
**Fire detection and fire alarm systems for buildings –
Part 1: Code of practice for design, installation,
commissioning and maintenance of systems in non-
domestic premises**

BOS 813-1:2023



BOTSWANA BUREAU OF STANDARDS



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Table of Contents

	Page
Foreword	iii
Section 1: General	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	3
4 Need for a fire detection and fire alarm system and type of system	7
5 Categories of system	8
6 Exchange of information and definition of responsibilities	10
7 Variations from the recommendations of this standard	12
Section 2: Design considerations	14
8 Relationship between system category and protected areas	14
9 Actuation of other fire protection systems or safety facilities	16
10 Systems In explosive gas or dust atmospheres	17
11 System components	17
12 Monitoring, integrity and reliability of circuits external to control equipment	18
13 Detection zones	23
14 Alarm zones	25
15 Communication with the fire and rescue service	27
16 Audible alarm signals	30
17 Visual alarm signals	33
18 Fire alarm warnings for people who are Deaf and hard of hearing	34
19 Staged fire alarms	37
20 Manual call points	39
21 Types of fire detector and their selection	41
22 Spacing and siting of automatic fire detectors	47
23 Control and indicating equipment	62
24 Networked systems	65
25 Power supplies	66
26 Cables, wiring and other interconnections	69
27 Radio-linked systems	75
28 Electromagnetic compatibility	77
29 Electrical earthing	78

Section 3: Limitation of false alarms and unwanted fire alarm signals	80
30 Responsibility for limitation of false alarms and unwanted fire alarm signals.....	80
31 Categories of false alarms.....	82
32 Acceptable rate of false alarms.....	82
33 Causes of false alarms.....	83
34 Design process for limitation of false alarms and unwanted fire alarm signals.....	84
35 Measures to limit false alarms and prevent unwanted fire alarm signals	85
Section 4: Installation.....	91
36 Responsibility of installer	91
37 Installation Practices and workmanship	92
38 Commentary	94
Section 5: Commissioning and handover	96
39 Commissioning.....	96
40 Documentation.....	98
41 Certification	99
42 Acceptance.....	100
43 Verification	101
Section 6: Maintenance.....	102
44 Routine testing.....	102
45 Inspection and servicing	103
46 Non-routine attention	107
Section 7: User's responsibilities	111
47 Premises management	111
48 Logbook.....	112
ANNEX A (normative) Choice of appropriate category of fire detection and fire alarm system and frequency of servicing fire alarm systems	113
ANNEX B (informative) Typical noise levels in buildings.....	116
ANNEX C (normative) Control and transmission equipment for tactile alarm devices provided for people who are Deaf and hard of hearing	119
ANNEX D (normative) Method for calculating standby battery capacity	121
Annex E (informative) The Selection and Application of Fire Detectors	122
ANNEX F (normative) Model format for system logbook	129
Annex G (informative) Model certificates.....	132
Bibliography	139

Foreword

This Botswana standard was approved by the Technical Advisory Committee of the Standards Council on 2023-02-07.

The Botswana Bureau of Standards (BOBS) was established under the Standards Act No.16 of 1995 with a primary responsibility of preparing Botswana Standards.

During the preparation of this standard, assistance was derived from the British standard, BS 5839-1:2017, The Design, Installation, Commissioning and Maintenance of Fire Detection and Fire Alarm Systems in Non-domestic Premises. Published by British standards institute

During the preparation of this standard, the following organizations were directly represented in the Technical Committee, MED 6 – Fire Safety:

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Fire detection and fire alarm systems for buildings – Part 1: Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises

Section 1: General

1 Scope

This standard provides recommendations for planning, design, installation, commissioning and maintenance of fire detection and fire alarm systems in and around buildings, other than domestic premises. It does not recommend whether or not fire detection should be installed in any given premises. Recommendations for fire detection and fire alarms systems in domestic premises are given in BS 5839-6.

The term fire detection and fire alarm system, in the context of this standard, includes systems, that range from those comprising of only one or two call points senders to complex networked systems that incorporate a large number of automatic fire detectors, manual call points and sounders, connected to numerous inter - communicating control and indicating panels.

The term also includes systems that are capable of providing signals to initiate the operation of other fire protection systems and equipment (such as fire extinguishing systems, smoke control systems or automatic door release equipment) or safety measures (such as shutdown of air handling systems, closing of oil or gas valves or grounding of lifts). It does not apply to the other systems and equipment themselves, or the ancillary circuits to interface with them. Recommendations for the planning installation and servicing of facilities for operation of certain fire protection systems by the systems addressed within this this standard are given in BS 7273 (all parts)

This standard does not cover systems whose primary function is to extinguish or control fire, such as sprinkler or automatic extinguishing systems, even though they might have a secondary alarm function; it does, however, cover the use of a signal from an automatic extinguishing system as one initiating element of a fire alarm system (e.g. by use of a pressure or flow switch).

This standard does not cover voice alarm systems. Recommendations for voice alarm systems and voice sounders are given in BS 5839-8, This standard does not cover systems combining fire alarm functions with other non-fire related functions. Recommendations for such integrated systems are given in DD CLC/TS 50398.

This standard does not cover the 997 (or 112) public emergency call system, or manually or mechanically operated sounders. This standard does not cover audible or visual way-guidance systems which are designed to complement fire alarm systems.

Recommendations for fire detection and fire alarm systems in electronic data processing installations and similar critical electronic equipment rooms are given in BS 6266, which provides recommendations over and above those given in this standard.

This standard applies to extensions and alterations to existing systems, at least in respect of the design, installation, commissioning and certification of the new work, albeit that the extended or altered system might not, overall, conform to the recommendations of this standard.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Botswana Bureau of Standards (BOBS) maintains registers of currently valid documents.

BS 476, *(relevant parts), Fire tests on building materials and structures*

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

BS 5839-6, *Fire detection and fire alarm systems for buildings*

BS 5839-8, *Fire detection and fire alarm systems for buildings - Part 8: Code of practice for the design, installation, commissioning and maintenance of voice alarm systems*

BS 5839-9, *Fire detection and alarm systems for buildings - Part 9: Code of practice for the design, installation commissioning and maintenance of emergency voice communication systems*

BS 6266, *Fire Protection for Electronic Equipment Installations*

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

BS 7629-1, *Electric cables - Specification for 300/500 V fire resistant screened, fixed installation cables having low emission of smoke and corrosive gases when affected by fire - Part 1: Multicore cables*

BS 7671, *Requirements for Electrical Installations - JET Wiring Regulations (Seventeenth edition)*

BS 7846, *Electric cables - Thermosetting insulated, armoured fire-resistant cables of rated voltage 600 / 1000 V fixed insulation, having low emission of smoke and corrosive gases when affected by fire -Specification*

BS 8434-2, *Methods of test for assessment of the fire integrity of electric cables - 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 8591, *Remote centres receiving signals from alarm systems-Code of practice*

BS EN 54-2:1997+A1:2006, *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 heat detectors*

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

BS EN 54-10, *Fire detection and fire alarm systems- Part 10: Flame Detectors - Point detectors*

BS EN 54-11, *Fire detection and fire alarm systems- Part 11: Manual call points*

BS EN 54-12, *Fire detection and fire alarm systems - Part 12: Smoke detectors - Line detectors using an optical beam*

BS EN 54-13, *Fire detection and fire alarm systems - Part 13: Compatibility and connectability assessment of system components*

BS EN 54-20, *Fire detection and fire alarm systems-Part 20: Aspirating smoke detectors*

BS EN 54-21, *Fire detection and fire alarm systems - Part 21: Alarm transmission and fault warning routing equipment*

BS EN 54-23, *Fire detection and fire alarm systems - Part 23: Fire alarm devices – Visual alarm devices*

BS EN 54-25:2008, *Fire detection and fire alarm systems-Part 25: Components using radio links*

BS EN 54-26, *Fire detection and fire alarm systems - Part 26: Carbon monoxide detectors - Point detectors*

BS EN 54-29, *Fire detection and fire alarm systems - Part 29: Multi-sensor fire detectors- Point detectors using a combination of smoke and heat sensors*

BS EN 54-30, *Fire detection and fire alarm systems-Part 30: Multi-sensor fire detectors – Point detectors using a combination of carbon monoxide and heat sensors*

BS EN 54-31, *Fire detection and fire alarm system -Part 31: Multi-sensor fire detectors – Point detectors using a combination of smoke, carbon monoxide and optionally heat sensors*

BS EN 50200:2015, *Method of test for resistance to fire of unprotected small cables for use in emergency circuits*

BS EN 60079-14, *Explosive atmospheres. Electrical installations design, selection and erection*

BS EN 60079-17, *Electrical apparatus for use in the presence of combustible dust -Part 17: Inspection and maintenance of electrical installations hazardous areas (other than mines)*

BS EN 60702-1, *Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V - Part 1: Cables*

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

BS EN 61386 (all parts), *Conduit systems for cable management*

BS EN ISO 13943, *Fire safety- Vocabulary*

ISO 7240-8, *Fire detection and alarm systems — Part 8: Point-type fire detectors using a carbon monoxide sensor in combination with a heat sensor*

ISO 7240-15, *Fire detection and alarm systems — Part 15: Point-type fire detectors using smoke and heat sensors*

SANS 10400 Part T, *The application of the National Building Regulations Part T: Fire protection*

3 Terms and definitions

For the purpose of this standard this standard, the terms and definitions in ISO 13943 and the following apply.

3.1 addressable system: system in which signals from detectors, manual call points or any other devices are individually identified at the control and indicating equipment.

3.2 alarm receiving centre (ARC): continuously manned premises, remote from those in which the fire detection and fire alarm system is fitted, where the information concerning the state of the fire alarm system is displayed and/or recorded, so that the fire and rescue service can be summoned

3.3 alarm zone: geographical subdivision of the protected premises, in which the fire alarm warning can be given separately, and independently, of a fire alarm warning in any other alarm zone

3.4 aspirating smoke detection system: smoke detection system in which a sample of the atmosphere in the protected space is drawn by a fan or pump into a detector which may be remote from the protected space.

3.5 audibility: property of a sound which allows it to be heard among other sounds

NOTE Audibility depends upon the relative loudness and frequency content of the sound in comparison with other sounds which are present at the same time.

3.6 automatic fire detection and fire alarm system: system (other than a single self-contained smoke or fire alarm) in which an alarm of fire can be initiated automatically.

3.7 circuit: assembly of fire alarm components supplied from the same control equipment and protected against overcurrent by the same protective devices) r current limitation arrangements.

3.8 circulation area: area (including a stairway) used mainly as a means of access between a room and an exit from the building or compartment.

3.9 Coincidence: arrangement designed so that an output is obtained only when at least two independent input triggering signals are present at the same time

NOTE This is not to be mistaken for “double knock”: which is a colloquial term often used for an arrangement whereby an output is given only when two successive signals are received from the same device.

3.10 combustion gas detector: automatic fire detector sensitive to gaseous products of combustion and/or thermal decomposition.

3.11 commissioning: process by which it is determined that the installed system meets the defined requirements.

3.12 competent person: person with the relevant current training and experience, and with access to the requisite tools, equipment and information, and capable of carrying out a defined task.

Note The technician shall have a qualification in Electronics and Electrical Engineering or its equivalence

3.13 control and indicating equipment (CIE): component or components of a fire detection and fire alarm system through which other components can be supplied with power and which:

- a) are used:
 - 1) to receive signals from the connected detectors, manual call points or any other devices (e.g.in put/output units);
 - 2) to determine whether these signals correspond to a fire alarm condition;
 - 3) to indicate any such fire alarm condition audibly and visually;
 - 4) to indicate the location of the danger; and
 - 5) possibly to record any of this information;
- b) are used to monitor the correct functioning of the system and give audible and visible warning of any faults (e.g. short circuit, open circuit or fault in the power supply);
- c) if necessary, are able to pass on the fire alarms signal:
 - 1) to audible or visible fire alarm devices or to a voice alarm system,
 - 2) to the fire alarm routing function to a fire ARC;
 - 3) to the control function for fire protection equipment or systems; and
 - 4) to other systems or equipment, such as a mimic panel.

3.14 critical signal path: components and interconnections between every fire alarm initiation point (manual call point or automatic fire detector) and the input terminals on, or within, each fire alarm device and (where provided) transmission equipment within the premises for routing of signals to an ARC designer person or organization taking responsibility for design considerations.

3.15 Designer: person or organization taking responsibility for design considerations

3.16 detection zone: subdivision of the protected premises such that the occurrence of a fire within It is indicated by a fire detection and fire alarm system separately from an indication of fire in any other subdivision.

NOTE A detection zone usually, consists of an area protected by several manual call points and/or detectors, and is separately indicated to assist in location of the fire, evacuation of the building and firefighting.

3.17 Detector: part of an automatic fire detection and fire alarm system that contains at least one sensor which constantly, or at frequent intervals, monitors at least one suitable physical and/or chemical phenomenon associated with fire, and that provides at least one corresponding signal to the CIE

NOTE The decision to give the alarm of fire or to operate automatic fire protection equipment might be made at the detector or another part of the system, for example at the CIE.

3.18 dual path alarm transmission system: alarm transmission system consisting of one primacy alarm transmission system and one secondary alarm transmission system using diverse technology

3.19 false alarm: fire signal resulting from a cause(s) other than fire

NOTE False alarms can be subdivided into four categories:

- a) unwanted alarms, in which a system has responded, either as designed or as the technology might reasonably be expected to respond, to any of the following:
 - 1) a fire-like phenomenon or environmental influence (e.g. smoke from a nearby bonfire, dust or insects, processes that produce smoke or flame, or environmental effects that can render certain types of detector unstable, such as rapid air flow)
 - 2) accidental damage;
 - 3) inappropriate human action {e .9. operation of a system for test or maintenance purposes without prior warning to building occupants and/or an ARC);

- b) equipment false alarms, in which a false alarm has resulted from a fault in the system;
- c) malicious false alarms, in which a person operates a manual call point or causes a fire detector to initiate a fire signal, whilst knowing that there is no fire;
- d) false alarms with good intent, in which a person operates a manual call point or otherwise initiates a fire signal in the belief that there is a fire, when no fire actually exists.

3.20 fire alarm device: component of a fire detection and fire alarm system, not incorporated in the CIE, which is used to give a warning of fire

NOTE For example, a sounder or visual alarm device.

3.21 fire alarm sounder: audible fire alarm device.

3.22 fire engineering solution: application of science and engineering to the achievement of one or more fire safety objectives in such a way that the objectives are achieved without following, in full, prescriptive recommendations of a recognized code of-practice.

3.23 fire hazard level: likelihood of fire occurring

3.24 fire-resisting construction: construction that is able to satisfy for a stated period of time some or all of the appropriate criteria given in the relevant parts of BS 476 (or equivalent International Standards)

3.25 fire risk: combination of the probability of fire occurring and the magnitude of the consequences of fire.

3.26 fire signal: signal intended to indicate the occurrence of a fire.

3.27 flame detector: automatic fire detector which responds to the radiation emitted by the flames from a fire

3.28 heat detector: automatic fire detector which responds to an increase in temperature.

3.29 installation: work of fixing and interconnecting the components and elements of a system

3.30 installer: person or organization having responsibility for all or part of the process of installation.

3.31 lantern-light: construction standing above the surface of a roof and intended to admit light to the space below.

3.32 line detector: detector which responds to the phenomenon sensed in the vicinity of a continuous line

3.33 low fire risk area or room: area or room containing little or no combustible material and no ignition source in which any foreseeable fire is unlikely to spread such as to present any significant threat to escape by occupants or damage to property.

NOTE Examples of combustible materials are furniture, fittings, storage or linings.

3.34 Maintenance: work of inspection, servicing and repair necessary in, and testing in order to maintain the efficient operation of the installed system.

3.35 manual call point: component of a fire detection and fire alarm system which is used for the manual initiation of an alarm.

3.36 manual system: system containing no automatic detectors and in which an alarm of fire can only be initiated manually.

3.37 maximum alarm load: maximum load imposed on a fire alarm system power supply under fire conditions, comprising the power required for simultaneous operation of all fire alarm devices, fire signals from all automatic fire detectors and manual call points in the building, any power drawn by other systems and equipment in the alarm condition and any power required for transmission of fire signals to an ARC (if a facility for this is provided).

3.38 mimic diagram: topographic representation of the protected premises and their subdivisions, using light-emitting indicators for each subdivision such that the indications of the fire detection and fire alarm system can be rapidly related to the layout of the premises.

3.39 minimum static response temperature minimum temperature at which a heat detector would produce a fire alarm signal if subjected to a very small rate of rise of temperature

3.40 multi-sensor fire detector: fire detector that monitors more than one physical and/or chemical phenomenon associated with fire

3.41 networked system: fire detection and fire alarm system in which several items of CIE are

interconnected and able to exchange information.

3.42 normal supply: supply from which the fire detection and fire alarm system is expected to obtain its power under normal conditions.

NOTE The normal supply is usually derived from the public electricity supply system.

3.43 phased evacuation: system of evacuation in which different parts of the premises are evacuated in a controlled sequence of phases, those parts of the premises expected to be at greatest risk being evacuated first.

NOTE A phased evacuation normally requires at least a two-stage alarm system.

3.44 point detector: detector which responds to a phenomenon sensed in the vicinity of a fixed point

3.45 pre-alarm warning early warning of conditions which might (or might not) represent a fire but indicates an approaching alarm condition.

3.46 premises management: persons having day-to-day control of the premises, the fire detection and fire alarm system(s) and implementation of the fire procedures

NOTE In large premises, a single person with specialist knowledge is often delegated the responsibility for the fire detection and fire alarm system and associated matters. In small premises, a person with specialist knowledge is unlikely to be present, but responsibility for the fire detection and fire alarm system can still be delegated to a specific person.

3.47 Protection: presence of one or more automatic fire detector(s) able to initiate actions needed for the safety of life or property in the event of a fire.

3.48 Purchaser: person or organization taking primary responsibility for acceptance of and payment for the installed system

3.49 radio-linked system: fire detection and fire alarm system in which some or all of the interconnections between components are made by radio links.

3.50 rate of rise heat detector: automatic fire detector which initiates an alarm when the rate of change of the measured phenomenon with time exceeds a certain value, for a sufficient time.

NOTE For each class in BS EN 54-5, there are two subclasses: R and S. So-called rate of rise heat detectors may be taken to correspond to R, and fixed temperature detectors to S.

3.51 repair: non-routine work necessary to restore the efficient operation of the installed system.

3.52 search distance: distance which has to be travelled by a searcher within a zone in order to determine visually the position of a fire.

NOTE The distance is not measured between the point of entry of the zone and the location of the fire, but only between the point of entry and the location at which a person searching for the fire would first become aware of the location of the fire.

3.53 Sector: subdivision of the protected premises normally containing several zones

NOTE A sector can cover more than one building.

3.54 Servicing: routine process of work on the system (including cleaning, realignment, adjustment and replacement) carried out at predetermined intervals

3.55 short circuit isolators: device, which can be connected into a transmission path of a fire detection and fire alarm system, to limit the consequences of low parallel resistance faults between the lines of this transmission path.

NOTE A short circuit isolating device can be a physically separate device or it can be incorporated into another device (e.g. integrated into a smoke detector or detector base).

3.56 Smoke: particulate and aerosol products of combustion generated by a fire, whether this be of the smouldering or open flame type.

NOTE In general, the particle diameters range from 1 nm (invisible smoke) to 10 µm (visible smoke).

3.57 smoke detector: automatic fire detector sensitive to particulate products of combustion and/or pyrolysis suspended in the atmosphere (aerosols)

3.58 soak period: period after a fire detection and fire alarm system has been commissioned, but prior to handover, during which the system's performance in relation to false alarms and faults is monitored.

3.59 staff alarm: restricted alarm, following the operation of a manual call point or automatic fire detector;

given to curtain staff in the premises to permit investigation prior to evacuation and/ or summoning of the fire and rescue service

NOTE The use of staff alarms in response to signals from manual call points is not generally acceptable (see 19.2.2).

3.60 staged fire alarm: arrangement in which two or more stages of alarm can be given within a given area.

NOTE 1 Examples of staged alarm systems are a two-stage system capable of giving "alert" or "evacuate" signals, or a three-stage alarm system capable of giving "staff alarm: "alert" or "evacuate" signals.

NOTE 2 The normal condition, under which no alarm is given, is not counted as a stage of alarm.

NOTE 3 In this standard, in order to avoid confusion:

- a) the term "stage" is used to describe the different stages of alarm in part, or all, of the premises;
- b) the term "phase" is used in describing the sequence of phases of evacuation from different areas of the premises.

NOTE 4 A pre-alarm warning (see 3.45) is not a stage of alarm.

3.61 standby supply: electricity supply, commonly from a rechargeable battery, which is automatically connected to the fire alarm system when the normal supply fails.

3.62 time-related system: system in which the response or sensitivity of automatic fire detectors is changed with the time of day.

3.63 unwanted fire alarm signal UFAS: false alarm from an automatic fire detection and fire alarm system that has been passed on to the fire and rescue service.

3.64 user: person or organization having control of the building (or part of the building) in which the fire detection and fire alarm system is installed.

3.65 visual alarm device: device which generates a flashing light to signal to the occupants of a building that a fire condition exists.

3.66 voice alarm system: sound distribution system that provides means for automatically broadcasting speech messages and warning signals

NOTE Voice alarm system commonly include a facility for transmission of live voice messages, as well as automatically generated messages

3.67 voice sounder: fire alarm sounder that contains the components necessary to generate and broadcast digitally recorded speech messages

3.68 zone plan: diagrammatic representation of a building, showing specific topographic information and the division of the detection zones

4 Need for a fire detection and fire alarm system and type of system

4.1 Commentary

The need for a fire detection and fire alarm system in any specific building is normally determined by the authority responsible for enforcing fire safety legislation in that building and/or by a fire risk assessment carried out by the owner, landlord, occupier(s) or employer(s), as appropriate. In general, it is appropriate to install some form of fire detection and fire alarm system in virtually all buildings, other than very small premises that are relatively open-planned, so that any fire is quickly detected by occupants, who will then be able to warn others by word of mouth or simple mechanical devices such as hand-operated bells or super sounders

Manual fire detection and fire alarm systems are often sufficient to satisfy legislation in workplaces in which no one sleeps. Automatic fire detection is usually required by legislation to supplement the manual system in premises in which people sleep. Automatic fire detection might also be necessary to satisfy legislation under the following circumstances:

- a) where the automatic fire detection forms part of a fire engineering solution;
- b) where fire protection systems, such as door closing facilities or smoke control systems, are to be operated automatically in the event of fire;
- c) where the low level of occupancy of a building, or part of a building, is such as to create the potential for fire to prejudice means of escape by occupants before they are aware of the fire.

Automatic fire detection is also commonly used to protect property by ensuring the early attendance of the fire and rescue service, in response to summoning by occupants of the building or by transmission of fire alarm

signals to an ARC from where the fire and rescue service will be summoned. Automatic fire detection and fire alarm systems might, therefore, be required or recommended by the property insurers.

The early detection of fire by automatic means, and rapid summoning of the fire and rescue service in the event of fire, is also important in premises in which people cannot readily be evacuated immediately. In certain premises of this type (e.g. residential care premises), it is also important to give accurate and unambiguous information to staff regarding the location of a fire. In general, this standard makes no recommendations as to whether systems need to be addressable; it is possible for addressable and non-addressable systems to satisfy the recommendations of Section 2. However, where accurate and unambiguous information about the location of a fire is critical to the safety of life, it is sometimes necessary to use only an addressable system.

4.2 Recommendations

The following recommendations are applicable.

- a) Where there is uncertainty regarding the need for a fire detection and fire alarm system, or the category of system to be used (see Clause 5), the developer, potential purchaser or user should make reference to one or more of the following:
 - 1) SANS 10400 Part T;
 - 2) guidance documents that support fire safety legislation;
 - 3) any authority responsible for enforcing fire safety legislation that applies to the premises;
 - 4) the property insurer;
 - 5) Mandatory fire risk assessment in all commercial building
- b) The purchaser or user should ensure that the fire engineer designer or installing company of fire alarm system is adequately apprised of the objectives of the system and any relevant requirements of enforcing authorities and insurers.

Where occupants of a building are likely to need assistance from staff to evacuate the building (e.g. in residential care premises and hospitals), the fire detection and fire alarm system should be addressable if the building has facilities for more than 10 people to sleep.

5 Categories of system

5.1 Commentary

5.1.1 Introduction

Fire detection and fire alarm systems can be installed in buildings to satisfy one, or both, of two principles objectives, namely protection of life and protection of property. The objectives can differ in time or place. Other possible objectives exist, such as protection against business interruption and protection of the environment; these are likely to be satisfied by the recommendations in this standard for protection of property. Because of the great variety of applications for systems covered by this standard, systems are divided into a number of different Categories, as described in 5.1.2, 5.1.3 and 5.1.4.

5.1.2 Category M systems

Category M systems are manual systems and, therefore, incorporate no automatic fire detectors.

5.1.3 Category L systems

Category L systems are automatic fire detection and fire alarm systems intended for the protection of life. They are further subdivided into:

- a) Category L1: systems installed throughout all areas of the building. The objective of a Category L1 system is to offer the earliest possible warning of fire, so as to achieve the longest available time for escape,
- b) Category L2: systems installed only in defined parts of the building. A Category L2 system ought to include the coverage necessary to satisfy the recommendations of this standard for a Category L3 system; the objective of a Category L2 system is identical to that of a Category L3 system, with the additional objective of affording early warning of fire in specified areas of high fire hazard level and/or high fire risk;
- c) Category L3: systems designed to give a warning of fire at an early enough stage to enable all occupants, other than possibly those in the room of fire origin, to escape safely, before the escape routes are impassable owing to the presence of fire, smoke or toxic gases;

NOTE 1 To achieve the above objective it is normally necessary to install detectors in rooms which open on to an escape route (see 8.2.).

- d) Category L4: systems installed within those parts of the escape routes comprising circulation areas and circulation spaces, such as corridors and stairways. The objective of a Category L4 system is to enhance the safety of occupants by providing warning of smoke within escape routes;

NOTE 2 The installation of detectors in additional areas is not precluded, and the system could then still be regarded as a Category L4 system.

- e) Category L5: systems in which the protected area(s) and/or the location of detectors is designed to satisfy a specific fire safety objective (other than that of a Category L1, L2, L3 or L4 system). Often, the design is based on a localized need for fire detection in only part of a building. Protection might be provided to compensate for some departure from normal guidance elsewhere or as a part of the operating system for a fire protection system. Such a system could be as simple as one that incorporates a single automatic fire detector in one room (in which outbreak of fire would create undue risk to occupants, either in the room or elsewhere in the building), but the system could comprise comprehensive detection throughout large areas of a building in which, for example, structural fire resistance is less than that normally specified for buildings of that type.

NOTE 3 The protection afforded by a Category L5 system might, or might not, incorporate that provided by a Category L2, L3 or L4 system.

5.1.4 Category P systems

Category P systems are automatic fire detection and fire alarm systems intended for the protection of property. They are further subdivided into:

- a) Category P1: systems installed throughout all areas of the building.

The objective of a Category P1 system is to offer the earliest possible warning of fire so as to minimize the time between ignition and the arrival of firefighter;

- b) Category P2: systems installed only in defined parts of the building.

The objective of a Category P2 system is to provide early warning of fire in areas of high fire hazard level, or areas in which the risk to property or business continuity from fire is high.

NOTE The defined parts of the building might be as few as one or more rooms, or as extensive as, for example, complete floors of the building.

5.1.5 Selection of category

Even in buildings with comprehensive fire detection, the provision of manual call points is still normally of great value; people in the vicinity of a fire are normally aware of the fire, and able to raise the alarm by use of a manual call point, before it is detected automatically.

If a system is intended to fulfil the objectives of more than one category of system, then the system needs to conform to the recommendations for each of the categories. For - example, a system whose sole purpose is to provide property protection throughout the building (a Category P1 system) might not need to give an alarm signal of sufficient audibility to rouse all occupants who might sleep in the building. If, however, the system was also installed for the purpose of life safety (a Category L system), sufficient fire alarm sounders to rouse sleeping occupants would be necessary.

This standard does not recommend which category of system needs to be installed in any given premises. The various system categories are to be regarded as a "menu" from which purchasers, users, specifiers, enforcing authorities, insurers or system fire engineer designers or servicing company can select a suitable system for any building. However, Annex A provides information on the Categories of systems that are typically installed in various types of premises.

Because of the wide range of systems covered by the recommendations of this standard, the specification of requirements for a system, by a purchaser, user, enforcing authority or insurer, or the description of a system by a fire engineer designer or servicing company by reference to this standard, without a reference to system category, has little meaning.

The category of system to be installed always needs to be included in the specification. Similarly, the specification of any category of system, other than Category L1, M P1, always needs to include details of those areas of the building that are to be protected.

In some cases, there is little distinction between, for example, a Category P1 system with variations (see Clause 7) and a Category P2 system. In such cases, either description could be used; the designated system

category is to be regarded as a shorthand form of description, rather than a rigid form of prescription. Where a choice exists, however, the description needs to be based on the specified objective of the system.

5.2 Recommendations

The following recommendations are applicable.

- a) Any statutory requirements imposed by enforcing authorities, and any requirements imposed by property insurers, for a fire detection and fire alarm system should clearly state the category of system required.
- b) The purchaser of the system or their agent should inform the fire engineer designer or servicing company as to the category of system that is required (e.g. in purchase or tender specifications).
- c) If the fire engineer designer or servicing company is not informed as to the category of system required, the fire engineer designer or servicing company should make clear, to the purchaser or their agent, the category of system that is proposed, prior to an order for the system being of the situations described in a), b) and c), the description of the system should be further amplified by adequate information on the areas of the building that are to be protected, except in the case of a Category L1 or P1 system, for which such further information might not be necessary.
- d) In each of the situations described in a), b) and c), the description of the system should be further amplified by adequate information on the areas of the building that are to be protected, except in the case of a Category L1 or P1 system, for which such further information might not be necessary.
- e) Category L1, L2, L3 and L4 systems should also satisfy the recommendations of this standard for a Category M system.
- f) Where the recommendations of this standard for a Category M system are to be satisfied in conjunction with the recommendations for a Category P1, P2 or L5 system, the combined system should be described as a Category P1/M, P2/M or L5/M system respectively.
- g) Where the objectives of more than one type of system are to be satisfied, the system should be described as a Category X/Y system (e.g L2/P2 or L3/P2).
- h) The system design certificate (see clause 41) should clearly state the category of system that has been designed and should, except in the case of a Category M, L1 or P1 system, provide a brief description of the areas of the building that are protected by automatic fire detection.

6 Exchange of information and definition of responsibilities

6.1 Commentary

The purpose of a fire detection and fire alarm systems is to support the fire safety strategy for the buildings. It is, in particular, important that fire engineer who designs or servicing company suitably supports the required fire evacuation procedures, rather than those procedures being designed around a predetermined system design. To a large extent, the design of the fire detection and fire alarm system depends on the actions required after the alarm has been given. Particular care is necessary in the case of a system that is capable of giving a two (or more) stage alarm (see Clause 19).

If a building contains alarm systems associated with hazards other than fire, the various hazard alarms need to be properly coordinated and be distinct from each other. In these buildings, the relative priorities need to be carefully assessed, and the system arranged so that a higher priority alarm cannot be prevented or obscured by one of a lower priority. Although, in general, fire has the highest priority, there are buildings in which other hazards can have higher priorities than fire.

The system requirements, including those imposed by the evacuation procedures, the configuration of the building, and the use to which the building is put, need to be ascertained as accurately as possible by consultation between the user or purchaser and other interested parties, such as the enforcing authority or fire insurer.

It is advisable that there also be relevant consultation between the user or purchaser and the fire engineer designer or servicing company. In a small, simple building, the extent to which such consultation is necessary might be minimal; the user or purchaser might have little knowledge of fire safety principles, and system design can involve little more than determination of the appropriate locations of manual call points and fire alarm devices. In complex premises, there is a need for extensive consultation between the user or purchaser, the enforcing authority, the fire engineer designer or installing company and, possibly, specialist consultants.

The design may be undertaken by the supplier, the installing company representatives of the user or purchaser or by any combination of these parties. It is desirable that, at the contract stage, a single organization takes

responsibility for the design of the system, a single organization takes responsibility for the installation work, including compliance with the design, and responsibility for commissioning of the system. The two of these parties may take the form of one single organization. The responsibility for each of these three stages needs to be clearly defined and documented. Experience shows that the responsibility for provision of a zone plan [see 23.2.2(e)] is often ill-defined, leading to the absence of a suitable zone plan when an installation is handed over. It is important that this responsibility is defined at an early stage of the planning of an installation.

It is essential that, at the design stage, avoidance of the potential for false alarms and unwanted fire alarm signals are considered, as well as the effectiveness of the system to give a -warning in the event of fire (see Section 3).

6.2 Recommendations

The following recommendations are applicable.

- a) The user or purchaser of the system should ensure that, to the extent appropriate, there is consultation at, or prior to, the system design stage with all relevant interested parties within the following list:
 - 1) the authority responsible for enforcing fire safety legislation (e.g. the building control authority, fire and rescue authority, local authority. Health and Safety Executive);
 - 2) the property insurer.

NOTE 1 Where any variations from the recommendations of this standard are proposed, they need to be agreed with the relevant interested parties.

NOTE 2 Some of the consultations may be undertaken by parties, such as the fire engineer designer or installing company, acting on behalf of the user or purchasers.

NOTE 3 Even where none of the above is considered to be an interested party, advice is available from enforcing authorities and, in the case of Category P systems, installing company or risk assurer.

- b) The fire engineer designer or installing company of the system should ensure that, to the extent appropriate, there is consultation at the design stage with all relevant interested parties within the following list:
 - 1) the user or purchaser;
 - 2) consultants (including architects, fire engineer, fire servicing companies, fire consultants)
- c) The installing company of the system should ensure that, to the extent appropriate, there is consultation with all relevant interested parties. These might include the following:
 - 1) the fire engineer designer; fire servicing companies, fire consultants
 - 2) the user or purchaser;
 - 3) the supplier of the system;
 - 4) consultants (including architects, fire engineer, fire servicing companies, fire consultants)
- d) Before an order is placed for the system, the responsibility for each of the following stages should be clearly defined and documented:
 - 1) system design;
 - 2) installation,
 - 3) commissioning.

One of these stages should include the provision of a zone plan [see 23.2.2e)].

- e) Where a fire detection and fire alarm system is to be integrated with a voice alarm system, one installing company should take responsibility for the interface connections and all necessary communications between the fire detection and fire alarm system and the voice alarm system.
- f) Where a fire detection and fire alarm system is to be interfaced with another system or facility (such as a fire extinguishing system, smoke control system or lift grounding facility and HVAC) that is the responsibility of an installing organization of the fire detection and fire alarm system, the responsibility of each organization should be clearly defined and documented.

7 Variations from the recommendations of this standard

7.1 Commentary

This standard is code of practice and, as such, its contents take the form of recommendations. The recommendations are primarily based on recognized good practice in the design, installation, commissioning and maintenance of fire detection and fire alarm systems. Accordingly, they are likely to be suitable for the majority of normal applications.

There are, however, applications in which the recommendations are unsuitable and would lead to systems that would be unnecessarily expensive, incorporating measures that could not be regarded as cost-effective, or that could be difficult to install. In extreme cases, the recommendations might even be inadequate to provide the appropriate level of protection.

In these circumstances, variations from the recommendations might be necessary, even though, in general, the user, purchaser, enforcing authority or insurer requires quite strict compliance with the standard.

This does not, however, imply that the fire engineer designer or installing company has freedom to ignore the recommendations of this standard under circumstances in which a user, purchaser, enforcing authority or insurer seeks compliance with it. Variations always need to be the subject of specific agreement amongst all interested parties and need to be clearly identified in all relevant system documentation.

Some variations can arise from a fire risk assessment, in which it is determined, for example, that an area of the building might be unprotected by automatic fire detection, albeit that, in the category of system otherwise deemed necessary, protection is mandatory. Other variations might be based on the engineering judgment of a competent person, who might, for example, consider that the extent of protection disabled in the event of a single cable fault can slightly exceed the limitations recommended in this standard, without any significant decrease in the integrity of the system.

It also needs to be borne in mind that, while it is necessary for certain limitations or performance levels recommended in this standard to be quantified, so that the relevant recommendations are expressed numerically, the values quoted are often arbitrary. The values are often based on well-established and proven custom and practice, or on the judgment of experts. While they are, therefore, generally applicable, rigid adherence to them might not be appropriate in every case, nor is it the case that minor variations need necessarily have any significant effect.

Examples of arbitrary values include, but are not restricted to, the following:

- maximum zone size;
- maximum area of protection disabled in the event of specified fault conditions;
- maximum size of open areas in public buildings above which duplication of sounder circuits is recommended;
- maximum travel distance to the nearest manual call point;
- maximum area of coverage of an automatic fire detector;
- minimum sound pressure levels;
- minimum duration of standby power supplies; and
- performance parameters for standard and enhanced fire-resisting cables, and restrictions on the use of the former type of cable.

Thus, for example, although this standard recommends that no one be required to travel further than 23 m to reach the nearest manual call point.

7.2 Recommendations

The following recommendations are applicable:

- a) Any variations from the recommendations of this standard incorporated within a specification or design proposal should be clearly identified so that they are obvious to any party from whom approval of the specification or design proposal might be sought, such as the user; purchaser; enforcing authority or insurer.
- b) Any variations from the recommendations of this standard identified or proposed during installation or commissioning, but not clearly identified in the documented design, should be documented (other than in the case of errors or "snags" for which rectification is proposed), for subsequent approval.

NOTE This recommendation is not intended to imply that it is the responsibility of the installing company to verify or certificate conformity of the system design with this standard. However, if variations are identified by an installing company particularly variations related to circumstances that might not have been known to the designer (e.g. structural features of the building that affect detector number or siting, or conditions in the building that might result in an unacceptably high rate of false alarms), they ought to be documented for referral to the designer, user or purchaser for agreement or action.

- c) All variations, whether of the type described in a) or b), should be agreed amongst the interested parties (see Clause 6).
- d) All variations should be listed in the relevant system certificate (see Clause 41).
- e) Major non-compliances (see 46.2) that are agreed variations should be clearly recorded in the logbook so that they are readily available for future reference by servicing companies and any other interested parties.

Section 2: Design considerations

8 Relationship between system category and protected areas

8.1 Commentary

8.1.1 General

Before fundamental system design can begin, it is essential that the system category is defined, as this governs the areas in which the manual call points and any automatic fire detectors are to be installed, along with other design parameters. The areas that are to be protected are those which enable the objective of the system to be satisfied (see 5.1).

System category is simply a shorthand means of describing whether the system is manual or automatic, and, in the case of automatic systems, the object of the automatic fire detection and fire alarm system. The appropriate extent of automatic fire detection is normally determined by a fire risk assessment, rather than a rigid application of system category to every building of a specific type or occupancy.

8.1.2 Protection of life

If the objective of the system is to protect the occupants of building in which no one sleeps, and fire is likely to be detected by people before smoke seriously reduces visibility in escape routes, automatic fire detection might not be necessary: a Category M system might suffice. Whether there is a need for automatic fire detection and, if so, the extent to which it needs to be provided is often determined by a fire risk assessment carried out on behalf of the user; such a fire risk assessment is mandatory in this standard (see 4.2 a.)

If there is significant probability that a fire in the building, or part of the building, could threaten escape by occupants before it is detected by people in the building, a Category M system is unlikely to be adequate, and the provision of automatic fire detection will be necessary. This could arise from the likelihood of the presence of occupants at special risk (including sleeping occupants), inadequate structural fire protection or the probability of very rapid-fire development.

In some buildings, a fire risk assessment might determine that unacceptable risk to occupants can be reduced by the installation of fire detectors in all rooms or areas in the building.

If there is a need for a reliable means of warning of the presence of smoke in escape routes, a Category L4 system, in which smoke detectors are installed in escape routes, such as corridors and stairways, might be appropriate. For example, this can arise from the presence of lone workers in a large, generally unoccupied area of a building in which the fire hazard level is assessed to be relatively high.

In buildings in which people sleep within rooms accessed by corridors, other than short lengths of corridor, research has shown that passage of hot fire gases through a door crack can produce smoke sufficiently dense and cool for a corridor to become smoke-logged before adequate warning can be given by detectors in the corridor. In this case, a Category L3 system, in which detectors are installed in rooms that open onto the escape routes, as well as within the escape routes themselves, is likely to be appropriate. The purpose of the detectors in these rooms is to give an early enough warning to occupants, other than, possibly, the person in the room of fire origin, such that they have adequate time to escape before their escape route is impassable as a result of smoke. Accordingly, within the rooms, the use of one or more of the following types of detectors is satisfactory: heat, smoke, combustion gas or multi-sensor detectors.

In some circumstances, even a Category L3 system might not be sufficient to achieve the life safety objective. A fire risk assessment might determine that, in addition to the protection afforded by a Category L3 system, fire detectors need to be installed in rooms or areas that would not be protected in a Category L3 system. The resulting system would then be a Category L2 system. A Category L2 system would be appropriate if a risk assessment determines that the fire risk associated with rooms other than those opening onto escape routes is unacceptable. Alternatively, there might be a need to give enhanced early warning to occupants of certain rooms, such as disabled people, of a fire in their own room. In this case, smoke or combustion gas detectors within the rooms in question are necessary; heat detectors will not respond quickly enough.

The highest possible enhancement of life safety is provided by a Category L1 system. In a Category L1 system, all areas of the building are protected by automatic fire detectors. In rooms or areas in which there is a need for automatic detection of fire in order to protect the occupants of these rooms or areas, smoke or combustion gas detectors need to be provided. In other rooms, heat detectors might be acceptable. An L1 system might be appropriate in buildings in which there is a significant number of occupants at special risk in the event of fire (e.g. hospitals and certain residential care premises), or in which, throughout the building, structural fire precautions are not of as high standard as normally specified for buildings of that type.

A Category M system, in which there is no automatic fire detection and fire alarm system, is only likely to be sufficient if no one sleeps in the building and fire is likely to be detected by people before smoke seriously reduces visibility in the escape routes.

8.1.3 Protection of property

If the objective of the system is property protection, there needs to be sufficient provision of automatic fire detectors to ensure that fire is detected at an early stage, that an effective warning is given in time for firefighters to take action before unacceptable damage to property occurs and that an indication of the location of the fire is given to those responding to the alarm signal. The value of the system depends on a combination of the speed of detection, the delay before firefighters are summoned, the attendance time of trained firefighters, and the probable rate of fire spread. If the attendance time of the fire and rescue service (whether private or local authority) is incompatible with the probable rate of fire spread, adequate property protection might not be achieved purely by automatic fire detection, even if a Category P1 system is installed. The system might, however, form one component of a "package" of fire protection measures, such as compartmentation (to limit the extent of fire spread prior to the arrival of the fire and rescue service) or an automatic fire suppression system (to control or extinguish the fire prior to the arrival of the fire and rescue service).

