal P clips or metal cable ties.

If using PVC trunking or conduit for containment then the cables inside will need to fixed with either P clips or a manufacture’s proprietary system

Once a fire alarm signal occurs, fire alarm devices ought not to be dependent on a continued signal from any fire detector or manual call point. In large buildings and buildings with multi-stage alarm systems, the ability of the system to provide indications from further fire detectors and manual call points during the course of a fire may be of value to the fire service or may be essential to ensure that the need for “Evacuate” signals in additional alarm zones can be identified.

6. THE SPECIFICATION OF CABLES FOR FIRE ALARM SYSTEM

The following information is provided for guidance on the selection of soft skinned fire alarm and cable, both standard PH30 and enhanced PH120 classifications. It should be noted that MICC cable meets the PH 120 classification.

6.1 RECOMMENDED CABLE TYPE

Correct operation of a fire alarm system depends very much on the interconnections between the control equipment, detectors, call points and sounders. Unless these interconnections operate correctly when required the system will not fulfil its intended functions.

The types of cable, it’s routing and its physical and electrical protection characteristics should be specified for each particular installation.

For fire detection and alarm system applications, cables must continue to function for a specified period of time. Either 30 minutes “standard” or 120 minutes “enhanced”

Cables that satisfy this requirement without further protection are manufactured to BS 7629 and comply with BS 6387 and meet the requirements for categorisation as CWZ.

Fig 5 - Enhanced cable undergoing testing to requirements of BS6387 Category C to test resistance to fire alone

6.2 CHARACTERISTICS OF RECOMMENDED CABLE TYPE

1. Cables used shall be manufactured and approved to BS 7629 or BS 7842 or BS EN 60702-2 and certified by British Approvals Service for Cables (BASEC).
2. Cables shall comply with the following fire performance standards:
   - a. Resistance to fire — IEC331, BS 6387 category CWZ
   - b. Smoke emission — IEC1034, BS 7622
   - c. Acid gas emissions — IEC754-1, BS 6425-1 (less than 0.5% acid gas)
   - d. Flame retardant — IEC332-1, BS 4066-1
   - e. Reduced flame propagation — IEC332-3 cat c, BS 4066-3 category C
3. Cables shall be manufactured under an ISO 9001 Quality System certified by BASEC
4. All fire resistant cable shall be rated 300/500 volts.
5. All materials within the cable and associated accessories shall be Low Smoke Zero Halogen (LSOH) in performance as assured by the tests.
6. Insulation shall be high performance damage resistant.
7. BS 7671 gives recommendations on the bend radii of cables. The minimum bending radius shall be 6 x D for mineral insulated cables and cables with an overall diameter exceeding 25 mm (where D is the nominal cable diameter), or 4 x D where the overall diameter is less than 25 mm.
8. Where cables are fixed direct to building fabric, purpose designed coloured LSOH coated 'P' clips with the same fire rating as the cable, must be used to ensure the fire survival properties of the installation.
9. In addition to the above, purpose designed LSOH glands, should be used supplied by the cable manufacturer (refer to manufacturer's literature).
10. The use of plastic cable management is strictly prohibited unless the cable is secured to the building structure by means of a fire resistant cable support.
11. Wiring, in general, must comply with the latest issue of BS7671 *Requirements for Electrical Installations - IEE Wiring Regulations* and in conjunction with the manufacturer's recommendations. Installation should also comply with BS5839 & BS5266.
12. Fire alarm cables within a system should utilise a single colour, preferably red. A different colour may be used. However, it should not use the same colours as any other electrical services T
13. The cable should be clipped as per the recommendations of the on-site guide to BS 7671:2008 Table 4A. This is reproduced in section 6.3

Fig 6 - Fire resistance cable clips

6.3 BS 7671 SPACINGS OF SUPPORTS FOR CABLES IN ACCESSABLE POSITIONS

BS 7671:2008 On Site Guide. Table 4A Spacings of supports for cables in accessible positions (this includes fire rated cables)

Overall diameter of cable	Non- armoured thermosetting, thermoplastic sheathed cables (i.e. soft skin)		Armoured Cable		Mineral insulated copper sheathed or aluminium sheathed cable (i.e. MICC)	
	Generally					
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
mm	mm	mm	mm	mm	mm	mm
Not exceeding 9 mm	250	400	-	-	600	800
Exceeding 9 mm and not exceeding 15 mm	300	400	350	450	900	1200
Exceeding 15 mm and not exceeding 20 mm	350	450	400	550	1500	2000
Exceeding 20 mm and not exceeding 40 mm	400	550	450	600	-	-

The spacings stated for horizontal runs may be applied also to runs at an angle of more than 30° from the vertical.