The highest standard of property protection is provided by a Category P1 system. In a Category P1 system, automatic fire detectors are installed in all areas of the building. This category of system might be appropriate if the system is intended to satisfy the requirements of fire insurers, if the building or its contents are of high value, or if the facilities provided within the building are critical to the operations of an organization.

A lower, but often adequate, standard of property protection is provided by a Category P2 system. In a Category P2 system, automatic fire detectors are provided only in specified rooms or areas of the building. The protected areas are usually those in which the fire hazard level is high, or from which there is significant potential for fire to spread and cause damage to contents of high value. Since the determination of these factors depends on a fire risk assessment, it is important that whoever specifies a Category P2 system qualifies this description with details of the rooms or areas that are to be protected.

8.2 Recommendations

The following recommendations are applicable:

- a) System documentation, including any purchase specification, tender document design proposal, submission to enforcing authorities or insurers for approval and the certificate issued by the designers (see Clause 41), should clearly identify the system category as well as, where appropriate, the areas to be protected and any specific proposals for the type(s) of detector to be used.
- b) Any specification or proposal for a Category L5 system should clearly identify the rooms or areas that are to be protected by automatic fire detectors.

NOTE 1 There might also be benefit in giving a simple description of the objective of the protection proposed, particularly in submissions to enforcing authorities.

NOTE 2 The standard of protection (extent of coverage) of a Category L5 system might be lower or higher than that afforded by Category L2, L3 or L4 systems.

- c) In Category L3 and L4 systems, smoke detectors, multi-sensor detectors conforming to the fire sensitivity requirements of BS EN 54-7 or a mixture of smoke and combustion gas detectors, should be provided in the following:
 - 1) all escape stairways;
 - 2) all corridors; and
 - 3) any other areas that form part of the common escape routes.

NOTE 3 Main access and egress stairways normally form part of escape routes, and ought to be treated as escape stairways.

- d) In Category L3 systems, heat, smoke, combustion gas or multi-sensor detectors should be installed in all rooms that open onto the escape routes described in c), except that rooms opening onto corridors of less than 4 m in length need not be protected, provided fire resisting construction including, doors, separates these corridors from any other section of the escape routes.

NOTE 4 For recommendations on the siting of these detectors, see 22.3e).

NOTE 5 An open-plan area of accommodation, in which occupants quickly become aware of fire, need not be protected in a Category L3 or L4 system, even though occupants within the area clearly need to pass through the area in the first stage of escape, unless it forms part of the escape route from other areas. However, in a Category

L3 system a heat, smoke, combustion gas detector or multi-sensor detector ought to be installed on the accommodation side of any door that opens into an escape stairway, a corridor of more than 4 m in length or, alternatively, where stairways are approached through low fire risk lobbies, any door that opens onto the lobby.

- e) In a Category L2 system, the rooms or areas protected should conform to the recommendations in c) and d) for a Category L3 system, but, in addition, automatic fire detectors should be installed in rooms in which the fire risk (see 3.25) is high enough to warrant individual protection.

NOTE 6 Any reference to a Category L2 system (e.g. in a specification, proposal or submission to an enforcing authority needs to clearly identify the rooms or areas in which these additional detectors are to be installed and identify the type of detector (e.g. heat, smoke or combustion gas) required.

NOTE 7 The first step in designing a Category L2 system is to design a Category L3 system. Thereafter a decision is taken as to which unprotected rooms or spaces warrant further detection, or the detector type or siting needs to be modified.

- f) In a Category L1 or P1 system, automatic fire detectors should be installed in all rooms and areas of the building, but the following rooms or areas need not be protected if they are of low fire risk (see 3.33):

1) toilets, shower rooms and bathrooms;

NOTE 8 In some public buildings, such as hospitals and shopping centres, toilets might not be of low fire risk, owing to the potential for malicious ignition.

2) stairway lobbies and toilet lobbies;

3) small cupboards (typically, less than 1 m²); and

NOTE 9 A riser in which there is a fire-resisting floor and ceiling may be treated as a cupboard.

NOTE 10 If detection can be excluded from any room or area in a Category L1 system, it can also be excluded from such rooms or areas in a Category L2, L3 or L4 system.

4) some shallow voids (less than 800 mm in depth) [see 22.2d)].

- g) In a Category L1 system, the detectors within escape routes should be smoke detectors, multi-sensor detectors conforming to the fire sensitivity requirements of BS EN 54-7 or a mixture of smoke and combustion gas detectors.

NOTE 11 Some smoke and multi-sensor detectors can be programmed such that they would not then meet the fire sensitivity tests of BS EN 54-7; in that operating mode, the detectors would not satisfy the recommendations of 8.2c) and g).

- h) In a Category P2 system, the rooms or areas to be protected by automatic fire detectors should be clearly identified in the specification or proposal. There should be physical barriers between protected and unprotected areas to limit the spread of smoke and hot gases in, at least, the early stages of fire.

NOTE 12 It is not necessarily the case that these physical barriers have a recognized period of fire resistance.

NOTE 13 The physical barriers described in h) might be unnecessary where detectors are installed to detect fires in specific equipment.

9 Actuation of other fire protection systems or safety facilities

9.1 Commentary

Any of the system categories defined in 5.1 may be used to actuate other fire protection systems or trigger safety facilities, whether for the purpose of life safety, property protection or a combination of the two.

If the system is to be used for the actuation of other fire protection systems or safety facilities, the, recommendations of this standard might, or might not, be necessary or sufficient. The system might have special requirements in respect of the number, zoning and siting of detectors, provision of power supplies, control, indication or other facilities, or monitoring and fire resistance of interconnecting wiring.

It needs to be ensured that the interconnection of other systems or equipment with the fire detection and fire alarm system does not prejudice the reliability of the fire detection and fire alarm system.

9.2 Recommendations

The following recommendations are applicable in the case of systems intended to actuate other fire protection systems or safety facilities (e.g. by triggering an automatic fire extinguishing system, closing fire-resisting doors, shutting down an air handling system or grounding lifts).

- a) The system should conform to the recommendations of any applicable part of BS 7273.

- b) if no part of BS 7273 is applicable, any special requirements for system design should be identified in the purchase specification or design proposals.
- c) if operation of the fire detection and fire alarm system during routine testing would have an undesirable effect on other systems or equipment, means should be provided for disabling the automatic actuation of the system or equipment. The facility for disablement, and the indication of disablement, should conform to BS EN 54-2.
- d) The other equipment or systems should not draw power from the fire detection and fire alarm system in the non-fire state, other than for indicators and interface devices (e.g. relays). The power consumption of any such indicators and interface devices should be taken into account in the calculation of battery capacity (see 25.4).

10 Systems In explosive gas or dust atmospheres

10.1 Commentary

If it is necessary to install fire alarm equipment or wiring in areas where an explosive atmosphere could result from the presence of flammable gases, vapours or mists, or the presence of combustible dusts, special protection measures are essential to ensure that the potential/or ignition of the atmosphere by the fire alarm equipment or wiring is minimized.

10.2 Recommendations

The following recommendations are applicable.

- a) Any system (or part of a system) protecting an area, or with cables passing through an area, in which there might be an explosive gas, vapour or mist atmosphere should conform to BS EN 60079-14.
- b) Any system (or part of a system) protecting an area, or with cables passing through an area, in which there might be an explosive dust atmosphere should conform to BS EN 60079-14 and BS EN 60079-17.

11 System components

11.1 Commentary

The reliability of the system to perform its functions on demand is, to a significant degree, governed by the reliability of individual components. Components, such as manual call points, detectors, CIE and fire alarm devices, are required to conform to relevant standards, and need to have undergone type testing to these standards. It is advisable to use components having certification under a recognized product certification scheme [comprising third-party certification of product conformity against a relevant standard, based on testing and continuing surveillance, together with assessment of the manufacturer's quality assurance systems against BOS ISO 9001).

Where there is no relevant Botswana or international Standard, it is advisable that care is taken to ensure, as far as possible, that the components are fit for their purpose. Third-party approval against an appropriate test standard can provide assurance of this.

Conformity of an individual component to a recognized standard does not necessarily ensure that it will operate satisfactorily in conjunction with another component that conforms to the relevant standard for that component. It is essential that compatibility between components is taken into account by the designer of the system. BS EN 54-13 can be used to confirm system compatibility.

11.2 Recommendations

The following recommendations are applicable.

- a) Manual call points should conform to the requirements of BS EN 54-11 for Type A ("single action") manual call points.
NOTE 1 This standard recommends that a protective cover is fitted to a type A manual call point, see 20.2b).
- b) Point heat detectors should conform to the requirements of BS EN 54-5 for Class A1 or A2 detectors, unless the foreseeable maximum ambient temperature in the protected area is 40 °C or above, in which case a Class B-G detector should be used as appropriate (see section 3 of this standard).
- c) Point smoke detectors should conform to BS EN 54-7.
- d) Flame detectors should conform to BS EN 54-10.

- e) Optical beam smoke detectors should conform to BS EN 54-12.
- f) Aspirating smoke detectors should conform to BS EN 54-20.
- g) Components and systems using radio links should conform to BS EN 54-25.
- h) Multi-sensor, optical and heat detectors should conform to either:
 - 1) ISO 7240-15;
 - 2) BS EN 54-29; or
 - 3) BS EN 54-5 and BS EN 54-7.
- i) Multi-sensor, carbon monoxide and heat detectors should conform to ISO 7240-8 or BS EN 54-30.
- j) Multi-sensor detectors combining smoke, carbon dioxide and heat sensors should conform to BS EN 54-31.
- k) If there is a facility in a multi-sensor detector to disable sensors leaving a single active sensor, the multi-sensor detector should also meet the performance requirements of the appropriate part of BS EN 54 relevant to that single active sensor.
- l) Carbon monoxide fire detectors should conform to BS EN 54-26.
- m) CIE should conform to BS EN 54-2.

NOTE 2 BS EN 54-2 contains optional performance characteristics which are not necessarily provided in all CIE, even if third-party certificated against BS EN 54-2. It needs to be ensured that the CIE provided has appropriate facilities to enable conformity to all the recommendations of this Botswana Standard and the project specification.

- n) Audible fire alarm devices should conform to BS EN 54-3.
- o) Visual alarm devices should conform to BS EN 54-23.

NOTE 3 Wireless audible and visual alarm devices are outside the scope of BS EN 54-3 and BS EN 54-23 respectively, but this does not preclude their use in a system that conforms to this standard, provided the devices satisfy the relevant performance requirements of these standards.

- p) Power supply equipment should conform to BS EN 54-4.
- q) Cables should conform to the recommendations of Clause 26.
- r) Those functions of the system that are recommended in this standard, for which the storage of programs and data are necessary to control the fire detection and fire alarm system, should conform to the additional design requirements for software-controlled CIE in BS EN 54-2.
- s) Where a PC or similar IT equipment is used as a user interface, e.g. in networked systems, it should be considered as a supplementary interface and there should be CIE conforming to BS EN 54-2 mounted nearby, as it is unlikely that a PC would conform to BS EN 54-2.
- t) Radiopaging transmitters and receiver s should conform to the relevant Botswana or harmonized European Standards applicable.
- u) Alarm transmission and fault warning routing equipment should conform to the product requirements (but not the installation requirements) specified in BS EN 54-21.

NOTE 4 Some elements of a) to r) may be combined to form a single device

12 Monitoring, integrity and reliability of circuits external to control equipment

12.1 Commentary

External circuits need to be arranged such that the probability of faults that could prevent the system from giving a fire warning is minimized. However, such faults occur occasionally. Work on the system, for the purpose of modification, repair or routine attention, can also cause an impairment of the system to operate as designed in the event of fire.

Measures are incorporated within this standard to limit the probability of impairments, whether as a result of faults or work on the system, and to limit the duration of any impairment. The wiring of all critical signal paths is protected against mechanical damage and damage by fire. Critical signal paths are monitored, so that faults are identified quickly. Compliance to maintenance these systems shall ensures that any such fault is quickly repaired. The probability that a fault would exist at the time of a fire is, therefore, considered to be extremely

low. In the event of fire, fire damage to wiring during the period required for evacuation is unlikely to occur in view of the recommendations of this standard for the fire resistance of cables.

As a result of the above considerations, duplication of, or redundancy in, external circuits is not normally necessary. However, in the case of circuits serving fire alarm devices, special measures need to be taken to ensure that, during, or following, evacuation, damage to any wiring, with resultant loss of the evacuation signal, does not imply to occupants of the building that it is safe to remain in, or reoccupy, the building.

This can be achieved by ensuring that, in the event of a short circuit developing on any fire alarm device circuit during a fire (e.g. at a cable termination), a minimum of one audible fire alarm device continues to sound as a reminder that the system has not been silenced or reset. Normally, this sounder is located close to the CIE as this equipment is sited in a suitable area (e.g. a reception area, security control room or main entrance foyer) at which the reminder needs to be given.

Note that duplication of sounder circuits throughout a building is not generally necessary and can even fail to achieve the objective outlined above. In this case, if fire damages one circuit, it is also likely to damage any other circuit in the same area. However, in a large building with multiple sounder circuits, each serving a different area of the building, the above objective is satisfied. In a smaller building, which could be served by a single sounder circuit, additional measures are necessary to ensure that, if this single circuit fails during a fire, at least one sounder (e.g. on a second circuit) continues to operate.

However, in buildings designed to accommodate the general public in large numbers, typically within a single space, the threat to life in the event of a fire might be such that additional fire alarm device circuits, over and above those described above, is justified; this then addresses the remote possibility of failure or impairment of a single circuit serving a large public space at the time of a fire. Frequently, such buildings are served by a voice alarm system. In the case of such systems, BS 5839-8 recommends additional loudspeaker circuits in large, uncomparted public spaces of public buildings such as transport terminals, shopping malls, places of entertainment, large department stores and leisure centres. The size of the uncomparted public space above which additional loudspeaker circuits are recommended by BS 5839-8 is entirely arbitrary but, for consistency, if such a large public space is protected by audible fire alarm devices, duplicated and evenly distributed fire alarm device circuits need to be installed within the space. Such duplication is, however, not necessary in other parts of the building.

System design needs to be arranged to limit the extent of impairments, whether as a result of faults or work on the system. A fault but not fire signal needs to be given at the CIE in the event of any failure in the critical signal path (see 3.14).

Care needs to be taken in the use of multicore cable for the wiring of more than one circuit. It needs to be assumed that any fault that affects a multi core cable affects all conductors of the cable; this precludes the use of multicore cable for certain applications in which the failure of more than one circuit as a result of a single fault is precluded by the recommendations of this standard.

12.2 Recommendations

12.2.1 Fault monitoring

The following recommendations are applicable.

- a) A fault indication should be given at the CIE within 100 s of the occurrence of any of the following conditions:
 - 1) short circuit or open circuit in any circuits servicing manual call points or fire detectors;
 - 2) the removal of a manual call point or a fire detector that is designed to be detachable;
 - 3) short circuit or open circuit of any circuits serving fire alarm devices;
 - 4) short circuit or open circuit of any wiring between any power supply that is in a separate enclosure and the equipment to which it supplies power;
 - 5) any earth fault that is capable of preventing the system from performing in accordance with the recommendations of this standard
 - 6) the rupture of any fuse, or the operation of any other protective device, that affects the ability of the system to perform as recommended in this standard;
 - 7) a short circuit or open circuit in the wiring between separate control and/or indicating equipment that is provided in order to satisfy the recommendations of this standard
 - 8) a short circuit or open circuit in the wiring between main and any repeat control and/or indicating equipment (such as a mimic diagram) that is provided in order to satisfy the recommendations of

this standard

- 9) a short circuit or open circuit in the wiring between control equipment and any separate enclosure of equipment used for transmission of alarm signals to an ARC [see 15.2l);
- 10) removal from its circuit of a fire alarm device that is designed to be detachable.
- b) A fault indication should be given, within the times indicated below, in the event of any of the following:
 - 1) failure of the main power supply to any part of the system (within 30 min of occurrence);
 - 2) failure of the standby power supply (within 15 min of occurrence);
 - 3) failure of the battery charger (within 30 min of occurrence);
 - 4) reduction of the battery voltage to less than the voltage specified in BS EN 54-4 at which a fault warning should be given (within 30 min of occurrence).

- c) Visual indications of the faults identified in a)3) and a)9) should continue to be given at the CIE during a fire alarm condition. Other fault indications may be suppressed during the fire alarm condition.

NOTE The recommendations of a), b) and c) can be satisfied by the use of CIE and power supply equipment conforming to BS EN 54-2 and BS EN 54-4, respectively, provided the system installation complies with the recommendations of the manufacturer, on which conformity with BS EN 54-2 and BS EN 54-4 might be reliant,

- d) Where any standby power supply comprises a number of batteries connected in parallel, a fault indication should be given in the event of disconnection of any one battery (within 15 min of occurrence).
- e) If the system incorporates a separate voice alarm system or fire warning system for people who are Deaf and hard of hearing. any short circuit or disconnection of the communicating link between the fire detection and fire alarm system and the other system, should be indicated at the fire detection and fire alarm system CIE within 100 s.
- f) If the system is used to actuate other fire protection systems or safety facilities (see reference should be made to BS 7273 (all parts) or other applicable codes of practice for recommendations on monitoring connections between the fire detection and fire alarm system and the other systems or equipment.
- g) Where tactile fire alarm devices provided for people who are Deaf and hard of hearing are installed, the system should conform to Annex C and indicate the failure to receive a monitoring signal correctly [see 18.2.lb)].

12.2.2 System integrity

The following recommendations are applicable.

- a) A fault on one circuit containing manual call points, fire detectors or fire alarm devices, or a combination of them, should not affect any other circuit.
- b) A single short circuit or open circuit fault on an automatic fire detector circuit should neither disable protection within an area of more than 2 000 m², nor on more than one floor of the building plus a maximum of five devices (automatic detection, manual call points, sounders or a combination of these) on the floor immediately above and five devices on the floor immediately below that floor.
- c) Two simultaneous faults on a manual call point or fire detector circuit should not disable protection within an area greater than 10 000 m²

NOTE 1 The areas quoted in b) and c) are relatively arbitrary; in the case of b), the recommendation is based on custom and practice in non-addressable fire detection and fire alarm systems over many years. Engineering judgement might determine that, in a given system, minor increases in the areas quoted do not significantly impede the system integrity, but this ought then to be regarded as a variation from the recommendations of this standard.

- d) For software-controlled CIE that has more than 512 detectors and/or manual call points connected, reference should be made to the manufacturer's instructions regarding the means by which conformity with BS EN 54-2 is to be achieved.
- e) Where detectors are designed to be detachable from their bases for the purpose of routine maintenance of the system:
 - 1) removal of any detector(s) from the circuit should not affect the operation of any manual call point regardless of whether locking devices are used to secure the detectors within their bases;

NOTE 2 This recommendation applies even if all fire detectors in the system are removed from circuit.

- 2) during the design stage, the possibility of malicious removal of detectors should be taken into account. If malicious removal is considered likely, detectors of a type that can be removed only by the use of a special tool or special technique should be used.

NOTE 3 A special tool in this context is a tool not likely to be carried by a member of the general public. Slot-headed screws would not be acceptable, since various articles can be used as screwdrivers.

- f) Any facility specifically provided for deliberate disablement of manual call point or detector circuits should be such that it is possible to disable protection throughout one zone of the system without disabling protection in other zones. Use of such facilities should not prevent evacuation of the building by use of an evacuate control on, or close to, the CIE.
- g) Removal of any manual call point or detector from its circuit should not affect the ability of any fire alarm device to respond to an alarm signal other than in the case of fire alarm devices and detectors that are combined at a single fixing position.
- h) Fire alarm devices should be capable of being removed only by the use of a special tool.
- i) In the event of a single open circuit or short circuit fault on any circuit that serves fire alarm sounders, at least one single fire alarm sounder, normally located in the vicinity of the CIE, should still sound correctly if a fire alarm condition occurs anywhere within the building. This fire alarm sounder should have an identical sound to the general fire alarm sounders in the building [see also 15.2c)].

NOTE 4 It is possible to comply with this recommendation by at least the following two arrangements although are not precluded:

- wiring all fire alarm sounders within the building on a single sounder circuit, with the additional provision of a second, independent sounder circuit, to which only a single sounder, located in the vicinity of the CIE is connected (see Figure 1a)];
- wiring all fire alarm sounders on a ring circuit capable of transmitting signals in either direction; the first (or last) three devices on the circuit would then comprise a short circuit isolator, capable of isolating the circuit in the event of detection of a short circuit, a sounder and a further short circuit isolator (see Figure 2 b)).

NOTE 5 The sounder that continues to operate normally comprises one of the general alarm sounders in the area in which the CIE is housed. In a building without phased evacuation, the alarm sounder gives an "Evacuate" signal until silenced. In a building with multiphase evacuation, the sounder may give an "Evacuate" signal or "Alert" signal until silenced, according to the location(s) from which the fire alarm signal originates and the phase of the evacuation at the time in question.

- j) In buildings designed to accommodate the general public in large numbers (e.g. transport terminals, shopping centres, places of public entertainment, department stores and leisure centres), at least two sounder circuits should be provided in every uncompartmented public space if the space is either:
 - 1) greater than 4 000 m² in area; or
 - 2) is designed to accommodate more than 500 members of the public.

This should be achieved either:

- i) by means of at least two sounder circuits, which are evenly distributed and interleaved such that adjacent sounders are on different circuits; or
- ii) by means (e.g. a protected loop circuit) such that not more than 50% of sounders in that area are lost in the event of a single open or short circuit fault.

NOTE 6 The figures of 4 000 m² and 500 members of the public are arbitrary, but are the criteria for duplication of loudspeaker circuits of voice alarm systems conforming to BS 5839-8. Engineering judgement might determine that, in a given system, a single sounder circuit can be used to protect a public space that slightly exceeds these criteria without undue increase in risk to occupants. This would then be regarded as a variation from the recommendations of this standard.

NOTE 7 It is not intended that this recommendation would be applied to small cellular spaces or non-public areas of the buildings in question,

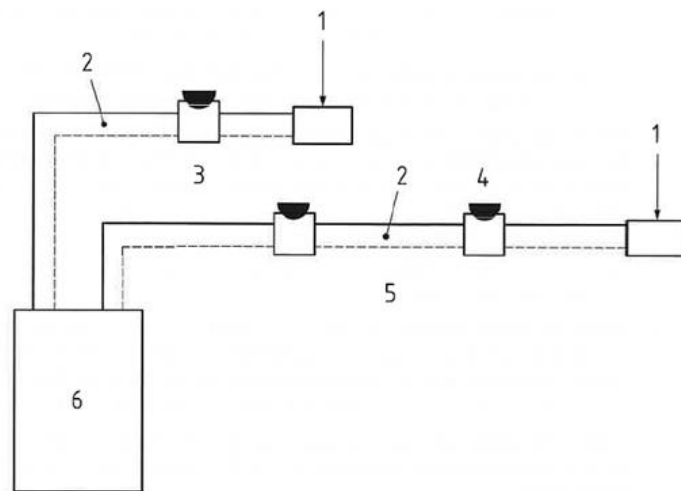
- k) Where two (or more) sounder circuits are necessary in order to satisfy the recommendations of i) or j), the circuits should not be contained within a common cable sheath. For example, two circuits intended to satisfy these recommendations should not be served by a common four core cable, as this would not adequately protect against the simultaneous loss of both circuits.

NOTE 8 This recommendation does not apply to those sounder circuits that need not be independent to satisfy the recommendations of this standard (e.g. that are provided purely as a result of electrical engineering considerations).

- l) If the CIE is supplied with power from power supply: equipment contained in a separate enclosure, the cables between the equipment should be duplicated such that a single open or short circuit in the connections does not completely remove power from the CIE. The duplicate cables should be separated by at least 300 mm where practical.

Where a power supply unit or a standby battery(ies) is housed in a separate enclosure from the CIE, any cable between that enclosure and the CIE should be suitably protected against overcurrent in accordance with BS 7671.

NOTE 9 Where the enclosure is located immediately adjacent to, and in contact with, the CIE, such that cables run directly between the enclosure and the CIE, the enclosure need not be regarded as separate from the CIE; the recommendations of 12.2.2l) do not then apply.

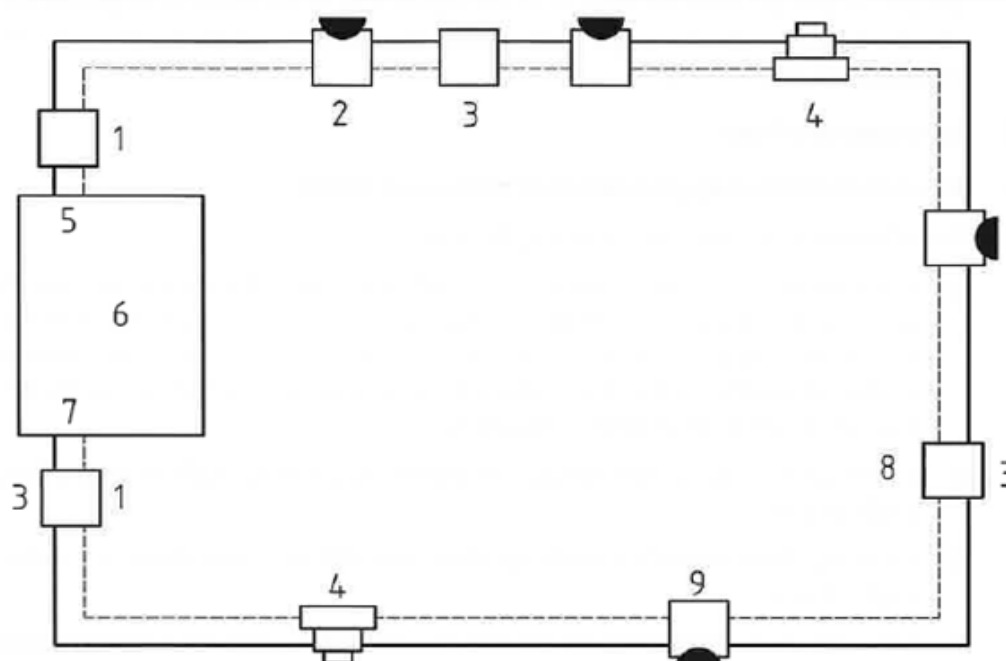


a) Radial sounder circuits [see 12.2.2j)]

Key

- | | |
|---|--|
| 1 End of line device | 4 Sounder |
| 2 Sounder circuit one | 5 Sounders serving the remainder of the building |
| 3 Normally located in the vicinity of the control panel | 6 Control and indicating equipment |

Figure 1a — Radial Sounder Circuit



b) Ring sounder circuits (e.g. addressable loops [see 12.2.2j]))

Key

- | | |
|--|--|
| 1 Short circuit isolator may be in control equipment | 6 Control and indicating equipment |
| 2 Sounder close to control equipment and protected on both sides with a short circuit isolator | 7 Loop in |
| 3 Short circuit isolator | 8 Additional short circuit isolator as necessary to satisfy 12.2.2c) |
| 4 Detector | 9 Sounder |
| 5 Loop out | |

NOTE to 1b) Short circuit isolators may be incorporated within each device.

Figure 1b — Ring Sounder Circuit

13 Detection zones

13.1 Commentary

In order to direct those responding to a fire alarm signal particularly the fire and rescue service, to the area of a fire, all buildings, other than very small buildings, need to be divided into detection zones (see 3.16). Detection zones need to be small enough for a fire to be located quickly.

Even if the system is addressable (see 3.1), detection zone indication needs to be provided, as this often provides a quicker, albeit less specific, indication of the location of a fire than typical addressable text displays. Zone indicators also provide a simple "at a glance" overview of the extent of fire or smoke spread.

If the alarm is raised by a manual call point, as opposed to an automatic detector, detection zone indication might be misleading; on discovery of a fire a person might operate a manual call point that is a considerable distance from the fire. The benefits of zoning in a Category M system are, therefore, less significant.

If a detector is concealed in a relatively inaccessible area (such as a floor or ceiling void), it is normally desirable to provide a remote indication of its operation. In an addressable system, the provision of an individual remote indicator might not be necessary provided that the location of each fire detector is clearly indicated at the CIE.

13.2 Recommendations

13.2.1 Recommendations applicable to all detection zones

The following recommendations are applicable.

- a) If manual call points are located on the landings of an enclosed stairway [see 20.2d), the manual call point on each level, other than a final exit level from the stairway, should be incorporated within the zone that serves the adjacent accommodation on that level. A manual call point located within the stairwell at a final exit to open air may be incorporated within the detection zone serving the stairwell [see 13.2.3c)].
- b) If the total floor area of the building is greater than 300 m² each zone should be restricted to a single storey.
- c) If the total floor area of the building is less than 300 m² a zone may cover more than a single storey.
- d) For voids above or below the floor area of a room, these may be included within the same zone of the room, provided that the voids and the room constitute a single fire compartment.

13.2.2 Additional recommendations applicable to detection zones that contain only manual call points

The floor area of a single zone should not exceed 2 000 m² other than in the case of a zone comprising mainly a single, open-plan area (e.g. an compartmented warehouse), which should not exceed 10 000 m² in area.

13.2.3 Additional recommendations applicable to detection zones that contain non-addressable automatic fire detectors

The following recommendations are applicable:

- a) The floor area of a single zone should not exceed 2 000 m²
- b) The search distance (see 3.5.2.) should not exceed 60 m.

NOTE 1 Having entered the zone, the person responding to the alarm signal need not reach the seat of the fire within the recommended search distance; it is only necessary to become aware of the location of the fire.

NOTE 2 In measuring search distance, the worst case, in which the fire is located at the furthest concealed area from any likely point of entry to the zone, ought to be considered (see Figure 2).

- c) Automatic fire detectors within any enclosed stairwell, lift well or other enclosed flue-like structure should be considered as a separate detection zone. Manual call points located at final exits to open air from stairwells may be incorporated within these detection zones [but may, alternatively, be incorporated within the detection zone described in 13.2.1a)].

13.2.4 Additional recommendations applicable to detection zones containing addressable automatic fire detectors

The following recommendations are applicable.

- a) Zone indication should be given at the CIE even if addressable text information is also available
- b) The recommendations of 13.2.3. apply, except that 13.2.3b) does not apply if:
 1. clear addressable text display of the location of, at least, the first detector to respond to a fire is available at the CIE, without manual intervention; and
 2. the display, if necessary in conjunction with other information on, or adjacent to, the CIE, would enable firefighters, unfamiliar with the building, to proceed to the location of the fire.

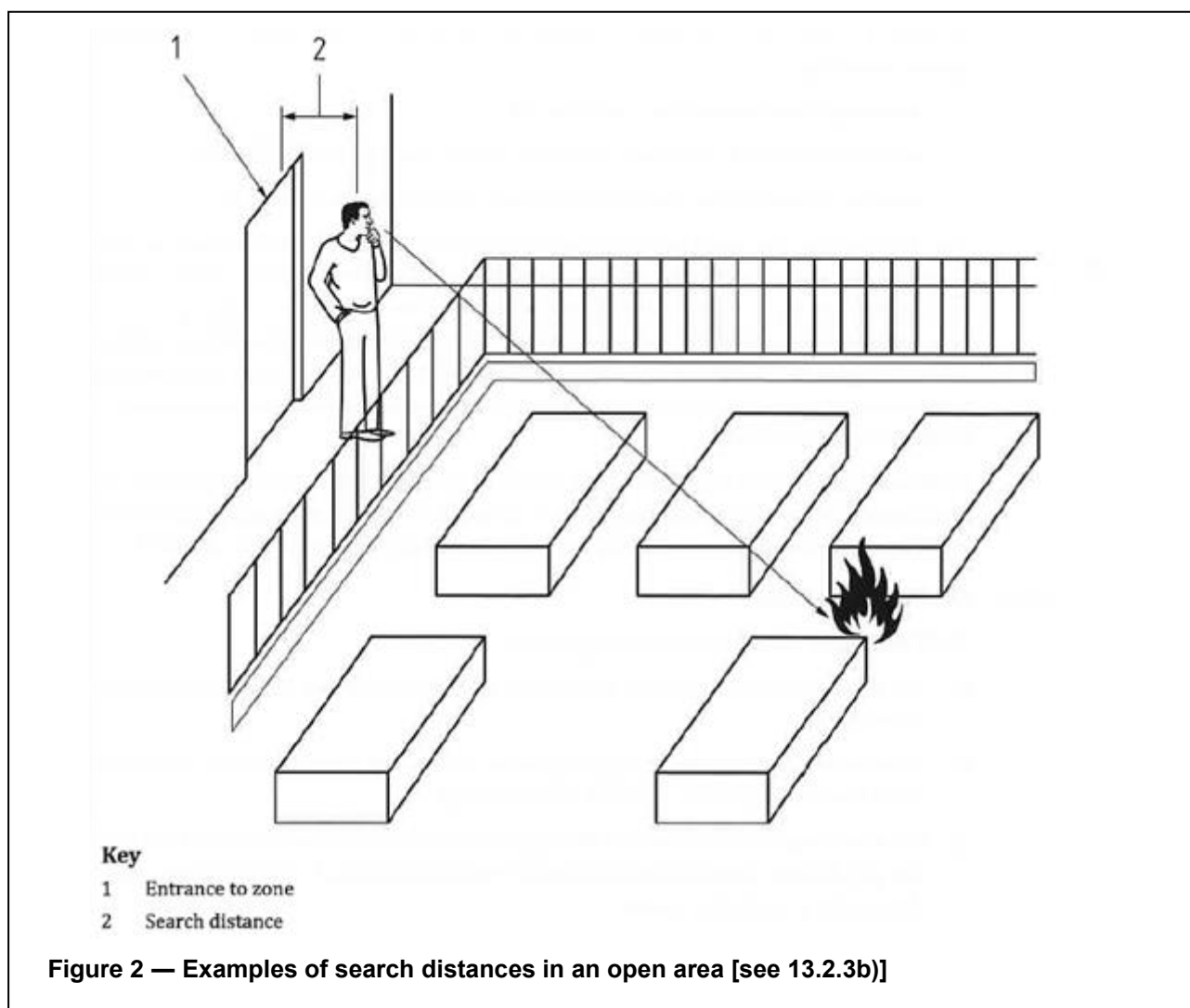
NOTE For example, the CIE might provide a text indication of room number, and a plan adjacent to the CIE might show the location of the room.

13.2.5 Remote indication of detector operation

Any remote indicators should be clearly labelled to indicate their function. They should be sited and/ or labelled in such a way as to assist in determining the location of the detector that they serve.

Any cable between a detector and a remote indicator required for conformity to this standard should conform to, and be installed in accordance with, the recommendations of 26.2

NOTE Remote indicators might be required in a specification for areas such as inaccessible voids or locked rooms. See also 40.2. for the as-fitted drawing.



14 Alarm zones

14.1 Commentary

In many buildings, the evacuation strategy is very simple; on operation of any manual call point, or detection of fire by an automatic fire detector, fire alarm sounders operate throughout the building to indicate the need for evacuation of the entire building.

In larger, more complex buildings, the "Evacuate" signal might, in the first instance, be restricted in extent (e.g. to a single floor, a limited number of floors or a limited area of the building). In other areas, an "Alert" signal might be given to warn occupants of the alarm signal, without any requirement for those occupants to evacuate.

In order to support such arrangements, it is necessary for the building to be divided into a number of individual alarm zones, such that the operating state of fire alarm sounders in any alarm zone is independent of the operating state of fire alarm sounders in all other alarm zones. The fire alarm sounders in the building are thus grouped, so that, at any point in time, all alarm sounders within any given alarm zone are in the same state (i.e. silent, giving an "Alert" signal or giving an "Evacuate" signal).

The need for subdivision of a building into discrete alarm zones might arise for a number of reasons, including:

- the use of phased evacuation (see Clause 19);
- to avoid unnecessary disruption when false alarms occur (see Section 3); and
- any other circumstances in which a two-stage alarm arrangement applies,

Since it is the case that, when occupants of one alarm zone are required to evacuate, occupants of one or more alarm zones above, below or adjacent to that zone will be expected to remain in the building, every alarm zone needs to be separated from all other alarm zones by fire-resisting construction. (In some complex public

buildings, such as shopping centres, alarm zones are designed to coincide with smoke control zones, which are separated from each other by smoke curtains, rather than fire-resisting construction. However, in this case, the audible signal is normally given by a voice message, rather than audible fire alarm devices.)

As the subdivision of a building into alarm zones implies that, in the early stages of a fire, occupants in certain areas will not be expected to evacuate, the configuration of alarm zones might require approval by the authority responsible for the enforcement of fire safety legislation in the building

14.2 Recommendations

The following recommendations are applicable.

- a) The boundaries of every alarm zone (other than external walls) should comprise fire-resisting construction.
- b) The extent of any overlap of signals between alarm zones should not be sufficient to result in confusion of occupants in any area of the building.
- c) A common signal should be used throughout all alarm zones to convey the need for evacuation, and a (different) common signal should be used throughout all alarm zones for any alert signal that can be given by the system.
- d) While an alarm zone may incorporate more than one detection zone (but not vice versa), the boundaries of alarm zones should coincide with the boundaries of the relevant detection zones (see Figure 3).
- e) The user or purchaser should ensure that, where appropriate, the configuration of alarm zones is approved by the relevant enforcing authority or authorities.

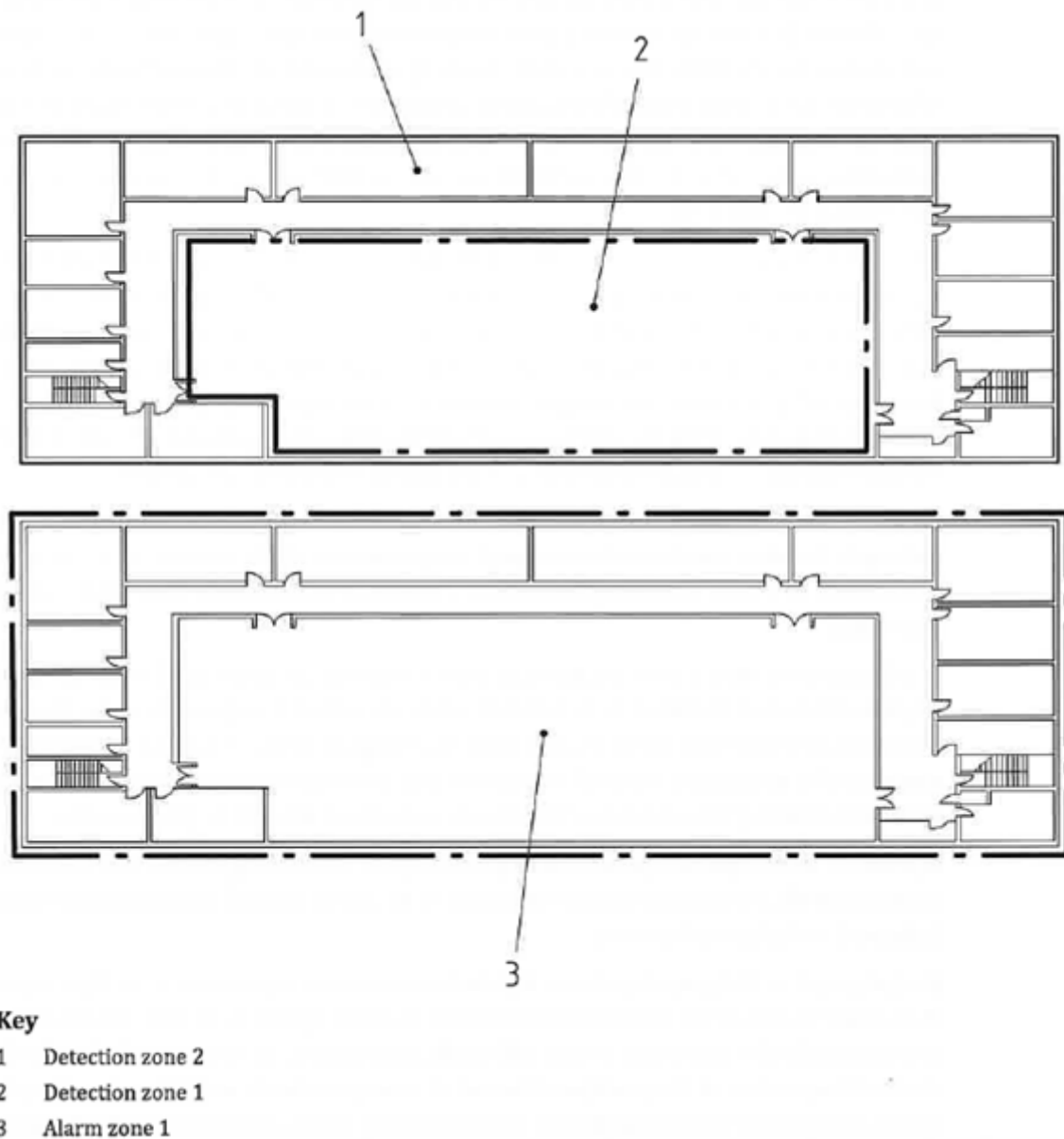


Figure 3—All Zones [see 14.2d]

15 Communication with the fire and rescue service

15.1 Commentary

For a fire alarm and fire detection system to give the maximum benefit, the fire and rescue service needs to be summoned as quickly as possible on every occasion that it operates in the event of a fire, unless, in order to avoid false alarms being passed to the fire and rescue service, filtering arrangements are appropriate (see 35.2.7).

In occupied buildings, the primary means for summoning the fire and rescue service needs to comprise a call to the fire and rescue service by occupants, using the 997. This is the case even if there is a means for automatic transmission of alarms to an ARC, as any automatic system can fail at the time it is required to operate. It needs to be ensured that the fire alarm sounders cannot interfere with any emergency call to the fire and rescue service.

In the case of manual fire alarm systems, automatic transmission to an ARC is usually unnecessary. When the building is unoccupied, the system does not respond to fire; when the building is occupied, the call to the fire and rescue service from occupants suffices. Automatic means for transmission is only likely to be of benefit,

as a secondary means of summoning the fire and rescue service, if factors such as the size or complexity of the building, or low level of occupancy, could result in a significant delay between discovery of fire and summoning of the fire and rescue service, thereby warranting the duplication of the call to the fire and rescue service (i.e. with calls made manually from the premises and automatically via an ARC).

Since the objective of a Category L system is evacuation of occupants, rather than protection of property, manual summoning of the fire and rescue service by occupants might, again, suffice. However, if the early attendance of the fire and rescue service is likely to be essential to life safety in the event of fire (e.g. in hospitals and residential care homes), a secondary, automatic means of transmission might be warranted, unless there are adequate arrangements to ensure that there is no delay at any time in manual summoning of the fire and rescue service by occupants. In practice, automatic transmission of fire alarm signals is considered necessary in the case of residential care premises.

Even in a Category L system, if the premises are unoccupied at certain times and the system incorporates automatic fire detection throughout a significant proportion of the premise, it can represent a missed opportunity, in respect of property protection, if no means of automatic transmission of alarm signals is provided.