For runs at an angle of 30° or less from the vertical, the vertical spacings are applicable

In order to avoid mechanical damage, cables should not be installed in the same conduit as cables used for other services. Separate compartments should be used where cables are sharing a common trunking. This compartment should be reserved solely for the fire alarm cables. The reason for this recommendation is so that the risk of damage, which could be caused by the stripping out of other cables, or to modify the system, can be reduced.

In other situations, e.g. the fire alarm system within the building is being updated. There may be need to consider a variation to BS 5839 on the grounds of practicality, in that the existing fire alarm does not have its own separate compartment. However, care must be taken to ensure that the risk of electro-magnetic interference from other services will not cause unwanted interference.

Rodent damage of the cable should be considered. In relatively friendly environments, cable could be clipped to a robust surface. However, where the cable is installed in areas of less than 2m from the floor, the use of additional protection may be necessary. This normally applies to manual call points and door release units.

Cable joints should be avoided where possible. Where this cannot be avoided, the enclosure and termination must be able to withstand the same temperature as the cable specified. The enclosure should be labelled “Fire Alarm”. These joint boxes should be available in red fire resistant plastic, or metal with ceramic terminal boxes.

Cable support systems should also be able to withstand the same temperature as the specified cable. This requirement has the effect of precluding the use of plastic cable ties, trunking and cable clips where these items form the sole means of support. Plastic trunking may be used as a means of mechanical protection; however, cable should be fixed inside the Trunking in accordance with the table above.

Mineral insulated copper covered cables and steel core armoured cable can be used without further mechanical protection.

The 230 Volt i.e. mains supply should be separated from the d.c Volt circuits. Cables specified in BS 5839 which are screened, can be considered as having a suitable level of segregation. However, 230 Volt supplies to panels and power supplies should not share the same entry point as the d.c Volt cables.

7. THE RESPONSIBILITY OF THE INSTALLERS

This section 36 of this part of BS 5839 provides recommendations for the work associated with installation of the fire alarm equipment in a building. This work might be undertaken by the same organization that designed the system or by a different organization. For example, the designer and installer might be a single, specialist fire alarm contractor. Alternatively, the purchaser might be responsible for the design of a fire alarm system (which might be undertaken by consultants acting on behalf of the purchaser), and the design might then be communicated, by means of a specification and/or drawings, to a specialist fire alarm contractor or to an electrical installation contractor, which would, in either case, then be responsible for installation

Even if a specialist fire alarm contractor is responsible for installation, the actual installation work might then be sub-contracted to a third party, such as an electrical installation contractor.

Various contractual arrangements are possible, but it needs to be ensured that one organization is responsible for compliance with this section of the standard and that this responsibility is agreed prior to the start of the installation contract.

It is not, in general, the responsibility of the installer to check or verify whether the design of the system complies in full with the recommendations of the standard, unless the installer is also the designer. In general, the responsibility of the installer is to install the system fully in accordance with the requirements of the designer and to follow good practice in the installation work. However, in practice, compliance with a number of

recommendations of BS 5839 impact on both design and installation, and may, therefore, be delegated by the designer to the installer, provided the responsibility for compliance is clear in any specification or contract. Also that the installer is competent to address the issues, and that the responsibility is accepted by the installer. For example, the designer may delegate decisions regarding cable routes to the installer, by simple reference in the design to compliance with BS 5839, with which it would then be the responsibility of the installer to comply.

At the design stage, the designer might have inadequate information to enable compliance with all recommendations. For example, it is rarely possible, at the design stage, to warrant that the sound pressure levels will be satisfied by a particular number and distribution of fire alarm sounders (unless the number is greatly over- specified). Similarly, drawings on which the design is based might not show sufficient information about structural features of the building to enable the design to comply with BS 5839. Accordingly, it will often be necessary for compliance, or at least the reporting of non-compliant issues to rest with an installer, unless the designer still has control of the system.

Nevertheless, the designer needs to provide sufficient information and guidance to the installer to enable the installer to satisfy the relevant recommendations of section 2 of BS 5839. If the installer does not have the relevant expertise in the design of fire alarm systems. Then in this respect, the installer is, in effect, simply complying with specified requirements of the designer.

Even though identification of design shortcomings is not generally the responsibility of an installer, good practice would dictate that, if the installer were aware of any shortcomings. Particularly those arising from features of the building that the designer might not have been aware of. Then the shortcomings should be brought to the attention of the designer, user or purchaser.

8. INSTALLATION PRACTICE, WORKMANSHIP, FIRE STOPPING

The nature and quality of the installation work needs to be such as to maintain the integrity of the fire alarm system and minimize the duration and extent of disablement of the system during maintenance or modifications. Installation practices and workmanship need to conform to the requirements of BS 7671, requirements for Electrical installations.