In a Category P system, unless the premises are continuously occupied at all times, the objective of property protection is unlikely to be satisfied unless the system incorporates means for automatic transmission of alarm signals to an ARC. Even in a Category P2 system, unless the extent of the automatic fire detection is minimal, in premises that are not continuously occupied, the absence of an automatic means of transmission of fire signals to an ARC is likely to be false economy.

In premises in multiple occupation, the responsibility for summoning the fire and rescue service on operation of the fire alarm system always needs to be clearly defined, particularly in the case of Category L or Category P systems.

If a Category L or Category P system is installed in non-domestic premises in multiple occupation, there might be a need for automatic transmission of alarm signals to an ARC. The primary means of summoning the fire and rescue service still needs, if practicable, to comprise a call to the fire and rescue service from persons on the premises. However, in some premises in multiple occupation, the reliability of this arrangement can be insufficient, and a secondary means of summoning the fire and rescue service via an ARC might be warranted.

The reliability of the means for summoning the fire and rescue service, whether by manual or automatic means, always needs to be subject to consideration. Various methods of automatic alarm transmission system to an ARC are available.

Their performance, reliability and security characteristics vary, depending upon the type of technology used. BS EN 50136-1 defines ten categories of alarm transmission system (ATS): SP1 to SP6 are based on a single alarm transmission path. DP1 to DP4 add resilience by requiring a dual transmission path.

Alarm transmission systems that incorporate reporting of an alarm transmission path (ATP) failure are preferred. The reporting time period varies with the ATS category selected (32 days to 90 seconds). BS EN 50136-1 shows these performance criteria together with alarm transmission times and the ATS and ATP availability in any 7-day period.

PD 6669 gives guidance that is additional to BS EN 50136-1, with particular reference to dual path alarm transmission systems.

Regardless of whether the arrangement for summoning the fire and rescue service is manual or automatic, the effect of fire on the reliability of the arrangement needs to be considered (e.g. the effect of fire on persons tasked with summoning the fire and rescue services and on communication lines and equipment).

If the services of a commercially operated ARC are used, it needs to be ensured that the alarm receiving centre has a formal arrangement with the fire and rescue authority in whose area the protected premises are situated for rapid communication with the fire and rescue service by reliable means.

If provision is made for automatic transmission of fire signals to an ARC, it is often quite simple to arrange for fault signals on the fire alarm system to be transmitted as a separately identifiable signal; this has the benefit of ensuring that faults on the fire alarm system receive attention when the premises are unoccupied.

It is now common practice for the transmission of fire alarm signals to an ARC to be routed via the alarm routing equipment of an intruder alarm system. Notwithstanding that the mains power supplies, cable types and cable routing for this alarm routing equipment might not necessarily conform to the recommendations of this standard, this practice is regarded as acceptable and need not be regarded as a variation from the recommendations of this standard. However, standby battery capacity and any cable between the CIE and the alarm routing equipment needs to conform to the recommendations of this standard.

15.2 Recommendations

The following recommendations are applicable:

- a) The user should ensure that there are suitable arrangements for summoning the fire and rescue service when the fire detection and fire alarm system operates. The arrangements should be such as to minimize the risk to any person responsible for summoning the fire and rescue service. Systems that automatically transmit a pre-recorded message direct to the fire and rescue service, via the public emergency call system, should not be used.
- b) In occupied buildings, the primary means of summoning the fire and rescue service should always comprise a call to the fire and rescue service by occupants, using the public emergency call system.
- c) In any area specifically designated as that from which the fire and rescue service is to be summoned in the event of fire, the fire alarm signal should not be so loud as to interfere with telephone speech.

NOTE 1 Cases have been reported in which the frequency of the alarm sounders has been such as to corrupt tone dialling systems, leading to failure of the emergency call.

- d) The designer should determine from the purchaser or user whether automatic means of transmission of alarm signals to an ARC is required by the user.
- e) If the early summoning of the fire and rescue service is considered critical to the safety of occupants (e.g. on the basis of a fire risk assessment), facilities should be provided for automatic transmission of alarm signals to an ARC, unless there are reliable arrangements for summoning the fire and rescue service by persons in the building
- f) In residential care premises, facilities should be provided for automatic transmission of alarm signals to an ARC.
- g) Except in the case of continuously occupied premises, Category P systems should incorporate a means for automatic transmission of fire signals to an ARC.
- h) In non-domestic premises in multiple occupation, Category L systems should incorporate an automatic means for transmission of alarm signals to an ARC, unless there are arrangements in place for summoning the fire and rescue service by occupants of the building, at all times that the premises are occupied (or partly occupied).
- i) Any ARC to which fire alarm signals are relayed should conform to the recommendations of BS 8591 and have in place an agreement with the appropriate fire and rescue service to pass on fire signals from fire alarm systems at the monitored property.

NOTE 2 An ARC that conforms to the recommendations of BS 5979 (withdrawn, superseded by BS 8591) in respect of monitoring of fire alarm signals is acceptable.

NOTES 3 Schemes exist for third-party certification of ARC's to BS 8591 and BS 5979 (withdrawn, superseded by BS 8591). However, transmission of fire alarm signals (as opposed to intruder alarm signals) is not always within the scope of the ARC's certification; if reliance is placed on third-party certification, it needs to be confirmed that monitoring of fire alarm signals is within the scope of certification.

- j) If a Category L or Category P system incorporates facilities for automatic transmission of fire signals to an ARC, any telephone switch room or frame room on which automatic transmission depends should be protected by automatic fire detection or an automatic fire extinguishing system. As far as reasonably practicable, any cables within the building (including telephone lines) on which communication depends should be:
 - 1) routed through areas of low fire risk; or
 - 2) routed through areas protected by automatic fire detection or an automatic fire extinguishing system; or ;
 - 3) cables of standard or enhanced fire resistance (see Clause 26).

- k) Automatic transmission of alarm signals should not be prevented by the act of silencing fire alarm sounders, nor should it depend on the state of any silencing switch.

NOTE 4 Although any ARC to which fire signals are relayed is normally operated on a commercial basis, the function could, for example, be fulfilled by a fire and rescue service control room or a continuously manned security control room on the same site as the protected premises.

- l) Where an alarm transmission device is mounted in an enclosure separate from that of the fire alarm CIE, the connection from the CIE to the alarm transmission device should be monitored and comprise cables of standard fire resistance. The CIE should conform to BS EN 54-2.

NOTE 5 Monitoring may be performed by the alarm routing equipment. For example, the connection between the CIE and the alarm routing equipment may comprise a cable from an input in the alarm routing equipment to the common fire relay in the CIE, such that an open circuit fault in the cable results in transmission of a fault signal to the ARC.

- m) Power supplies for any facility used for the transmission of fire alarm signals to an ARC should conform to Clause 25.

NOTE 6 15.2m) does not apply to the mains power supplies for an intruder alarm system, to which 15.2n) applies.

- n) Where fire alarm signals are routed via the routing equipment of an intruder alarm system, the standby power supplies for the routing equipment should conform to the recommendations in 25.4
- o) If it is intended for the CIE to signal a fault from the fire alarm system to an ARC, the CIE should have a suitably monitored means of interfacing with the relevant fault routing equipment.

NOTE 7 Monitoring may be performed by the fault routing equipment. For example, the connection between the CIE and the fault routing equipment may comprise a cable from an input in the fault routing equipment to the common fault relay in the CIE, such that an open circuit fault in the cable results in transmission of a fault signal to the ARC.

NOTE 8 It is common for the alarm routing equipment and the fault routing equipment to comprise a single device.

- p) Faults in either the alarm transmission equipment or in the alarm transmission path should be displayed at the CIE.

NOTE 9 It is recognized that temporary loss of service in the alarm transmission path or service provision might occur. The risk associated with loss of communications can be mitigated by use of a dual path alarm transmission system where primary and secondary signal paths are provided. For dual path alarm transmission systems, loss of both signal paths is indicated as a fault at the CIE. However, it is not necessary to indicate loss of a single transmission path at the CIE.

- q) Where the alarm transmission path relies upon a physical TCP /IP or similar data connection, the following recommendations apply.

- 1) Final connections to the alarm routing equipment should be secured against unauthorized disconnection.
- 2) Power supplies for routing equipment within the premises on which alarm transmission depends should conform to the recommendations of 25.4e).

NOTE 10 Where there is a dual path alarm transmission system, the recommendations contained in 15.2q)2) need only be applied to one of the transmission systems.

- 3) The physical data network cable used for alarm transmission within the building should be differentiated from other services by colour.

NOTE 11 Where the network cable cannot conform to the recommendations of 15.2q)3), or where local data network reliability is a concern, a dual path alarm transmission system would be beneficial.

16 Audible alarm signals

16.1 Commentary

In practice, a Category P system is usually combined with a Category M system, in which case the considerations applicable to the Category M system take precedence as these are more onerous. In those areas in which audible alarm signals are intended to alert occupants, the sound pressure level and frequency of alarm signals need to be adequate to provide unambiguous warning of fire. Particular care needs to be taken to ensure adequate sound pressure levels in small cellular spaces, such as cellular offices, toilets and plant rooms. If the alarm signal comprises a speech message, it is also necessary to ensure that the message(s) is intelligible.

Traditionally, a sound pressure level of 65 dB(A) has been regarded as the minimum acceptable sound pressure level for fire alarm signals. However, a sound pressure level difference of 2 dB to 3 dB is only just perceptible to the human ear. It is, therefore, unnecessary to install additional fire alarm sounders if, in open areas, 65 dB(A) is generally achieved. If, at specific points of limited extent within any area, a sound pressure level of at least 60 dB(A) is achieved this is considered acceptable. It is also acceptable for the sound pressure level to be as low as 60 dB(A) in small enclosed spaces, such as cellular offices, and in stairways.

In order to prevent excessive sound pressure levels, which can cause disorientation or even damage to hearing, a larger number of quieter sounders is preferable to a few very loud sounders.

Once started, alarm signals generally need to continue until manually silenced by use of a silencing control. In large sites comprising many buildings in single ownership (e.g. industrial sites), an external fire alarm device can be of value in directing firefighters to the correct building; an external fire alarm device can also be useful in directing firefighters to the correct entrance of a large building with many entrances. It is not necessary for an external fire alarm sounder to sound for a prolonged period; for it to do so is unlikely to be acceptable because of disturbance in neighbouring properties, particularly if false alarms occur when the protected premises are unoccupied.

In radio linked systems, in which the power supply for sounders may comprise batteries, prolonged operation of sounders (e.g. as a result of a false alarm when the premises are unoccupied) can exhaust the batteries, leaving the premises without an operational fire alarm system when they are subsequently reoccupied. Since this creates greater risk than that associated with automatic silencing of alarm signals, the alarm signal may be automatically silenced in certain radio-linked systems, subject to the agreement of the enforcing authority.

16.2 Recommendations

16.2.1 Recommendations applicable to Category M and L systems (other than in hospitals and residential care premises)

The following recommendations are applicable.

- a) The sound pressure level of alarm signals should be:
 - 1) throughout all accessible areas of the building [other than as described in **15.2c**] and in enclosures of less than 1 m²], not less than 65 dB(A) but, as shown in Figure 4, this may be reduced to 60 dB(A) in:
 - i) stairways;
 - ii) enclosures of not more than approximately 60 m² in area (e.g. cellular offices); and
 - iii) specific points of limited extent;
 - 2) where the sound pressure level of background noise is greater than 60 dB(A), the sound pressure level of the fire alarm signal should be 5 dB above the sound pressure level of the background noise;

NOTE 1 Background noise that is unlikely to persist for longer than 30 s may be ignored.

NOTE 2 This recommendation does not apply to noise created by running water in bathrooms and shower rooms.

NOTE 3 Typical noise levels in buildings are given in Annex 8.
 - 3) not less than 75 dB(A) at the bedhead within rooms in which the fire detection and fire alarm system is intended to rouse people from sleep;

NOTE 4 Experience has shown that this normally necessitates the provision of a fire alarm sounder within the room in question.
 - 4) not greater than 120 dB(A) at any normally accessible point.

NOTE 5 All these figures are arbitrary but are judged to be generally appropriate.

NOTE 6 In carrying out measurements to verify compliance with these recommendations, other than in the case of 16.Z.1a)3), account need not be taken of sound pressure levels within 500 mm of any walls or partitions.

NOTE 7 Measurements need to be made with all doors shut,

NOTE 8 An instrument conforming to BS EN 61672-1, set to slow response and A weighting, is suitable for measuring the sound pressure level of the alarm signal.

NOTE 9 It is often necessary to measure the sound pressure level of the fire alarm signal in the presence of background noise. The sound pressure level of the fire alarm signal (in isolation) can be deemed to be 5 dB above background noise if, when the background noise is present, a sound pressure level increase of 6 dB occurs on operation of the fire alarm system.
- b) The fundamental frequency(ies) produced by fire alarm sounders should lie in the range of 500 Hz to 1 000 Hz, unless the frequency of background noise is such as to mask these frequencies, in which case the use of sounder frequency outside this range is acceptable. The sounders should produce a continuous output, although the frequency and amplitude might vary (e.g. as in a warbling note), to indicate the need for evacuation or other immediate response.
- c) All fire alarm sounder within a building should have similar sound characteristics, unless particular conditions, such as an area of high background noise, make this impracticable. The sounders should

be distinctive in sound from the sounds of other alarm systems in the building. The fire alarm sounders should be distinctive in sound.

NOTE 10 On a site where occupants move regularly between buildings, there is a benefit to adopting fire alarm signal that has similar sound characteristics throughout all buildings on the site.

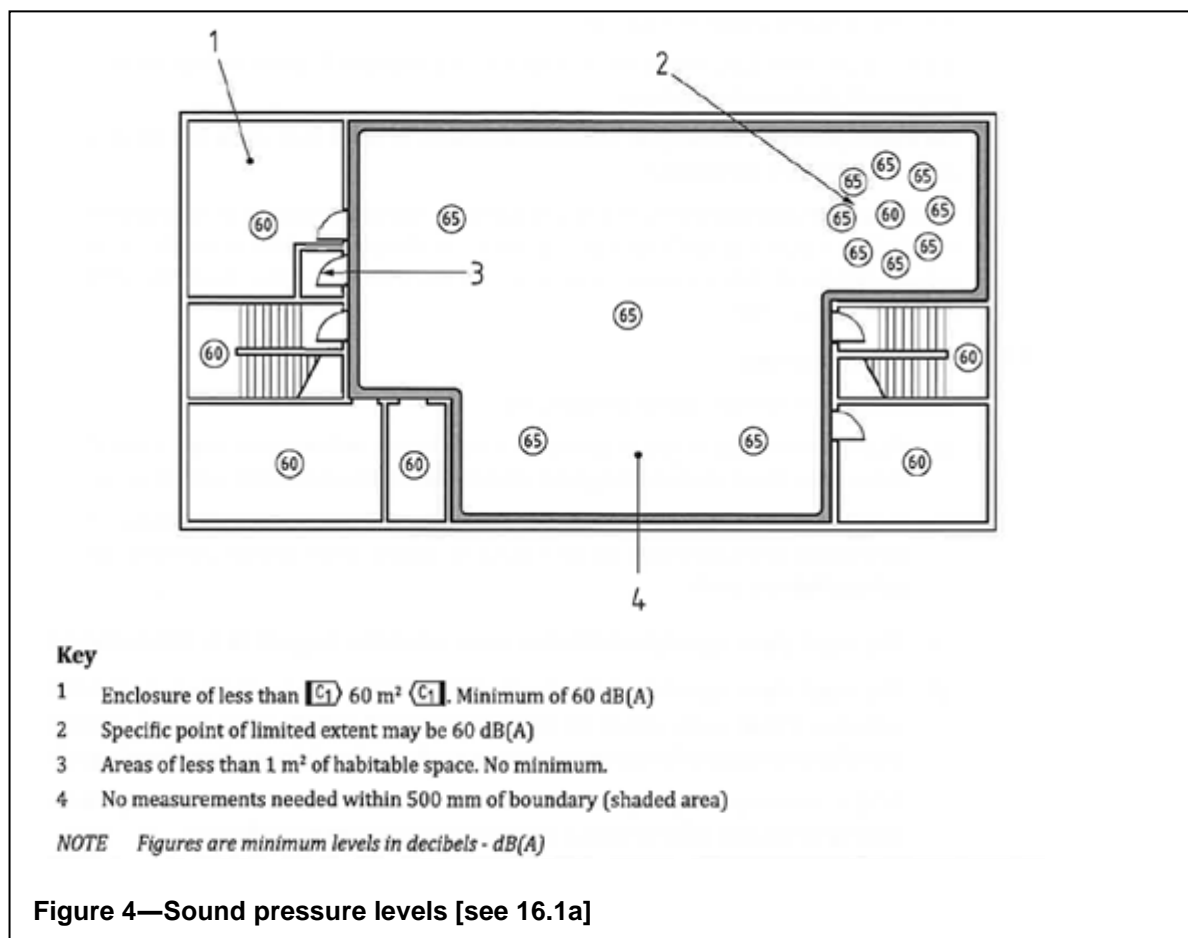
- d) In premises designed for public entertainment, retail and similar premises, in which the sound pressure level of music is likely to be greater than 80 dB(A), the music should be muted automatically when a fire alarm signal is given.

NOTE 11 In premises with two (or more) stage alarm systems, consideration ought to be given as to whether the music is to be muted at the "Alert" or the "Evacuate" stage.

NOTE 12 Where the sound pressure level of the music is likely to be between 60 dB(A) and 80 dB(A), the recommendation of 16.2.1a)2) applies.

- e) In parts of a building with noisy machines, in order to achieve 5 dB(A) above background noise, the fire alarm sounders ("primary sounders") may be supplemented by mains powered sounders, without a standby supply ("secondary sounders"), operated from the same final circuit(s) as the noisy machines, so that failure of the supply to the secondary sounders also results in silencing of the noisy machines. The primary sounders should still be sufficient to satisfy the recommendations of 16.2.1a)1) when the machines are silent.
- f) In large sites with many buildings, or in the case of large buildings with many entrances, an external sounder(s) and/or visual alarm devices may be provided to direct firefighters to the building or appropriate entrance to the building. Where the provision of such sounders and/or visual alarm devices is considered, there should be consultation with the fire and rescue service to confirm the need of, or benefit from, their provision. The sounder(s) and/or visual alarm device(s) should be clearly marked with the words "FIRE ALARM".
- g) A facility should be provided to enable silencing of alarm signals. The operation of the facility should:
 - 1) require a manual operation;
 - 2) not cancel any visual signal of the alarm at the control equipment;
 - 3) sound any fire alarm sounders configured to that zone if, following silencing of fire alarm sounders, a new zone goes into alarm, and normally should also resound those fire alarm sounders which were previously sounding;
 - 4) not prevent the correct operation of any control for starting or restarting the alarm sounders [see 23.2.3b)];
 - 5) not prevent the transmission of an alarm to an ARC.
- h) Alarm signals should not silence automatically (i.e. after a predetermined time period), other than in the following circumstances:
 - 1) any external fire alarm sounders [see 16.2.1f)] in Category Land P systems should silence automatically after 30 min, unless the premises are continuously occupied so enabling manual silencing by occupants. After silencing, the sounders might (or might not) restart if, before the system is reset, a further alarm condition occurs.
 - 2) where a radio-linked Category L or P system incorporates battery powered fire alarm sounders, the sounders should silence automatically after 30 min, unless the premises are continuously occupied so enabling manual silencing by occupants. The sounders should restart if, before the system is reset, a further alarm condition occurs. Where a period longer than 30 min is required, e.g. for phased evacuation, the 30 min period may be extended to meet the requirements of the system specification.
 - 3) in a two (or more) stage alarm system, alert signals may be silenced automatically after a predetermined period, subject to compliance with 19.2.3d).
- i) The system should incorporate at least two fire alarm sounders, even if the recommended sound pressure levels could be achieved with one sounder. At least one sounder should be provided in each fire compartment.
- j) If audible alarms comprise speech messages generated by a voice alarm system, the relevant recommendations of BS 5839-8 should be followed in respect of message content, sound pressure levels and speech intelligibility. If voice sounders (see 3.61) are used, reference should be made to BS 5839-8, as well as complying with the recommendations of this standard.

- k) Fire alarm sounders should not be used for purposes other than warning of fire, unless the response required is identical to that required in the event of fire (i.e. immediate evacuation by use of all escape routes). However, as an established exception, the fire alarm signal may be used in schools to indicate start or finish of predetermined periods. The duration of such signals should not exceed 5 s.



16.2.2 Recommendations applicable to Category P systems

The recommendations of apply in respect of those areas where audible alarm signals are required.

16.2.3 Recommendations applicable to hospitals and residential care premises

The following recommendations are applicable.

- a) Audible alarms in hospitals should conform to the recommendations of the Department of Health Publications.
- b) Audible alarms in residential care premises should conform to 16.2.1, except that, if the alarm signal is not intended to rouse occupants of some or all rooms from sleep, 16.2.1a)3) does not apply.

17 Visual alarm signals

17.1 Commentary

Visual alarm signals need to be used to supplement audible alarm signals in situations in which the latter are likely to be ineffective, but normally ought not to be used on their own. Their use is principally in areas with high ambient sound levels, where hearing protection is likely to be worn. However, they are sometimes used, as the sole initial warning to staff, in situations in which the disturbance of an audible warning is undesirable (e.g. television and radio studios, cinemas, theatres and hospital operating theatres). Visual alarm signals can also be used as a means of giving warning of fire to people who are deaf and hard of hearing (see Clause 18).

Where visual alarm signals are used, consideration might need to be given to the potential effects on people with photosensitive epilepsy.

For more information, see the Joint LPCB/FIA document CoP 0001, Code of Practice for visual alarm devices used for fire warning [1].

Visual alarm devices recommended in this standard are intended to apply to circumstances in which the visual alarm is a primary warning of fire, but not to situations in which the visual alarm provides only supplementary information, such as those recommended in BS 7273-1 for areas protected by a gaseous fire suppression system.

17.2 Recommendations

The following recommendations are applicable.

- a) Visual alarm signals should be provided in areas where ambient noise levels exceed 90 dB(A) and in other areas where hearing protection is likely to be used under normal circumstances.
- b) Visual alarm devices should be sufficient in number and distribution to be readily visible from all normally accessible locations, throughout the area in which they are provided, under normal ambient lighting levels.
- c) The visual alarm signal should flash at a rate within the range of 30 to 120 flashes per minute.
- d) The visual alarm signal should be clearly distinguishable from any other visual signal used in the premises. Visual alarm signals should be white or red, or both white and red, in colour, unless use of another colour is necessary to distinguish the signals from other visual signals.

NOTE 1 Labelling the visual alarm device with the word "FIRE" such that it would be legible from a position standing on the floor might be adequate to distinguish it from other visual signals.

NOTE 2 Care needs to be taken to ensure, as far, as reasonably practicable, that visual alarm signals do not cause epileptic seizures in people with photo sensitive epilepsy. In this connection, a flash rate of 3 Hz or less (from a single visual alarm device) is unlikely to result in seizures, but care is necessary to ensure that, in open areas, the field of view from any point is not such that multiple, unsynchronized visual signals can result in an apparent flash rate of a greater frequency; to avoid this, synchronization of visual alarm devices might be necessary. It is important to note that red flashing light is more likely to result in seizures than white (or other coloured) flashing light. Particular care is necessary in, for example, certain health care premises in which a number of people with photosensitive epilepsy might congregate.

- e) The intensity M output of visual alarm devices should be sufficient to attract attention, but not so high as to cause difficulty with vision due to glare.

Note 3 Guidance on the use and siting of visual alarm devices conforming to BS EN 54-23 is given in LPCB/FIA CoP 0001 [1] This permits two alternative approaches: an engineered, application-specific solution for relatively complex situations and a "predetermined approach" for rooms of simple geometry, specified size and frequently encountered levels of ambient illumination.

- f) Visual alarms should be securely fixed in accordance with the mounting position (ceiling or wall) and orientation specified by the manufacturer. The mounting height should not be less than 2.1 m.

18 Fire alarm warnings for people who are Deaf and hard of hearing

18.1 Commentary

Impairment of hearing does not mean that a person is completely insensitive to sound. Many people with severe impairment have sufficiently clear perception of some types of conventional audible alarm signals to require no special provision for warning of fire. There will be, in some situations, other people present who can alert people who are Deaf and hard of hearing to the need for evacuation, and in this case, it might be necessary to put procedures in place that rely upon others to provide the necessary warning.

However, in circumstances, such as buildings with a significant number of people who are Deaf and hard of hearing, buildings in which one or more people who are Deaf or hard of hearing work in relative isolation, and buildings in which one or more people who are Deaf or hard of hearing tend to move around the building to a significant extent (including into toilet areas), additional means of giving warning to these people might be appropriate. If the occupants in question tend to be located for a large proportion of their time within a limited area of the building, visual alarm signals might be appropriate in that area (and associated toilets). If they sleep in the building, tactile devices, with or without associated visual alarm devices, might need to be considered (e.g. for compliance with the accessibility requirement imposed under Building Regulations. These devices, which can, for example, be placed under pillows or mattresses, may be wired into fire alarm device circuits or be triggered by radio signals.

Alarm devices for people who are Deaf and hard of hearing can be fixed, movable or portable.

Fixed equipment is equipment fastened to a supply; or otherwise secured in a specific location, or equipment not provided with a carrying handle and having such a mass that it cannot easily be moved (e.g. a fire alarm system control panel screwed, to the wall).

Moveable equipment is equipment which is not fixed equipment and which is not normally in operation while the location is changed (e.g. a local unit or controller which is placed on a table top and operates a vibrating pad in a bed).

Portable equipment is equipment designed to be in operation while being carried (e.g. radio pager or other system using radio communication). For the purposes of this clause, portable alarm devices are:

- intended for, carrying by people who are Deaf and hard of hearing;
- capable of giving visual and/or tactile signals;
- normally radio controlled but other methods are not excluded; and
- normally require control equipment for transmission of signals to the portable devices, interfaced to the fire detection and fire alarm control equipment

Wherever possible, the recommendations of this clause ought to be followed and any variations ought to be subject to a risk assessment to ensure that no person who is Deaf or hard of hearing is exposed to undue risk.

It is important to note that all radio paging systems used with fire detection and fire alarm systems need to be licensed with relevant authority. There are three types of licence currently available:

- the short-range business paging (SRBP) licence which gives no protection from interference from other authorized or unauthorized users of the same radio frequency;
- the self select licence which offers some protection from interference by unauthorized use of the frequency;
- the manual frequency coordinated licence which ensures the elimination of Interference from both authorized and unauthorized users of the assigned radio frequency.

18.2 Recommendations

18.2.1 General

The following recommendations are applicable.

- a) Visual alarm signals provided for people who are Deaf and hard of hearing should conform to Clause 17. The visual alarm devices should be regarded as fire alarm devices for the purpose of this standard and, for example, circuits serving the devices should be monitored and protected against fire accordingly.
- b) Tactile alarm devices provided for people who are Deaf and hard of hearing may be fixed, moveable or portable. Fixed or moveable tactile devices should be regarded as fire alarm devices for the purpose of this standard. For example, circuits serving the devices should be monitored and flexible cables attached to devices should be protected against fire if they are greater than 3 m in length.
- c) The intensity of output of tactile alarm devices should be sufficient to attract attention.
- d) Advice should be sought from relevant authority as to the conformity with regulatory requirements for any system using radio signals.
- e) Where tactile devices are provided, control and transmission equipment should conform to the recommendations of Annex C.

18.2.2 Portable alarm devices

Portable alarm devices to supplement: the primary means of giving an alarm of fire, if activated by radio signals, should conform to the following recommendations.

- a) The alarm should be given at the portable alarm device within 5 s of the generation of the alarm signal at the fire detection and fire alarm CIE.
- b) The alarm signal emitted by the portable alarm device should continue for at least 60 s after reception of every alarm transmission or until it is acknowledged at the portable alarm device. This emitted alarm signal may be intermittent.
- c) In a fire condition the transmission equipment should continue transmitting the alarm signal to the portable alarm devices until the alarm is cancelled by a signal from the fire alarm control equipment. If the transmission equipment does not send the alarm signal continuously, it is acceptable for the transmission equipment to send the alarm signal repeatedly at periods not exceeding 10 s.

NOTE 1 The purpose of this recommendation is to ensure that, in the event of fire, the portable alarm device continues to emit a signal until the fire alarm control equipment is silenced or reset

NOTE 2 The recommendations in 18.2.2b) and 18.2.2c) are intended to ensure that, in the event fire, each portable alarm device emits an alarm signal continuously, until the fire alarm CIE is silenced or reset.

NOTE 3 In the context of 18.2.2c), cancellation of the alarm signal from the fire alarm control equipment might, for example, constitute the resetting of a relay at the fire alarm control equipment.

- d) Where the portable alarm device is also used for other purposes (e.g. general paging), the recipient should, by means of the cadence pattern, be able to tell the difference between a signal of fire and a signal for other non-emergency purposes.

NOTE 4 It is acceptable to use the fire signal cadence pattern for other emergencies that require a similar urgency of response to a fire (e.g. a bomb warning).

NOTE 5 The manufacturer's, or supplier's, instructions for users are likely to stress the importance of not using the fire signal cadence pattern for non-emergency purposes.

NOTE 6 While virtually all radio-paging systems have fire as their highest level of priority, it might be that in some special cases there could be a higher level of priority e.g. a security attack alarm. In these rare cases, it might be deemed that the fire signal does not have priority over any other signal. Such a decision ought to result from an adequate risk assessment and be agreed with relevant parties.

- e) Where the portable alarm device is also used for other purposes (e.g. general paging), the fire signal should have priority over any other signal so that 18.2.2a) is satisfied regardless of the occurrence of other system activity (e.g. transmission of general paging messages).
- f) A failure of the interconnection (e.g. radio transmission) between the transmission equipment and the portable alarm device should be identified at the portable alarm device by a visual and tactile signal within five minutes of the failure. The visual indication should remain until the interconnection is reconstituted or the portable alarm device is switched off. The tactile indication may be cancelled by operation of a manual control, provided that, at intervals not exceeding 15 min, it is then repeated for a duration of at least 0.5s, unless the portable alarm device is switched off.
- g) Portable alarm devices may be operated from a single power source (e.g. battery). A low power source voltage should be identified at the portable alarm device by a visual and tactile signal. If the tactile signal is given continuously until manually acknowledged, the signal should, after acknowledgement, be repeated for at least 3 s at intervals not exceeding 15 min until the capacity of the battery can no longer support the tactile signal. If the battery low signal automatically stops after a predetermined period, the signal should be repeated at intervals not exceeding 15 min until the capacity of the battery can no longer support the tactile signal. In any case, a text or other. Visual indication should be given continuously and remain until either the battery is replaced or the battery can no longer support the display, unless overridden by a fire signal or other message.
- h) If a portable alarm device is fitted with an off switch, or a switch disabling the alarm signal, the design of the switch should be such as to avoid inadvertent operation.
- i) All faults identified at the control equipment for the portable alarm system should result, in, at least, a common fault warning at the fire detection and fire alarm system CIE within 100 s of the fault being identified at the portable alarm control equipment. Any cable used in a circuit provided in order to satisfy this recommendation should be monitored, so that an open or short circuit fault in the cable is indicated at the fire detection and fire alarm system CIE. However, it is not necessary for this cable to be fire-resisting.

NOTE 7 The audible and visual fault indication may be given by equipment separate from the fire detection and fire alarm CIE, provided the audible and visual indications conform to the requirements of BS EN 54-2 for fault signals.

- j) The system should conform to the recommendations of the following clauses and subclauses of this standard

• 12.2.1a)4)	• 12.2.1e)	• 23.2.1e)	• 27.2g)1)
• 12.2.1a)5)	• 12.2.1g)	• 23.2.1f)	• 27.2g)2)
• 12.5.1a)6)	• 12.2.21)	• 25	• 27.2g)3)
• 12.2.1a)7)	• 23.2.1b)	• 26	• 29.2e)
• 12.2.1b)	• 23.2.1c)	• 27.2c)	• Annex C
• 12.2.1d)	• 23.2.1d)	• 27.2d)	

19 Staged fire alarms

19.1 Commentary

In simple buildings of limited size, a single stage fire alarm arrangement is likely to be sufficient. In such a system, on operation of any manual call point or automatic fire detector, a single, common fire alarm signal is given throughout the premises as a signal to all occupants to evacuate immediately (i.e. there is a "single phase" evacuation).

In certain large and/or high-rise buildings, a staged fire alarm arrangement might be more appropriate. In a staged fire detection and fire alarm system, the initial warning of fire is given in a restricted area, or is restricted to key personnel, but can be extended in further stages to warn, ultimately, all occupants of the premises. The arrangement might apply regardless of whether the alarm is triggered by a manual call point or an automatic fire detector, or it might apply only to alarm signals triggered by automatic fire detectors.

There are various circumstances in which a staged fire alarm arrangement might be appropriate. These include, but are not restricted to, the following.

- a) In certain large or high-rise buildings, it might be desirable to evacuate first those areas closest to the fire and immediately above it; other areas are evacuated thereafter. A particular example of this arrangement, commonly used in high-rise buildings, is known as phased evacuation. This arrangement enables the number and/or widths of stairways to be reduced; under these circumstances, it is important that no control is provided to evacuate the entire building in a single phase, as there will be insufficient stairway capacity for simultaneous evacuation of all occupants.
- b) Phased evacuation is also sometimes used in other types of building, irrespective of whether there are reduced stairway capacities (e.g. leisure complexes, shopping centres and transportation terminals). In these cases, the initial phase of evacuation might be horizontal, into a place of relative safety within the building.
- c) In hospitals, a system of "progressive horizontal evacuation" is used, in which patients closest to a fire are moved horizontally to an adjacent fire compartment. In a large hospital, further evacuation might, again, involve only horizontal movement, without the need for more difficult vertical evacuation.
- d) To minimize disruption from false alarms, signals triggered by automatic fire detectors might be restricted in the first instance to staff, who investigate before any general evacuation signal is given and/or the fire and rescue service is summoned; alternatively, the area of initial evacuation might be restricted in extent (see Section 3). In residential care premises, where early extinguishing action by the fire and rescue service is critical to life safety, it is not appropriate to delay the summoning of the fire and rescue service when the fire alarm system operates.
- e) In certain public buildings, such as places of public entertainment, an initial warning of fire is sometimes restricted to staff in order to avoid incorrect reaction by members of the public; staff are then responsible for controlling the evacuation, often by use of a voice alarm system.
- f) In a widely spread range of low rise buildings, such as an industrial complex, there might be no need for evacuation of occupants in one area of the complex, even in the event of a confirmed fire of limited size some considerable distance from those occupants.

In all of the above cases, the evacuation strategy described normally requires the support of a staged alarm system, which is capable of giving two or more stages of alarm within any area. In a two-stage alarm, the system might be capable of giving an "Alert" signal in those areas not immediately affected, as a warning of impending evacuation, and an "Evacuate" signal in those areas in which immediate evacuation is required. Another form of two-stage alarm is one in which the initial alarm is restricted to staff, usually by means of paging or a coded voice alarm message (a "staff alarm", with the subsequent stage taking the form of an "Evacuate" signal throughout all or part of the premises. In a three-stage alarm system, the system might be capable of giving a staff alarm, an "Alert" signal and an "Evacuate" signal.

The purpose of the fire detection and fire alarm system is to support the required fire and evacuation procedures. Since various arrangements are possible, it is absolutely vital that, other than in small, simple buildings, the fire procedures and evacuation strategy are formulated before final design of the fire detection and fire alarm system is completed. The "cause and effect" logic of the system, the control facilities provided, and the configuration of fire alarm device circuits are governed by the procedures the system is intended to support. For example, to facilitate a staged alarm arrangement in which "Alert" and "Evacuate" signals can be given, it is necessary to divide the building into alarm zones (see Clause 14).

The use of staged alarm systems can necessitate the provision of additional facilities, such as a voice alarm system and/or an emergency voice communication system to control evacuation. Recommendations for the

design of voice alarm systems are given in BS 5839-8. Recommendations for the design of emergency voice communication systems are given in BS 5839-9.

In buildings with inner rooms from which escape is possible only by passing through another ("access" room, it is common practice for a smoke detector to be installed in the access room unless there is adequate vision between the inner room and the access room. The purpose of this smoke detector is to give early warning to occupants of the inner room before fire in the access room prevents their means of escape.

19.2 Recommendations

19.2.1 Recommendations applicable to all staged alarm systems

In multi-storey buildings with phased evacuation, if stairway capacity is inadequate to support a simultaneous evacuation of all floors, no single control should cause an "Evacuate" signal to be given throughout the building; a separate "Evacuate" control should be provided for each alarm zone.

NOTE In some buildings, a two-phase evacuation arrangement is used; the area of fire origin is evacuated first and the remainder of the building is evacuated simultaneously as a second phase. 19.2.1 does not apply to such situations, as adequate stairway capacity exists to evacuate the entire building in one phase.

19.2.2 Recommendations applicable to staff alarms

The following recommendations are applicable.

- a) Staff alarms should be used only where staff, including any night staff, are sufficient in number and fully trained in the action they are to take in the event of fire.
- b) In residential care premises, a staff alarm should not incorporate any delay in summoning of the fire and rescue service when the fire alarm system operates, but there may be a delay in the general alarm signal, provided all staff are made aware of the fire alarm signal [see also 15.2f)].
- c) Staff alarms should normally be generated only in response to signals from automatic fire detectors, but not in response to signals from manual call points, heat detectors or sprinkler systems. However, in premises, other than residential care homes, that generate a high number of unwanted fire alarm signals, automatic transmission of a signal to an ARC might be delayed pending investigation of alarm signals from these devices. Any proposal to use a staff alarm as the initial response to a signal from a manual call point should be subject to special consideration. In such special circumstances, there should be adequate arrangements to ensure that a person operating a manual call point is not left in doubt as to the success of the operation (e.g. by means of visual indication at the call point that the signal has been correctly received at the control equipment and a suitable warning that operation of the manual call point will not result in an immediate audible fire warning).

NOTE 1 It is common practice for both manual call points and automatic detectors in large places of public entertainment to initiate only a staff alarm, so that staff can be prepared to assist in an orderly evacuation, which is then initiated by a voice alarm message. Such arrangements necessitate a high level of training and awareness on the part of staff and might not be appropriate in other premises.

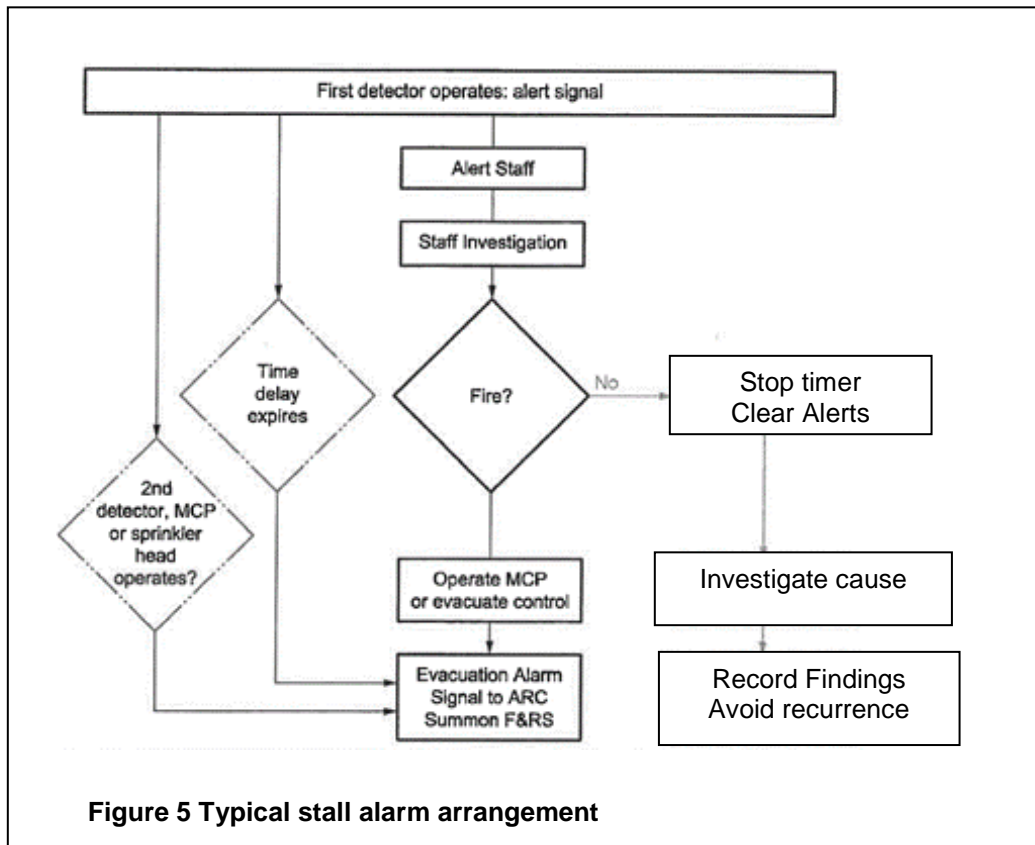
- d) Staff alarm signals comprising visual fire alarm devices should conform to Clause 17.
- e) In premises with a staff alarm system, there should always be provision, throughout all areas of the building, for sounding an audible fire warning conforming to Clause 16. Facilities should be provided at the CIE, and at additional locations if appropriate, to change the stage of alarm from a staff alarm stage to an "Evacuate" stage. Since operation of a manual call point should not normally result in a staff alarm [see 19.2.2c)], it should normally also be possible for those responding to a staff alarm signal to change the stage of the alarm by operation of a manual call point.
- f) A staff alarm signal should automatically change to an audible fire warning in at least the relevant alarm zone after a preset period, unless manual intervention to stop the associated timer occurs at the control equipment. The period for the staff to investigate should not normally exceed six minutes.
- g) A staff alarm signal should automatically change to an audible fire warning in at least the relevant alarm zone if a second detector operates before the system is reset. (This is known as "coincidence detection").

NOTE 2 Coincidence may be arranged such that a full alarm is given only if the second detector is in the same defined area as the first detector or if a second detector anywhere in the building operates.

NOTE 3 A typical staff alarm arrangement is shown in Figure 5.

- h) In buildings with a staff alarm, smoke detectors in access rooms that form the only means of escape from inner rooms should give an immediate local warning of fire to occupants of the inner rooms, even though the alarm signal might be delayed elsewhere in the building, unless there is adequate vision

between the inner room and the access room.



19.2.3 Recommendations applicable to audible "Alert" signals

The following recommendations are applicable.

- The audible alert signal should be intermittent (1 ±0.5) s on and (1 ±0.5) s off.
- Signals from different fire alarm devices should be synchronized.
NOTE 1 Synchronization ought to be sufficient to ensure that the "Alert" signal cannot be confused with a continuous "Evacuate" signal.
- Provision should be made for manually changing the "Alert" signal to the "Evacuation" signal in any area.
NOTE 2 Provision may also be made for automatically changing from the "Alert" signal to the "Evacuate" signal.
- Provision may be made for the "Alert" signal to cease automatically after 30 s, provided that, at periods not exceeding three minutes, the signal is restored for a period of at least 10 s until it is manually silenced.

20 Manual call points

20.1 Commentary

Manual call points (MCPs) need to be prominently sited, readily distinguishable from non-fire alarm call points and need to be distributed such that, from any point in the building, it is impossible to leave the storey or the building without passing a manual call point.

Sufficient call points need to be provided to minimize, to a reasonable extent, the delay between discovery of a fire and the sounding of the alarm. Where the fire hazard level is high and rapid-fire development is anticipated, this delay needs to be commensurately shorter.

MCPs can, if present in unsupervised areas, be subject to malicious operation. For this reason, they are not normally provided in, for example, public common areas of shopping complexes and certain public houses. In public car parks within a building, use of an emergency voice communication system could be considered instead of MCPs.

In the event of an evacuation signal, people evacuate the building via an exit that leads to a place of ultimate safety, that is, a place in which there is no immediate or future danger from fire. To conform to this standard, MCPs are sited adjacent to all storey exits and exits to open air that lead to a place of ultimate safety.

Therefore, if, for example, a door leads to an enclosed courtyard that is in the open air but has no exit to a place of ultimate safety, this door would not need to be provided with an MCP as the provision of an MCP at this point could infer that the door leads to a place of safety. Moreover, to escape, people would need to re-enter the building and would therefore be afforded an opportunity to operate the fire alarm system on their route to a suitable exit. Similarly, the same would apply to a door leading to a flat-roofed area from which there is no suitable means of escape (e.g. external escape stairway).

Some openings in the building envelope (such as a roller shutter door) are not normally considered as a pedestrian exit, but in an emergency are likely to be used as such. It might, therefore, be appropriate to consider them as an exit and provide an MCP at the opening. If openings cannot be used as a means of safe egress from the premises to a place of ultimate safety, MCPs might not need to be provided.

20.2 Recommendations

The following recommendations are applicable.

- a) The method of operation of all MCPs in a system should be that of type A as specified in BS EN 54-11. All call points should be identical unless there is a special reason for differentiation.

NOTE 1 The Type A manual call point is defined in BS EN 54-11 as follows. "Type A Direct operation. A manual call point in which the change to the alarm condition is automatic (i.e. without the need for further manual action) when the frangible element is broken or displaced."

NOTE 2 The fitting of a protective cover to the type A manual call point is not deemed to conflict with **20.2a**).

- b) All MCPs should be fitted with a protective cover; which is moved to gain access to the frangible element.
- c) The delay between operation of an MCP and the giving of an "Evacuate" signal in, at least, the alarm zone within which the call point is located should not exceed 3 s.

NOTE 3 BS EN 54-2 permits a delay of up to 10 s in the response of control equipment; accordingly, a delay of 10 s might be acceptable, subject to the agreement of the relevant enforcing authority and the recording of the delay as a variation on the completion certificate.

- d) MCPs should be located on escape routes and, in particular, at all storey exits and all exits to open air that lead to an ultimate place of safety (whether or not the exits are specifically designated as fire exits).

Those located at storey exits may be sited within the accommodation or on the landing of a stairway to which the storey exit gives access (see Figure 6). In multi-storey buildings with phased evacuation, in which only a limited number of floors are evacuated at one time, only the former option applies; under these circumstances, MCPs should not be located on stairway landings, as persons travelling down the stairway might operate an MCP several floors below that on which a fire is located, resulting in evacuation of inappropriate areas.

- e) Distribution of MCPs should be such that no one need travel more than 23 m [except where 20.2f) applies] to reach the nearest MCP, measured along the route that a person would actually follow taking into account the layout of walls, partitions and fittings. If, at the design stage, the final layout of the premises is unknown, the maximum straight line distance between any point in the building and the nearest MCP should not exceed 15 m [except where 20.2f) applies]; final fit out of the premises, the limit of 23 m should still then apply.
- f) The figures of 23 m and 15 m recommended in e) should be reduced to 15 m and 10 m, respectively, in the following circumstances:
 - 1) where a significant proportion of occupants have limited mobility and it can be reasonably anticipated that one of these occupants will be the appropriate person to first operate fire alarm system in the event of fire; or
 - 2) where processes in the area result in the likelihood of rapid fire development (e.g. where there is use, or processing, of highly flammable liquids or flammable gases).
- g) Where specific equipment or activities result in a high fire hazard level (e.g. kitchens or cell paint spraying), a MCP should be sited in close proximity.

NOTE 5 In both examples given in g) other considerations also apply. Kitchens or food preparation area might require the use of a non-glass frangible element to avoid the possibility of food contamination glass fragments.

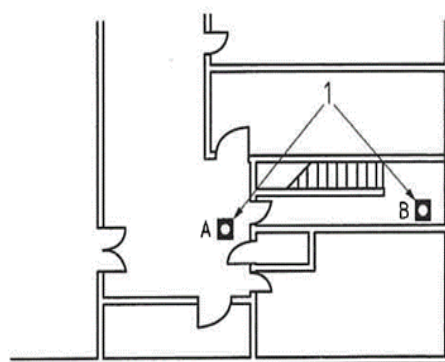
The spraying area might require the use of equipment certified for use in potentially atmospheres (see Clause 10).

- h) In buildings with phased evacuation, additional MCPs are necessary to ensure that a MCP is located at every designated exit from an alarm zone.
- i) MCPs should be fixed at a height of 1.4 m above finished floor level, at easily accessible, well illuminated and conspicuous positions free from potential obstruction. They should be sited against a contrasting background to assist in easy recognition. A lower mounting height is acceptable in circumstances where there is a high likelihood that the first person to raise an alarm of fire will be a wheelchair user.

NOTE 6 The measurement ought to be made between the finished floor level and the centre point of frangible element.

NOTE 7 The figure of 1.4 m is arbitrary but reflects long established custom and practice. A minor differs (e.g. less than 300 mm) in mounting height (e.g. to align with the mounting height of light switches) need be regarded as significant, nor need it be recorded as a variation.

- j) MCPs may be flush mounted in locations where they will be seen readily, but, where they will be viewed from the side (e.g. corridors), they should be surface mounted or only semi-recess with the front face proud of the mounting surface by no less than 15 mm.
- k) In public car parks, any use of an emergency voice communication system in lieu of MCPs should be subject to approval by the relevant enforcing authority, and the system should conform to BS 5839-9. All outstations should be Type B outstations in accordance with BS 5839-9. The master station should be sited in a permanently manned location, such as a control room.



Key

1 Manual call point may be sited in position A or B

Figure 6 — Manual call points on escape routes [see 20.2d]

21 Types of fire detector and their selection

21.1 Commentary

21.1.1 General

Fire detectors are designed to detect one or more of the four characteristics of fire, namely:

- heat;
- smoke;
- combustion gas (such as carbon monoxide);
- infrared or ultraviolet radiation.

In some fire detection and fire alarm systems, a fire signal is initiated when the characteristic reaches a predetermined threshold. A signal may, instead or in addition, be initiated when the rate of change of the characteristic is representative of a fire.

In the case of point detectors, the characteristic is detected at a defined point(s) within the protected area. In contrast "line" detectors are capable of detecting the characteristic along a defined line within the protected space. In an "integrating line detector"; the effect of the characteristic on the detector is integrated along the

line. In a "non-integrating line detector"; this is not the case, and the detector behaves effectively as though it comprised an infinite number of point detectors arranged along a line.

In multi-sensor fire detectors, each detector contains more than one sensor and thus monitors more than one of the characteristic fire phenomena (e.g. heat and smoke). By analysis of the signals received from the sensors, potential response to phenomena other than fire can be reduced while still providing an adequate response to fire.

When applying the recommendations in 21.2, refer also to Annex E for guidance on the selection of detection type and any settings of mode or sensitivity. Clause 40.2b)1) recommends that a designer record the selection of the detector type and configuration using Table E.1.

21.1.2 Heat detectors

Heat detectors may take the form of either point type detectors or line type detectors. The detection system may be designed to respond when a fixed temperature is reached. The heat detector may also include a sensor that responds to the rate of rise of temperature. In this case, the detector responds either the temperature rises at more than a certain rate, or when the fixed temperature is reached.

Heat detectors conforming to BS EN 54-5 operate in the manner described above. Heat detectors that operate only when the rate of rise of temperature is abnormal, but not when a fixed temperature is reached, do not conform to BS EN 54-5 and ought not to be used; they can fail to detect a slowly developing fire.

21.1.3 Smoke detectors

Point smoke detectors utilize one (or both) of two principles:

- ionization chamber smoke detectors detect smoke by the reduction it causes in the current that flows between electrodes in an ionization chamber within the detector;
- optical smoke detectors detect smoke by means of the light scatter that results from the presence of a small light source within the detector.

Optical beam smoke detectors are effectively line type smoke detectors. They comprise a light source (usually operating at infrared frequencies) and a receiver. The two are either separated or housed within a single unit, in which case reflectors are used to reflect light from the transmitter back to the associated receiver. Optical beam detectors operate by detecting the obscuration of the light source that occurs in the presence of smoke. Some optical beam detectors can also detect heat by means of variation in the refractive index of light ("shimmer effect") that occurs at turbulent interfaces hot and cold air.

In an aspirating smoke detection system, air samples are drawn, by a pump or fan, through sampling points (holes in the pipework) within the protected area, to a central detector. The detector can open on ionization chamber or optical principles.

The amount of air entering each sampling point is usually small and ought not to be considered as modifying air or smoke flows within the protected space. In general, each sampling point may be considered as a separate point type smoke detector provided that a single sampling point has equivalent sensitivity to a point type smoke detector.

21.1.4 Combustion gas detectors

Combustion gas detectors are point-type detectors that respond to one (or more) of the gases production by a fire. For example, carbon monoxide is produced when incomplete combustion occurs as a result restriction of the amount of oxygen available to support the combustion process.

Carbon monoxide can spread by diffusion through certain forms of construction. In the event of fire, therefore, carbon monoxide detectors could operate at a considerable distance from the fire, and floors other than the floor of fire origin. Care needs to be taken to ensure that this does not result in misleading information for firefighters or others responding to a fire signal.

Electrochemical sensors within combustion gas detectors have a finite life, after which replacement is necessary. It is important that the user is made aware of the likely lifetime of any combustion gas detector used within a fire detection and fire alarm system.

21.1.5 Flame detectors

Flame detectors detect the infrared and/or ultraviolet radiation that is emitted by flame. Both types radiation-sensitive cells that "see" the fire either directly or through built-in lenses or reflectors.

Infrared flame detectors are usually designed to respond to flame characteristics such as flicker, size of more than one specific radiation frequency. Types intended for outdoor use can be designed to respond to specific infrared frequency bands that are not characteristic of solar radiation.

Ultraviolet flame detectors normally operate within wavelengths that the ozone layer filters out of solar radiation. Hence, ultraviolet detectors do not normally respond to sunlight and may generally be used outdoors.

21.1.6 Multi-sensor fire detectors

In a fire detection system incorporating multi-sensor detectors, each multi-sensor fire detector contains more than one sensor, each of which responds to a different physical and/or chemical characteristic of fire. The purpose of combining sensors in this way is to enhance the performance of the system in detection of fire, or its resistance to at least certain categories of false alarm, or both.

The method (if any) of combining the signals from each sensor varies between different proprietary multi-sensor fire detection systems. In some such systems, there is significant potential for reduction of many types of false alarm.

With some multi-sensor fire detectors, it is possible to disable an individual detection sensor. This might be used in a time-related system to reduce false alarms (see 35.2. 7.1). For example, with a heat and optical multi-sensor detector the optical sensor might be disabled during the day. If this is the case, it is vital that the detectors are spaced for the least sensitive sensor, in this case, heat.

21.1.7 Video fire detectors

Fire can also be detected by video techniques, in which video cameras monitor the protected space.

The images from each camera are analysed electronically to detect the presence of smoke and/or flames by monitoring changes that occur in the camera's field of view.

Video fire detectors rely on appropriate and continuous illumination of the field of view. Such lighting can be normal lighting, specially installed infrared light sources, or a combination of the two.

Video fire detectors can also be used as a means of verifying a fire (see Section 3). Where they are the sole means of detection, they need to be designed, and their suitability and performance verified, by a qualified specialist.

There are currently no product standards that define the performance of video fire detectors and reliance is placed on manufacturers' recommendations. In many cases, they tend to be used as supplemental detection or for special applications where other detection techniques are inappropriate or ineffective.

21.1.8 Choice of fire detection principle

No one type of detector is the most suitable for all applications. Final choice depends primarily on:

- the speed of response required (to satisfy, the fire safety objective);
- the need to minimize false alarms;
- the nature of the fire hazard.

However, other factors, such as cost, suitability for the environment and maintenance requirements, might need to be considered. In some circumstances, a mixture of different types of detectors might be appropriate to optimize speed of detection or to minimize false alarms.

All fire detectors will respond to some extent to phenomena other than fire. Measures to minimize such false alarms and their effects are described in Section 3.

Heat detectors are generally less sensitive to most fires than all other types of fire detector, but can detect certain very clean-burning fires, such as those involving certain flammable liquids (e.g. alcohol) before a smoke or combustion gas detector. They are unlikely to respond to smouldering fires and, as a simple rule of thumb, require the flames from a fire to reach about one-third of the distance to the ceiling before they operate.

In view of their lack of sensitivity, heat detectors are not suitable for the protection of areas where warning of the presence of smoke is required or where a small fire would cause unacceptable damage.

On the other hand, heat detectors generally have a greater resistance to environmental conditions than other types of detectors. Accordingly, in most situations, they have the greatest immunity to false alarms. In addition, they generally require only the minimum of routine attention during system maintenance.

Ionization chamber smoke detectors are particularly sensitive to smoke containing small particles, such as are produced in rapidly burning flaming fires, but might be less sensitive to the larger particles found in optically dense smoke of similar mass, such as can result from smouldering fires, including those involving polyurethane foam or overheated PVC.

Optical smoke detectors are sensitive to optically dense smoke but are less sensitive to the small particles found in clean-burning fires that produce little visible smoke. Detectors that operate on the principle of light

scatter are more sensitive to light coloured smoke; very dark smoke, by definition, absorbs light rather than scatters it, but will be readily detected by a smoke detector that operates on the principle of obscuration (e.g. an optical beam type detector).

One of the hazards on escape routes and stairways is visible smoke, which might obscure the visibility of the route and of exit signs. Optical smoke detectors are therefore well suited for use in escape routes because they detect visible smoke and might operate before the escape route becomes impassable.

Both optical and ionization chamber smoke detectors conforming to BS EN 54-7 have a sufficiently wide range of response to be suitable for most applications in which a smoke detector is appropriate. In some premises, however, there might be specific risks for which one type is more suitable, either in respect of sensitivity to the type of fire that is anticipated or resistance to false alarms (see Section 3). In specific circumstances, it might be advisable to install point smoke detectors having a higher or lower sensitivity, possibly in conjunction with a time-related system. Specialist application guidance ought to be sought from the manufacturer.

Optical beam smoke detectors can prove economical and effective for the protection of large, open-plan spaces with relatively high ceilings (e.g. warehouses), particularly if access to point smoke detectors for maintenance could present practical difficulties. It is, however, essential that they are mounted to solid construction that is unlikely to "flex" as a result of changes in temperature or imposed load, as this can cause misalignment of the optical beam and, hence, fault signals or false alarms. The band of sensitivities of optical beam smoke detectors conforming to BS EN 54-12 is defined by an absolute maximum sensitivity (corresponding to an obscuration in the near infrared of 0.4 dB) and a minimum sensitivity that is defined by the ability to pass fire tests TF2 to TFS (typically 5 dB). In specific circumstances, it might be advisable to install optical beam smoke detectors having a higher or lower sensitivity. Specialist application guidance ought to be sought from the manufacturer.

Conventional smoke detection systems cannot detect the products from clean-burning fires (such as burning alcohol), which do not produce smoke particles. This is not usually a serious disadvantage because a fire normally involves other combustibles at an early stage. A fire that involves only a material that burns without the production of smoke can, however, be detected by optical beam smoke detectors that incorporate thermal turbulence detection.

A multi-sensor fire detector is one that incorporates, in a single mechanical enclosure, sensors which detect more than one physical or chemical phenomenon of a real fire. The overall fire performance is determined using a combination of the detected phenomena. Sensors included in currently available multi-sensor fire detectors detect smoke, carbon monoxide and heat.

Single-sensor fire detectors are suitable in most instances. However, certain multi-sensor fire detectors can provide, depending on the detection algorithm used, some or all of the following advantages in certain applications:

- when the expected fire is of a specific type;
- when the expected fire does not produce smoke particles;
- when there is a specific threat from a certain type of unwanted alarm (see Clause 35);
- when the risk varies at different times of day; or
- when it is deemed advantageous to standardize on one type of detector for all areas of the building.

Some multi-sensor detectors can be configured into an operating mode for which they have not been certificated or do not conform to standards. Any variation in configuration from that first designed can be recorded as explained in Annex E.

In general, smoke detectors give appreciably faster response to most fires than heat detectors but are more likely to give false alarms (see Section 3). Where there are production or other processes that produce smoke, fumes, dust, etc., which might operate smoke detectors, an alternative type of fire detector needs to be used.

Aspirating smoke detection systems commonly incorporate a detector of much higher sensitivity than point or optical beam smoke detectors. Such "high sensitivity" aspirating smoke detection systems are designated Class A systems in BS EN 54-20 and are often used to protect critical electronic equipment rooms, in which even a very small fire can result in unacceptable damage. Guidance on fire protection of such facilities is given in BS 6266.

Aspirating smoke detection systems are also used to protect spaces in which point, or beam type smoke detectors would present difficulties on the basis of:

- aesthetics (aspirating pipework might be run in floor voids, with capillary tubes sampling air from the space below via a small hole drilled in the ceiling);

- height of the space (the cumulative sampling provided by aspirating smoke detection systems, coupled with the possibility of running pipework vertically on the walls and storage racks, can provide enhanced protection compared with point smoke detectors mounted at ceiling level);
- temperature of the space (e.g. in cold stores, the detector can be located outside the space, so that it is not directly exposed to low temperatures);
- difficult maintenance access (in areas where access for maintenance will be restricted or even impossible after installation, the detector can be located outside the restricted space).

Typically, a Class B (enhanced sensitivity) or Class C (normal sensitivity) aspirating smoke detection system is used in such applications, but it is important to seek advice from suppliers or other competent persons with sufficient experience and knowledge of aspirating smoke detection systems and BSEN 54-20.

For aspirating systems, specialist application guidance needs to be sought from the manufacturer.

Where the principal gas to which a combustion gas detector responds is carbon monoxide, the detector will be most sensitive to smouldering fires and fires in which the rate of burning is controlled by the supply of air. Such detectors can be relatively insensitive to free-burning fires supported by a plentiful supply of oxygen.

Carbon monoxide detectors can be immune to certain environmental influences that can result in false alarms from certain smoke detection systems, such as dust, steam and cigarette smoke, while responding to many types of fire appreciably faster than heat detectors.

Because of their inability to detect smouldering fires, flame detectors ought not to be considered as general-purpose detectors, and are normally used for specialized applications, such as detection of fires in plants handling or storing highly flammable liquids or gases.

Infrared flame detectors are sometimes used to protect very high spaces, such as cathedrals or atria. The detectors do not need to be ceiling-mounted; they can be mounted at relatively low levels on walls around a very high protected space, within which only a very large fire could be detected by ceiling-mounted heat or smoke detectors. Ultraviolet flame detectors are not generally suitable for this application, since ultraviolet radiation is greatly attenuated by smoke, whereas infrared radiation penetrates smoke well.

While achievement of the fire safety objective (e.g. warning occupants of fire before escape routes are impassable) always takes precedence, avoidance of false alarms needs to be given similar weight in consideration of the detection principle by the designer at the design stage. A high level of false alarms is not merely disruptive to occupants and business activities; it can result in failure to achieve the fire safety objective as a result of disablement of part, or all, of the system, or of inappropriate response of occupants to fire signals.

Choice of fire detection principle therefore needs to take into account:

- the speed of fire detection required, based on an assessment of fire risk;
- the nature and quantity of the combustible materials present, including ease of ignition, heat release rate, likely form of combustion (e.g. smouldering or flaming) and propensity for smoke production;
- probable rate of fire growth and spread;
- the nature of the environment (e.g. humidity, temperature, cleanliness, extent of pollutants and nature of work processes);
- the proposed fire evacuation strategy;
- the height and geometry of the protected area;
- the attendance time of the fire and rescue service (particularly in the case of Category P systems);
- other active and passive fire protection measures present;
- the susceptibility of contents to heat, smoke and water; and
- the speed of response to fire, and the probable false alarm rates, of different types of fire detector.

In general, in a slow smouldering fire, a smoke or combustion gas detector will operate before a heat detector. A fire that evolves heat and flame rapidly and with very little smoke could operate a heat or flame detector before a smoke or combustion gas detector. With a flammable liquid fire, a flame detector could operate first. Where speed of response is important in an environment in which false alarms might result from the type of fire detection that is desirable, multi-sensor fire detectors or a system incorporating coincidence detection can enable early detection of fire without an unacceptable rate of false alarms.

While the fastest achievable response to fire is desirable, it might not always be necessary, given the objective of the system, the other fire protection measures present, the likely nature of a fire and the potential for fire-spread; nor is it desirable if the result is an unacceptable rate of false alarms.

If for example, there were a requirement to protect a transformer chamber in a dirty environment, consideration would need to be given to the reason for the protection. If the reason were concern regarding the hazard that the oil-filled transformer created to adjacent areas, from which it was separated by substantial fire-resisting construction, heat detection might be appropriate. A fire involving the flammable oil would be detected quite quickly and well before the integrity of the fire-resisting construction was threatened. Even if earlier warning could be given by smoke detection, the increased potential for false alarms and increased maintenance burden might not be warranted. If, alternatively, the reason for the protection were to protect the transformer, on which a high revenue earning process depended, from a fire in cables within the enclosure, smoke detection might be necessary.

Similarly, it is acceptable, in a Category L2 or L3 system within a building in which people sleep, to install heat detectors in bedrooms. The objective of these detectors is not to provide the earliest possible warning to occupants of a bedroom in which fire starts, but to warn other occupants before the integrity of the door of the bedroom is threatened by fire.

Earlier warning would be given by smoke detectors, and might be desirable in, for example, rooms occupied by disabled people, but at an increased risk of false alarms. Earlier warning with a lesser increase in the risk of false alarms might be given by carbon monoxide detectors or by a multi-sensor fire detection system.

In order to ensure that the objectives of the system are satisfied without an unnecessary level of false alarms, early consultation between the interested parties is desirable (see Clause 6). An assessment of the fire risk would be included in this consultation.

21.2 Recommendations

The following recommendations are applicable.

- a) The type(s) of fire detector used in a system should provide adequate protection of occupants, property or both, as appropriate to the category of system, while minimizing the risk of false alarms as far as practicable (see Section 3). In case of doubt, there should be early consultation between all interested parties (see Clause 6). Maintenance requirements for different types of detectors should also be taken into consideration, along with any special requirements of the user (e.g. regarding the impact of the fire detection system on aesthetics).
- b) Heat detectors may be used in any area, other than the following:
 - 1) areas of a Category P system in which a small fire (including any form of smouldering fire) has the potential to cause unacceptable damage;
NOTE 1 Products of combustion might be corrosive and cause considerable damage without burning the contents of the affected area.
 - 2) escape routes in Category L systems (but heat detectors may be used in other areas, including rooms that open onto escape routes);
 - 3) areas in which the production of smoke could present a threat to occupants' escape before it is likely to be detected by people or heat detection.
NOTE 2 It is generally accepted that occupants in a room of fire origin are likely to be aware of a fire before it is detected by any form of fire detector, unless they are asleep. Even if occupants are asleep, the risk to occupants of typically sized bedrooms might not be such as to warrant smoke detection within the bedrooms, except in the case of dormitory accommodation or rooms intended for mobility-impaired disabled people who require additional time to escape from a fire in their bedroom.
 - 4) areas in which heat detectors would have a high potential for false alarms (see Section 3).
- c) Smoke detectors may be used in any area, other than the following:
 - 1) areas in which the principal fire hazard is the presence of flammable liquids or gases that produce little smoke when involved in a fire;
NOTE 3 If fire is likely to involve carbonaceous materials, such as wood, paper, textiles, etc., in the early stages, smoke detection might be suitable.
 - 2) areas in which smoke detectors would have a high potential for false alarms (see Section 3), unless the risk from fire warrants the provision of automatic fire detection and the use of other forms of fire detection is precluded on the basis of their speed of response to fires of the type that might be anticipated.

NOTE 4 This does not imply that a high rate of false alarms is ever acceptable; methods, such as filtering, might be necessary to avoid an unacceptable rate of evacuation signals and calls to the fire and rescue service (see section 3.).

NOTE 5 Use of an optical smoke detector instead of an ionization chamber smoke detector (or vice versa) can change the potential for false alarms considerably (see section 3)

- d) In Category L systems, smoke detectors installed within corridors and stairways that form part of the means of escape should be of the optical type, unless the use of optical detectors would significantly increase the rate of false alarms (see Section 3).

NOTE 6 Multi-sensors containing a smoke detector might be suitable in circumstances referred to in 21.2c) and 21.2d).

- e) In areas in which early detection of a smouldering fire is required, optical smoke detectors, optical beam detectors, aspirating smoke detection systems, carbon monoxide fire detectors or suitable multi-sensor fire detectors should be used.
- f) In areas in which early detection of a relatively fast and clean-burning flaming fire is required, ionization chamber smoke detectors, suitable multi-sensor fire detection systems or flame detectors should be used; suitably sensitive heat detectors may also be considered.
- g) Carbon monoxide fire detectors may be used to protect any of the following areas:

- 1) any area in which the use of a heat detector would be acceptable, other than areas in which the principal fire hazard comprises flammable liquids that, when ignited, result in a rapid flaming fire;
- 2) rooms opening onto escape routes in a Category L3 system;

NOTE 7 Use of carbon monoxide fire detectors in bedrooms provides a higher standard of protection of sleeping occupants than heat detectors, but the potential for false alarms will be less than in the case of smoke detectors.

- 3) all escape routes within Category L3 or L4 systems, provided carbon monoxide detectors are used in conjunction with smoke detectors. Specialist application guidance should be sought from the manufacturer;
- 4) any other area in which the fire hazard (e.g. the nature of the combustible materials, the type of fire that could be expected and the amount of ventilation) is of such a nature that there is test evidence to demonstrate that the carbon monoxide detectors proposed would offer adequate fire protection.
- h) Flame detectors should only be used in situations in which it is sufficient for the fire detection system to respond to flaming fires, but not fires that produce smoke without significant flame (e.g. smouldering fires). For flame detectors to be effective, they should have a clear line-of-sight to the area being protected.
- i) Ultraviolet flame detectors should not be used as the sole means of fire detection in areas within buildings in which a fire can produce significant quantities of smoke before flaming occurs.
- j) When video fire detectors are used as the sole means of detection, the recommendations of the product manufacturer and/or suppliers in terms of detection performance and application limitations should be followed and, wherever required, specialist knowledge should be sought.

NOTE 8 It is important that video fire detectors are capable of detecting flame and/or smoke reliably in the absence of the normal lighting in the building and the absence of a mains power supply to any lighting provided specifically to aid the detection of flame and/or smoke.

- k) Where detection can be set to a number of different operating modes (e.g. a multi-sensor fire detection system with a number of different response characteristics), the basis for selection of the response characteristics selected should be recorded in the operating and maintenance manual for the system. See 40.2b) and Annex E.

22 Spacing and siting of automatic fire detectors

22.1 Commentary

Heat and smoke detectors depend on convection to transport hot gases and smoke from the fire to the detector. Spacing and siting of these detectors needs to be based on the need to restrict the time taken for this movement and to ensure that the products of combustion reach the detector in adequate concentration. In a building, the hottest gas and the greatest concentration of smoke generally form at the highest parts of the enclosed areas, and it is here, therefore, that heat or smoke detectors need to be sited.

As the smoke and hot gases from a fire rise, they become diluted with clean, cool air, which is drawn into the plume. Hence, the size of fire required in order to operate heat or smoke detectors increases rapidly as the height of the ceiling above the fire increases. To some extent, this effect can be countered by the use of more sensitive detectors. Optical beam detectors and aspirating smoke detection systems are less sensitive to the effects of ceiling height than are point-type detectors, since the increased size of plume will involve a greater proportion of the path length of the optical beam or more sampling holes and so help to alleviate the effects of reduced smoke density.

In addition, the entrainment of air cools the gases. If the ceiling is high and the ambient temperature in the uppermost areas within the protected space is high, the plume of smoke and hot gases might reach ambient temperature before reaching the ceiling. If the temperature of the surrounding air increases with height (e.g. as a result of solar gain), it is possible for the air at the uppermost levels to be at a higher temperature than that of the plume. The plume will then spread out to form a smoke layer before it reaches the ceiling, as though there were an "invisible ceiling" at a specific height within the protected space. This is known as stratification, and, at this stage of the fire growth, the smoke and hot gases will not operate ceiling-mounted detectors, regardless of their sensitivity.

It is usually difficult to predict with any degree of certainty the level at which stratification occurs; this depends on the convective heat output of the fire and the temperature profile within the protected space at the time of the fire, neither of which are accurately known quantities. If detectors are mounted at an expected stratification level, and stratification does not occur or occurs at a higher level, detection might be dangerously delayed, as the relatively narrow plume can "bypass" the detectors. In some cases, a high density of detection at a low level might be sufficient to detect any rising plume. Alternatively, multi-level detection can be provided by, for example, using sampling holes of an aspirating fire detection system at multiple levels, or by aiming an optical beam detector at an angle to the horizontal, so that it might detect smoke as it stratifies.

Ultimately, as the fire grows and releases more heat, the plume will break through the thermal barrier and ceiling-mounted detectors will operate, albeit at a later stage of the fire than if no stratification had occurred. [However, a larger fire can normally be "tolerated" if the ceiling height is greater.] Thus, where multi-level supplementary detection is provided in a high space with the intention of detecting the stratified layer, ceiling-mounted detectors need to be used. However, where the design intent of the low level detection is to detect a rising plume (taking into account the fact that since the plume of hot gas is relatively narrow, the radius of coverage of any supplementary detection intended to detect a rising plume needs to be reduced), omission of ceiling-mounted detectors might be considered, provided that there is no discernible fire risk above the low-level layer of detectors.

Flame detectors do not rely on convection, but detect the radiation emitted from flame. Accordingly, they do not need to be mounted on ceilings, and they are not affected by stratification. Their sensitivity to a fire does decrease, however, as their distance from the fire increases and as the intensity of the radiation decreases approximately in proportion to the square of the distance from its source. On the one hand, they may be mounted at relatively low level within a high space to maximize sensitivity to a fire at ground level; on the other hand, since they depend on a clear line-of-sight to the fire, mounting at too low a height can preclude early detection of a shielded fire.

Although, for general protection of any space, the above considerations apply, localized "spot" protection can be provided by additional fire detectors. For example, line-type heat detection systems might be particularly suitable for protecting items of plant or cabling. When used for these purposes, the detector needs to be mounted as close as possible to the place where fire or overheating might occur, and either mounted above the item to be protected or in thermal contact with it.

The effectiveness of an automatic fire detection system is affected by obstructions between heat or smoke detectors and the products of combustion. It is important that heat and smoke detectors are not mounted too close to obstructions to the flow of hot gases and smoke towards the detector and that radiation from flame is not obscured from flame detectors. At the junction of a wall and a ceiling, there is a "dead space"; within which heat, or smoke detection would not be adequately effective. The effect on detection efficiency might be less in the case of carbon monoxide detection, since transport of carbon monoxide to the detector is assisted by diffusion.

Similarly, as the hot gases and smoke flow horizontally across a ceiling, there **is** a stagnant boundary layer at the surface of the ceiling; this precludes the sensitive element of a heat or smoke detector from being mounted flush with a ceiling. This restriction does not apply to the sampling points of an aspirating smoke detection system, which can be flush-mounted because the sampled air drawn into the sampling hole comes from the main flow outside the boundary layer. By contrast, a point type smoke detector relies on the flows across the ceiling (outside the boundary layer) to drive the smoke into the chamber.

In siting heat, smoke and combustion gas detectors, consideration needs to be given to the possible pattern of air movement in the premises. Air conditioning and ventilation systems with high air change rates might

adversely affect the response of detectors by drawing fresh air over them, by drawing heat, smoke and combustion gases away from them, or by diluting the smoke and hot combustion gases produced by a fire. It might be necessary to seek specialist advice.

Guidance on protection of ceiling voids in this standard is based on still air within the voids. Where there is significant air flow within a void, such as where the void is used as an air handling plenum, special consideration might need to be given to the spacing, siting and sensitivity of detectors within the void.

Smoke detectors may be sited to monitor smoke within ventilation extract ducts. In general, such detectors are intended to assist in the prevention of spread of smoke by the ventilation system, by enabling any recirculation to be shut off in the event of a fire. These detectors may be connected to the fire detection and fire alarm system but, if the smoke detectors are of normal sensitivity, they would not constitute a satisfactory means of detecting a fire in the area from which the air is drawn, as the smoke is diluted by the clean air that is extracted. Smoke might collect in one or more layers in ventilation ducts, so as much of the duct needs to be sampled as is practical. Duct probe sampling pipes with adequate holes are therefore arranged to cover the widest dimension of the duct.

Certain very high-sensitivity smoke detection systems (often of the aspirating type) are sensitive enough to detect smoke that has been substantially diluted with clean air. Experience has shown that such systems, when used to monitor return air to air conditioning units by means of air sampling points mounted directly in the airflow, are capable of detecting very small, incipient fires, involving, for example, smouldering of electronic components within equipment cabinets in the protected space.

This arrangement is usually regarded as supplementary to other forms of fire detection in the protected space (including aspirating systems with air sampling points sited in accordance with practice normally adopted for point smoke detectors), owing to its limited response capability once the air movement ceases.

For remotely situated or hard-to-access detection equipment, consideration needs to be given to the feasibility of testing and maintenance at the design stage.

22.2 Recommendations for provision of automatic fire detectors

The following recommendations are applicable.

- a) Fire detectors should be provided in accordance with 8.2
- b) In stairways, fire detectors should be sited at the top of the stairway and on each main landing.
- c) Other than in Category L4, LS and P2 systems, if any flue-like structure, shaft for a lift, escalator or hoist, or any enclosed chute, penetrates one or more ceilings, a fire detector should be sited at the top of the shaft or enclosure and, on each level in the accommodation area, within approximately 1.5 m of the penetration.

The need for fire detectors in these positions should be considered at the design stage of Category LS and P2 systems.

NOTE 1 For any of these flue-like structures a fire detector within 1.5 m is needed only in the areas protected by the category of system in question.

- d) If the system category is such that automatic fire detection should be provided in any area that contains a horizontal void of 800 mm or more in height, automatic fire detection should also be provided in the void. Voids less than 800 mm in height need not be protected, unless either:
 - 1) the void is such that extensive spread of fire or smoke, particularly between rooms and compartments, can take place before detection; or
 - 2) on the basis of a fire risk assessment, the fire risk in the void is such as to warrant protection of the void.

NOTE 2 In Category P systems, it is common practice to protect all floor voids in electronic data processing installations, regardless of their depth, if the voids contain cables. Usually, this is on the basis of the probability of ignition and the amount of combustible material within the void, in conjunction with the consequences of a fire within the void in respect of business continuity. Guidance on protection of electronic data processing installations is given in BS 6266.

NOTE 3 In a Category L2 or L3 system, detectors in rooms opening onto escape routes are provided only to give a warning of fire before it affects the escape routes. Detection in voids above or below the rooms might not be necessary for this purpose (e.g. if fire-resisting construction separates a void from the adjacent escape route).

NOTE 4 If the fire risk within a void of 800 mm or more is considered to be low, consideration might be given to omission of fire detection from the void, subject to the agreement of the interested parties (see Clause 6), this ought to be recorded as a variation on the relevant system certificate. This might arise, for example, if the probability of

ignition and development of fire in the void were very low, or if the void were limited in extent that spread of fire beyond the room of origin, via the void, were unlikely.

- e) If any lantern-light (see 3.3.1) within a protected area is 800 mm or more in depth, or is used ventilation, a fire detector should be sited in the lantern-light.

22.3 Recommendations for siting of heat, smoke and multi-sensor detectors

The following recommendations are applicable.

- a) Under flat ceilings, the horizontal distance between any point in a protected area and the detector nearest to that point should not exceed:

- 1) 7.5 m if the nearest detector is a smoke detector;
- 2) 5.3 m if the nearest detector is a heat detector.

NOTE 1 In corridors of width not exceeding 2 m, only points close to the centre line of the corridor need be considered, and accordingly the above recommendations will be satisfied if smoke or heat detectors are sited at intervals of 15 m and 10.6 m respectively, with the maximum dimension from the end wall being 7.5 m and 5.3 m respectively.

NOTE 2 Where it is the design intention regularly to disable sensors in a multi-sensor fire detection system, such that the sensors rely solely or substantially on a heat detector, the location of sensors is governed by 22.3a)2).

- b) Where the recommendations of BS 7273-4 conflict with the recommendations of 22.3a), the recommendations of BS 7273-4 should take precedence.

NOTE 3 This might arise only in the case of Category L4 and LS systems in which there are electronically held-open fire doors; in certain circumstances, the maximum spacing between smoke detectors in corridors recommended in BS 7273-4 is less than the maximum specified in this standard.

- c) If the protected area has a pitched ceiling, for detectors at or near the apex, the horizontal distances recommended in 22.3a) may be increased by 1 % for each degree of slope, up to a maximum increase of 25%. For detectors not at or near the apex the distances given in 22.3a) apply.

- d) In apex roofs, fire detectors should be sited at or near each apex, except that, if the difference in height between the bottom of the roof and top of the apex is less than the following figures, the roof may be treated as flat (see Figure 7):

- 1) 600 mm if the area is protected by smoke detectors;
- 2) 150 mm if the area is protected by heat detectors.

NOTE 4 Detectors may be regarded as "near the apex" referred to in 22.3c) and 22.3d) if the vertical distance from the apex to the detector is within the figures given in 22.3d)1) and 22.3d)2) for the appropriate type of detector.

- e) Other than within rooms in a Category L3 system (see 22.3f) or in voids [see 22.3g) or where a horizontal ceiling comprises a series of small cells (see 22.3l), fire detectors should be sited on ceilings, such that their sensitive elements are between the following distances below ceilings:

- 1) 25 mm to 600 mm for smoke detectors;
- 2) 25 mm to 150 mm for heat detectors.

- f) Detectors within rooms that open onto escape routes in a Category L3 system should either be sited in accordance with 22.3e) or should be sited on a wall, close to any door that opens onto an escape route. Wall-mounted detectors should be sited such that the top of the detection element is between 150 mm and 300 mm below the ceiling, and the bottom of the detection element is above the level of the door opening.

NOTE 5 Particular care is necessary in rooms with a high ceiling height (for example height exceeding 4 m).

NOTE 6 Where an automatic sprinkler installation initiates a fire alarm signal, via the fire detection and fire alarm system, on flow of water from a single sprinkler head, a sprinkler head within a room may be regarded as an automatic fire detector for the purpose of this recommendation.

NOTE 7 Wall mounting may also be adopted in those rooms or areas in which the protection afforded by a Category L2 system reflects only the recommendations for a Category L3 system, in that the purpose is protection of the adjacent escape route (i.e. other than in areas in which detector siting needs to reflect the objective of protecting the occupant of the room of fire origin, as is the case in bedrooms intended for disabled people, or giving warning in areas in which the likelihood of fire is high).

- g) In unventilated voids not greater than 1.5 m in depth, the sensing element of fire detectors should be sited within the top 10% of the void or the top 125 mm, whichever is the greater (see Figure 8). Voids greater than 1.5 m in depth should be treated as a room and the recommendations of 22.3e) should be applied. In shallow voids, it might be necessary to mount the fire detector in an unusual orientation, in which case

care should be taken that the deposition of dust or dirt cannot adversely affect the operation of the detector. The manufacturer's recommendations should be followed with regard to orientation and the ingress of dirt and dust and any consequent servicing recommendation.

- h) Heat and smoke detectors should not be mounted within 500 mm of any walls, partitions or obstructions to flow of smoke and hot gases, such as structural beams and ductwork, where the obstructions are greater than 250 mm in depth. (This recommendation does not apply to detectors within rooms opening into escape routes in a Category L3 system).

NOTE 8 If an enclosed area has no horizontal dimension greater than 1 m, it is impossible to comply with this recommendation; this need not be regarded as a variation if the detector is sited as close as possible to the centre of the space.

- i) Where structural beams, ductwork, light fittings or other isolated ceiling attachments not greater than 250 mm in depth create obstacles to the flow of smoke, detectors should not be mounted closer to the obstruction than twice the depth of the obstruction (see Figure 9).

NOTE 9 In some circumstances, compliance with this recommendation might result in non-compliance with 22.3h. In such circumstances, non-compliance with 22.3h (or 22.3i) need not be regarded as a variation.

- j) Where an area contains partitions or storage racks that reach within 300 mm of the ceiling, the partitions or storage racks should be treated as walls that extend to the ceiling (see Figure 10).

NOTE 10 Where a rack contains high-value or high-risk materials or where the height of the rack exceeds 8 m, the use of in-rack detection might be considered. For more information, see the FIA Code of Practice for Design, Installation, Commissioning and Maintenance of Aspirating Smoke Detector (ASD) Systems [Z].

- k) Ceiling obstructions, such as structural beams, deeper than 10% of the overall ceiling height should be treated as walls see Figure 11a).

NOTE 11 Within horizontal voids, beams or obstructions that are deeper than 10% of the overall depth of the void, regardless of whether the void is above the ceiling or below the floor, ought to be treated as walls that subdivide the void.

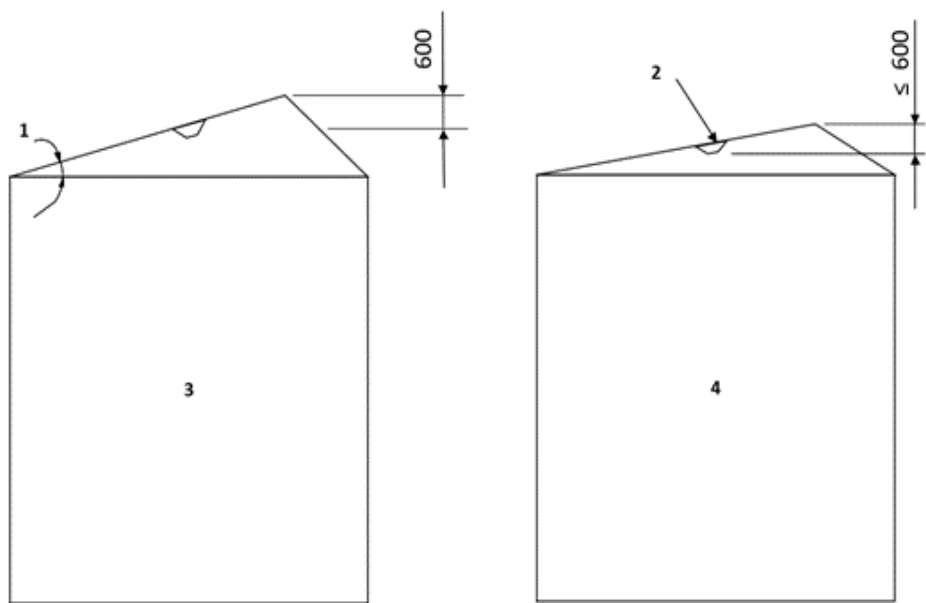
NOTE 12 For a cellular structure or closely spaced beams in a void, see 22.31.