Penetration of construction (e.g. for the passage of cables, conduit, trunking or tray) need to be made good to avoid the free passage of fire or smoke, regardless of whether the construction has a recognised degree of fire resistance.

Fig 7 - Fire sealing of holes using a fire rated mastic

Fig 8 - Fire rated Collar for Conduit/Trunking

Regulation 527.2 within BS 7671:2008 covers sealing of Wiring System Penetrations. The BS 5839 suite of standards recommends that installation practices and workmanship need to conform to the requirements of BS 7671.

The passage of system cables through a building will inevitably require that apertures or holes need to be created. Therefore, consideration needs to be given to the fire stopping so that the passage of fire and smoke can be prevented.

There are many solutions available such as fire rated mortar, fire rated pillows, fire rated boards, fire rated cable transect systems, fire rated pipe collars, fire rated pipe works, fire rated acrylic, illumescent mastic, fire rated silicone mastic and fire rated foam; which can be selected.

When the installer is running cable(s) through any wall or floor that has a 30-minute fire separating function. The installer should keep the holes where the cable penetrates both of the linings as small as possible and the gaps must be sealed with an intumescent sealant, or compound to prevent the fire getting into the cavity. Plastic conduit and plastic trunking should be terminated at the face of the linings and the individual cables be sealed as above. The sealant shall have been tested in conjunction with electrical cables to ensure that no adverse reaction occurs between the cable and the sealant and to ensure the 30-minute fire rating.

When cables pass through 60 minute studded or joisted walls or floors, then it is recommend that a proprietary fire stopping and sealing systems (including those designed for service penetrations i.e. fire pillows) are used. These should have been tested to meet the requirements of BS 476-22.

When the wiring is contained in plastic conduits or plastic trunking which passes through one or both of the linings of a 60 minute wall or floor, these should be fitted with a suitable intumescent 'collar' system which will crush the melting conduit/trunking at the point of fire attack. For ceiling linings, the collar needs to be only fixed to the underside and in wall applications only to the room side in any protected stair or corridor situation

9. INSPECTION AND TESTING OF WIRING.

On completion of wiring, or sections of wiring, the installer needs to carry out tests to ensure the integrity of cable insulation and adequacy of earthing. Usually, the tests on cables will be carried out with equipment disconnected and prior to completion of the entire system. Insulation resistance testing at 500 V d.c. Should be carried out between conductors, between each conductor and earth, and between each conductor and any screen. The results should be, at least, 2 MΩ. Further tests will need to be carried out on completion of the system.

These tests may form part of the commissioning process. In some (usually addressable) systems, maximum circuit impedance may be specified by the system manufacturer. If this is the case measurement of circuit impedance recommended by the manufacturer. Need to be carried out and checked for compliance against the manufactures recommendations, either on completion of installation or at commissioning.

Fig 9 - Testing of Wiring

The results of all tests should be recorded and made available to the organization responsible for commissioning the system.

Note: Earth continuity and, for mains supply circuits, earth fault loop impedance, should be tested to ensure compliance with BS 7671:2008

10. FIRE DETECTION AND ALARM SYSTEM ELECTRICAL INSTALLATION CHECK LIST:

The electrical installation work carried out on site in accordance with BS 5839 generally covers the following:

CHECKLIST

1. Consult the drawings and specification and communicate with all the parties concerned related to the installation of the system.
2. Liase with any other trades involved in the project that may require co-ordination.
3. Arrange a secure location for the equipment and materials stored when they are delivered to site.
4. Ensure that all site safety arrangements have been assessed prior to commencing work.
5. Ensure that the structure is adequate and site the equipment, fixing it securely in accordance with the manufacturers recommendations, using screws, bolts or special fixings.
6. Locate the control equipment and power supplies in a prepared accessible position, in accordance with the specification, the manufacturers recommendations and clauses 23 (control and indication equipment), 24 (networked systems) and 25 (power supplies) of BS 5839-1.
7. Carefully survey the safe and optimum cable routes.
8. Detectors, call points, input/output units, and any auxiliary units should be located in accordance with the manufacturers recommendations and clause 22 (spacing and sitings of automatic fire detectors) of BS 5839-1.

9. Install the cable and containment in accordance with BS 7671 and BS 5839-1 clause 37 (Installation practices and workmanship), securely fixing all the devices to the building structure, with suitably selected fire resistant fixings
10. Upon completion of the installation of the cable, containment, and equipment carry out a pre-commissioning test and inspection of the installation as described in clause 38 (Inspection and testing of wiring) of BS 5839-1 and record the appropriate results of all the tests.
11. Finally complete the appropriate sections of a BS 7671 electrical installation certificate. Complete an installation certificate in accordance with clause 41 (Certification) of BS 5839-1.To-enable handover of the system to the commissioning engineer.