- l) Where a horizontal ceiling comprises a series of small cells (a honeycomb ceiling), detector spacing and siting should be in accordance with Table 1 and Figure 14 [see Figure 11b)]. Where there are a number of closely spaced structural beams, such as floor joists, the cells become elongated. Provided that the longer dimension of the cells is not more than L, then across the shorter cell dimension, the spacing, M, between detectors should be as given in Table 2 and Figure 15. The spacing for the end detector to the end wall is half M. Detectors should be in the centre of the cells. If the longer dimension of the cells is more than L, then the cell should be stopped to the depth of the beam and at not more than L. If this is impractical, detection should be installed in every cell [see Figure 11c)].

L = 10.6 m for smoke detectors.

L = 7.5 m for heat detectors.

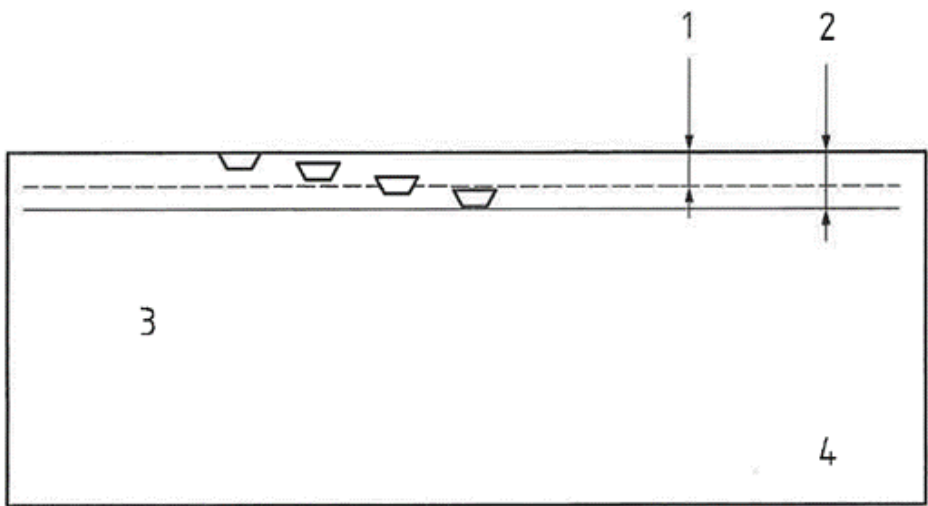
- m) Detectors above a perforated false ceiling may be used for protection of the area below the false ceiling if:
 - n) the perforations are substantially uniform, appear across the complete ceiling and throughout they make up more than 40% of the surface; and
 - 1) the minimum dimension of each perforation in any direction is 10 mm; and
 - 2) the thickness of the ceiling is not greater than three times the minimum dimension of each perforation.
 - o) In all other cases, detectors should be mounted below the false ceiling, and if protection of the void above the false ceiling is necessary [see 22.2d)], further detectors should be installed on the true structural ceiling within the void.
 - p) Detectors should not be mounted within 1 m of any air supply point of a ventilation system. Where air is forced through a perforated ceiling, the ceiling should be imperforate for a radius of at least 600 mm around each detector (see Figure 12).
 - q) Detector siting should be such that a clear space of 500 mm is maintained below each detector (see Figure 13).



Key

- | | |
|---------------------|--|
| 1 Roof angle | 3 For roofs with a pitch deeper than 600 mm, smoke detectors should be within the top 600 mm and increased coverage due to the angle of the roof will then be applicable [see 22.3b)] |
| 2 Detector | 4 For roofs with a pitch less than 600 mm, smoke detectors may be anywhere on the roof. [see 22.3c)] |

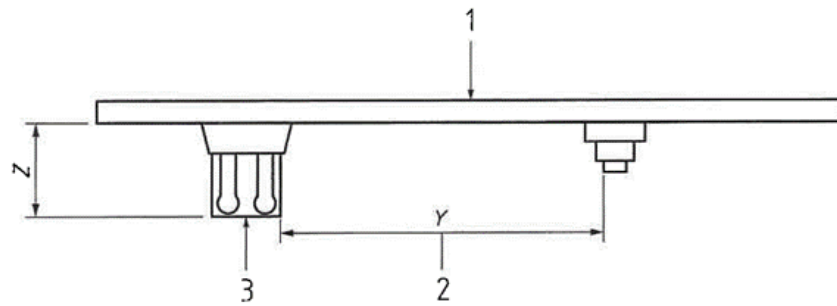
Figure 7 – Smoke Detectors in Pitched roofs [see 22.3d]



Key

- | | |
|-----------------------------|---|
| 1 Top 10% of void | 3 Any of these detector positions would be acceptable in this example, using a suitable bracket if necessary |
| 2 Top 125 mm of void | 4 Depth of void 800 mm |

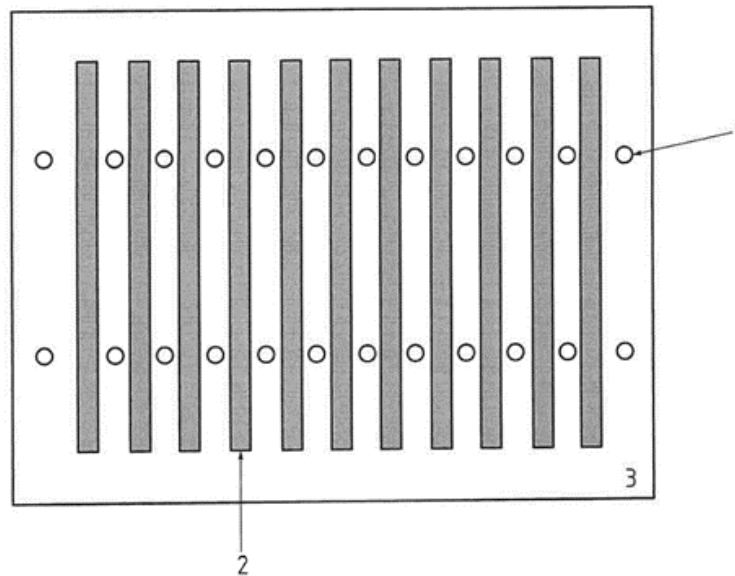
Figure 8 – Detectors in top 10% of a void [see 22.3g)]

**Key**

1 Ceiling

3 Light fitting or other projection

2 Y should not be less than 2Z

Figure 9 – Proximity of detectors to ceiling fittings [see 22.3i)]**Key**

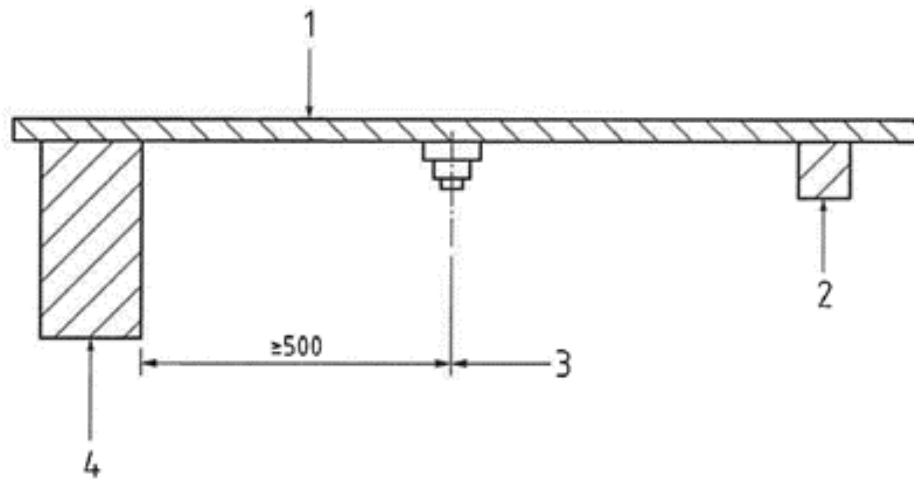
1 detector

3 Plan view

2 Storage racks

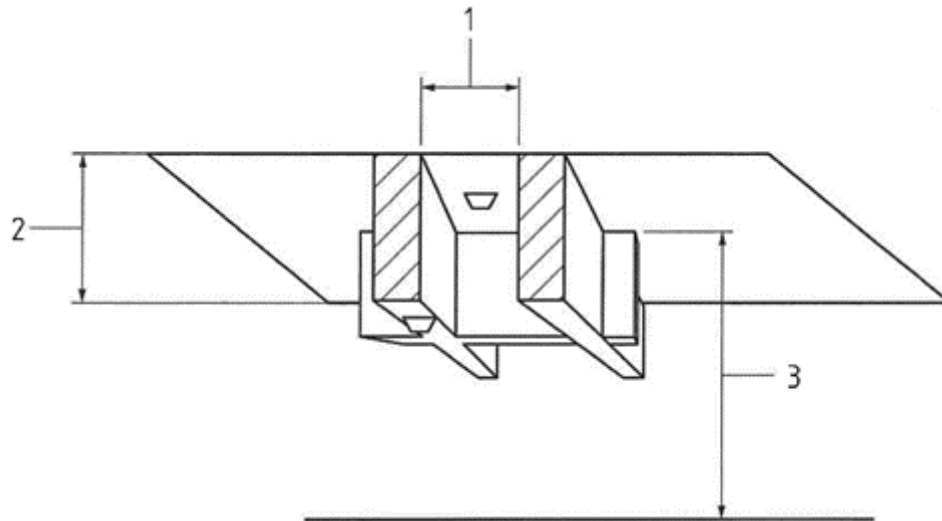
NOTE Example of warehouse with storage racks. The gap between the racks and the ceiling is less than 300 mm. Each rack is therefore treated as a wall and detection is needed in each aisle.

Figure 10 – Partitions or storage on racks

**Key**

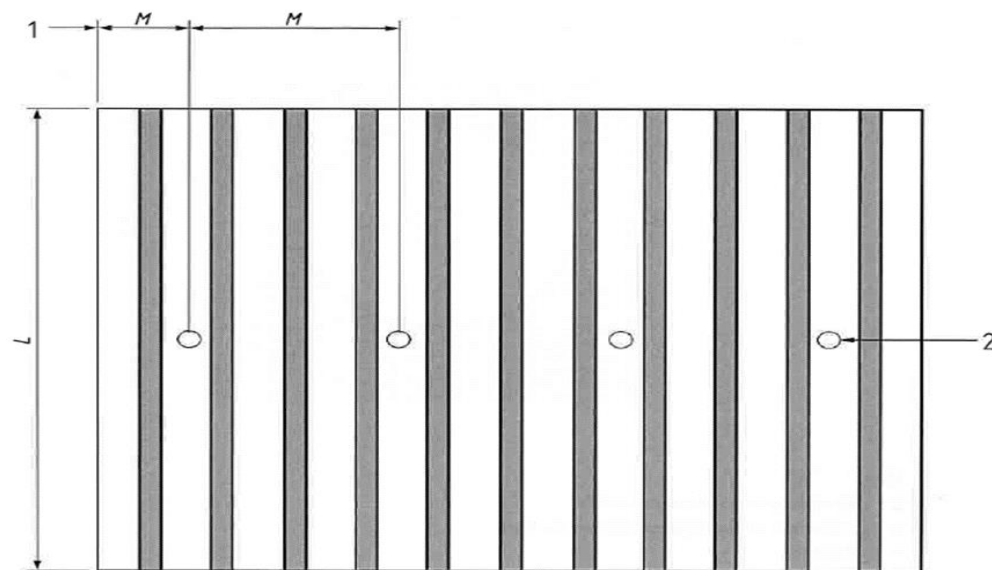
- | | | | |
|---|---|---|---|
| 1 | ceiling | 3 | No less than 500 mm |
| 2 | Beam down stand less than 10% of room height ignore | 4 | Beam down stand greater than 10% of room height Treat as wall |

Figure 11a – Ceilings – Obstructions treated as walls [see 22.3k]

**Key**

- | | | | |
|---|---------|---|--|
| 1 | ceiling | 3 | Height from floor or likely height of fire to ceiling slab |
| 2 | Depth | | |

Figure 11b – Ceilings – Horizontal ceiling obstructions a series of small cells [see 22.3l]

**Key**

- | | |
|---|-----------|
| 1 | Half M |
| 2 | Detector |
| 3 | Plan view |

NOTE 1 In this example beam downstands are greater than 10% of ceiling height, H . $H = 3$ m.

NOTE 2 Smoke detectors are used in this example. Using Table 2, the spacing M should be no more than 2.3 m

Figure 11c – Ceilings – Cells formed from joists [see 22.3k) and 22.3l]

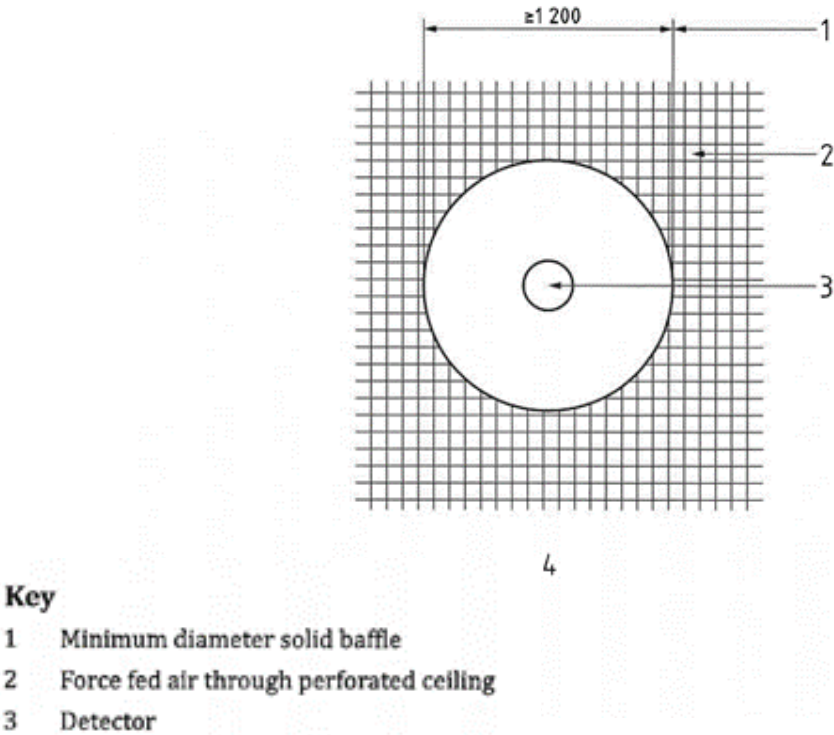


Figure 12 – Detector on perforated ceiling [see 22.3o]

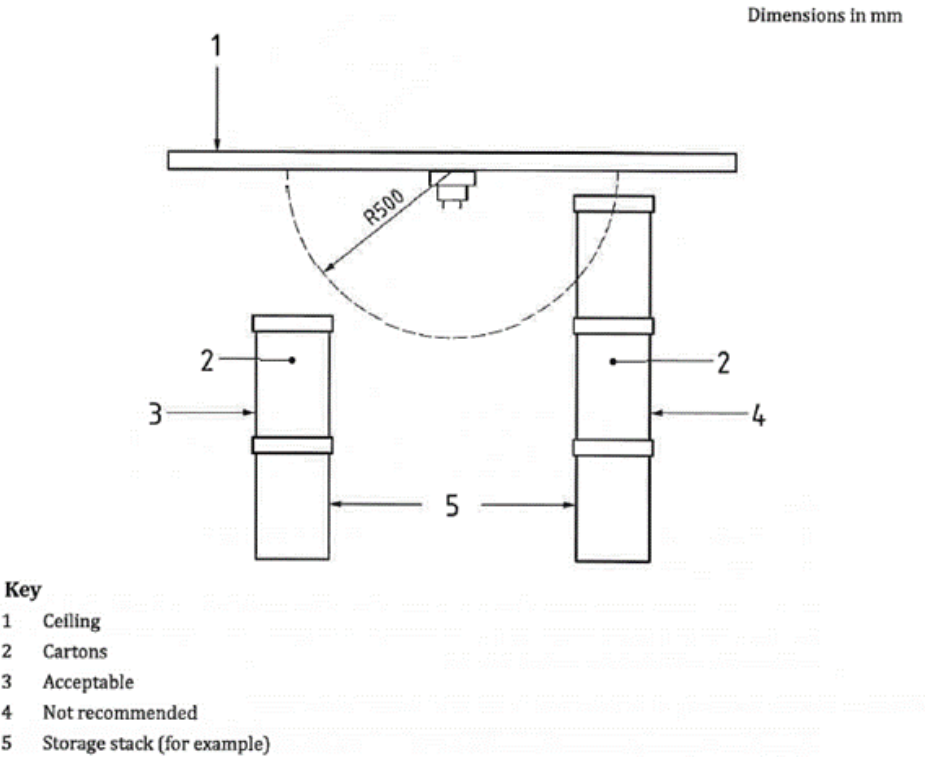
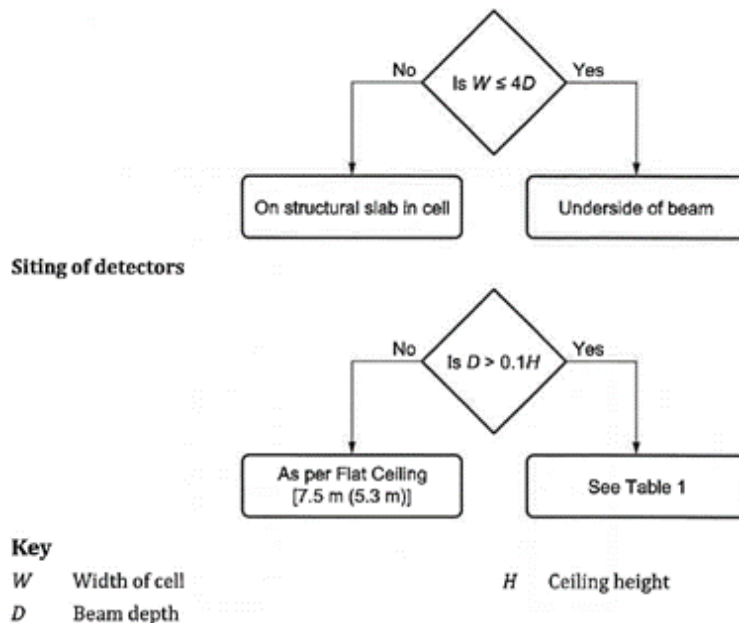


Figure 13 – Clear space around a detector [see 22.3p)]



NOTE Since mounting detectors at a depth of more than 600 mm below the highest point in the protected spaces does not conform to 22.3e), protection in these circumstances might need careful consideration to determine the most suitable location and spacing of detectors.

Figure 14 — Spacing and siting of detectors on honeycomb and similar ceilings

Table 1- Spacing and siting of detectors on honeycomb and similar ceilings

Overall ceiling height from floor into cell H (to nearest whole metre)	Maximum distance between any point and the nearest smoke (heat) detector
≥3m	4.5 m (3.0 m)
4m	5.5 m (4.0 m)
5m	6.0 m (4.5 m)
≥6m	6.5 m (5.0 m)

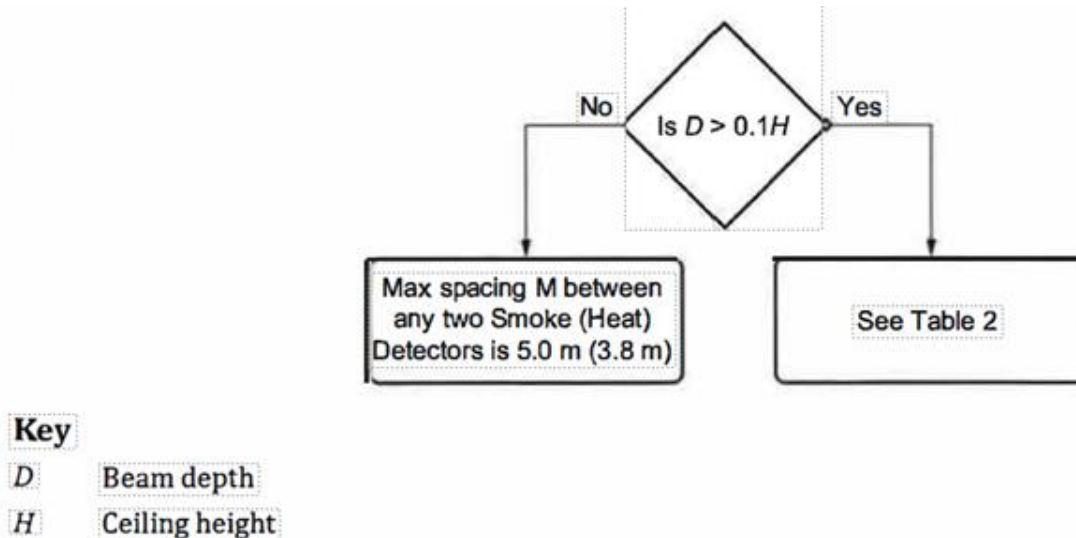


Figure 15 — Spacing and siting of detectors on ceiling with closely spaced structural beams or joists

Table 2 - Spacing and siting of detectors on ceiling with closely spaced structural beams or joists

Overall ceiling height from floor into cell H (To nearest whole metre)	Maximum distance between any smoke (heat) detectors measured across the beam M
≥3 m	2.3 m (1.5 m)
4 m	2.8 m (2.0 m)
5 m	3.0 m (3.2 m)
≥6 m	3.3 m (2.5 m)

22.4 Recommendations for siting of carbon monoxide fire detectors

Carbon monoxide fire detectors should be sited in accordance with all recommendations of 22.3. for smoke detectors.

22.5 Recommendations for siting of optical beam smoke detectors

The following recommendations are applicable.

- Optical beam-type detectors should be sited in such a way that the horizontal distance between any point in the protected space and an optical beam does not exceed 7.5 m (see Figure 16).
- If the protected area has a pitched ceiling, for optical beam detectors at or near the apex, the figure of 7.5 m given in 22.5a) may be increased by 1 % for each degree of slope, up to a maximum increase of 25%. For optical beam detectors not at or near the apex the distance given in 22.5a) applies.
- The recommendations of 22.3d), 22.3e), 22.3g), 22.3j), 22.3k) and 22.3m) should be applied to the exceptions given in 22.5d).
- Optical beam smoke detectors may be installed at a distance of more than 600 mm below ceiling level (or 600 mm below the apex of a pitched roof) in the following circumstances.

- When the optical beam detectors are intended to provide supplementary detection of a rising smoke plume within high space (e.g. an atrium),

In such cases, the width of the area protected on each side of an optical beam should be regarded as, 2.5 % of the height of the beam above the highest likely seat of fire (see Figure 16)

NOTE 1 Where there is no discernible fire load above such a layer of detectors it may be justifiable to forego the provision of detection at or near the ceiling.

- When the optical beam detectors are installed at an angle from the horizontal, pointing down from the ceiling, in order to provide supplementary detection of smoke stratifying and failing to reach the ceiling.

NOTE 2 The spacing recommendations for angled optical beam detectors within the three-dimensional space below a ceiling is beyond the scope of this code of practice. However, while it is possible that a single angled optical beam detector will eventually detect a spreading layer of stratified smoke, the installation of more beams, strategically positioned through the three-dimensional space, will provide a substantially better chance of detecting stratifying smoke and reduce detection times. In general terms, for everyone optical beam detector at the ceiling a further two or three detectors angled through the space might be appropriate.

- When the optical beam is positioned close to the apex of a pitched roof and the physical features in the roof space prevent it being installed in accordance with 22.3d).

In such cases the vertical distance of the optical beam from the apex should be minimized (within the practical restraint of the building) and should not exceed the lesser of H/10 (where H is the height of the apex above the floor) and 2.5 m.

- Where the physical features in the roof space prevent the optical beam detector being installed within 600 mm of a horizontal ceiling (in accordance with 22.3e).

In such cases the distance from the ceiling should be minimized and should not exceed the lesser of H/10 (where H is the height of the ceiling above the floor) and 2.5 m. Moreover, the potential negative effects should be compensated by one or more of the following means:

- reducing the maximum horizontal spacing as given in 22.5a);
- use an optical beam detector with enhanced sensitivity compared to the minimum required by BS EN 54-12 (e.g. alarm at 35% attenuation or less): or

- introduce (or consider any existing) restrictions to flow of smoke across (and potentially along) the ceiling which can restrict the spread of smoke and increase the depth of the smoke layer. Containing the spread of smoke in both directions is preferable.

The degree of the compensation measures should be sufficiently conservative to compensate for the excessive distance from ceiling and in case of doubt a smoke test should be performed.

- e) Where optical beams run closer than 500 mm to any wall, partition or obstruction to the flow of hot gases, such as structural beams and ductwork, then that section of the optical beam should be discounted from providing detection.

NOTE 3 Those parts of the optical beam within 500 mm of the beam's transmitter and receiver or reflector(s) need not be considered for the purpose of this recommendation.

- f) If there is a probability of people walking within the area of the optical beam, then the optical beam should be at least 2.7 m above floor level. Consideration should also be given to the possibility of the optical beam being obstructed by the use of forklift trucks, in which case the optical beam detector should be mounted at a suitable height.

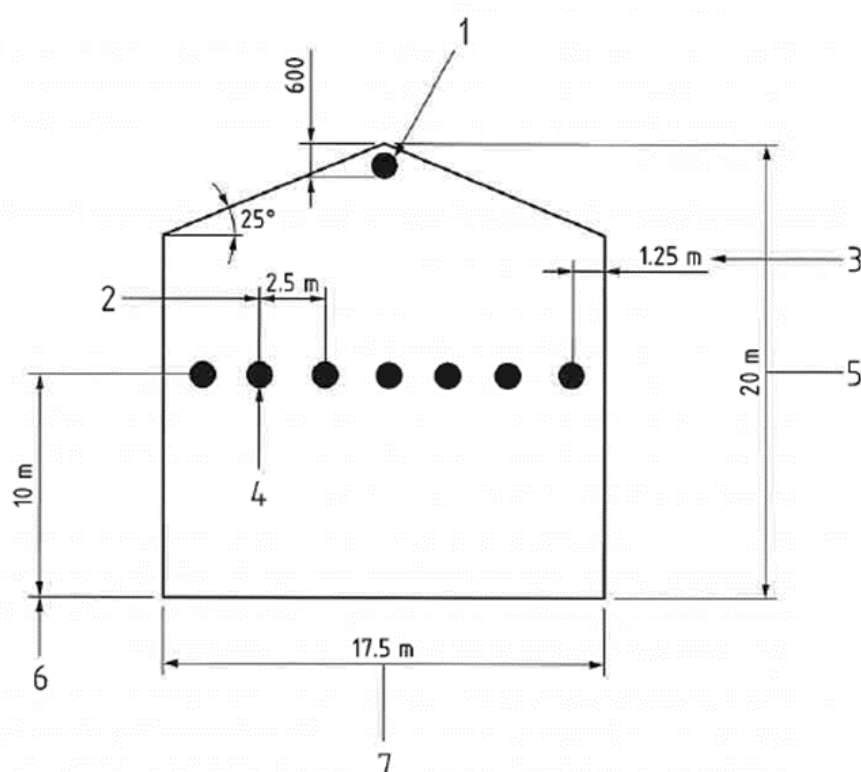
NOTE 4 It is also necessary to comply with 22.5d).

- g) Transmitters, receivers and any reflectors should be mounted on solid construction that is not subject to movement, likely to adversely affect the alignment of the optical beam, as a result of changes in temperature or imposed load.

- h) The path length of the optical beam should not exceed that recommended by the manufacturer.

NOTE 5 Where the optical beam detector uses a reflector, the path length is the distance from the transmitter to the reflector and back to the receiver.

- i) The area covered by an optical beam detector should not exceed that of a single detection zone given in Clause 13.



Key

- 1 ≤18.75 m width covered by one optical beam detector within 600 mm vertically of the apex, using the extra coverage of 25% given by the roof
- 2 2.5 m calculated from twice 12.5% of 10 m mounting height
- 3 1.25 m calculated from 12.5% of 10 m mounting height
- 4 Seven optical beam detectors required at this height
- 5 20 m high
- 6 10 m mounting height
- 7 17.5 m width

NOTE In this example, the likely source of the fire is at floor level.

Figure 16 — Sitting optical beam detectors

22.6 Recommendations for siting of line heat detectors

The following recommendations are applicable.

- a) Line heat detectors should be sited in such a way that no point in the protected space is further than 5.3 m horizontally from the nearest point on a line heat detector.
- b) If the protected area has a pitched ceiling, for line heat detectors at or near the ceiling, the figure of 5.3 m given in 22.6a) should be increased by 1 % for each degree of slope up to a maximum increase of 25%. For line heat detectors not at or near the apex the distance given in 22.6a) applies.
- c) The recommendations of 22.3d), 22.3e), 22.3g), 22.3j), 22.3k) and 22.3m) apply.
- d) Where a line heat detector runs closer than 500 mm to any wall, partition or obstruction to the flow of hot gases, such as structural beams and ductwork, then that section of the line heat detector should be discounted from providing detection.

NOTE Those parts of a line heat detector within 500 mm of the control equipment need not be considered for the purpose of this recommendation.

- e) Where a line heat detector is installed to protect a particular item of plant or cabling, as opposed to

providing general area protection, the detector should be mounted as close as possible to the place where fire or overheating might occur, and either be mounted above the risk or in thermal contact with it.

22.7 Recommendations for siting of aspirating smoke detection systems

The following recommendations are applicable.

- a) Where an aspirating smoke detection system is intended to provide general area protection, each aspirating sampling point should be regarded as a point smoke detector, provided that a single sampling point has equivalent sensitivity to a point type smoke detector. Accordingly, the siting of these sampling points should conform to 22.3. However, as the detector actually draws samples of air through sampling points (holes in the pipework), 22.3e) does not apply and the sampling points may be flush with a ceiling.
- b) Where an aspirating smoke detection system is intended to provide very early warning that is supplementary to other forms of automatic fire detection (e.g. by monitoring return air to air conditioning equipment or monitoring specific items of equipment), the system should be installed in accordance with the guidance of the manufacturer.
- c) Where an aspirating smoke detection system is used to protect spaces with high ceilings (>25 m) and there is a risk that the smoke could stratify before reaching the ceiling, sampling should be provided at multiple levels using drop-pipe arrangements at the wall and, where practical, within the main space.

NOTE For more information see the FIA Code of Practice for Design, Installation, Commissioning and Maintenance of Aspirating Smoke Detector (ASD) Systems [Z].

22.8 Recommendations for siting of flame detectors

The following recommendations are applicable.

- a) Spacing of flame detectors should be within maximum limits specified by the manufacturer.
- b) Where flame detectors are intended to provide general area protection, there should be a clear line of sight between all points within the protected area and one or more flame detectors.
- c) Where flame detectors are intended to provide protection for specific hazard(s), there should be a clear line of sight between the hazard(s) and one or more flame detectors.

22.9 Recommendations for limits of ceiling height

Heat, smoke and combustion gas detectors should not be mounted on ceilings higher than the limits recommended in column 1 of Table 3. If small sections of ceiling, not exceeding in total 10% of the ceiling area within the protected area, exceed these limits, these higher sections are adequately protected provided that the ceiling height does not exceed the limits in column 2 of Table 3.

The limits recommended in Table 3 are intended for ceilings over large, open areas. In vertical or flue like structures, such as lift shafts and stairwells, the limits should be used for guidance.

NOTE 1 A very high shaft (e.g. exceeding 25 m) would be better protected by detection at several levels and/or greater sensitivity at the ceiling.

NOTE 2 The recommendations in Table 3 for the Class and minimum number of ASD sampling holes may be adapted for vertical or flue-like structures. For example, the detection provided by 15 Class C sample points on a ceiling covering just 200 m² can be achieved using fewer sample points at a higher sensitivity, e.g. just 3 sample points which are 5 times more sensitive than the Class C.

Table 3 - Limits of ceiling height

Detector type	Column 1 Generally applicable maximum ceiling height m	Column 2 Max ceiling height for 10% of ceiling area m
Heat detectors (BS EN 54-5)		
Class A1	9.0	10.5
Other classes	7.5	10.5
Point smoke detectors (BS EN 54-7)	10.5	12.5
Carbon monoxide detectors (BS EN 54-26)	10.5	12.5
Optical beam smoke detectors (BS EN 54-12)		
Normal sensitivity	25	28.0
Enhanced sensitivity (alarm at 35% attenuation or less)	40.0 (see Note 1)	43.0 (see Note 1)
Aspirating smoke detection systems (BS EN 54-20)		
General limit	10.5	12.5
Class C with at least 5 holes	15.0	18.0
Class C with at least 15 holes	25.0	28.0
Class B with at least 15 holes	40.0 (See Note 2)	43.0 See Note 2
Other fire detectors	As specified by the manufacturer	
NOTE 1 The use of supplemental detection is recommended [see 22.5d) J unless the risk (i.e. probability x consequence) of stratification is minimal.		
NOTE 2 The use of multi-level sampling is recommended [see 22.7c) J unless the risk (i.e. probability x consequence) of stratification is minimal.		

22.10 Smoke detectors in ventilation ducts

Where the specification requires smoke detectors within air extraction ducts, the following recommendations are-applicable.

- Smoke detectors-Or duct probes should be installed in straight stretches of ductwork, at a distance downstream from the nearest bend, corner or junction of at least three times the width of the duct.

NOTE 1 See FIA Code of Practice for Design, Installation, Commissioning and Maintenance of Duct Smoke Detector (DSD) Systems [8].

- The suitability of the smoke detector for this type of application should be determined from guidance produced by the manufacturer.
- The sampling inlet probe and the holes in the probe should be arranged, according to the manufacturer's instructions, to cover as much of the duct as possible.

NOTE 2 To comply with this subclause normally requires the probe to cover the wider dimension of the duct and the length of the probe to be at least two-thirds of that dimension.

NOTE 3 See FIA Code of Practice for Design, Installation, Commissioning and Maintenance of Duct Smoke Detector (DSD) Systems [8].

NOTE 4 It is not considered that detectors, other than smoke detectors, are suitable for detecting products of combustion that are circulated by means of forced air ventilation systems.

23 Control and indicating equipment

23.1 Commentary

CIE performs three principal functions:

- automatic monitoring and control of circuits external to the equipment (such as fire detection and fire alarm device circuits) and supply of power to these circuits;
- indication of fire signals, fault signals and their location;
- manual control to facilitate actions such as testing, disablement of devices, triggering of fire signals, silencing of audible fire warnings and resetting the system after a fire signal.

As these facilities are required by different people at different times, all these facilities need not be provided at a single location. For example, according to the premises, indication of faults might be required by a site engineer, who might not require detailed information on fire signals, whereas accurate information on the location of a fire is essential to the fire and rescue service, who might need no specific information about system faults.

In small, simple systems, the control, indicating and power supply equipment for the system is normally housed within a single enclosure. In large, complex premises, the main control equipment circuitry might be installed at one location, power supplies might be distributed around the building, while main indicating equipment incorporating certain basic controls is installed at another location, such as near a main entrance to the building; repeat indicating equipment, with or, without controls, might be installed at further locations, such as alternative points of entry for the fire and rescue service.

Since premises vary in size, complexity and fire strategy, it is essential that the nature and siting of manual controls and all indicating equipment, in particular, is suitable for the fire and evacuation procedures that are to be adopted and for the persons who will use the system, including security or reception staff and firefighters attending a fire. Siting of control circuitry and power supplies will more likely be determined by engineering considerations and the preference of the purchaser or user.

Although the use of text displays (e.g. liquid crystal or vacuum fluorescent displays) might be sufficient for the needs of the user, the provision of a separate, light-emitting indicator for every zone on the system is regarded as valuable to firefighters. This enables a simple "at a glance" overview indication of all zone(s) in which fire has been detected, without the need for manual intervention by firefighters, and enables spread of fire to be easily monitored.

In at least one multiple-fatality fire, it has been determined that some or all of the deaths could have been avoided if a diagrammatic representation of the premises (commonly described as a zone plan) had been provided in close proximity to the CIE. Accordingly, it is important to ensure that a suitable zone plan is provided adjacent to all CIE (including any repeat control and/or indicating equipment), unless the CIE incorporates a suitable display (e.g. an illuminated mimic diagram). The objective is to ensure that those responding to a fire alarm signal (including staff on the premises and firefighters) are given unambiguous information as to the location of a fire.

23.2 Recommendations

23.2.1 The following recommendations are applicable to the siting of CIE.

- a) Indicating equipment, in conjunction with suitable manual control facilities, should be sited at an appropriate location for both staff and firefighters responding to a fire signal, such that controls can be readily operated and indications are readily visible. This should normally comprise an area on the ground floor close to the entrance to the building likely to be used by the fire and rescue service, or a suitably sited, continuously manned control room from which at least initial control of any fire incident, by staff and/ or the fire and rescue service, will be implemented.

NOTE 1 In complex premises, there could be benefit in consultation between the user or purchaser (or others acting on their behalf and the fire and rescue service, regarding the siting of all CIE and the facilities provided. Where there are multiple entrances to a complex building, there could also be benefit in consultation with the fire and rescue service regarding the possible need for repeat control and/or indicating equipment.

NOTE 2 It is expected that the form of display, including the display at repeat CIE, will indicate the location of the first detector to operate without manual intervention.

- b) All control, indicating and power supply equipment that is likely to need routine attention for maintenance should be sited in readily accessible locations that facilitate safe maintenance work.
- c) The ambient light level in the vicinity of all CIE should be such that visual indication can be clearly seen, controls easily operated and any instructions or legends can be easily read.
- d) The ambient noise level in the vicinity of all CIE should not be such as to prevent audible indications (such as the fault warning sounder) from being heard.
- e) The fire alarm CIE, extra low voltage (ELV) power supply equipment for the CIE and other essential control facilities should be sited in areas of low fire hazard level, so that the equipment is unlikely to

be involved in a fire before adequate warning has been given.

- f) In Category Land Category P systems, the area(s) in which any CIE(s), power supply (or supplies) for the CIE and other essential control facilities should be protected by automatic fire detection, unless:
 - 1) the fire hazard level is negligible and there is an adequate degree of fire separation between that area and any area in which the fire hazard level is not negligible; or

NOTE 3 The above conditions often apply to a relatively low fire risk foyer of a building.

 - 2) the area is continuously manned in the case of Category P systems, or continuously manned when the building is occupied by any person in the case of Category L systems.
- g) In premises in multiple occupation with communal parts, main CIE should be located within a communal area, such as an entrance hall. Where no communal parts exist, the equipment should be sited in an area to which access is possible at all times that the premises are generally occupied.

23.2.2 The following recommendations apply to the facilities provided for visual indication of fire signals.

- a) The indicating facilities should be suitable for the fire and evacuation procedures intended for the building. In complex premises, there should be adequate consultation between the Interested parties (see 6.2) to ensure that appropriate indicating facilities are provided.
- b) The primary indication of the area(s) from which a fire signal(s) has originated should comprise an indication of the zone.
- c) The form of zone indication should comprise a separate light-emitting indicator for each zone of the system (e.g. a LED matrix or illuminated mimic diagram), such that the indicating equipment is capable of simultaneous display of fire signals on every zone.

NOTE 1 In very large premises it might be acceptable to use a hierarchal arrangement of displays. For example, C/E might indicate the sector of origin, while further indicating equipment in the sector indicates the detection zone(s) of origin.

- d) A visual display unit (VDU) may be used to provide the display recommended in 23.2.2c) provided that:
 - 1) the VDU can provide a simultaneous display of fire signals in all zones, without manual intervention; and
 - 2) because the reliability of a single VDU is not adequate, a back-up form of zone indication is provided; this may comprise a second method of indication conforming to 23.2.2c), a second VDU or a printer configured to automatically print out the fire information.

NOTE 2 Printers are not considered suitable as a primary indication since, in the event of ink, ribbon or paper being exhausted, the indication will be lost. They might, however, be acceptable as a back-up or supplement to another display.

- e) On or adjacent to indicating equipment, there should be a diagrammatic representation of the building, showing at least the building entrances, the main circulation areas and the division into zones. The diagrammatic representation may comprise any of the following:
 - 1) an illuminated mimic diagram;
 - 2) a VDU with an appropriate back up; or
 - 3) a printed, correctly orientated, zone plan (see 3.6.8.).

NOTE 3 In some complex premises, e.g. shopping centres, additional information, such as occupier names, might be of value to those who are unfamiliar with the premises. This could be provided by a supplementary list that, for example, enables a unit number on a zone plan to be related to the occupier's name, such as the name of a retailer in a shopping centre. Where such information is provided, it is important that it is kept up-to-date.

23.2.3 The following recommendations apply to facilities provided for control of the system.

- a) The control facilities should be suitable for the fire and evacuation procedures intended for the building. In complex premises, there should be consultation between the interested parties (see 6.2.) to ensure that appropriate control facilities are provided
- b) In addition to the sounder silence and re-sound control provided by the CIE there should also be an evacuate control. A clearly labelled facility should be provided on or immediately adjacent to the control equipment to enable fire alarm sounders to be started. Where evacuate control(s) comprise manual call point(s), the call points should be clearly labelled to distinguish their function from that of other manual call points in the building. Operation of such a control should not be dependent on the state of

any silencing or disablement device. The evacuate control may be the same as the re-sound control, provided that it starts all of the fire alarm sounders on the system and is appropriately labelled.

- c) Where the premises are divided into two or more alarm zones (see 3.3), the strategy for phased evacuation should be implemented by the system designer (see 19.2.1). Normally a separate evacuate control, conforming to 23.2.3b), should be provided for each part of the protected premises in which an evacuation signal needs to be given simultaneously. In premises with phased evacuation, in which stairway capacity is inadequate for a single-phase evacuation, no single control that initiates an "Evacuate" signal in all alarm zones simultaneously should be provided, but such a control should be provided in all other buildings with two or more alarm zones (see 19.2.1).
- d) The operation of certain manual controls (for example, a disablement control) should be limited to authorized personnel. Where this limitation is not provided on the control equipment (for example, by use of a key operated switch), then it may be provided by restricting access to the equipment by the use of a lock or, in a disciplined environment (such as a security control room), by restriction of access to the control equipment to authorized personnel.

NOTE The operation and access of all manual controls is defined in BS EN 54-2. Access level 1 has no security, but access level 2 requires authorized access. The control of certain facilities such as the manual evacuate control [see 23.2.3b) and 23.2.3c)], when included within the CIE, is restricted to personnel authorized at access level 2.

24 Networked systems

24.1 Commentary

With a networked system, the functions of the CIE are not centralized in one location or panel but instead are distributed amongst a number of sub-panels" located remotely from each other. These panels are then interconnected by a network, which usually serves as a data highway. Some sub-panels might simply act as "data gathering" panels and provide no indications. Others might be fully functional control and indicating panels, configured so as to "stand alone" and continue to operate normally in the event of a failure of the communications link between sub-panels.

Networked systems are usually installed in the following circumstances:

- a) where the fire detection and fire alarm system is large and beyond the capacity of single CIE; and
- b) where there is a need for centralized monitoring and/or control of a number of fire detection and fire alarm systems in different buildings in the same vicinity (e.g. on the same site).

The effect of a failure of the communications link and the implications for fire detection and fire alarm system operation depends on the configuration of the networked system the type of network and whether or not the network forms part of the critical signal path (see 3.14).

Ring or loop networks are more resilient to communications failures than radial type networks. Peer to peer networks are less vulnerable to loss of function than networks with a central processor controlling panel to panel communications.

If all sub-panels can function as "stand alone "detection and fire alarm systems and do not depend on the network to facilitate primary alarm function (e.g. sounding the alarm and summoning the fire and rescue service), a communications failure will have no significant effect, and the network can be considered as an ancillary circuit.

If, however, the cause-and-effect logic for the operation of the system depends on the network, the communications link needs to be afforded the monitoring, integrity and reliability of a critical signal path. The more the networked system is dependent upon the communications link to effect primary functions of the fire detection and fire alarm system, the greater needs to be the protection afforded to the communication link.

In the case of a), the overall integrity, reliability and availability of the networked system needs to be the same as that of a single fire detection and fire alarm system and needs to satisfy the recommendations of all other clauses of this standard. In particular, the network needs to be monitored for faults (see 12.2.1), be wired in a suitable cable (see Clause 26) and, beyond the alarm zone of origin, needs to be capable of facilitating an appropriate response to the operation of a manual call point within 10s. The recommendation for a three second response within the alarm zone of origin remains unaffected.

In this case, the communications link between sub-panels needs to be considered as part of the critical signal path. The communications link also needs to be considered as a critical signal path in the case of 24.1b) if the communications link is required to facilitate primary alarm functions.

24.2 Recommendations

The following recommendations are applicable.

- a) Sub-panels not required for indication purposes need not incorporate the indication facilities recommended in 23.2 and need not be visible, but should still be readily accessible for maintenance purposes. Similarly, audible warnings may be suppressed or disabled.
- b) The communications link between sub-panels should be monitored in accordance with 12.2.1 for wired networks and BS EN 54-25:2008, 4.2.6, for radio networks.
- c) A fault on the communications link between sub-panels should not affect the operation of any sub-panel.
- d) In networked systems in which the communications link forms a critical signal path and comprises one or more cables, the cable installation should conform to 26.2, except that standard fire-resisting cables [see 26.2 and Figure 17a) and Figure 17b)] may be used in all circumstances in which:
 - 1) the network is configured as a loop; and
 - 2) there is diverse routing of incoming and outgoing circuits, except in the immediate vicinity of the sub-panel; and
 - 3) there will be no loss of communication to any sub-panel in the event of a single open or short circuit on the loop.
- e) The delay between operation of any manual call point and the giving of an "Evacuate" signal in, at least, the alarm zone within which the manual call point is located should conform to 20.2b. The delay in the giving of appropriate alarm signals in alarm zones beyond that in which the manual call point is located should not exceed 10 s.
- f) In networked systems in which the communications link forms an ancillary circuit and comprises one or more cables, the cable installation should conform to 26.6. for the ELV supply from an external power supply unit.

NOTE subclause 26.2 recommends fire resistance one, for cables that comprise parts of the critical signal paths and for low voltage (LV) mains supply cables.

25 Power supplies

25.1 Commentary

The normal power supply for the fire detection and fire alarm system is normally derived from the low voltage mains supply in the building, transformed or modified as necessary. The mains supply needs to be reliable and capable of supplying the largest load that can be placed on it under normal, fire and fault conditions. If the fault condition relates to the power supply and causes an over current condition on the low voltage supply circuit, it is accepted that the low voltage circuit breaker could trip out.

In order to minimize the potential for failures, the design of the mains supply to the system needs to be such that it is unlikely to be affected by faults on other circuits or equipment, or by isolation of supplies in the building for maintenance or economy in consumption of electricity.

It is, nevertheless, likely that the mains supply will fail at some time during the lifetime of the fire detection and fire alarm system. This can arise from failure of the mains supply to the building or failure of the final circuit serving the fire detection and fire alarm system. Accordingly, the mains supply needs to be backed up by a standby supply that is able to support the system while the fault in the mains supply is corrected.

In most parts of this standard, most failures in public electricity supplies are relatively short in duration, and prolonged failures exceeding 24 h are uncommon. The recommendations in this standard are based on this assumption, and, for Category M and Category L systems, the duration of standby batteries need not, therefore, normally be capable of supplying power to the system for longer than 24 h. A greater duration might, however, be necessary if the probability of failure of a public or private electricity supply for periods exceeding 24 h is considered to be significant.

In the event of a more prolonged failure of the supply to a Category M or Category L system, when the premises are unoccupied, no one is at risk. If on reoccupation, the supply to the building is still isolated, most users can reasonably be expected to appreciate the effect on the fire detection and fire alarm system and indeed other safety systems (such as emergency escape lighting) and to take appropriate action.

Failure of the final circuit serving the fire detection and fire alarm system is, however, possible. If this occurs when the premises are unoccupied (e.g. over a weekend) the system might be inoperative on

reoccupation. This will be less obvious to the user, and it is important that the presence of a power supply to the system is indicated by a visual indicator at the indicating equipment to enable total power failure to be identified by the user, who needs to check the fire detection and fire alarm system on reoccupation [see 47.2a)].

Category P systems are required to provide protection when the premises are unoccupied. However, there is a need to set some practical limit on the duration of stand batteries. If it is considered by the user that the limit recommended in this standard is insufficient to cater for the longest period for which premises might be unattended, the user needs to consider arrangements for inspection of the system during the unoccupied period, consider a facility to transmit power supply fault signals to an ARC, or consider the need for standby batteries with a longer duration.

If the premises are provided with an automatically started standby generator, the capacity of the standby batteries in a Category M or Category L system may be reduced, provided the circuits served by the generator include that of the fire detection and fire alarm system. This relaxation does not apply to Category P systems, as, when the premises unoccupied, there is no one present to detect, and take action on, a failure of the standby generator to start on mains power failure.

In some complex buildings, such as shopping centres, additional indicating equipment, such as colour graphics terminals, not essential for compliance with this standard, might be provided to assist the user in the monitoring and control of fire incidents. This additional equipment can sometimes draw substantial current. If the equipment is not essential/or full compliance of the system with this standard, it might not be necessary for the power supplies for the equipment to conform in full to the recommendations of this standard, particularly in respect of standby battery capacity. However, if the equipment is used as the normal user interface for the purposes of control or indication, confusion of operators and degraded monitoring and reduced control of a fire incident might result. In these circumstances a standby power supply still needs to be provided for the additional monitoring equipment, but its duration may be reduced below that otherwise recommended in this standard.

25.2 Recommendations for mains power supplies

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

NOTE 1 This supply needs to be regarded as an integral part of the fire detection and fire alarm system, particularly for the purpose of certification of the system (see Clause 41), regardless of whether the electrical installation within the building is provided by the organization responsible for Installation of the fire detection and fire alarm system

- a) For reasons of electrical safety, the mains supply to all parts of the fire detection and 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 needs to isolate the building during closed hours, a separate supply should be provided for the fire detection and fire alarm system that should not normally be isolated during closed hours.
- b) The mains supply final circuit(s) to all parts of the fire detection and fire alarm system should be dedicated solely to the fire detection and 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. The electricity supply should not be connected via a card or coin-operated meter or similar device.
- c) To facilitate local isolation during maintenance, suitable means should be provided for local isolation of the low voltage supply circuit that serves the power supply and control equipment [see 29.2e)].

Note 2 A number of switching devices do not meet the required isolation performance criteria. BS 7671 for the purpose of "isolation details whether a particular device can actually be used.

- d) Subject to compliance with 25.2a), 25.2b), 25.2c) and BS 7671, the number of isolating devices between the incoming power supply to the building and the fire detection and fire alarm system power supply unit should be kept to the minimum practicable.

NOTE 3 For example, the supply can comprise a dedicated circuit emanating from the first electrical distribution board in the building electrical distribution system.

- e) In certain systems within very large buildings, in which networked control panels or distributed power supply units are used, the recommendation of 25.2d) might be impracticable. If, with the agreement of the interested parties (see Clause 6), a variation is adopted, whereby the mains power supply to this equipment is derived from one or more local distribution boards in the building, the number of isolating devices between the main incoming supply and the local distribution board should still be kept to the minimum practicable. It should also be ensured that any need to isolate the supply to the local distribution board (e.g. for maintenance) will be infrequent, and that the risk of inadvertent isolation is low. In addition, there should still be compliance with 25.2b), 25.2f), 25.2g) and 25.2h).

NOTE 4 It is recognized that in such an arrangement the recommendations of Clause 26 in respect of the fire resistance of the mains power supplies cables, other than the cables of the final circuit, do not apply.

- f) Every isolator and protective device that can isolate the supply to the fire detection and fire alarm system, other than the main isolator for the building, should be labelled either:
 - 1) "FIRE ALARM": in the case of a protective device that serves only the fire alarm circuit, but incorporates no switch;
 - 2) "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; or
 - 3) "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.
- g) Labels should be clear and in durable fade resistant material.
- h) Every isolator, switch and protective device that is capable of disconnecting the mains supply to the fire detection and fire alarm system should be situated in a position inaccessible to unauthorized persons or be protected against unauthorized operation
- i) The circuit supplying the fire detection and fire alarm system should not be protected by a residual current device unless this is necessary to conform to BS 7671. Where a residual current device is necessary for electrical safety, a fault on any other circuit or equipment in the building should not be capable of resulting in isolation of the supply to the fire detection and fire alarm system.
- j) Irrespective of the condition of any standby battery (e.g. disconnected or fully discharged), the mains power supply should be capable of supplying the maximum alarm load of the system (see 3.37),

25.3 Recommendations for fire detection and fire alarm system power supply units

The following recommendations apply to every power supply unit that forms part of the alarm system.

- a) Transition between the normal supply and the standby supply, and vice versa, should not cause any interruption to the operation of the system or result in a false alarm.
- b) A fault in the normal supply should not adversely affect the standby supply or vice versa. The operation of a single protective device should not result in failure of both the normal and the standby supply.
- c) The presence of the normal or the standby supply should be indicated by a green indicator, located in a position that makes it readily obvious to any person responsible for monitoring faults on the fire detection and fire alarm system (e.g. at the location of the main indicating equipment).
- d) Normal and standby supplies should each be independently capable of supplying the maximum alarm load of the system (see 3.37), irrespective of the condition of the other supply.

25.4 Recommendations for standby supplies

The following recommendations are applicable.

- a) The standby supply should comprise a secondary (rechargeable) battery with an automatic charge
- b) The battery should be of a type having a life of at least four years under the conditions of use likely to be experienced in the fire detection and fire alarm system. Automotive batteries (of the type used for starting car engines) should not be used.
- c) Labels should be fitted to all batteries indicating their date of installation. The labels should be sited so that they can be read without disturbing the batteries.
- d) The charging rate of the battery should be such that, having been discharged to its final voltage, the battery can be charged sufficiently to conform to 25.4e) after a charging period of 24 h.

NOTE 1 This is the requirement within BS EN 54-4, but it is included here as a reminder that connecting larger batteries than originally designed, for example due to an unforeseen extra load, can result in unacceptably long recharge times.

- e) The capacity of all standby batteries that serve any part of the system which has to operate correctly in order to satisfy the recommendations of this standard should be such as to satisfy the following recommendations. The capacity required to satisfy these recommendations should be calculated in accordance with Annex D.
 - 1) For a Category M or Category L system, the capacity should be sufficient to maintain the system in operation for at least 24 h, after which sufficient capacity should remain to provide an "Evacuate"

signal in all alarm zones for at least 30 min, unless the building is provided with an automatically started standby generator [see 25.4e)2)).

NOTE 2 If the premises are likely to be unoccupied for longer than the duration of the standby battery capacity at any time, and there is a facility for transmission of fire signals to an ARC, it would be of benefit to transmit power supply fault signals to the ARC for notification of the user.

NOTE 3 BS 5839-6 recommends the provision of 72 h standby supply for Grade A systems, which are largely similar to this standard's systems

- 2) For a Category M or Category L system in a building with an automatically started standby generator that serves the fire detection and fire alarm system, the capacity should be sufficient to maintain the system in operation for at least six hours, after which sufficient capacity should remain to provide an "Evacuate" signal in all alarm zones for at least 30 min.

NOTE 4 If a circuit serving part of the fire alarm system (e.g. distributed power supply unit) is not served by the standby generator, the capacity of the standby battery ought to conform to 25.4e)1).

- 3) For a Category P system in which either of the following apply, the capacity should be sufficient to maintain the system in operation for at least 24 h, after which sufficient capacity should remain to operate all fire alarm devices for at least 30 min:
 - i) where the building is continuously manned, or inspected outside normal working hours, such that staff in the building would be aware of a power supply fault indication on the system within no more than six hours of its occurrence; or
 - ii) where power supply fault signals are transmitted automatically to an ARC, instructed to notify a keyholder and, if required, the previously agreed service provider immediately on receipt of a fault indication from the premises
- 4) For all other Category P systems, the capacity should be sufficient to maintain the system in operation for at least 24 h longer than the maximum period for which the premises are likely to be unoccupied or for 72 h in total, whichever is less, after which sufficient capacity should remain to operate all fire alarm service for at least 30 min. If the building is likely to be unoccupied for more than the duration of the standby battery capacity at any time, and there is a facility for transmission of fire signals to an ARC, power supply fault signals should also be automatically transmitted to the ARC, for immediate notification of a keyholder:
- f) If, in addition to the equipment recommended in Clause 23, additional CIE, over and above that necessary for compliance with this standard, is provided, it might not be necessary for any standby battery capacity supplying the additional equipment to conform to 25.4e. However, if the equipment is used as the normal method of indication of fire to persons responsible for monitoring the system, a standby supply should still be provided for this additional equipment.

If the equipment recommended in Clause 23 is suitably sited for use as a "default" in the event of failure of the additional equipment, the capacity of the standby batteries serving the additional equipment should be sufficient to operate the system in the quiescent mode for at least four hours. If the equipment recommended in clause 23 is not suitably sited to enable effective control and monitoring of a fire incident, the standby power supplies for the additional equipment should satisfy the recommendations of 25.4e).

26 Cables, wiring and other interconnections

26.1 Commentary

The components of most fire detection and 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 Clause 27. 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, fire alarm devices, and alarm routing equipment. 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).

It is not normally possible to predict, with any accuracy, those areas of a building in which fire can or cannot occur. At the design stage, the exact routes that cables will follow might also be unknown. Therefore, to ensure that cables used for critical signal paths (see 3.14) 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. Unless cables are supported in such a manner that they remain supported for a duration similar to that for which the cable itself can survive a fire, early failure of the circuit might occur because of strain on terminations as a result of collapsing cables.

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.

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 might be of value to the fire and rescue service or might be essential to ensure that the need for "Evacuate" signals in additional alarm zones can be identified.

This standard makes recommendations for two levels of fire resistance of fire-resisting cable systems, termed "standard" and "enhanced". These terms defined by the fire tests in 26.2d) and e); BS 7629-1 now includes these requirements, which clarifies cables that fall within the Scope of that standard using the same terminology. In general, cables of standard fire resistance are suitable for most applications. However, for certain critical applications in which prolonged circuit integrity is necessary in the event of fire, cables of enhanced fire resistance are recommended. Examples are unsprinklered high-rise buildings with phased evacuation arrangements and premises of such a nature or size 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 probability of disablement of any part of the fire detection and 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 in areas where cables are susceptible to mechanical damage. Monitoring of circuits does not ensure that cable faults do 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 the responsibility of the designer to ensure that the electrical characteristics of the cables, including current carrying capacity and voltage drop, are suitable for the system. The choice of cable and routes selected need to take into account the need to avoid electromagnetic interference from other cables and sources of electromagnetic radiation, particularly in the case of systems in which cables are used for transmission of data (such as addressable device circuits). In the latter case, the cable selected also needs to be compatible with the characteristics of the data transmission e.g. speed and waveform, and remain so for an adequate length of time during the relevant exposure to fire for the category of cable.

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;
- or 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 ought preferably to 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 is less likelihood of inadvertent manual interference with the circuits of fire alarm systems (e.g. during work on other electrical circuits).

26.2 Recommendations

The following recommendations are applicable.

- a) The electrical characteristics of all cables, such as voltage drop for the ELV supply from an external power supply, current carrying capacity, impedance and, where appropriate, ability to transmit data, should be suitable for the system.
- b) Cables used for all parts of the critical signal paths (see 3.14.), for the ELV supply from an external power supply unit and for the final circuit providing low voltage mains supply to the system, should conform to 26.2d) or 26.2e) and comprise one of the following:
 - 1) mineral insulated copper sheathed cables, with an overall polymeric covering. Conforming to BS EN 60702-1, with terminations conforming to BS EN 60702-2;

- 2) cables that conform to the requirements of BS 7629-1, and that satisfy the definition of standard or enhanced fire resistance in 26.2d) or 26.2e);
 - 3) cables that conform to the requirements of BS 7846 and that satisfy the definition of standard or enhanced fire resistance in :26.2d) or 26.2e);
 - 4) cables rated at 300/500 V (6r greater) that provide the same degree of safety to that afforded by conformity to the requirements of BS 7629-1 for standard or enhanced fire resistance.
- c) Cable systems used for all parts of the critical signal paths, and for the low voltage mains supply to the system, should adequately resist the effects of fire. For most fire detection and fire alarm systems, standard fire-resisting cables [see 26.2d)] should be considered to provide sufficient resistance to the effects of fire, with appropriate methods of support and jointing [see 26.2g)].

For fire detection and fire alarm systems for the following applications, cable systems comprising "enhanced" fire-resisting cables [see 26.2e)], with appropriate methods of support and jointing should generally be used [see 26.2g)]:

- 1) in unsprinklered buildings (or parts of buildings) in which the fire strategy involves evacuation of occupants in four or more phases;

NOTE 1 In a building with a networked system (see clause 24), individual, self-contained fire detection and fire alarm systems sometimes serve parts of the buildi"9 that are evacuated in less than four phases, even though the entire building is evacuated in four or more phases. in such cases, cables of enhanced fire resistance need not be used for these systems, but there might be a need to use cables of enhanced fire resistance for the network [see Figure 17a.) and Figure 17b)).

- 2) in unsprinklered buildings greater than 30 m in height;

NOTE 2 Height of a building is taken as the height from the lowest level of the ground around the perimeter of the building to the floor level of the top storey.

- 3) in unsprinklered premises and sites in which a fire in one area could affect cables of critical signal paths associated with areas remote from the fire, in which it is envisaged people will remain in occupation during the course of the fire [see Figure 17c)]. Examples might be large hospitals with central control equipment and progressive horizontal evacuation arrangements, and certain large industrial sites;

NOTE 3 If the single range of buildings shown in Figure 17c) were served by a networked system, and each of the independently evacuated sections shown were served by individual self-contained fire detection and fire alarm systems, cables of enhanced fire resistance would not be necessary except, in the case of the network cables, if required to satisfy the recommendations of Clause 24.

- 4) in any other buildings in which the fire engineer designer or installing company specifier or enforcing authority, on the basis of a fire risk assessment that takes fire engineering considerations into account, considers that the use of enhanced fire-resisting cables is necessary;

NOTE 4 Effects of fire include discharge of water from extinguishing systems or equipment and impact by falling objects.

NOTE 5 A cable system comprises the cables, the means by which cables are secured and the means by which cables are jointed.

NOTE 6 For the purpose of 26.2c), a building is regarded as sprinklered only if an automatic sprinkler installation conforming to BS EN 12845 is provided throughout the building, except that the requirements of BS EN 12845 for life safety installations need not be applied.

NOTE 7 In some fire engineering solutions used for complex buildings, a reduction in the normal level of other fire protection measures throughout the building might be acceptable to an enfordn9 authority provided an automatic fire detection system is installed. In such cases, an enforcing authority might or might not, as part of the fire engineering solution, require cables of enhanced fire resistance, and early consultation with the authorities responsible for enforcing fire safety legislation is strongly recommended (see Clause 6).

- d) Standard fire-resisting cables should have a duration of survival of 30 min when tested in accordance with BS EN 50200.

NOTE 8 This correspond to class PH 30 as detailed in BS EN 50200:2015, Annex D.

In addition, the cables should meet the 30 min survival time when tested in accordance with BS EN 50200:2015, Annex E.

- e) Enhanced fire-resisting cables should have a duration of survival of 120 min when tested in accordance with BS EN 50200.

NOTE 9 This corresponds to class PH 120 as detailed in BS EN 50200:2015, Annex D.

In addition, the cables should meet the 120 min survival time when tested in accordance with BS 8434-2.

- f) Methods of cable support should be non-combustible and such that circuit integrity is not reduced below that afforded by the cable used and should withstand a similar temperature and duration to that of the cable, while maintaining adequate support.

NOTE 10 In effect, this recommendation precludes the use of plastic cable clips, cable ties or trunking, where these products are the means of cable support.

NOTE 11 Experience has shown that collapse of cables, supported only by plastic cable trunking, can create a serious hazard for firefighters, who could become entangled in the cables.

- g) Cables should be installed without external joints wherever practicable. All terminations and other accessories should be such as to minimize the probability of early failure in the event of fire. Other than in the case of joints at or within system components such as control equipment, manual call points, fire detectors and sounders, terminals used to joint cables should be constructed of materials that will withstand a similar temperature and duration to that of the cable. All joints, other than those within system components, should be enclosed within junction boxes, labelled with the words "FIRE ALARM" to avoid confusion with other services.

NOTE 12 Examples of suitable terminals include metal components mounted in ceramic terminal blocks.

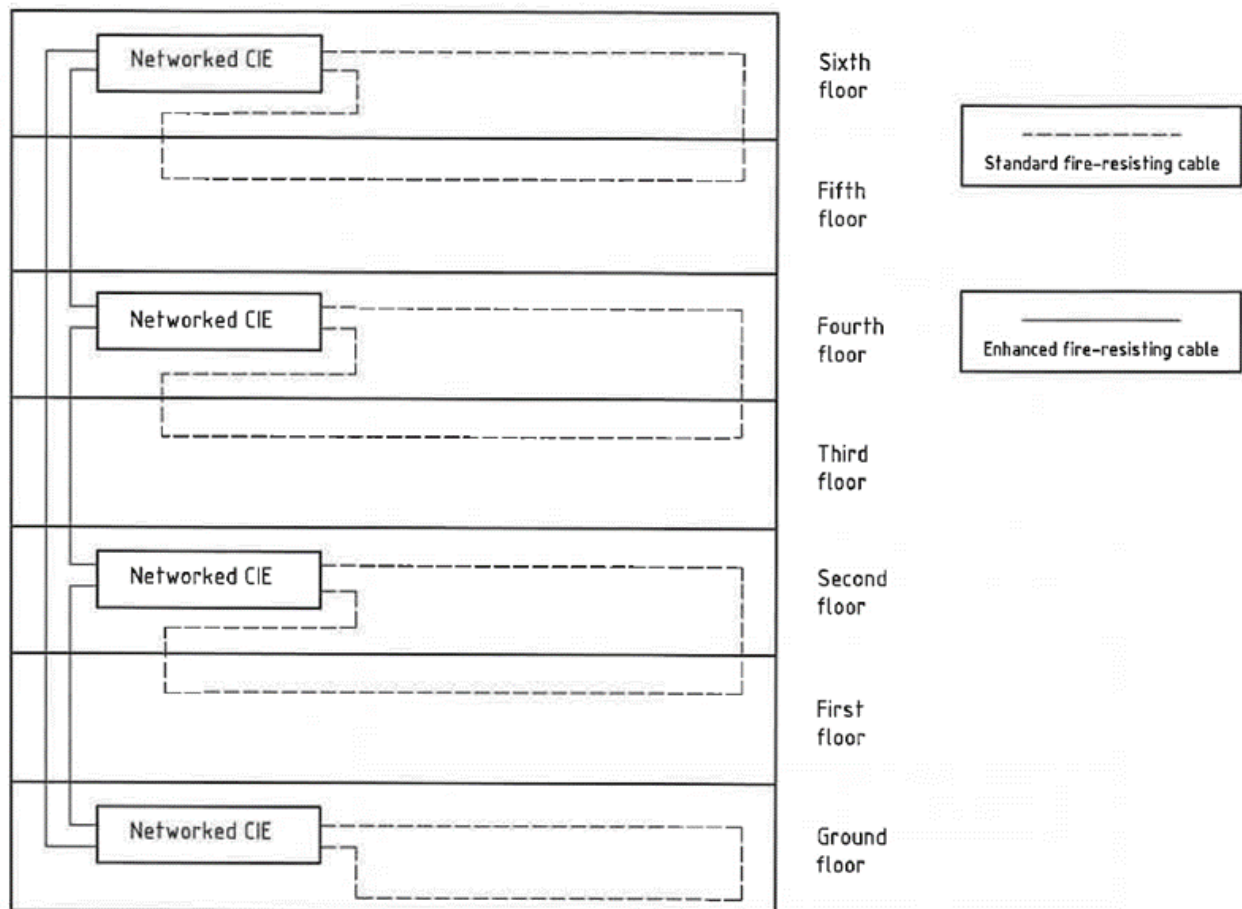
NOTE 13 At the time of drafting this standard, no definitive guidance can be given on the means for ensuring that the entire cable system, as opposed to the cable itself, can provide adequate resistance to the effects of fire. The manufacturer's recommendations need to be followed.

- h) Except in particularly arduous conditions, mineral insulated copper sheathed cables conforming to BS EN 60702 (Parts 1 and 2) and steel wire armoured cables conforming to BS 7846 may be used throughout all parts of the system without additional mechanical protection. Other cables should be given mechanical protection in any areas in which physical damage or rodent attack is likely. Particular consideration should be given to all areas that are less than 2m above floor level; other than in relatively benign environments (e.g. offices, shops and similar premises) in which cable is clipped directly to robust construction, mechanical protection should be provided in these areas. Protection may be provided by laying cable on a tray; protecting it by burying in the structure of the building, or by installation in conduit, ducting or trunking. Where particularly arduous conditions might be experienced (such as impact by forklift trucks or goods trolleys), additional, robust protection should be given to all cables by burying the cable in the structure of the building or installation in metal conduit or trunking.
- i) Where conduit is used to satisfy the recommendations of 26.2h), the conduit should conform to the relevant part of BS EN 61386. Any non-metallic trunking used in the system should conform to BS 4678-4.
- j) All conductors should have a cross-sectional area of at least 1 mm².
- k) To avoid the risk of mechanical damage to fire alarm cables, they should not be installed within the same conduit as the cables of other services. Where fire alarm cables share common trunking, a compartment of the trunking, separated from other compartments by a strong, rigid and continuous partition, should be reserved solely for fire alarm cables.
- l) To avoid electromagnetic interference with fire alarm signals, any recommendations by the manufacturer of the fire alarm equipment in respect of separation of fire alarm cables from the cables of other services should be followed.
- m) Where multicore cable is used for interconnection of fire alarm circuits, none of the conductors should be used for circuits other than those of the fire alarm system.

NOTE 14 This recommendation does not preclude the multiplexing of signals of other systems with those of the fire detection and fire alarm system. Guidance on such integrated systems is given in DD CLC/TS 50398.

- n) Fire alarm cables carrying power in excess of ELV should be segregated from ELV fire alarm circuits by use of cables conforming to 26.2b) and with 26.21). In particular, the mains supply cable to any control, indicating or power supply equipment should not enter the equipment through the same cable entry as cables carrying ELV. Within the equipment, low voltage (LV) and ELV cables should be kept separate to the extent practicable.
- o) All fire alarm cables should be of a single, common colour that is not used for cables of general electrical services in the building. to enable these cables to be distinguished from those of other circuits.

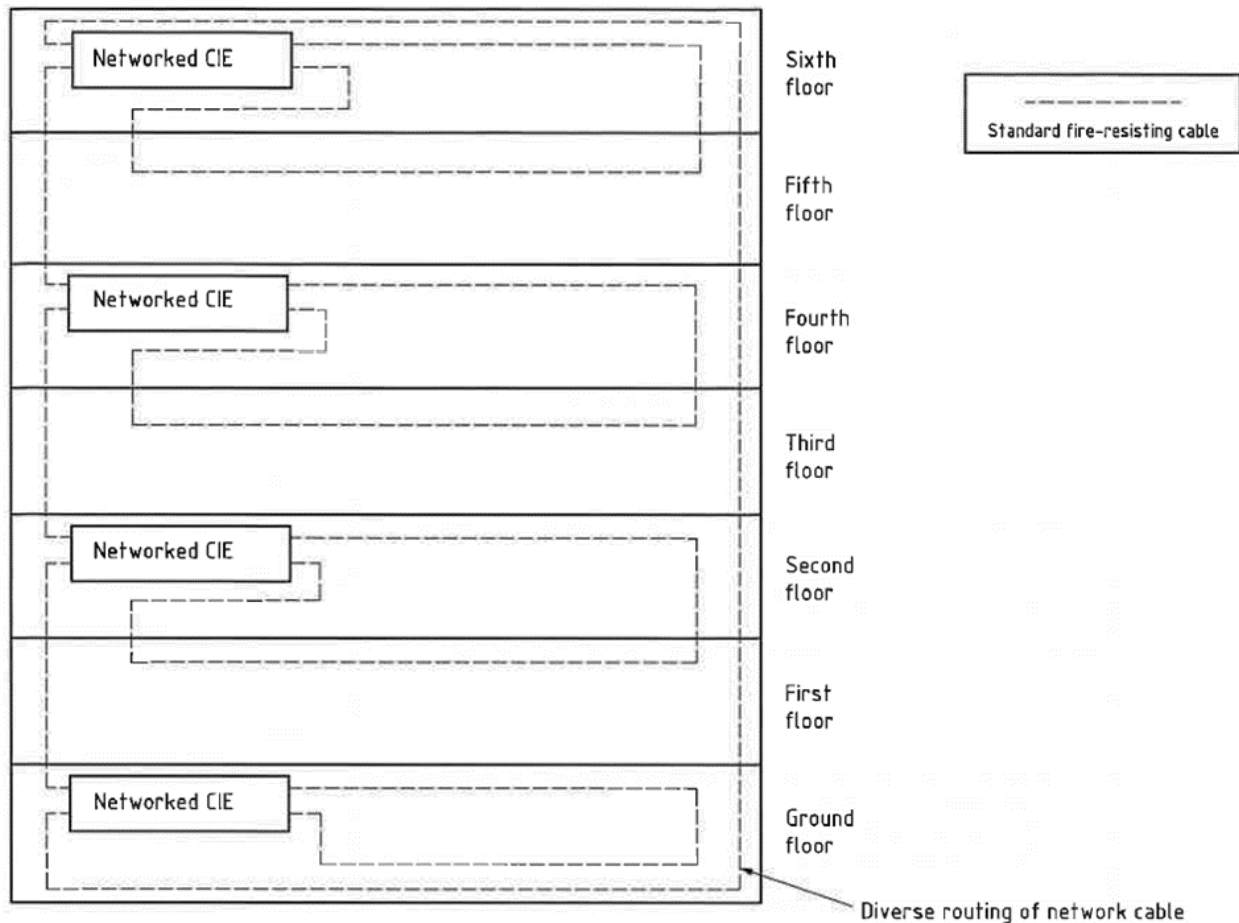
NOTE 15 The colour red is preferred



a) Example of a networked fire alarm system in a multi-storey building, showing standard cable grade for local wiring and enhanced grade for network cable [see 26.2c)]

NOTE The figure is an example only. This standard does not limit the local network to two floors.

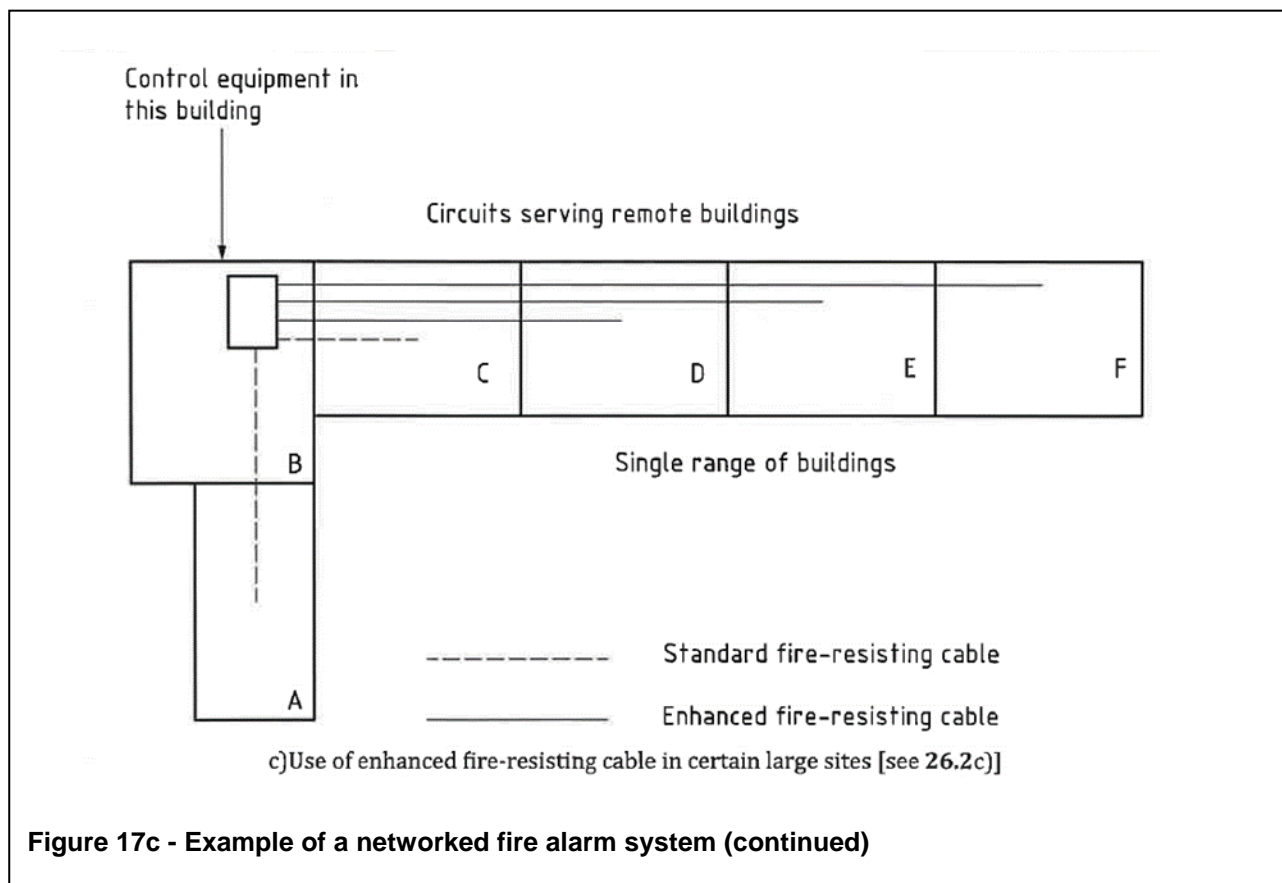
Figure 17a - Example of a networked fire alarm system



b) Example of a networked fire alarm system in a multi-storey building, showing standard cable grade throughout provided that there is diverse routing of the network cable loop [see 24.2]]

NOTE The figure is an example only. This standard does not limit the local network to two floors.

Figure 17b Example of a networked fire alarm system (continued)



27 Radio-linked systems

27.1 Commentary

Some of the recommendations of this standard, applicable to wired systems, are unsuitable for, or cannot be applied to, radio-linked systems. These include, in particular, those relating to power supplies and fault monitoring. Additional recommendations apply to radio-linked systems in order to address the integrity and performance of the radio communications link between components and the CIE.

In practice, no systems can have total reliability, but one of the objectives of good system design is to reduce the probability of the system being inoperative in the area of a fire when the fire starts. It is useful that the advantages and disadvantages between the two technologies, hardwired, and radio linked, are different because this allows for a system to be installed that suits the site. Great care needs to be taken when assessing a site and choosing the technology to use, as neither the radio nor hardwired system is singularly suitable for every site.

Components of a system interconnected by radio links can include fire alarm devices, such as fire alarm sounders, as well as detectors and manual call points. However, exercising the fire detection and fire alarm system with testing and evacuation drills in excess of those recommended by the manufacturer can reduce the life of the radio-linked fire alarm sounder batteries. Automatic silencing of radio-linked sounders is sometimes employed to overcome the potential for undue discharge of sounder batteries.

However, sounders with this facility need to reactivate with any new fire or phased evacuation command. Such a facility ought not to impair the system ability to provide an adequate audible warning to the occupants of the building in the event of fire.

Other components of a radio-linked system can include radio relay units, which are installed remote from the CIE so as to extend the range of the system. Where such relay units are separate control and indicating panels, this is a form of networked system (see Clause 24). Radio communications can also be used to link a small number of detectors and other components to what is essentially a wired system. Radio communication are sometimes adopted for temporary installations during construction or refurbishment work, as well as permanent installations. The recommendations of this standard apply equally to integral radio-linked systems of this nature.

27.2 Recommendations

The following recommendations are applicable.

- a) Components of a radio-linked system should conform to BS EN 54-25.
- b) Although BS EN 54-25 permits the use of a single battery in each device, radio-linked systems should also conform to the following:
 - 1) all radio-linked components should be supplied from at least two independent power supplies. These can be either:
 - i) the normal mains supply plus a reserve battery (primary or continuously charged secondary); or
 - ii) a primary battery plus a second primary battery; or
 - iii) a primary battery plus a secondary battery.

NOTE 1 Where secondary batteries are specified, capacitors with an appropriate specification may be used as alternative.

- 2) components, other than CIE, may utilize batteries to provide the normal power supply;
 - 3) at the point at which any power supply to any radio-linked component can maintain the component in normal operation for not more than 30 days, and, in addition, in the case of fire alarm devices, 30 min in the alarm condition, a fault warning should be given at the CIE.
- NOTE 2 A separate maintenance warning may be given at an earlier stage to indicate an impending need to replace a battery.
- c) Cables of antennae that are external to components of a radio-linked system should be monitored for open and short circuits. A fault condition should be given at the CIE within 300s of the occurrence of such a condition.
 - d) Cables of antennae that are external to components that form part of the critical signal path should satisfy the recommendations of 26.2. However, cables that do not conform to 26.2b) may be used provided they are routed through areas of low fire risk or are protected against exposure to fire by burial in at least 12 mm of plaster or by separation from any fire risk by materials that would afford a fire resistance of at least 30 min if tested in accordance with the relevant part of BS 476.
 - e) Facilities for automatic silencing of radio-linked fire alarm sounders may be provided, in which case these should conform to 16.2.1h).
 - f) Unless the visual indication at the detector of initiation of a fire alarm signal is manually reset at the control panel, it should remain illuminated for not less than 20 min after initiation. The illumination may then automatically extinguish.
 - g) Installation of a radio-linked system should only take place after a comprehensive radio survey has been undertaken to ascertain the following:
 - 1) there are no other sources of radio transmission that could interfere with, or block, radio communication between the CIE and other components of the system;
 - 2) there is adequate signal strength for communication both to and from components as appropriate in all areas of the building(s) in which radio-linked components are to be located. This should take into account the minimum acceptable signal level defined by the manufacturer in respect of the level of background radio "noise" at the time of the survey;
 - 3) where the system is networked it should be established that the communication conditions described in item 2) are achieved throughout the network;
 - 4) records of signal strength readings for each radio device taken at the time of the survey, and of the background noise level, should be kept for future reference.

NOTE 3 The record of signal strength and background radio noise may be combined into a single record of signal-to-noise ratio.

- h) Only radio survey test equipment that has been approved by the manufacturer, and regularly calibrated in accordance with the recommendations of the manufacturer, should be used to carry out the survey.

NOTE 4 The survey capability may be incorporated within the installed system.

- i) At the time of commissioning and after the installation of all equipment, including remote antenna(e), the following records relating to the radio data should be recorded where applicable:

- 1) the system coding (i.e. system address) which should, where possible, be unique to avoid the possibility of interference;
 - 2) the system's channel/frequency;
 - 3) details of the signal levels received at, or from, each of the receiver units. These data should include signal levels relating to all the radio devices and the background noise level, and confirmation that these signal levels are in compliance with the manufacturer's recommendations. In the case of a networked system (i.e. multiple panel system), this should also include the signal levels for the radio-links between panels. In addition to other servicing recommendations in other parts of this standard, this should be undertaken at each routine service visit.
- j) The signal levels recorded should be within the specifications set by the manufacturer of the radio system. If not within the specification, appropriate remedial action should be undertaken.
- k) A copy of the signal levels should be kept on site with the system logbook

28 Electromagnetic compatibility

28.1 Commentary

Particular care needs to be taken for the design and installation of the fire detection and fire alarm system to avoid electromagnetic interference, particularly received from, but also transmitted to, other equipment.

Electromagnetic interference to a fire detection and fire alarm system can result from mobile telephones, radio transmitters, other equipment used within the building lighting and power transients. It is known that ma/performance of some fire detection and fire alarm systems has occurred due to electromagnetic interference as a result of close-proximity of fire alarm cables to power cables with high current, inductive loads. The extent to which this might occur depends on a number of factors including:

- the susceptibility of the particular fire alarm equipment to electromagnetic interference.
- the level of screening afforded by the cable; and
- the separation distance between the fire alarm cables. and the cables of other services.

All cables recommended in 26.2b) provide a degree of screening, but care needs to be taken to ensure good installation practice in, for example, terminations, and that where practicable, fire alarm cables do not run unnecessarily long distances (say, more than 35 m in aggregate) in close proximity to high current power cables, particularly if these serve high inductive loads.

Electromagnetic interference can be reduced where there is a metal partition between the fire alarm cables and the power cables (as in the case of compartmented trunking). Achievement of separation between fire alarm cables and the cables of other services throughout an entire installation might not dictate that fire alarm cables share; for example, economy of installation might dictate that fire alarm cables share common tray or ducts with cables of other services. Care ought, however, to be taken to minimize the extent to which separation is not maintained, particularly in addressable and networked systems, unless guidance "from the system manufacturer indicates that separation is unnecessary; the extent will be minimized if, for example, fire alarm cables always cross the cables of other services at right angles.

More definitive guidance cannot be offered in this standard, but it is necessary to ensure compliance with any more specific recommendations of the fire alarm equipment manufacturer.

28.2 Recommendations

The following recommendations are applicable.