11. DOCUMENTATION

Once the system has been installed and commissioned the appropriate certificates should be issued. As well as an "as-fitted" drawing giving details all the detection and control equipment and the cable routes. This drawing can become invaluable if the system needs repairing or expanding.

A zone diagram should be placed next to the control panel. To enable fire fighters to quickly identify the areas which the alarm has been activated in.

12. MAINTENANCE OF FIRE DETECTOR AND ALARM SYSTEMS IN ACCORDANCE WITH BS5839 - PARTS 1 AND 6

Maintenance of fire detector and alarm systems is probably the largest element of the work related to these systems. The working life of the system can be extended or shortened by the level of care provided over the term of the system, and the lifetime cost of maintaining the system normally considerably exceeds the total cost of the installation.

Poorly maintained systems are one of the major causes of nuisance alarms, which as a result have brought about the introduction of the CFOA (Chief Fire Officer Association) URN (unique reference number) policy, in an effort to stamp out the number of costly false alarms attended by expensive fire appliances.

BS5839-1: 2002+A2: 2008 and BS5839-6: 2004 are codes of practice, which provide recommendations for the maintenance of fire detector and alarm systems. Part 1 of the standard deals with commercial and industrial premises, whilst Part 6 deals with domestic premises. It should be noted that although Part 6 references houses of multiple occupation (flats and apartments) it refers to these as Grade A systems and refers them back to Part 1. This should be read in association with clause 7 of Part 6 in order to fully understand the full Grade A system requirements.

Both BS5839-1 and BS5839-6 have their own sections and clauses, which are applied to the maintenance of fire detection and alarm systems. This section is designed to assist those who undertake the service and maintenance of systems using the codes of practice.

13. TYPES OF SYSTEMS

There are many makes and types of fire detection and alarm systems installed in all types of buildings, locations and protecting various industrial processes. Numerous companies, whose systems vary in many ways from each other, manufacture these systems.

13.1 CONVENTIONAL SYSTEMS

By far the commonest types of system currently installed are systems known as 'Conventional' systems. These are often termed as "Zonal". These systems have dedicated cable for each zone, which are wired in a radial fashion. Some of the newer panels can also have the sounders on the detection wiring. These are commonly known as bi-wire or two wire systems. A detailed description of detector and alarm zones can be found in clauses 13 (Detection zones) and 14 (Alarm zones) of BS5839-1 and clause 19 (Zoning and other means for identification of the source of alarm conditions) of BS5839-6.

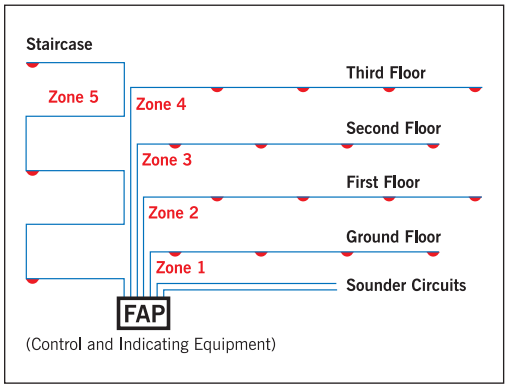


Fig 10 - Typical Conventional System

13.2 ADDRESSABLE SYSTEMS

The 'Addressable systems' are systems, which provide an address for each individual device on the system. Unlike conventional systems where zones are hard-wired, addressable system zones are programmed into the system's software. A word of warning for those who are maintaining addressable systems - Many systems in the market use what is known as 'stored protocols', this is software, which is specific to the particular manufacturer, and is password protected.

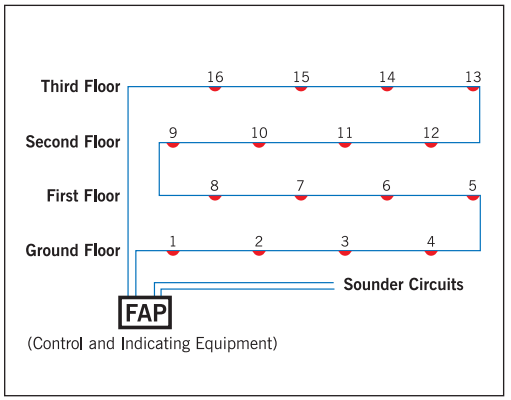


Fig 11 - Typical Addressable System

Although some organisations will claim that their systems are 'open protocol' there is in fact, currently no such thing as true 'open protocol'. Open protocol means that all detectors and panels would have to use a common software protocol.

Fig 12 - Typical Addressable Panel

Each control panel manufacturer will have a panel with a motherboard and will provide plug-in zone cards, which support different types of field equipment (detection, interface units etc). The control panel itself and its software are still exclusive to the particular panel manufacturer, and are password protected. But these manufacturers will freely provide their codes to anyone who buys their panel.

When you accept an addressable system on a maintenance contract, ensure that you have access to all the codes and that you are properly trained on those products, which you are offering to provide maintenance and support for.

14. MAINTENANCE OF FIRE DETECTION AND ALARM SYSTEMS

Recommendations for the maintenance of systems can be found in section 6 of BS 5839-1: 2002 +A2: 2008 and clause 24 of BS 5839-6: 2004. These clauses and sections cover all the aspects of fire detection and alarm system servicing and maintenance

Whilst BS 5839 makes recommendations these tend to be in general terms and do not take into account the multitude of products in the market place. It is therefore particularly important that manufacturers' recommendations are taken into account when servicing and maintaining of systems is undertaken.

Servicing and maintenance is generally carried out in occupied buildings, where there will be specific health and safety requirements. Engineers should acquaint themselves with the site safety requirements before starting work.

Some systems will be connected to an Alarm Receiving Centre (ARC). In these cases the ARC should be informed that the system is being maintained. This will prevent alarm signals being transmitted onwards to the Fire and Rescue Service. It is also important to inform the responsible person for the system that the automatic signal to the ARC is not functional for the period of the testing

Many larger and networked systems will be linked to building services plant such as: dampers, smoke extract fans, shutters ventilation systems and door release magnets etc) BS 5839 does not cover maintenance of these systems and equipment. However, these

systems need to function when the system is operated in an emergency. But care needs to be taken when caring out maintenance that these systems are not adversely affected during the maintenance visit.

Each system should have a logbook, which needs to be kept in a location adjacent to the main control panel. This is for the purpose of recording all events that occur related to the system. These will include all fire signals, fault signals and work carried out on the system.

The Log Book will contain:

1) Brief details of the maintenance arrangements
2) Dates and type of all service and maintenance visits (routine; non-routine)

The detailed recommendation of the logbook is set out in Clause 48 of BS5839-1: 2002+A2: 2008. Grade A systems as defined in BS5839-6: 2004 will require the same logbook as BS5839-1: 2002+A2: 2008 systems. However, a logbook will not be required for Grade B and C systems, but is recommended. Grade D, E and F-systems need only have a set of user instructions.

This documentation and its upkeep is an important part of the maintenance procedure. All details contained in the logbook/documentation should be reviewed for accuracy at each maintenance visit.

15. REQUIREMENTS FOR MAINTENANCE

The Regulatory Reform (Fire Safety) Order 2005 gives requirements for fire detection and alarm systems to be properly maintained. The frequency of the maintenance of the system will be determined by the responsible person, and documented in the building's fire risk assessment. Depending on the use of the building the maintenance of the system may require more visits than recommended in BS 5839. This information should be documented in the system logbook.

The Regulatory Reform (Fire Safety) Order 2005 requires that a competent person carries out the maintenance. The reform order states that:

A person shall be regarded as competent where he has sufficient training, and experience or knowledge and other qualities to enable him to properly implement the measures (service and maintenance). It is very likely that the responsible person will need proof for competency prior to placing a maintenance contract.

16. ROUTINE TESTING OF THE SYSTEM BY THE END-USER

Clause 44 (Routine testing) of BS5839-1: 2002+A2: 2008 and clauses 24, (User instructions) 25 (Routine testing) and 26 (Maintenance) of BS5839-6: 2004 deal with the responsibility of the user in the routine testing and maintenance of the systems.

16.1 WEEKLY TESTING BY THE USER

In accordance with the fire risk assessment, the end user would normally carry out the testing of the fire detection and alarm system on the same day, and where possible at a pre-defined time each week. Normally testing a manual call point would do this. However, some organisations prefer to sub-contract this testing to a specialist company.

A different manual call point should be used at the time of every weekly test, so that all manual call points in the building are tested in rotation over a prolonged period. There is no maximum limit for this period (e.g. in a system with 150 manual call points, the user could test each manual call point every 150 weeks). The result of the weekly test and the identity of the manual call point used should be recorded in the system log book

This test will ensure that the entire system or part of the system has not failed. It is important that the test is carried out in normal working hours, in order that the occupants become familiar with the sound of the evacuate signal. Where the system has a two-stage alarm signal the operation of both stages should be carried out in order that the occupants recognise the two sounds.

Where companies operate a shift system, additional monthly tests should be carried out so that those working shifts become familiar with the alarm signals.