- a) Fire detection and fire alarm systems should be so designed and installed that they do not cause, and are not unduly susceptible to, electromagnetic interference.
- b) To ensure electromagnetic compliance of the installed system, there should be conformity with, at least, the following recommendations, although these might not, alone, be sufficient to ensure compliance:
 - 1) every system component should satisfy the relevant requirements of the product standard for that component in respect of electromagnetic capability (see Clause 11);
 - 2) cables should be segregated in accordance with 26.21) and 26.2n);
 - 3) installation workmanship should conform to the relevant recommendations of Section 4, particularly in relation to quality of terminations and continuity of screens. For mineral insulated copper sheathed cables, terminations of screens should be effective around the entire 360° of the

screen. For other cables, care should be taken to ensure that the scree of the cable is continued to the appropriate terminal in the control panel or device. This is normally achieved using cables where an uninsulated circuit protective conductor is in constant contact with the screen throughout its length;

- 4) any cable specifications stipulated by the manufacturer should be adhered to. However, cables not compliant with the recommendations of this standard should only be used with the prior agreement of all interested parties and should be recorded as a variation;
- 5) correct earthing of equipment is vital for adequate EMC performance as well as electrical safety. The recommendations of Clause 29. 37.2f) and Figure 18 should also be followed;
- 6) exposure of the cores outside of the screen should be kept to a minimum, consistent with practical installation requirements;
- 7) where the manufacturers of the control equipment advise that the system is sensitive to multiple screen earths for each circuit, then their instructions in respect of these should be followed (see 37.2f) and Figure 18);
- 8) where required, the screen should have continuity throughout the whole circuit (see 37.2f) and Figure 18;
- 9) where it is necessary to crossfire detection and fire alarm system cables with those that can potentially cause interference, the cables should be crossed at right angles.

29 Electrical earthing

29.1 Commentary

Fire alarm power supplies need to conform to BS EN 54-4. If terminals for extra low voltage (ELV) circuits can be exposed, when for example a detector is removed from its base, the fire alarm power supply needs to meet the requirements of a separated extra low voltage (SELV) installation. Any SELV protective measure by definition conforms to the relevant requirements of Section 414 of BS 7671:2008+A3. To achieve this, it is essential that all connections to low voltage (LV) supplies or equipment are made by components that are rated for connection to LV. This would include all power supplies and all interfaced to LV components used in the fire alarm system. Where the fire alarm is interfaced to ELV equipment that might not be intended for use with removable components, such as fire detectors, the ELV equipment ought to be treated as if it was LV, so as to maintain electrical safety.

29.2 Recommendations

The following recommendations are applicable.

- a) The system design should be such as to satisfy the relevant requirements of BS 7671. In particular, CPCs should be adequately rated.
- b) The CIE manufacturer's instructions or product marking should be followed, particularly in respect of earthing arrangements.
- c) LV and ELV circuits should be segregated throughout in accordance with 26.2n) and Clause 28. In particular, if any ELV fire alarm cables share the same wiring containment with other cables, the cable insulation of the fire alarm cables should be rated for the highest voltage.
- d) For ELV circuits with removable components (e.g. detectors or parts of detectors) that expose to touch conductive circuit parts at ELV potential, the following applies.
 - 1) All relevant power supplies for the fire detection and fire alarm system should conform to BS EN 54-4.
 - 2) In dry conditions, fire detectors do not have to be locked into their bases.
 - 3) In areas where conditions are wet, the arrangement should be one or more of the following:
 - i) circuit voltages are less than 15 V ripple free d.c. or 6 V a.c. rms;
 - ii) a tool or special technique is necessary to remove parts exposing ELV parts; or
 - iii) the parts are positioned out of reach of persons other than authorized maintenance personnel.

NOTE 1 Wet areas include the following:

- locations containing a bathtub or shower basin;
 - swimming pools;
 - hot air saunas;
 - agricultural and horticultural premises: and
 - abattoirs, cold stores and certain food preparation areas.
- e) Means should be provided for local isolation of the mains supply to all parts of the system; the isolation facilities should be suitably sited, in the vicinity of the equipment served, for use by maintenance technicians without the need for access to remote parts of the building. It should be possible to lock facilities in both the normal and isolate positions to prevent unauthorized use. See Clause 25,

NOTE 2 The contractor responsible for supplying the 230 V mains power supply needs to ensure that the particular device used does actually afford Isolation. A number of switching devices do not meet the required isolation performance criteria. BS 7671 :2008+A3:2015, Table 53.4, details whether a particular device can be used for the purpose of isolation.

Section 3: Limitation of false alarms and unwanted fire alarm signals

30 Responsibility for limitation of false alarms and unwanted fire alarm signals

30.1 Commentary

False alarms cause disruption to the normal operation of business and create a drain on fire and rescue service resources. False alarms can even seriously prejudice the safety of occupants, who might not react correctly when the system responds to a real fire if they have recently experienced a number of false alarms.

Responsibility for limitation of false alarms and unwanted fire alarm signals rests with every party involved in the specification, design, installation, commissioning, management at operational level and maintenance of the fire detection and fire alarm system.

The major part of the responsibility for limitation of false alarms and unwanted fire alarm signals rests with the designer, but it is important that enforcing authorities and insurers have a good knowledge of the guidance contained in this section, so that requirements for forms of automatic fire detection, which, realistically, are unsuitable for the conditions in the building, are not imposed.

The role of the installing company is simply to install the system in accordance with the requirements of the designer. However, where, during installation, if an installing company identifies conditions in the building (eg. environmental conditions) that might result in an unacceptable rate of false alarms and unwanted fire alarm signals, the designer, purchaser or user needs to be informed, so that the need for modification of the design can be considered. Any installing company purporting to have specialist capability in installation of fire alarm systems needs to have a good understanding of the guidance contained in this section.

At commissioning (see Clause 39), a special check needs to be carried out to ensure that there is no obvious potential for the system to generate an unacceptable rate of false alarms and unwanted fire alarm signals.

Where there is cause for concern regarding possible potential for false alarms and unwanted fire alarm signals that is not definite enough to warrant action at commissioning, this needs to be recorded so that particular attention can be given to the matter in examining the false alarm record at the time of the first (and, if necessary, subsequent) service visits.

Any party responsible for accepting a fire detection and fire alarm system needs to ensure that they are satisfied that the ultimate user is aware of the need, and means, for limiting false alarms and unwanted fire alarm signals. Verification of compliance with this standard includes verification that suitable steps have been taken by all parties to ensure that false alarms and unwanted fire alarm signals can be limited as far as reasonably practicable.

Once a compliant system has been handed over to the user, it is incumbent on the user to ensure that the system and the building itself are suitably managed to avoid unnecessary false alarms and unwanted fire alarm signals. Where an unacceptably high rate of false alarms does occur, it is the responsibility of the user to ensure that appropriate steps are taken to reduce the rate at which they occur. It is also the responsibility of the servicing organization to consider the recorded false alarm experience on each occasion that the system is serviced, so that unacceptable rates of false alarms can be identified and that appropriate advice can be given to the user.

Systems in which the parties responsible have not taken adequate care to limit false alarms and unwanted fire alarm signals, and systems that produce unacceptable high rates of false alarms and unwanted fire alarm signals, need to be regarded as non-compliant with this standard

30.2 Recommendations

The following recommendations are applicable.

- a) When Imposing requirements for automatic fire detection, enforcing authorities and property insurers should take the guidance contained in this section into account, so that, subject to the overriding need for adequate protection of life and/or property, the form of detection specified does not have the potential to create an unacceptable rate of false alarms and unwanted fire alarm signals.
- b) The system designer should ensure that system design takes account of the guidance contained in this section. As evidence of compliance with this recommendation, the measures incorporated within the design to limit false alarms and unwanted fire alarm signals should be recorded on the design certificate (see Annex G).
- c) Where an installing company identifies any circumstances that might lead to a high rate of false alarms and unwanted fire alarm signals, the designer, purchaser or user should be informed accordingly [see also 7.2b)].

- d) At commissioning, a check should be carried out to ensure that there is no obvious potential for an unacceptable rate of false alarms and unwanted fire alarm signals. As evidence of compliance with this recommendation, the completion of the check should be recorded on the commissioning certificate, along with any potential false alarm and unwanted fire alarm signals problems that should be subject to further consideration at the time of service visits.
 - e) The designer and the supplier of the system should jointly provide the user (or a suitable representative of the user) with sufficient information to enable a user who is unfamiliar with the technology of fire detection and fire alarm systems to minimize the rate of false alarms and unwanted fire alarm signals. Any person responsible for acceptance of the system (See Clause 42) should confirm that this information has been provided to the user.
 - f) Any person responsible for verification of the compliance of a system with this standard (see Clause 43) should verify, as far as reasonably practicable, that adequate account has been taken of this section in the design, installation and commissioning of the system.
 - g) The user should arrange for suitable investigation and, if appropriate, action to be taken on every occasion that a false alarm occurs. This may, for example, comprise managerial changes within the building, modifications to the fire detection and fire alarm system or an investigation by the organization that maintains the system.
 - h) The user should record appropriate details regarding every false alarm and/or unwanted fire alarm signal that occurs. Information recorded should include the following:
 - 1) date and time;
 - 2) identity and location of device (if known);
 - 3) category of false alarm (if known) (see 3.1.2.);
 - 4) reason for false alarm (if known);
 - 5) activity in the area (if the reason for the false alarm is unknown);
 - 6) action taken on the cause of the false alarm;
 - 7) whether the fire and rescue service were called;
 - 8) whether the fire and rescue service attended; and
 - 9) the person responsible for recording the information.
 - i) At the time of every service visit, the system false alarm record should be checked carefully to determine the following:
 - 1) the rate of false alarms during the previous 12 months, expressed as number of false alarms per 100 detectors per annum (the rate should be recorded in the logbook by the service technician);
 - 2) whether; since the time of the previous service visit, two or more false alarms, other than false alarms with good intent (see 3.19), have arisen from any single manual call point or fire detector (or detector location);
 - 3) whether any persistent cause of false alarms can be identified; and
 - 4) whether the number of unwanted fire alarm signals during the previous 12 months is recorded in the logbook.
- NOTE 1 The user needs to make historic events records available.
- j) At least, a preliminary investigation should be carried out as part of the service work if any of the following apply:
 - 1) the rate of false alarms over the previous 12 months has exceeded one false alarm per 25 detectors per annum;
 - 2) 11 or more false alarms have occurred since the time of the previous service visit (i.e. typically, within the previous 6 months);
 - 3) two or more false alarms (other than false alarms with good intent) have arisen from any single manual call point or fire detector (or detector location) since the time of the last service visit;
 - 4) any persistent cause of false alarm is identified; or
 - 5) more than two unwanted fire alarm signals have occurred in the previous 12 months.

The purpose of the preliminary investigation is to determine whether any action could be taken to reduce the potential for false alarms and/or unwanted fire alarm signals; the user should be informed of the outcome of the investigation and be given appropriate advice, including advice regarding the need for a more in-depth investigation (see 32.2)

31 Categories of false alarms

31.1 Commentary

It is a common misconception that most false alarm arise from faults in equipment. In fact, most false alarms arise from a combination of environmental influences, fire-like phenomena, inappropriate action by people in the building and accidental damage. The term "unwanted alarms (see 3.19) is now used to describe this latter group of false alarms, to distinguish these false alarms from those arising from malfunction of equipment, which are now described as "equipment false alarms: Two further categories of false alarm are "malicious false alarms arising from malicious action, and false alarms with good intent involving genuine belief by a person that there is a fire (see 3.19).

In order for any investigation of false alarms to be successful, and for appropriate action to be taken on false alarms, it is important that false alarm records record the category of false alarm whenever this can be accurately determined.

31.2 Recommendations

When false alarms are recorded by the user (see 30.2h) the category of false alarm (if known) should also be recorded. Where any doubt exists, the cause should be recorded as "unknown" (e.g. it should not be assumed that. in the absence of other information, a false alarm needs to have arisen from an equipment fault.

32 Acceptable rate of false alarms

32.1 Commentary

From the point of view of the user and the fire and rescue service, any false alarm is undesirable. Nevertheless, it needs to be accepted that particularly in installations that incorporate a large number of automatic fire detectors, complete elimination of false alarms is impossible. From time to time, events will occur that give rise to a false alarm. The objective of all parties involved, from specification and design to everyday use of the system, is to minimize the number of false alarms and unwanted fire alarm signals that occur.

It follows, therefore, that there is a need to define an "acceptable" rate of false alarms. As recommended in 30.2/, the service organization needs to make, at least, a preliminary investigation if, at the time of a service visit, it is determined that the rate of false alarms in the previous 12 months has exceeded one false alarm per 25 detectors per annum. The user needs to investigate an in-depth special investigation at an even higher rate. This can be undertaken by the servicing organization, the manufacturer of the system or a suitably qualified third party (such as fire engineer consultant).

On a more routine basis, false alarm rates need to be monitored periodically by the "premises management" (see Clause 47). Little information is available as to the "average" rate of false alarms from fire detection and fire alarm system and a benchmark, against which false alarm performance can be judged, cannot be defined with any real precision. The key to quantifying false alarms is the examination of historic system records.

For any given system, the "average" rate of false alarms depends on many factors, including:

- the number of automatic fire detectors;
- the environment in which automatic fire detectors are installed;
- the activities in the building;
- the degree of control over the activities of third parties (such as contractors);
- the extent to which strong electromagnetic fields are present;
- the level of occupation of the building (e.g. day shift or 24 h working); and
- the propensity for malicious action.

The number of false alarms that can be anticipated is virtually proportional to the number of automatic fire detectors installed. The constant of proportionality will normally be highest where the fire detectors are smoke

detectors. Systems incorporating only manual call points or manual call points in conjunction with heat detectors do not normally produce many false alarms; the regular occurrence of false alarms in such systems warrants particular attention by the user and/or servicing organization.

Experience suggests that, in a relatively benign environment, in which there is no tendency for dust, fumes or insects to occur, and in which there is a good standard of management, false alarm rates equal to, or less than, one false alarm per 100 detectors per annum are possible, even if the proportion of smoke detectors is very high. On industrial sites with shift working, this figure ought to be regarded as a possible target, but not a norm; a figure of one false alarm per 75 detectors per annum is probably a more realistic expectation.

In general, false alarm rates of one false alarm per 50 detectors per annum can be readily achievable with modern technology systems, unless there are severe environmental challenges for automatic fire detection; where such challenges occur; consideration needs to be given to whether automatic fire detection is appropriate and/or whether it is necessary for a signal from a single automatic fire detector (particularly a smoke detector) to initiate an evacuation or result in summoning of the fire and rescue service.

It follows that, while a rate of one false alarm per 50 detectors per annum might represent quite reasonable and, hence, 'acceptable' performance on an industrial site with processes that create an unfavourable environment for automatic fire detectors, this rate might not be regarded as acceptable in a controlled environment, such as a computer room.

In general, in systems with more than 40 automatic fire detectors, a rate of more than one false alarm per 20 detectors per annum is never to be regarded as acceptable, particularly if the false alarms result in evacuation of the premises or summoning of the fire and rescue service. In premises with 40 automatic fire detectors or less, more than two false alarms per annum is to be regarded as unacceptable.

Notwithstanding the above, the user has a duty to mitigate all instances of false alarms.

In the future, it is possible that a fire and rescue authority will take appropriate action against the user if a fire detection and fire alarm system consistently produces false alarms and unwanted fire alarm signals at such unacceptable rates.

32.2 Recommendations

The following recommendations are applicable.

- a) In systems that incorporate more than 40 automatic fire detectors, the user should instigate an in-depth investigation by suitable specialists if, in any rolling period of 12 months, either:
 - 1) the average rate of false alarms. exceeds one false alarm per 20 detectors per annum: or
 - 2) three or more false alarms are initiated by any single manual call point or automatic fire detector (or detector location).
- b) In systems that incorporate 40 or less automatic fire detectors, an in-depth investigation, as described in 32.2a), should be instigated by the user if, in any rolling 12 months period, three or more false alarms occur.

33 Causes of false alarms

33.1 Commentary

In many premises, most false alarms take the form of unwanted alarms (see 3.19). Recognized causes of unwanted alarms (albeit, in some cases only from certain types of automatic fire detector) are as follows:

- fumes from cooking processes [including toasting of bread];
- steam (from bathrooms, shower rooms and industrial processes);
- tobacco smoke;
- dust (whether built up over a period of time or released from an industrial process);
- insects;
- aerosol spray (e.g. deodorants and cleaning fluids);
- high air velocities;
- smoke from sources other than a fire in the building (e.g. from an external bonfire);
- cutting, welding and similar "hot work";

- processes that produce smoke or flame (e.g. flammable of food);
- cosmetic smoke (e.g. in discotheques and theatres);
- incense;
- candles;
- electromagnetic interference;
- high humidity;
- water ingress;
- substantial fluctuation in temperature;
- accidental damage (particularly to manual call points);
- testing or maintenance of the system, without appropriate disablement of the system or warning to building occupants and/or an ARC; and
- pressure surges on water mains serving automatic sprinkler systems that are interfaced with the fire detection and fire alarm system.

Most of these causes can be minimized by appropriate choice of detection system and suitable management arrangements.

False alarms can also arise from faults in equipment (equipment false alarm). These can be minimized by choice of good quality equipment that satisfies relevant standards (see Clause 11), has third-party certification and has been regularly serviced and maintained in accordance with Section 6 of this standard.

Malicious false alarms (see 3.19) tend to occur with most frequency in certain premises to which the public resort in large numbers, such as shopping centres, places of entertainment, public car parks and sports centres, and in educational establishments, such as universities and schools. Mainly, malicious operation of manual call points is involved. Manual call points in certain public houses can also be subject to malicious operation. Where there is significant potential for malicious false alarms, or an existing system is subject to these, consideration needs to be given to the locations of manual call points and to the possible use of two-action devices.

Little can be done to prevent false alarms with good intent (see 3.19). These are unlikely to present a significant problem, and it is important that people are never discouraged from operating a manual call point if they suspect that there might be a fire.

However, in some premises where frequent good intent false alarms occur, investigation and consideration can be given to addressing the incident frequency. It is possible that processes causing smoke-like odours and a mistaken belief of fire could be better controlled and staff could be better informed. In situations involving manual call points, where these are being mistaken for exit door releases, better signal and alarm covers can be employed to address the problem. It is also possible that applying variations is an appropriate resolution.

33.2 Recommendations

Any person responsible for specification, design, commissioning or maintenance of fire detection and fire alarm systems should be conversant with the major causes of false alarms. Particular care should be taken to limit the potential for unwanted alarms and, in certain vulnerable premises, malicious false alarms.

34 Design process for limitation of false alarms and unwanted fire alarm signals

34.1 Commentary

The majority of false alarms arise from automatic fire detectors, particularly smoke detectors, rather than manual call points. Although, in most circumstances, automatic fire detection greatly enhances the level of fire safety, and any risk assessment needs to take into account the benefit of automatic fire detection compared with the potential for false alarms and unwanted fire alarm signals. Examples include simple buildings in which all areas are occupied on a 24 h basis (e.g. certain small factories).

Normally, it is inappropriate to avoid automatic fire detection simply to avoid false alarms and unwanted fire alarm signals. Limitation of false alarms and unwanted fire alarm signals normally involves, firstly, identification of the likely conditions that could give rise to false alarms from the form of detection proposed. By suitable choice of system type, detection principle and detector siting, in most cases the likely frequency of false alarms will be acceptable.

However, the designer needs to, at the design stage, make a judgement as to the likely frequency. This need not be quantitative in all cases, but can be expressed qualitatively (e.g. low, medium, high). Alternatively, in very large systems with many smoke detectors, it might be of value for the designer to give the user some very approximate rate at which false alarms could occur; the information contained in Clause 32 may form a basis for estimation. If this frequency is unacceptable, whether on the basis of the guidance in Clause 32 or on the basis of consultations with the user or purchaser, additional measures might need to be incorporated into the design to further limit false alarms and unwanted fire alarm signals or their effects.

Additional measures to control false alarms and unwanted fire alarm signals might involve a change in detection principle from that originally proposed, a change in system type to a more complex, sophisticated system, or a form of "filtering" false alarms so that those that do occur do not lead to evacuation of the building or summoning of the fire and rescue service. It is essential, however, that any additional measures do not compromise the protection afforded by the system to a degree that its objectives (whether in respect of protection of life, protection of property, protection against business interruption or protection of the environment) are no longer satisfied; in the case of some measures, agreement of the interested parties (see Clause 6) might be necessary.

Each major area of the building needs to be considered separately and the design process might need to be iterative, in that, if the initial design is not adequately robust in its limitation of false alarms and unwanted fire alarm signals, further measures might need to be considered until the potential for false alarms and unwanted fire alarm signals is suitably minimized. A schematic of the recommended design process is shown in Annex E.

34.2 Recommendations

The following recommendations are applicable:

- a) at the design stage of every system, there should be formal consideration of the potential for false alarms and unwanted fire alarm signals, with a view to confirming that design is such that the frequency of false alarms and unwanted fire alarm signals is likely to be acceptable (see Clause 32);
- b) any relevant design information regarding false alarms and unwanted fire alarm signals should be recorded and documented in accordance with Clause 40.

35 Measures to limit false alarms and prevent unwanted fire alarm signals

35.1 Commentary

In principle, measures to limit false alarms and unwanted fire alarms signals can be divided into eight groups:

- siting and selection of manual call points;
- selection and siting of automatic fire detectors;
- selection of system type;
- protection against electromagnetic interference;
- performance monitoring of newly commissioned systems;
- filtering measures;
- system management; and
- regular servicing and maintenance .

35.2 Recommendations

35.2.1 General

The following recommendations constitute general guidelines that should be taken into account by any parties responsible for specification, design, commissioning or verification of a fire detection and fire alarm system, and by maintenance organizations at the time of consideration of false alarm problems. The recommendations should not, however, be regarded as definitive "rules".

35.2.2 Recommendations for siting and selection of manual call points

The following recommendations are applicable.

- a) This standard recommends manual call points shall be fitted with protective covers [see 20.2b)]. While that recommendation is not retrospective, in existing systems in which there is frequent unwanted operation of manual call points, protective covers shall be fitted.

- b) Manual call points should not be sited where they are likely to be exposed to accidental damage (e.g. by normal operations in the building, trolleys or forklift trucks). Where compliance with 20.2 makes such siting essential, suitable guards should be provided to prevent impact on the manual call points.

Examples include manual call points located adjacent to fire exits from sports halls and gymnasias in which ball sports are played. Protective covers shall be provided for this purpose.

- c) In areas in which manual call points are exposed to moisture, suitably water-resistant devices shall be used.

NOTE 1 Examples include external locations, wet areas of Industrial buildings, food-processing areas that are subject to periodic washing down and certain kitchens.

- d) To minimize the potential for malicious operation, manual call points should not normally be located within the malls of covered shopping complexes. Subject to the agreement of all relevant enforcing authorities, it might also be appropriate either to omit manual call points from areas accessible to the public or to site them so that they are accessible only to authorized persons, provided there is adequate surveillance of the entire premises by persons (or by CCTV) and that manual call points are provided at suitably staffed locations; examples of such premises include some public houses, cinemas, theatres and nightclubs.

NOTE 2 In public car parks, consideration can be given to the use of a suitable emergency voice communication system in lieu of manual call points [see 20.21k].

35.2.3 Recommendations for selection and siting of automatic fire detectors

The following recommendations are applicable.

- a) In areas with high levels of dust and dirt which could contaminate detectors and/or lead to an unwanted alarm, preference should be given to the use of aspirating smoke detectors as long as these incorporate mechanical filtrations of the air samples before they are analysed for the presence of smoke. It should be confirmed that the filters used for any such detectors are covered under the detectors' certification in accordance with BS EN 54-20. Furthermore, account should be taken of the consequences of blocked filters to the detection capability of the system and a rigorous regular maintenance regime established if needed.
- b) In areas in which automatic fire detectors are likely to result in a high level of unwanted alarms, it should be confirmed whether the provision of automatic fire detection is necessary to ensure that the objectives of the fire detection and fire alarm system are satisfied (see Clause 4).
- c) Since, in most premises, heat detectors are likely to give rise to lower rates of unwanted alarms than other forms of automatic fire detector, before other types are used it should be confirmed that the use of heat detectors would not satisfy both the objectives of the fire detection and fire alarm system and the recommendations of this standard (see Clause 5 and Clause 21).
- d) The minimum static response temperature (see 3.39) of heat detectors should not be less than 29 °C above the ambient temperature that the detector can be expected to experience for long periods of time, and not less than 4 °C above the maximum temperature that the detector can be expected to experience for short periods of time, under normal conditions.

NOTE 1 BS EN 54-5 specifies six classes of heat detector for use in high ambient temperatures (between 40 °C and 140 °C).

- e) Rate of rise heat detectors should not be installed in locations in which rapid fluctuations in temperature might occur; examples include kitchens, boiler rooms, loading bays with large doors to open air and lantern-lights.
- f) In the absence of overriding considerations (particularly in respect of effective detection of fire), the guidance contained in Annex E should be taken into account when considering the use of point and optical beam smoke detectors, or when selecting the principle of operation of these detectors.
- g) Optical beam smoke detectors should not be installed in areas in which obstruction of the beam might occur in normal circumstances.
- h) Where optical beam detectors are installed in any area, they should be suitably mounted [see 22.5g)].
- i) Certain fire detection and fire alarm systems which incorporate multi-sensor detectors have the potential to reduce greatly the potential for unwanted alarms. The extent to which the potential can be reduced depends on the characteristics of each proprietary multi-sensor detector and on the potential causes of unwanted alarms. The provision of more than one sensor within one fire detector does not, alone, necessarily have a significant impact on potential for unwanted alarms.

- j) Many aspirating smoke detection systems can operate at a level of sensitivity much higher than normal point type smoke detectors. Special consideration should be given to the potential for false alarms when a high sensitivity (Class A) or enhanced sensitivity (Class B) aspirating smoke detection system is proposed, to ensure that an unacceptable rate of unwanted alarms is not likely to result.

NOTE 2 Such systems are often used to provide signals intended to be managed as a "pre-alarm warning" (to indicate that an alarm addition is approaching) or as a very early warning (to alert staff of abnormal conditions that are worthy of investigation). Such signals might not be suitable (or intended) to be managed as an alarm signal that triggers alarm devices and evacuation of the building. However, such pre-alarm warnings or very early warning signals can be used to avoid false alarms, unnecessary evacuations and unwanted fire alarm signals to the fire and rescue service. In some applications in which Class A and/or Class B aspirating smoke detection systems are used, a Class C (normal sensitivity) signal is provided which is managed as an alarm condition.

- k) Carbon monoxide fire detectors should not be used in locations in which carbon monoxide might occur under normal circumstances, in quantities sufficient to create the potential for unwanted alarms.

NOTE 3 Such areas include badly ventilated kitchens, some laboratories and areas for which vehicle or other exhaust fumes occur.

- l) Carbon monoxide fire detectors should not be used in locations in which contamination of the electro-chemical cell could result in unwanted alarms. The guidance of the manufacturer on avoidance of unwanted alarms should be taken into account
- m) Flame detectors should not be located in areas in which sources of infrared or ultraviolet radiation create the potential for unwanted alarms. Since various techniques can be adopted in the design of the detector to minimize the potential for unwanted alarms as a result of radiation from non-fire sources, the guidance of the manufacturer of the detector in respect of sensitivity of detectors to such sources, should be taken into account.

35.2.4 Recommendations for selection of system type

The following recommendations are applicable.

- a) Unless there are overriding considerations, systems that incorporate a high number of smoke detectors should be of the analogue type.

NOTE 1 Analogue smoke detection systems are likely to offer better immunity to false alarms than conventional two-state fire detection systems, particularly if signal processing incorporates techniques specifically intended to discriminate between certain unwanted alarms and real fires. Some two-state fire detection systems also employ such signal processing. Many analogue systems also provide a pre-alarm warning (see 1:15), which enables investigation of conditions that, if no action is taken, would lead to an unwanted alarm

NOTE 2 A high number of smoke detectors might be regarded as more than 100 detectors.

- b) In systems that incorporate a very high number of automatic fire detectors (other than heat detectors), the use of systems that include multi-sensor fire detectors and incorporation of suitable measures to minimize the potential for unwanted alarms should be considered at the design stage.

NOTE 3 At the time of publication of this standard, a very high number of detectors might be regarded as more than 1000 detectors.

35.2.5 Recommendations for protection against electromagnetic interference

The following recommendations are applicable:

- a) In order to minimize the potential for electromagnetic interference to cause unwanted alarms, the recommendations of Clause 28 should be followed.
- b) The designer should take into account the likely sources of electromagnetic radiation in the building (e.g. mobile telephones, two-way radios, mobile telephone base stations and other high power transmitters).
- c) In special cases where unusually high electromagnetic field strengths occur (e.g. radio transmitter sites, airport terminals and radar stations), guidance should be sought from the system manufacturer in respect of suitability of the proposed system and any special measures (such as incorporation of filters on external circuits) to reduce the potential for unwanted alarms. In the case of an existing building, information provided to the system manufacturer should include field strength measures.

35.2.6 Recommendations for performance monitoring of newly commissioned systems

The following recommendations are applicable.

- a) In the case of systems incorporating more than 50 automatic fire detectors, after commissioning, a soak period (see 3.58) should follow. The duration of the soak period should be at least one week but

should be defined by the designer and incorporated within any tender specification. Systems that incorporate connection to an ARC should have this connection disabled during the soak period.

- b) Until successful completion of the unsoak test, the system should not be regarded as the operational means of giving warning of fire in the building. During the soak period, each manual call point should bear an indication that it is not to be used.
- c) The "soak test" should only be regarded as successfully completed if:
 1. during the soak period, no false alarm occurred; or
 2. investigation of all false alarms that occurred, by the supplier of the system, identified the cause of every false alarm and enabled any relevant measures to be taken to minimize potential for similar false alarms to occur in the future.

NOTE A purchasing specification might require that, on completion of any relevant measures, a further soak test be carried out.

35.2.7 Filtering measures

35.2.7.1 Commentary

The recommendations of 35.2.2, 35.2.3, 35.2.4, 35.2.5 and 35.2.6 apply to all systems. It might be considered at the design stage (see Clause 34), or following unsatisfactory operational experience, that the rate, or the periodicity, of false alarms, is likely to be (or has proved to be) unacceptable. Under these circumstances, it might be necessary to take further measures to ensure that false alarms do not result in continual evacuation of people or summoning of the fire and rescue service.

There are two principal means by which potential false alarms can be filtered. The first, which is only applicable to those systems provided for property protection, is to disable automatic fire detectors (particularly smoke detectors) automatically at certain times of day (or night), when environmental conditions (such as those arising from an industrial process) are likely to give rise to unwanted alarms.

In effect, the system might then become a Category M system during normal working hours, when people are present and can detect a fire, but a Category P system outside normal working hours (when the automatic fire detectors would be of most value in any case).

A system that operates in this manner is described as a "time-related system" (see 3.62), and, in effect, it filters out unwanted alarms, rather than obviating their cause. Other forms of time-related system may also be considered.

For example, rather than totally disabling automatic fire detectors, their sensitivity might be reduced automatically at certain times, so that a (reduced) standard of protection can still be afforded. In a multi-sensor fire detection and fire alarm system, one of the sensors (e.g. a smoke sensor) might be disabled (or reduced in sensitivity) at certain times, so that some protection is still afforded by another sensor (e.g. a heat sensor). (The detectors would then need to be sited in accordance with the recommendations for heat detectors.)

The second form of filtering involves the use of a staff alarm arrangement (see Clause 19). This permits an investigation period following activation of an automatic fire detector, prior to operation of fire alarm sounders and/or summoning of the fire and rescue service. Staff alarms that incorporate such an investigation period are now quite common in well-managed buildings that are protected by a high number of smoke detectors. The staff alarm arrangement can apply at all times or only at certain times of the day, such as normal working hours; in this case, the system is also a time-related system.

Where an investigation period is employed, the fire and rescue service ought not to be called until the outcome of the investigation is known (except in residential care premises where it is necessary to summon the fire and rescue service as soon as the fire detection and fire alarm system operates).

Equally, in a Category P system, consideration needs to be given to the overall period between operation of the fire detection and fire alarm system and the ultimate attendance of the fire and rescue service, as a combination of an investigation period and a long fire and rescue service attendance time might preclude the objective of the system from being satisfied.

Filtering might sometimes be applied solely to the summoning of the fire and rescue service. In this case, the building, or part of it, would be evacuated when the fire detection and fire alarm system operate, but the automatic summoning of the fire and rescue service would be delayed pending an investigation to confirm whether the alarm signal is false or the result of a real fire.

The use of a staff alarm normally incorporates certain safeguards to ensure that there is still early response to a real fire. This includes a full fire alarm signal if a manual call point is operated, or a heat actuated device

(such as a heat detector or sprinkler head) operates. A staff alarm arrangement also incorporates coincidence detection, so that the delay is cancelled if two detectors operate. See also Clause 19

35.2.7.2 Recommendations

The following recommendations are applicable.

- a) Filtering measures should be adopted under the following circumstances:
 1. in the case of category P systems in which it is proposed to incorporate an investigation period prior to the summoning of the fire and rescue service (whether manually or automatically), after consultation with the insurers; and
 2. where it is considered that either the rate of false alarms and unwanted fire alarm signals expressed as number of false alarms per 100 detectors per annum, or the actual number of false alarms, cannot be limited to a level acceptable to the user and the fire and rescue service by other means; and
 3. where it is considered that the incorporation of filtering measures does not negate the objectives of the system in terms of protection of life, property, business continuity or the environment
- b) Filtering should not be applied to signals initiated by manual call points, heat detectors or sprinkler systems.
- c) In time-related systems, the change of state of the system to unmanned mode should not rely on human action; it should occur automatically at predetermined times. The change of state to manned mode should be by human action at the fire alarm system to ensure persons are present.

NOTE 1 The control of these features might be possible either manually, through a day/night mode control, or automatically through a clock provided within the CIE. A combined system can be employed where the CIE automatically switches to the more sensitive mode with no filtering applied at a certain time, e.g. 6pm, and the less sensitive day mode is then manually selected on the initial occupation of the building the next day. However, these systems are liable to inappropriate activation due to circumstances such as when people remain in occupation later than expected leading to unwanted alarms. A better configuration might be to link the activation of filtering to the intruder alarm system, which is set or unset according to the building occupation status.

- d) Staff alarms should conform to 19.2.2

NOTE 2 19.2.2 recommends that, in residential care premises, the fire and rescue service is summoned immediately when the fire detection and fire alarm system operates.

- e) If the fire and rescue service is not summoned immediately at the start of any investigation period associated with a staff alarm, it is essential that they are summoned immediately on expiry of this period, unless it has been determined that the alarm signal is a false alarm.

NOTE 3 Reliability in compliance with this recommendation would be aided by a monitored facility for automatic transmission of an alarm signal to an ARC on expiry of the investigation period.

- f) Any arrangements for filtering of automatic summoning of the fire and rescue service by an ARC should conform to this standard. Such filtering should not be applied to signals from fire alarm systems in residential care premises.
- g) Where a signal from an automatic sprinkler system that is supplied from water mains is used as an input to the fire detection and fire alarm system (e.g. by means of a pressure or flow switch), there should be liaison with the organization responsible for installing or maintaining
- h) the sprinkler system to minimize the potential for unwanted alarms as a result of water pressure surges. A hydraulic or electronic time delay facility should be considered.

35.2.7.3 Recommendations for system management

The following recommendations are applicable.

- a) The user should ensure that staff in the building and visiting contractors are aware of the presence of any automatic fire detectors, and of the measures necessary to minimize the likelihood of false alarms and unwanted fire alarm signals.
- b) Tender documents for contact work to be carried out in a protected area should contain a clause making the contractors responsible for informing their staff of the presence of any automatic fire detectors, and of the precautions to be adopted when working.
- c) Where temporary work involving the generation of dust, smoke, paint spray, etc., is to be carried out in an area protected by smoke detectors, precautions should be taken to prevent unwanted alarms.

NOTE 1 One method of managing such work would be the operation of a permit to work system. Other suitable measures may include the following:

- i) temporary replacement of smoke detectors by other types of detectors that are less susceptible to the effects of the pollutants in question;
- ii) provision of a temporary screen between the work and the detectors. The flammability of the screen ought to be considered to ensure that it does not increase the fire risk;
- iii) provision of brightly coloured temporary covers over detectors to prevent the ingress of contamination;
- iv) disablement of automatic fire detectors. On completion of the work, the premises management (see Clause 47) should ensure that proper reinstatement of the protection occurs;
- v) disablement of communication with any ARC. On completion of the work, the premises management (see Clause 47) should ensure that proper reinstatement of the monitoring occurs.

NOTE 2 Unless the work involving generation of dust etc. is to be carried out throughout a large part of the building, the measures described in c)4) are preferable, as these still permit remote monitoring of fire alarm signals from areas where work is not being carried out

- d) Suitable notification of building occupants, and any ARC to which fire alarm signals are transmitted, should occur prior to routine testing or maintenance work on the fire alarm system that might result in the occurrence of a fire alarm signal.
- e) The user should ensure that building defects (e.g. leaking roofs), plant defects (e.g. steam leaks) and environmental problems (such as inadequate ventilation) that could cause unwanted alarms receive suitable attention.
- f) All false alarms should be properly recorded by the user in the system logbook (see 30.2h, .31.2) and Clause 48.
- g) Suitable action should be taken by the user when false alarms occur (see 30.2g and 32.2).

35.2.7.4 Recommendations for service and maintenance

Service and maintenance on the system should be carried out by a competent organization in accordance with Section 6 of this standard.

Section 4: Installation

36 Responsibility of installer

36.1 Commentary

This section gives 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 detection and 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 company or to an installing company which would, in either case, then be responsible for installation.

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 (see Clause 6). It is the responsibility of the installing company to check or verify whether the design of the system complies in full with the recommendations of this standard

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 Section 2 impact on both design and installation, and might, therefore, be delegated by the designer to the installer, provided the responsibility for compliance is clear in any specification or contract, that the installer is competent to address the issues and that the responsibility is accepted by the installer. For example, the designer might delegate decisions regarding cable routes to the installer, by simple reference in the design to compliance with Clause 26, 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 of Section 2. For example, it is rarely possible, at the design stage, to warrant that the recommendations of 16.2 in respect of 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 Clause 22. Accordingly, it is often necessary for compliance with certain clauses of Section 2, or verification of compliance, to rest with an installer.

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 in the absence of expertise design of fire detection and fire alarm systems. In this respect, the installer is then, 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 is aware of such shortcomings, particularly those arising from features of the building that might not have been known to the designer, they be drawn to the attention of the designer, user or purchaser.

36.2 Recommendations

The following recommendations are applicable to the responsibility of an installer.

- a) The responsibilities associated with the installation of the system should be clearly defined, agreed and documented prior to the commencement of the installation work.
- b) The installer should comply with 6.2c).
- c) The installer should comply with 7.2b).
- d) The installation of MCPs should be in accordance with 20.2d) to 20.2k).
- e) When installing point, heat, smoke and carbon monoxide detectors, the installer should, at least, ensure compliance with 22.3e), 22.3h) and 22.3n).
- f) When installing beam-type smoke detectors, the installer should, at least, ensure compliance with the recommendations of 22.5d), 22.5e), 22.5f) and 22.5g) and any manufacturer's recommendations for the mounting distance below the ceiling.
- g) When installing line heat detectors, the installer should, at least ensure compliance with 22.3e), 22.3g), 22.6c) and 22.6e).

- h) When installing smoke detectors in ventilation ducts, the installer should, at least, ensure compliance with 22.10a) and 22.10c).
- i) Where an installer identifies any circumstances that might lead to a high rate of false alarms, the designer, purchaser or user should be informed accordingly [see also 7.2b)].
- j) The installer of the mains power supplies to the fire alarm system should ensure that the supplies comply with 25.2.
- k) The installer should ensure that all control, indicating and power supply equipment that is likely to need routine attention for maintenance is sited in readily accessible locations that facilitate safe maintenance work
- l) All metallic parts of the installation, including conduit, trunking, ducting, cabling and enclosures, should be suitably separated from any metalwork forming part of a lightning protection system.

NOTE 1 Further guidance is given in BS EN 62305.

- m) The installer should comply with the requirements of 40.2c) unless it has been agreed that this is to be the responsibility of others.
- n) On completion of their works, the installer should issue a certificate in accordance with the model given in G.2, signed by installing company.

NOTE 2 Under BS 7671, the installer of the mains supply is required to issue an electrical installation certificate in accordance with the requirements of that standard. If the installer of the fire detection and fire alarm system does not install the mains supply, the installer of the mains supply ought also to issue a certificate in accordance with the model given in G.2, solely in respect of the mains supply.

NOTE 3 A designer might accept responsibility for variations from any of the above recommendations and communicate this in the form of specific written requirements (e.g. within a specification). In this case, the installer ought to record the relevant variations within the installation certificate issued by the installer (see clause 41)

37 Installation Practices and workmanship

37.1 Commentary

The nature and the quality of the installation work needs to be such as main the integrity of the fire detection and fire alarm, system and minimize the duration and extent of disablement of the system during maintenance or modification. Installation's practice and workmanship need to conform to BS 7671.

Penetration of construction (e.g. for passage of cables, conduits, trucking or tray) needs to be made good to avoid the free passage of fire or smoke, regardless of whether the construction has a recognized degree of resistance.