16.2 MONTHLY TESTING BY THE USER

Where an automatic emergency generator is used, this should be started up once a month, and the person undertaking this should have sufficient technical knowledge and be competent to do so. Any vented batteries should be visually inspected to ensure that the connections are in good condition, and the levels of electrolyte are satisfactory

17. INSPECTION AND SERVICING

Clause 45 (Inspection and servicing) of BS5839-1: 2002+A2: 2008 and clauses 25(Routine testing) and 26 (Maintenance) of BS5839-6: 2004, cover the requirements for routine testing and maintenance of fire detection and alarm systems.

Whilst BS 5839 makes recommendations regarding the need for quarterly, six-monthly and annual servicing of the system, it is the fire risk assessment, which will determine the exact requirements regarding the length of time between visits.

In the case of systems, which are powered by vented batteries, it is normal to test and inspect the batteries on a quarterly basis. Should the system be connected to an Alarm Receiving Centre (ARC) then it is also the usual practice to inspect and maintain the fire alarm and detection system on a quarterly basis.

The standard recommends that the period between successive inspection and servicing visits should not exceed six months; if this recommendation is not implemented, the system should not be considered to be compliant with BS 5839. This would consist of a six monthly visit and a twelve monthly visit. Clause 45 (Inspection and servicing) makes

specific recommendation for the (periodic) six-monthly visit and a separate set of recommendations for the (annual) twelve monthly visit.

Servicing of a Domestic Grade A system covered by BS5839-6: 2004 should be carried out on the same basis as described in the previous paragraph. Grade B and C systems should be serviced every six months in accordance with the manufacturers instructions.

Fig 13 - Service and maintenance in practice

Grade D, E and F-systems should be cleaned periodically in accordance with the manufacturers instructions.

18. NON-ROUTINE ATTENTION

There are a number of occasions when a fire alarm system will require non-routine attention, this will include:

1. Repair of faults or damage
2. Inspection and testing following a fire
3. An inspection when a new service provider takes over the system
4. Modification which takes into account change in the occupancy, extension, alteration or false alarms
5. Action to address successive false alarms from the system
6. Where a system has been disconnected over a long period

When a servicing organization takes over servicing arrangements for an existing system, a special inspection should be carried out, and existing records where available, should be studied, to obtain sufficient information to be documented for effective future servicing of the system

Major areas of non-compliance with BS 5839 should be documented and identified to the responsible person appointed by the user. The classification of a non-compliance as major is subjective, but the following non-compliances are generally considered as major

1) An inadequate number of call points to comply with the recommendations of clause 20.2, of BS 5839-1: 2002+A: 2008
2) Inadequate provision of fire detection to comply with the recommendations of this standard for the category of system that the system was designed to meet;
3) Sound pressure levels that fail to comply with the recommendations of clause 16.2; of BS 5839-1: 2002+A: 2008

4) Standby power supplies that fail to comply with the recommendations of clause 25.4 of BS 5839-1: 2002+A: 2008 The absence of any standby power supply should be highlighted to the responsible person, as systems that incorporate no standby supply breach the Health and Safety (Safety Signs and Signals) Regulations 1996 [1];

NOTE Serious shortcomings in cable support that could result in collapse of a significant length of cable in the event of fire might also be regarded as a major non-compliance. For example the use of nylon cable ties

5) Cabling with fire resistance that fails to comply with the recommendations of 26.2 of BS 5839-1: 2002+A: 2008: (particularly for sounder circuits)

6) Monitoring of circuits that fail to comply with the recommendations of 12.2.1 of BS 5839-1: 2002+A: 2008;

7) Standards of electrical safety such that the recommendations of Clause 29 of BS 5839-1: 2002+A: 2008 are not satisfied;

8) Exposure to, or experience of, false alarms, such as to preclude compliance with Section 3 of BS 5839-1: 2002+A: 2008;

9) Changes in the use, layout and construction of the protected premises that may impact on the effectiveness of the system.

If no logbook suitable for enabling compliance with the recommendations of 48.2 of BS 5839-1: 2002+A: 2008 exists, a suitable logbook should be provided by the servicing organization.

19. FREQUENTLY ASKED QUESTIONS

Q Can you joint fire alarm cables?

A It is not good practice to join fire resistant cables. They should be installed in one continuous length. If jointing is unavoidable then a fire resistant box containing ceramic connectors should be used and ladled as fire alarm.

Q Can I use Nylon Glands for the fire alarm cables?

A Yes as long as the Nylon glands are recommended for fire alarms. Brass or Steel glands may be used as alternatives.

Q Does fire cable require segregation?

A Fire alarm cable may generally be installed alongside other cables since it is screened. However BS5839-1 does not allow any fire alarm cable to be installed in the same conduit or common trunking (unless in its own compartment) as any other cables. The fire alarm equipment manufacturer may also recommend separation of cables to minimise electromagnetic interference.

Q Should I test the fire alarm cables with an insulation resistance tester when doing a periodic inspection?

A There is no recommendation in BS 5839 for testing of the cables once installed. As they are wired in fire resistant cable and continuously monitored by the panel for faults there is no need to test. They only part of a fire alarm system that would fall under the scope of a periodic inspection would be the mains supply to the panel which should be treated as any other circuit.

Q Do the supporting clip and fixings have to be fire resistant?

A All BS 5839-1 systems should be installed using fire resistant cables, Fire resistant clips and supports are required when using this type of cable. Equipment, cables, containment and clips should under no circumstances be stuck to the surfaces on which they are mounted or run. Nylon cable ties should not be used to support fire alarm cables

20. FSA/ECA Training Courses

Electrical Contractor's Association (ECA) Education & Training Department is the FSA's training provider of accredited training courses for the design, commissioning, installation and maintenance of fire detection and alarm systems and emergency lighting.

A comprehensive modular training programme has recently been launched, in partnership with the Fire Protection Association (FPA), designed to meet the needs and competency requirements of FSA members and the industry.

THREE TRAINING PATHWAYS ARE AVAILABLE:

- Fire Detection & Alarm Systems for the Workplace
- Fire Detection & Alarm Systems for Dwellings
- Emergency Lighting

For details: Download a brochure from www.eca.co.uk/courses or phone ECA Education and Training, short course division, on 0845 872 5361.

APPENDIX A - MAINTAINING ROUTINES

A.1 VISUAL CHECK BY THE USER - DAILY

1. Inspect the control panel for normal operation
2. Ensure all logged faults have been attended to

A.2 WEEKLY TEST BY USER OR SPECIALIST OPERATOR

1. Advise occupants of the building that the fire alarm is being tested
2. Switch system to test - advise alarm receiving centre if appropriate "take off watch"
3. Activate a manual call point
4. Note operation of warning devices
5. Check for the correct indicator on the control panel
6. Reset the control panel

7. Reinstate system test switch to operational
8. Clean control panel front if necessary
9. If the system has a printer, check paper - ink - ribbon
10. If connected to an alarm receiving centre “put back on watch” and confirm successful receipt of signals
11. Record details in the system logbook

A.3 QUARTERLY VENTED BATTERY MAINTENANCE BY SPECIALIST CONTRACTOR OR COMPETENT STAFF

1. Inspect batteries and replace if necessary
2. Top up with electrolyte if necessary
3. Using a test meter, measure battery voltage
4. Isolate the mains supply and run the system on battery power only
5. Check the charging current and re-check the voltage
6. Check the fuse ratings

A.4 PERIODIC INSPECTION AND TESTING BY SPECIALIST CONTRACTOR

The period between inspection and servicing visits should be based upon the fire risk assessment for each individual building. The recommended period should not exceed six months (2 visits per year). This is the minimum period acceptable for the system to be considered to comply with BS 5839.

The periodic inspection and testing routine is based on the recommendations provided in sub-clause 45.4 of BS 5839-1: 2002+A: 2008. However, this may be varied where manufacturers of the system and its components can provide proof that the system can automatically carry out the test functions recommended in sub-clause 45.4 of BS 5839-1: 2002+A: 2008

The work described in the following schedule can be carried out over two visits, i.e. the periodic service (six-months) and annual service (twelve months)

12 MONTHLY INSPECTION AND TESTING (BS 5839 SUB-CLAUSE 45.3 AND 45.4)

1. Examine system logbook and ask user if there are any problems or false alarms
2. Check panel and equipment fixings
3. Inspect installation for any changes in use
4. Ensure that any devices are not obstructed
5. Make visual inspection of the cabling and containment
6. Inspect batteries and replace if necessary
7. Top up with electrolyte if the batteries are vented

8. Check the fuse ratings
9. Using a meter, measure the battery voltage
10. Isolate the mains supply and run the system on battery-only and vice versa
11. Test the switch function of every manual call point
12. Functionally test and inspect all automatic fire/smoke detectors using the phenomena they are designed to detect
13. Every heat detector should be tested using a heat source which will not damage the detector
14. All optical smoke detectors should be functionally tested using a filter, smoke or simulated smoke
15. Aspirated fire detection systems should be functionally tested using smoke or simulated smoke, from the end of the sampling pipe.
16. Carbon monoxide detectors should be functionally tested
17. Check control panel and repeater panels for indication and functions
18. Visually inspect the building for changes
19. Check records of false alarms for previous 12 months
20. Ancillary systems should be checked for operation
21. All fault indication should be checked, where practical
22. Printers should be checked along with consumables
23. Radio systems should be checked as recommended by the manufacturer
24. Test the alarm warning devices/voice alarm and communications
25. Test the automatic transmission system
26. All flame detectors should be functionally tested
27. Analogue values should be determined at the control panel
28. Multi-sensor detectors should be functionally tested
29. Visual fire detector lenses should be cleaned
30. Any unmonitored filament lamps should be replaced
31. Radio signal strength should be checked
32. The cause and effect matrix should be confirmed
33. Any standby power should be checked
34. Any manufacturer recommended test should be carried out
35. On completion of the works any outstanding defects should be reported to the responsible person
36. The logbook should be completed
37. A record of the inspection and test should be made on the servicing certificate

REFERENCES

BS 5839-1:2002 +A2: 2008	Fire detection and alarm systems for buildings
BS 5839-6:2004	Fire detection and alarms for buildings - dwellings
BS 7671:2008	IEE (IET) Requirements for Electrical Installations
IEE (IET)	Electrical Maintenance 1999

The British Standard Institute along with the industry develop and produce BS 5839 parts and BS 7671. These publications are available to ECA members for purchase at a discounted price from: ECA ESCA House, 34 Place Court, London W2 4HY. Tele: 0207 313 4800 Fax: 0207 221 7344.

BRITISH AND EUROPEAN STANDARDS AND OTHER CODES OF PRACTICE WHICH ARE USEFUL REFERENCES:

BS 4678-4, Cable trunking – Part 4: Specification for cable trunking made of insulating material.

BS 9999 (relevant part), Code of practice for fire safety in the design, management and use of buildings.

BS 5839-8:2008, Fire detection and alarm systems for buildings-Part 8: Code of practice for design, installation and servicing of voice alarm systems.

BS 5839-9:2003, Fire detection and alarm systems for buildings – Part 9: Code of practice for design, installation and maintenance of emergency voice communication systems.

BS 5979:2000, Code of practice for remote centres, receiving signals from security systems.

BS 7273 (all parts). Code of practice for the operation of fire protection measures.

BS 7629 (all parts), Specification for 300/500 V fire resistant electric cables having low emission of smoke and corrosive gases when affected by fire.

BS 7671:2008 Requirements for electrical installations – IEE Wiring Regulations Seventeenth Edition

BS 7846 Electric cables 600/1 000 V armoured fire-resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire.

BS 8434-1, Methods of test for assessment of the fire integrity of electric cables – Part1: Test for unprotected small cables for use in emergency circuits-BS EN 50200 with addition of water spray.

BS8434-2, Methods of test for assessment of the fire integrity of electric cable-Part 2: Test for unprotected small cables for use in emergency circuits-BS EN 50200 with a 930 C flame and with water spray.

BS EN 54-2, Fire detection and fire alarm systems – Part 2: Control and indicating equipment.

BS EN 54-3, Fire detection and fire alarm systems – Part 3: Fire alarm devices – Sounders.

BS EN 54-4, Fire detection and fire alarm systems – Part 4: Power supply equipment.

BS EN 54-5, Fire detection and fire alarm systems – Part 5: Heat detectors – Point detectors.

BS EN 54-7, Fire detection and fire alarm systems – Part 7: Smoke detectors – Point detectors using scattered light, transmitted light or ionisation.

BS EN 54-10, Fire detection and fire alarm systems – Part 10: Flame detectors.

BS EN 54-11, Fire detection and fire alarm systems – Part 12: Smoke detectors – Optical beam detectors.

BS EN 50086 (relevant parts), Specification for conduit systems for electrical installations.

BS EN 50200, Method of test for resistance to fire of unprotected small cables for use in emergency circuits.

BS EN 50281-1-2, Electrical apparatus for use in the presence of combustible dust – Part 1-2: Selection, installation and maintenance.

BS EN 60079-14, Electrical apparatus for use in the presence of combustible dust – Part 14: Electrical installations in hazardous areas (other than mines)

BS EN 60707-1, IEC 60702-2, Mineral insulated cables and their terminations with a rated voltage not exceeding 750V –Part 2: Terminations.

BS EN 61558 (parts relevant to safety isolating transformers), Safety of power transformers, power supply units and similar.

BS EN ISO 13943, Fire Safety, Vocabulary.

Code of practice for Category 1 aspirating detection systems. British Fire Protection Systems Association, 1996.

LPS 1257, Test specification for transmission link integrity – Radio-linked fire detection and alarm equipment. Loss Prevention Certification Board, 2001.

Health Technical Memorandum 82, Alarm and detection systems. NHS Estates. London: TSO (The Stationery Office).