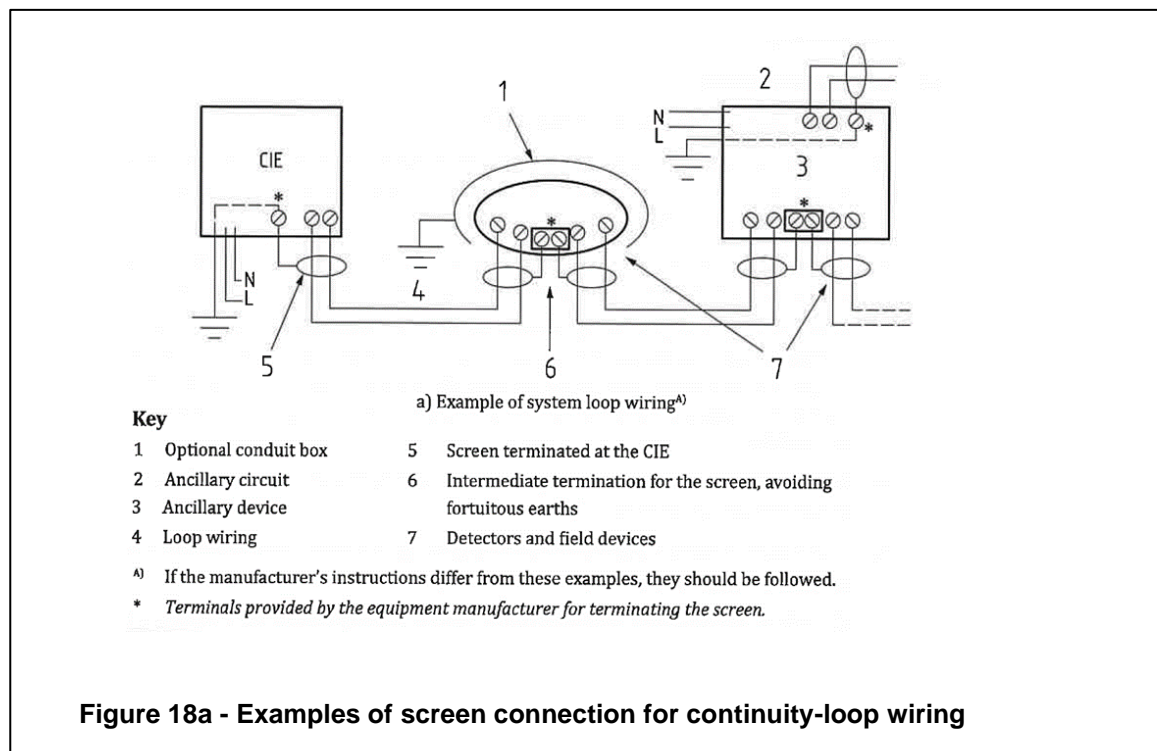
37.2 Recommendations

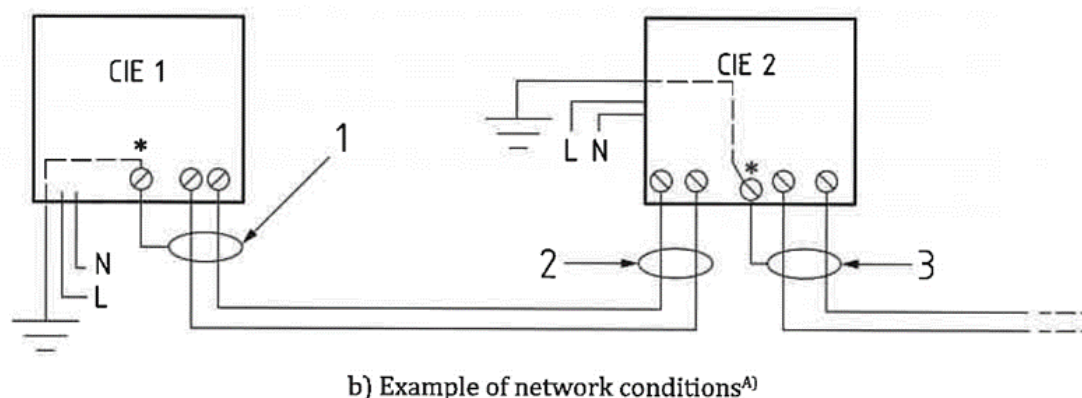
The following recommendations are applicable.

- a) The entire system should conform to the requirements of BS 7671. In general, the recommendations of this standard supplement, but do not conflict with, these requirements. Where any such conflict is considered to exist, the recommendations of this standard, should take precedence.
- b) Cables which are directly fixed to surfaces should be neatly run and securely fixed at suitable intervals, in accordance with the recommendations of the cable manufacturer. Cables should not rely on suspended ceilings for their support.
- c) The installer should ensure that all wiring complies with, at least, 26.2f) to 26.2o).
- d) Joints in cables, other than those contained within the enclosures of equipment, should be avoided wherever practicable [see 26.2g)].
- e) So far as is reasonably practicable, cable routes should be selected to follow the recommendations in 26g.
- f) Arrangements for earthing should be in accordance with the recommendations of the manufacturer. Care should be taken to ensure that electrical continuity of electromagnetic screens, including metallic sheaths of cables [see Figure 18 a) and b)],
- g) Where new conduit, trunking or tray is installed, its capacity should be in accordance with BS 7671.
- h) Where a cable passes through an external wall, it should be contained in a smooth-bore sleeve of metal or other non-hygroscopic material sealed into the wall. This sleeve should slope downwards

towards the outside and should be plugged with a suitable non-hardening waterproof compound to prevent the entry of rain, dust or vermin.

- i) Where a cable passes through an internal wall, a small clearance hole should be provided. If additional mechanical protection is necessary, a smooth-bore sleeve should be sealed into the wall.
- j) Care should be taken to ensure that the ends of any sleeves are free from sharp edges which might damage cables during installation.
- k) When a cable passes through a floor, the considerations of 37.2h), 37.2i) and 37.2j) apply. But the sleeve should extend as far above floor level as is required for protection of the cable it is to carry, but never less than 300 mm.
- l) Where cables, conduits, trunking or tray pass through floors, walls, partitions or ceilings, the surrounding hole should be as small as reasonably practicable and made good with fire-stopping materials that ensure that the fire resistance of the construction is not materially reduced. Spaces through which fire or smoke could spread should not be left around the cable, conduit, trunking or tray.
- m) If cables or conduits are installed in channels, ducts, trunking or shafts that pass-through floors, walls, partitions or ceilings, barriers with the appropriate level of fire resistance should be provided within the channels, etc. to prevent the spread of fire unless, in the case of ducts and shafts, the construction of the duct or shaft affords equivalent fire resistance to the structure penetrated. In the latter case, fire stopping need only be provided where cables pass into, or out of, the duct or shaft.





Key

1 Screen terminated at CIE 1

3 Screen terminated at CIE 2

2 Screen not terminated

* Terminals provided by the equipment manufacturer for terminating the screen.

^{A)} If the manufacturer's instructions differ from these examples, they should be followed.

Figure 18b - Examples of screen connection for continuity- Network conditions

38 Commentary

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 are carried out with equipment disconnected and prior to completion of the entire system. Further tests need to, therefore, be carried out on completion of the system; these tests can form part of the commissioning process.

In some (usually addressable) systems, maximum circuit impedance might be specified by the system manufacturer, in which case any measurements of impedance recommended by the manufacturer also need to be carried out, either on completion of installation or at commissioning (see Clause 39). As the entire fire alarm installation is an electrical installation, as defined in BS 7671, there is a need for inspection, testing and certification of the wiring in accordance with the requirements of BS 7671 before commissioning.

38.1 Recommendations

The following recommendations are applicable.

- a) All installed cables with a manufacturer's voltage rating suitable for mains use should be subject to insulation testing at 500 V d.c. Prior to this test, cables should be disconnected from all equipment that could be damaged by the test.
- b) Insulation resistance, measured in the above test, between conductors, between each conductor and earth, and between each conductor and any screen, should be at least 2 MΩ.

NOTE CIE can have fault sensing for wiring insulation resistance to earth. If this is, for example, set at 1 MΩ, the combined effect of all wiring earth insulation resistance ought to be well above this to avoid nuisance fault indications. For large systems, this 2 MΩ minimum needs to be much higher than this to achieve something in excess of 1 MΩ overall. For a small non-addressable system up to about four zones, 2 MΩ might be acceptable.

- c) Earth continuity and, for mains supply circuits, earth fault loop impedance, should be tested to ensure compliance with BS 7671.
- d) Unless there is specific agreement that the following tests form part of the commissioning process, the tests should be carried out on completion of the installation work:
 1. where maximum circuit resistance for any circuit is specified by the manufacturer or supplier; measurement of the resistance of every such circuit;
 2. any other tests specified by the manufacturer of the system; and
 3. correct polarity of circuits is checked where this is required for correct monitoring (to ensure operation of any manual call point while all detectors on a circuit are removed).

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

Section 5: Commissioning and handover

39 Commissioning

39.1 Commentary

The process of commissioning involves thorough testing of the installed system to ensure that it operates correctly in accordance with the recommendations of this standard and with the purchasing specification. At completion of commissioning, it also needs to be confirmed that all relevant documentation has been handed over to the user (see Clause 40). The installing organization is responsible for commissioning the system.

It is not, in general, the responsibility of the commissioning engineer to verify conformity of the design, or of the installation work, to this standard (i.e. with Section 2 and Section 4 of this standard). In general, the responsibility of the commissioning engineer is to verify that the system operates correctly in the manner designed and that the installation workmanship is generally of an adequate standard. However, in practice, it might be difficult to ensure that the system complies in full with all recommendations of Section 2 until the time of commissioning. For example, commissioning might represent the first (and only) opportunity to determine whether the number and distribution of fire alarm sounders is sufficient to enable compliance with 16.2 in respect of sound pressure levels. Similarly, commissioning presents an opportunity to ensure that structural features of the building, of which the designer might have been unaware, do not compromise the effectiveness of the system as it was originally designed.

Accordingly, it is necessary for anyone responsible for commissioning a fire detection and fire alarm system to possess at least basic knowledge of fire alarm design practices and of the recommendations of Section 2 and Section 4 of this standard. It is also necessary for the commissioning engineer to be provided with the specification for the system. In view of the importance now attached to the avoidance of false alarms, it is also essential that the commissioning engineer is able to verify compliance with, at least, the principles discussed in Section 3 of this standard.

39.2 Recommendations

The following recommendations are applicable to new systems, and to modifications and additions to systems.

- a) The system should be commissioned by a competent person (see 3.12), who has access to the requirements of the designer (i.e. the system specification) and any other relevant documentation or drawings.
- b) Any person responsible for commissioning a fire detection and fire alarm system in accordance with the recommendations of this standard shall be, competent person with understanding of Section 2. Section 3 and Section 4 of this standard.
- c) At commissioning, the entire system should be inspected and tested to ensure that it operates satisfactorily and that, in particular:
 - 1) all manual call points and automatic fire detectors function correctly in accordance with 45.4
 - 2) if the specification requires labelling or other means of visual identification of manual call points, automatic fire detectors, fire alarm devices or ancillary devices, this has been carried out;
 - 3) every manual call point and automatic fire detector, on operation, results in the correct zone indication, and, in the case of addressable systems, correct text display, at all indicating equipment;
 - 4) where an optical beam detector uses a combined transmitter/receiver unit in conjunction with a reflector, care should be taken to minimize the effect of reflections (e.g. from surfaces close to the transmitter/receiver unit) from dominating the received signal. Unless the equipment has specific features to compensate for such effects, at commissioning, the installed unit should be tested by partial obscuration of the beam near to the reflector.
 - 5) sound pressure levels throughout all areas of the building conform to 16.2 and, where appropriate for voice alarms, an acceptable level of intelligibility is achieved in accordance with BS 5839-8 throughout all areas of the building;
 - 6) any facility for remote transmission of fire alarm signals (and, where appropriate, fault signals) to an ARC operates correctly;

NOTE 1 It is essential that any ARC to which fire alarm signals are relayed is notified before, and immediately after completion of, any tests that could result in a fire alarm signal.

- 7) any cause and effect requirements of the designer (e.g. in respect of staged alarms or initiation of operation of other fire protection systems and equipment, safety measures, etc.) are fully satisfied;
- 8) all alarm, control, indicating, printing, and ancillary functions of the system operate correctly and are adequately labelled or identified;
- 9) no changes to the building since the time of original design have compromised the compliance of the system with this standard (e.g. by erection of new partitioning that affects the adequacy of siting of fire detectors or the effectiveness of warning devices);

NOTE 2 Particular care is advised where a system is commissioned in a "shell" property in advance of final occupation or fitting out.

- 10) siting of manual call points conforms to, at least, the recommendations of 20.2h) and 20.2i);
 - 11) siting of point heat, smoke and carbon monoxide detectors conforms to 22.3d) to 22.3j) and 22.3m) to 23p);
 - 12) siting of beam-type smoke detectors conforms to 22.3d), 22.3f), 22.3i), 22.3j), 22.3k), 22.5e), 22.5f) and 22.5g);
 - 13) siting of line heat detectors conforms to 22.3d), 22.3f), 22.3i), 22.3j), 22.6d) and 22.6e);
 - 14) siting of aspirating smoke detection systems conforms to the guidance of the manufacturer;
 - 15) siting of flame detectors conforms to 22.8b) and 22.8c);
 - 16) siting of any smoke detectors in ventilation ducts conforms to 22.10a);
 - 17) siting of control, indicating and power supply equipment conforms to 23.2.1b), 23.2.1b), 23.2.1c), 23.2.1d), 23.2.1e) and 23.2.1g);
 - 18) there is a suitable diagrammatic representation of the premises that satisfies the recommendations of 23.2.2e);
 - 19) the provision of any visual alarms conforms to Clause 17: of this standard
 - 20) mains power supplies are inspected as far as is reasonably practical to ensure conformity to 25.2;
 - 21) standby power supplies conform to 2.4 and that the system's actual load currents in all circumstances are close to the predictions used by the designer to determine the specified battery capacity;
 - 22) as far as it is reasonably practicable to ascertain, the specified cable type has been used in all parts of the system and the workmanship conforms to 37.2;
 - 23) as far as is reasonably practicable to ascertain, the system conforms to Section 3 of this standard;
 - 24) there are no other obvious shortcomings in compliance with Section 2 of this standard (e.g. unprotected areas within a Category L1 or P1 system, or incorrect spacing or siting of fire detectors):
- NOTE 3 This recommendation is not intended to imply that it is the responsibility of the commissioning engineer to verify or certify compliance of the system design with this standard. 'However, if variations are identified by the commissioning engineer, particularly variations related to circumstances that might not have been known to the designer, they need to be documented for referral to the designer, user or purchaser for agreement or action (see 7.2).
- 25) in radio-linked systems, radio signal strengths are adequate throughout all areas of the protected premises to ensure reliable operation of the system;
 - 26) records of insulation resistance, earth continuity and, where appropriate, earth loop impedance tests exist;
 - 27) all fault indicators and their circuits should be checked, where practicable, by simulation of faults conditions;
 - 28) all relevant documentation (see Clause 40) has been provided to the user or purchaser.
- d) Unless already undertaken and documented by the installer, the tests recommended in 38.2d) should be carried out and the results recorded. Where specifically agreed that the tests recommended in 8.2d) should be carried out at commissioning, these tests should be carried out and the results recorded.
 - e) Labels, visible when batteries are in their normal position, should be fixed to batteries, indicating the date of installation.

- f) On completion of the commissioning, a certificate, signed by a competent person in accordance with the model given in G.3, should be issued.

40 Documentation

40.1 Commentary

On completion of the system, it needs to be ensured that adequate records and other documentation are provided to the user or purchaser. (The user and purchaser might, or might not, be the same organization.)

The responsibility for provision of the documentation might rest with more than one organization and needs to be defined before an order for the system is placed. At commissioning, it needs to be ensured that, either the documentation has been provided to the relevant parties, or that any absent documentation is identified for appropriate action (see Clause 39).

Particular importance needs to be attached to the preparation and accuracy of as-fitted drawings and operation and maintenance manuals. The manuals need to be adequately specific to the system. Without these drawings and manuals, maintenance or future modification of the system might be difficult.

40.2 Recommendations

The following documentation should be provided to the purchaser or user of the system.

NOTE 1 The organization to which each form of documentation is provided needs to be defined in any contract for decision supply, installation and commissioning of the system

- a) Certificates for design, installation and commissioning of the system (see Clause 41).
- b) An adequate operation and maintenance manual for the system; this should provide information, specific to the system in question, regarding the following:

- 1) detector type, selection and configuration as documented by the designer using the template given in Table E.1
- 2) the equipment provided and its configuration, including, for radio-linked equipment to which Clause 27 applies, the data referred to in 27.2g)4);
- 3) use of all controls;
- 4) recommendations for investigation of a fire alarm or fault signal after the incident is over and the building declared safe for reoccupation;

NOTE 2 This is not intended to be the emergency or evacuation plan, which is the responsibility of the occupant.

- 5) recommendations for investigation in the event of a false alarm (see Section 3);
 - 6) routine weekly and monthly testing of the system by the user or their appointed agent (see Clause 44);
 - 7) service and maintenance of the system in accordance with Section 6 of this standard;
 - 8) avoidance of false alarms (see Section 3);
 - 9) the need to keep a clear space around all fire detectors and manual call points;
 - 10) the need to avoid contamination of detectors during contractors' activities;
 - 11) the importance of ensuring that changes to the building, such as relocation of partitions, do not affect the standard of protection;
 - 12) other use responsibilities described in Section 7.
- c) As-fitted drawings indicating at least the following:
- 1) the positions of all control, indicating and power supply equipment;
 - 2) the positions of all manual call points, fire detectors and fire alarm devices;
 - 3) the positions of all equipment that might require routine attention or replacement (e.g.
 - 4) short circuit isolators and remote indicators);
 - 5) the type, sizes and actual routes of cables.

NOTE 3 The cable routes shown need to comprise a reasonable representation of the route followed, such as to enable a competent person to locate the cable in the event of a fault or need for modification or extension of the system; a simple schematic showing the sequence in which devices are wired is unlikely to satisfy this recommendation, other than in small, simple systems.

NOTE 4 In the case of extensions or alterations, existing as-fitted drawings need to be updated.

d) A logbook in which all events, including fire alarm signals, faults signals, system tests and maintenance visits, can be recorded (see Clause 48).

NOTE 5 A model format for a logbook is given in Annex E

e) A record of any agreed variations from the original design specification.

f) Such other records as are required by any purchase specification (e.g. insulation resistance test records or commissioning records).

41 Certification

41.1 Commentary

On completion of design, installation and commissioning, a separate certificate needs to be issued for each of these three processes, confirming compliance with the recommendations of this standard for the stage in question (i.e. design, installation or commissioning) or identifying variations. All three processes might be undertaken by one organization or might be carried out by independent organizations; whichever arrangement applies, three separate certificates ultimately need to be issued. It needs to be possible for an organization to issue a certificate for the process for which they are responsible, regardless of whether a certificate has been issued for either of the other processes.

It is essential that the person who signs these certificates is competent to verify whether the recommendations of this standard in respect of the process to which the certificate refers have, or have not, been satisfied. The purchaser or user might, subsequently, rely on the certificate as, for example, evidence of compliance with legislation. Liability could arise on the part of any organization that issues a certificate without due care in ensuring its validity.

On completion of the system, it is handed over to the purchaser or user; at this stage, the organization bearing contractual responsibility to the purchaser for the system needs to issue a certificate of acceptance to the purchaser. [completion by the purchaser. The purpose of this certificate is to constitute objective evidence that the purchaser is satisfied, to the extent that the purchaser is competent to ensure that the system satisfies the requirements of the purchaser and the user. The certificate also needs to confirm that adequate documentation has been handed over to the user, that the user has been instructed in the use of the system and understands their obligations to ensure the system is maintained in a functional state and is regularly inspected and tested. The purchaser might wish to carry out an independent inspection of the system, or to witness certain tests (which might include any or all commissioning tests) as a prerequisite for completion of the acceptance certificate (see Clause 42).

For certain (usually large and/or complex systems), the purchaser or user might wish to arrange for an independent inspection, and possibly test, of the system to verify compliance with the recommendations of this standard in respect of design, installation and commissioning. If so, the organization that commissions the independent verification needs to require that a verification certificate be issued.

41.2 Recommendations

The following recommendations are applicable.

- a) On, or as soon as practicable after, completion of each of the following processes, a certificate should be issued by the organization responsible for the process, certifying compliance with the recommendations of this standard in respect of the process or, if variations exist, clearly identifying these variations:
 - 1) design;
 - 2) installation;
 - 3) commissioning.
- b) Following completion of the installation, the organization bearing contractual responsibility to the purchaser for the system should issue a certificate of acceptance to the purchaser (see for completion by the purchaser.
- c) If a purchaser or user commissions an independent audit of the system to verify, as far as practicable, that design, installation and commissioning conform to the recommendations of this standard (see Clause 43), the purchaser should request that the organization responsible for the audit issues a verification certificate.

NOTE 1 Model certificates of design, installation, commissioning, acceptance and verification are contained in Annex G.

NOTE 2 The certificate issued for any of these five processes can vary in format from that shown in Annex G but, as a minimum, the information and statements of compliance within the model certificates ought to be provided.

42 Acceptance

42.1 Commentary

On completion of the system, arrangements need to be made for formal handover of the system to the purchaser or user, and formal acceptance of the system by the purchaser (or representative of the purchaser).

Before accepting the handover of the system, the purchaser or a representative needs to ensure that they are satisfied with the installed system, that the user has an adequate understanding of the operation of the system and the measures necessary to prevent false alarms, and that relevant documentation has been provided. In the case of small, simple systems, or systems installed in the premises of small organisation with little relevant in house expertise, acceptance might involve little more than a brief inspection of the system by the user, demonstration of its operation by the commissioning engineer, and handover of the relevant documents to the user. In large, complex systems, it is likely that the purchaser would wish to witness relevant tests, as part of a formal and structured acceptance procedure.

As evidence of acceptance, an acceptance certificate needs to be signed by the purchaser (see Clause 41).

42.2 Recommendations

The following recommendations are applicable.

- a) A purchase specification should define the acceptance procedures required by the purchaser, including any tests that are to be witnessed [see 6.2d)] and details of the witnessing procedure, e.g. notice to be given.
- b) Before accepting a system, the purchaser (or appropriate representative of the purchaser) should ensure, at least, the following:

- 1) that all installation work appears to be satisfactory;
- 2) that the system is capable of giving a fire alarm signal;
- 3) that any facility for remote transmission of faults and alarms to an ARC operates correctly;

NOTE 1 An appropriate representative of the purchaser might be the user.

NOTE 2 It is essential that any ARC to which fire alarm signals are relayed be notified before, and immediately after completion of, any tests that could result in a fire alarm signal.

- 4) that the following documents have been provided to the purchaser or user:
 - i) as-fitted drawings;
 - ii) operating and maintenance instructions;
 - iii) certificates of design, installation and commissioning (see Clause 41);
 - iv) a logbook in which all events, including fire alarm signals, fault signals, system tests and
 - v) maintenance visits can be recorded;
- 5) that a suitable diagrammatic representation of the premises is provided close to all CIE [see 23.2.2e)];
- 6) that sufficient representatives of the user have been properly instructed in the operation of the system, including, at least, all means of triggering fire signals, silencing and resetting the system and avoidance of false alarms;

NOTE 3 In the case of large, complex systems, this is likely to necessitate a formal training course for a number of people. The requirements for such training need to be defined in the purchase specification.

- 7) that the premises management (see 3.46) have been advised of their responsibilities and how these might be discharged (see Clause 4-7); and
- 8) that all relevant tests, defined in the purchase specification have been witnessed.

NOTE 4 Some, or all, of these tests can be witnessed when commissioning carried out, although this would be less appropriate in large, complex systems.

- c) As evidence of acceptance, the purchaser (or appropriate representative of the purchaser) should sign an acceptance certificate (see Clause 41).

43 Verification

43.1 Commentary

Small fire detection and fire alarm systems are often designed, supplied, installed and commissioned by a single organization, or a substantial part of these tasks is undertaken by one organization. For example, the organization might be the system manufacturer or an electrical contractor.

While this might also be so even the largest, most complex systems, often, at least one of the above processes (e.g. design) is undertaken by a different organization from the others. Sometimes several organizations might be involved. For example, design might be undertaken by consultants, supply and commission by the manufacturer, and installation by an electrical contractor. The relevant certificates are then each completed by different organizations, no one of which has overall responsibility for the provision of a fire detection and fire alarm system that is suitable for its purpose and in accordance with the structural features of the building.

While the contractual arrangements whereby a system is designed, supplied, installed and commissioned are outside the scope of this standard, it needs to be noted that division of responsibility for these processes introduces scope for system shortcomings for which, in practice, none of the parties involved is directly responsible. For example, in a new building, the designer of the fire detection and fire alarm system might not be given all the relevant information regarding structural features of the building [e.g. deep beams, obstructions to the flow of smoke and similar features to which 22.3h), 22.3i), 22.3j), 22.3k) and 22.3l) apply]. Alternatively, the design of the building, or its internal layout, might change after design of the fire detection and fire alarm system, but before its installation.

It is accepted in this standard that it is not the responsibility of the installer or the commissioning engineer [or those carrying out routine maintenance (see 45.1)] to identify shortcomings in design, although, if these are identified, they need to be drawn to the attention of the relevant person [see 7.2b)]. A purchaser might consider that, as a result of division of responsibilities for design, supply, installation and commissioning, or for any other reason, there is significant potential for the installed system to deviate from the recommendations of this standard in these circumstances, verification needs to be obtained from a single organization. This organization needs to issue a single verification certificate. This verification needs to confirm that, as far as can reasonably be determined, the system complies with all recommendations of this standard (including the recommendations of Section 3), or that variations have been agreed and documented (see Clause 40 and G.5).

The verifying organization can be one of those involved in the design, supply, installation or commissioning processes (e.g. the system supplier or the designer) or an independent third party. It needs to be appreciated that, nevertheless, after completion of installation, it is unlikely that any one organization, particularly a third party, would be able to verify in full the compliance of the system with every recommendation of this standard. For example, much of the wiring might be impossible to inspect. The scope and extent of the verification process needs, therefore, to be subject to agreement between the purchaser or user and the organization responsible for verification. An indication of the scope and extent needs to be given in the verification certificate or documents associated therewith (e.g. a report).

43.2 Recommendations

The following recommendations are applicable.

- a) Where a purchaser or user considers that, as a result of division of responsibility for the design, supply, installation and commissioning processes, there is significant potential for the installed system to deviate from the recommendations of this standard, verification of compliance with this standard should be arranged.
- b) Any person responsible for verification should be competent in the design of fire detection and fire alarm systems, in accordance with this standard and familiar with the relevant installation practices.
- c) The scope and extent of the verification process should be agreed between the purchaser or user and the organization responsible for verification but should address the recommendations of Section 3.
- d) On completion of verification, a verification certificate should be issued, verifying that the system conforms to the recommendations of this standard, or identifying variations from these recommendations (see Clause 41). The certificate should also contain information on the scope and extent of the verification carried out or identify where this information is available.

NOTE A verification certificate can be of value to an enforcing authority or property insurer.

Section 6: Maintenance

44 Routine testing

44.1 Commentary

Although modern fire detection and fire alarm systems can incorporate a high degree of monitoring, so that faults are indicated automatically, it is still necessary for the premises management to ensure that fault indications at the panel are identified for appropriate action. It is also vital for a regular test to be carried out to ensure that there has not been any major failure of the entire system, or a significant part of the system.

Routine testing of the system also provides an opportunity for occupants of the building to become, and remain, familiar with the fire alarm signal(s) that the system produces. In systems with staged alarms that incorporate an "Alert" and an "Evacuate" signal, both signals need to be operated on the occasion of each test to ensure that occupants are aware of the existence of both signals and their different meaning.

44.2 Recommendations for weekly testing by the user

NOTE 1 When testing the fire detection and fire alarm system there might be a need to disable ancillary outputs.

The following recommendations are applicable.

- a) Every week, a manual call point should be operated during normal working hours. It should be confirmed that the control equipment is capable of processing a fire alarm signal and providing an output to fire alarm sounders, and to ensure that the fire alarm signal is correctly received at any ARC to which fire alarm signals are transmitted. It is not necessary to confirm that all fire alarm sounder circuits operate correctly at the time of this test.

NOTE 2 It is essential that any ARC is contacted immediately before, and immediately after, the weekly test to ensure that unwanted alarms are avoided and that fire alarm signals are correctly received at the ARC.

NOTE 3 The user need to take account of the manufacturer's recommendations, particularly when battery powered devices are being tested, e.g. within radio-linked fire detection and fire alarm systems.

- b) The weekly test should be carried out at approximately the same time each week; occupants should then be instructed that they should report any instance of poor audibility of the fire alarm signal. In systems with staged alarms incorporating an "Alert" and an "Evacuate" signal, the two signals should be operated, where practicable, sequentially in the order they would occur at the time of a fire (i.e. "Alert" and then "Evacuate").
- c) In premises in which some employees only work during hours other than that at which the fire detection and fire alarm system is normally tested, an additional test(s) should be carried out at least once a month to ensure familiarity of these employees with the fire alarm signal(s).
- d) 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 will 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 logbook [see 40.2d)].
- e) The duration for which any fire alarm signal is given (other than solely at CIE) at the time of the weekly test by the user should be at least 5 s, but should not normally exceed 60 s, so that, in the event of a fire at the time of the weekly test, occupants are warned by the prolonged operation of the fire alarm devices.
- f) Voice alarm systems should be tested weekly in accordance with BS 5839-8.

44.3 Recommendations for monthly attention by the user

The following recommendations are applicable.

- a) If an automatically started emergency generator is used as part of the standby power supply [see 25.4e)2)], it should be started up once each month by simulation of failure of the normal power supply and operated on-load for at least one hour. The test should be carried out in accordance with the instructions of the generator manufacturer, including instructions on the load that should be operated.

At the end of the test, the fuel tanks should be left filled, and the oil and coolant levels should be checked and topped up as necessary.

- b) b) If vented batteries are used as a standby power supply, a visual inspection of the batteries and their connections should be made to ensure that they are in good condition. Action should be taken to rectify any defect, including low electrolyte level.

NOTE Care is necessary to ensure that any person undertaking these tasks is competent to do so safely and has the relevant technical knowledge and training.

45 Inspection and servicing

NOTE According to best practice, safe isolation is carried out prior to working on or near live parts. In this context, safe isolation includes confirmation that isolation has been successful.

45.1 Commentary

It is essential that the system is subject to periodic inspection and servicing so that faults are identified, preventive measures can be taken to ensure the continued reliability of the system, false alarm problems are identified and suitably addressed, and the user is made aware of any changes to the building that affect the protection afforded by the system.

Periodic inspection and servicing needs to be carried out by a competent person with specialist knowledge of fire detection and fire alarm systems, including knowledge of the causes of false alarms, sufficient information regarding the system, and adequate access to spares.

This is normally an outside fire alarm servicing organization; care needs to be taken to ensure that, if, for example, in house employees are used for this task, they have equivalent competence to the technicians of a typical fire alarm servicing organization. Competence of a fire alarm servicing organization can be assured by the use of organizations that are third-party certificated, by a accredited certification body, to carry out inspection and servicing of fire alarm systems.

Routine servicing of a fire detection and fire alarm system does not constitute a fresh review of system design; it is a verification of the functionality and serviceability of the existing system. Accordingly, it is not necessarily the case that non-compliances with Section 2 of this standard will be identified at the time of routine servicing; in any case, the maintenance technician might not be aware as to whether an apparent non-compliance is, in fact, simply an agreed variation, particularly if the design certificate is not available. However, at their own prerogative, the maintenance organization can point out aspects of non-compliance with Section 2. Nevertheless, any such advice provided to the user by the maintenance organization cannot be regarded {by users, enforcing authorities or any other party) as an implication that the maintenance technician has identified, or has endeavoured to identify, all such areas of noncompliance, or that there has been any review of the original design.

45.2 Recommendation for quarterly inspection of vented batteries

All vented batteries and their connections should be examined by a person competent in battery installation and maintenance technology. Electrolyte levels should be checked and topped up as necessary.

NOTE In many large premises and sites, in-house maintenance personnel might be competent to carry out this task.

45.3 Periodic Inspection and test of the system

Some fire detection and fire alarm systems and components claim to include features that permit functions to be automatically monitored, and faults or warnings to be annunciated, or otherwise made available to authorized persons. In cases where this is proven, the recommendation for routine testing under this subclause and in 45.4 may be modified to omit testing which is proven to be unnecessary by the equipment manufacturer, provided it can be proven that the automatic monitoring achieves the same objective as the appropriate test recommended in this subclause and/or 45.4. In the case of detectors (all types), tests should ensure that products of combustion are capable of passing unhindered from the protected area to the sensing chamber/elements of the detector and not simply test the ability of the detector to sample /verify the status of the atmosphere already in the sensing chamber.

The periodic inspection and service in this clause shall be carried out by a competent person (see 3.12.). The period between successive inspection and servicing visits shall not exceed six months. If this is not implemented, it should be considered that the system is no longer compliant with this Standard

The following recommendations are applicable.

- a) The system logbook shall be examined. It shall be ensured that any faults recorded have received appropriate attention.
- b) A visual inspection should be made to check whether structural or occupancy changes have affected the compliance of the system with the recommendations of this standard for the siting of manual call points, automatic fire detectors and fire alarm devices. Particular care should be taken to verify whether:
 - 1) all manual call points remain unobstructed and conspicuous;
 - 2) any new exits that lead to a place of ultimate safety have been created without the provision of an

adjacent manual call point;

- 3) any new or relocated partitions have been erected within 500 mm horizontally of any automatic fire detector [see 22.3g)];
 - 4) any storage encroaches within 300 mm of ceilings, such as to obviate compliance with 22.3i);
 - 5) a clear space of 500 mm is maintained below each automatic fire detector [see 22.3o)], and that the ability of the detector to receive the stimulus that it has been designed to detect has not been impeded by other means;
 - 6) any changes to the use or occupancy of an area makes the existing types of automatic fire detector unsuitable for detection of fire or prone to unwanted alarms;
 - 7) any building alterations or extensions require additional fire detection and fire alarm equipment to be installed.
- c) The records of false alarms should be checked in accordance with 30.2i). The rate of false alarms during the previous 12 months should be recorded (see 30.2i). Action taken in respect of false alarms recorded should comply with 30.2j).
 - d) The battery voltage should be measured with the mains on to check the steady state charge voltage and check it is within the manufacturer's recommendations before any other tests that might discharge the battery and with no load on the power supply other than the quiescent or standing load.
 - e) The standby battery should be disconnected, the alarms activated and the power supply output voltage checked that it is close to the nominal voltage.

NOTE 1 If applying the full alarm load is not practicable, then the full load may be simulated.

NOTE 2 It would be reasonable to expect the power supply voltage to achieve at least 95% of nominal voltage.

- f) Batteries and their connections should be examined and momentarily load tested with the mains disconnected (other than those within devices such as manual call points, detectors and fire alarm sounders of a radio-linked system), to ensure that they are in good serviceable condition and not likely to fail before the next service visit Vented batteries should be examined to ensure that the specific gravity of each cell is correct.
- g) The fire alarm functions of the CIE should be checked by the operation of at least one detector or manual call point on each circuit. An entry should be made in the logbook indicating which initiating devices have been used for these tests.
- h) It should be confirmed that a fire alarm signal is given on operation of at least one manual call point or fire detector.
- i) All controls and visual indicators at CIE should be checked for correct operation.
- j) The operation of any facility for automatic transmission of alarm signals to an ARC should be checked. Where more than one form of alarm signal can be transmitted (e.g. fire and fault signals), the correct transmission of each signal should be confirmed.
- k) All ancillary functions of the CIE should be tested.
- l) All fault indicators and their circuits should be checked, where practicable, by simulation of fault conditions.
- m) All printers should be tested to ensure that they operate correctly and that characters are legible. It should be ensured that all printer consumables are sufficient in quantity or condition to ensure that the printer can be expected to operate until the time of the next service visit.
- n) Radio systems of all types should be serviced in accordance with the recommendations of the manufacturer.
- o) All further checks and tests recommended by the manufacturer of the CIE and other components of the system should be carried out.
- p) On completion of the work. any outstanding defects should be reported to the premises management, the system logbook [see 40.2d)] should be completed and an inspection and servicing certificate should be issued (see G.6).

45.4 Recommendations for inspection and test of the system over a 12-month period

In addition to the work recommended in 45.3 the following work should be carried out every year.

NOTE 1 The work described can be carried out over the course of two or more service visits during each 12-month period.

- a) The switch mechanism of every manual call point should be tested, either by removal of a frangible element, insertion of a test key or operation of the device as it would be operated in the event of fire.
- b) All automatic fire detectors and remote detectors should be examined, as far as practicable, to ensure that they have not been damaged, painted, or otherwise adversely affected. Thereafter, every detector should be functionally tested.

NOTE 2 The tests used need prove only that the detectors are connected to the system, are operational and are capable of responding to the phenomena they are designed to detect.

Where fitted, detector remote indicators should also be checked for correct operation. Information regarding the configuration of multi-sensor detectors and selection of type of detectors suitable for the application is given in Table E.1.

- c) Every heat detector should be functionally tested by means of a suitable heat source, unless operation of the detector in this manner would then necessitate replacement of part or all of the sensing element (e.g. as in fusible link point detectors or non-integrating line detectors).

Special test arrangements are required for fusible link heat detectors. The heat source should not have the potential to ignite a fire; live flame should not be used, and special equipment might be necessary in explosive atmospheres.

- d) Point smoke detectors should be functionally tested by a method that confirms that smoke can enter the detector chamber and produce a fire alarm signal (e.g. by use of apparatus that generates simulated smoke or suitable aerosols, around the detector). It should be ensured that the material used does not cause damage to, or affect the subsequent performance of, the detector: the manufacturer's guidance on suitable materials should be followed.
- e) Optical beam smoke detectors should be functionally tested by introducing signal attenuation between the transmitter and receiver, either by use of an optical filter (or any similar method of simulating obscuration by smoke), smoke or simulated smoke.
- f) Aspirating fire detection and fire alarm systems should be functionally tested by a method that confirms that smoke can enter the detector chamber and produce a fire alarm signal. It should be ensured that the material used does not cause damage to or affect the subsequent performance of the detectors; the manufacturer's guidance on suitable materials should be followed.

Furthermore, appropriate testing should be performed to verify that smoke is able to enter each sampling point (or collection of sampling points that are recommended by the manufacturer to cover the same area as a point smoke detector).

Note 3 This can be achieved by introducing smoke into each sampling point in turn and verifying a response at the detector.

However, where access is restricted or other site conditions prevent this, other verification techniques should be employed such as:

- 1) verifying transport time from furthest hole or a dedicated test point and comparing with previously recorded results to identify deviations;
- 2) confirming that the flow monitoring is capable of detecting loss of a single sampling point (or collection of sampling points that are deemed to be acceptable for the risks involved);
- 3) inspection of flow readings and comparing with previously recorded results to identify deviations which would indicate a loss of detection performance; or
- 4) measurement of the pressure at each sampling point and comparing with previously recorded results to identify deviations which would indicate a loss of detection performance.

The technique used is dependent on the particular features of the ASD technology, the risk and details of the specific application. Such techniques may also be supported by visual inspection of sampling points where this is possible but it should be verified that adequate detection performance is maintained.

Details of the techniques used should be recorded and agreed with all parties.

NOTE 4 For further guidance see the FIA Code of Practice for Design, Installation, Commissioning and Maintenance of Aspirating Smoke Detector (ASD) Systems [2].

- g) Carbon monoxide fire detectors should be functionally tested by a method that confirms that carbon monoxide can enter the detector chamber and produce a fire alarm signal (e.g. by use of apparatus that generates carbon monoxide or a gas that has a similar effect on the electro chemical cell as carbon monoxide).

WARNING. Carbon monoxide is a highly toxic gas, and suitable precautions should be taken in its use.

NOTE 5 It is necessary to ensure that any test gas used does not cause damage to, or affect the subsequent performance of the detector and that the manufacturer's guidance on suitable test gases is followed.

- h) Flame detectors should be functionally tested by a method that confirms that the detector responds to a suitable frequency of radiation and produces a fire alarm signal. The manufacturer's guidance on the testing of detectors should be followed.
- i) In fire detection systems that enable analogue values to be determined at the CIE, it should be confirmed that each analogue value is within the range specified by the manufacturer.
- j) Multi-sensor detectors should be operated by a method that confirms that products of combustion in the vicinity of the detector can reach the sensors and that a fire signal can be produced as appropriate.
 - 1) The guidance of the manufacturer on the manner in which the detector can be functionally tested effectively should be followed.
 - 2) Multi-sensor fire detectors should be physically tested by a method that confirms that products of combustion in the vicinity of the detector can reach the sensors and that the appropriate response is confirmed at the CIE.

NOTE 6 Suitable test methods for each type of sensor are as described in this subclause, e.g. for heat sensors, see 45.4c).

- 3) Where the detector or system design permits, each sensor on which a fire detection decision depends (e.g. smoke, heat, CO) should be physically tested individually.

Alternatively, individual sensors may be physically tested together if the detection system design allows simultaneous stimuli and individual sensor responses to be verified either individually or collectively.

NOTE 7 Where individual sensors cannot be tested individually, this recommendation does not apply.

NOTE 8 Where a system includes a time-related configuration of detection, care needs to be taken to ensure that a sensor is not excluded from being tested as a result of the time-dependent mode.

- 4) On completion of tests the system should be returned to its normal configuration.
- k) All fire alarm devices should be checked for correct operation. It should be confirmed that visual fire alarm devices are not obstructed from view and that their lenses are clean.

NOTE 9 This test is intended to ensure that every fire alarm device operates in response to a fire alarm signal. It is not intended that sound pressure level measurements are made.
- l) All unmonitored, permanently illuminated filament lamp indicators at CIE should be replaced.
- m) Radio signal strengths in radio-linked systems to which Clause 27 applies should be checked for adequacy, and the results recorded.
- n) A visual inspection should be made to confirm that all readily accessible cable fixings are secure and undamaged.
- o) The cause and effect programme should be confirmed as being correct by activating at least one cause and observing the operation of the effects. Where there are different types of devices (e.g. manual call points and automatic fire detectors), one cause and its effects should be tested for each type of device.

NOTE 10 Testing of a single cause is deemed acceptable and satisfies the recommendations of 45.3o). On a site with multiple cause and effect operations, if the user deems further causal testing is required, it is necessary for the user to specify this to the maintenance provider. Where no agreement is specified, testing of one cause will satisfy the recommendations.

- p) The standby power supply capacity should be checked to establish it remains suitable for continued service.

NOTE 11 Further guidance on testing of the batteries is given in FIA guidance: Testing of lead acid batteries used in Fire Detection & Alarm System Power Supplies [11].

- q) A check should be made to determine whether a suitable zone plan (or other suitable diagrammatic representation) of the premises is provided on or adjacent to all CIE and repeat indicating equipment

NOTE 12 Where repeat indicating equipment relates only part of the premises, the adjacent zone plan need only relate to that part of the premises.

- r) All further annual checks and tests recommended by the manufacturer of the CIE and other components of the system should be carried out.

- s) Video fire detectors should be subject to the manufacturer's guidelines in relation to annual test and inspection. Any lighting provided specifically to aid the detection of flame or smoke should be regarded as an integral part of the video fire detection system. As such, its correct operation should be confirmed, both it: the presence of any mains supply to the lighting and the absence of such a supply.

On completion of the work, any outstanding defects should be reported to the premises management and a record of the inspection and test should be made on the servicing certificate.

NOTE 13 Since stimulus of the sensing element through introduction of the phenomena or surrogate phenomena which the above detectors are designed to detect forms part of the test, use of a test button or a test magnet (for example) or compliance with 45.4i) does not satisfy the recommendations given.

46 Non-routine attention

46.1 Commentary

The arrangements in Clause 45 are intended to maintain the system in operation under normal circumstances. However, from time to time, the fire detection and fire alarm system is likely to require non-routine attention, including special maintenance. Non-routine maintenance includes:

- a special inspection of an existing fire detection and fire alarm system when a new servicing organization takes over servicing the system;
- repair of faults or damage;
- modification to take account of extensions, alterations, changes in occupancy or false alarms;
- action to address an unacceptable rate of false alarms; and
- inspection and test of the system following a fire.

46.2 Recommendations for special inspection on appointment of a new servicing organization

The following recommendations are applicable.

- a) When a servicing organization takes over servicing arrangements for an existing system, a special inspection should be carried out, and existing records (see Clause 40), where available, should be studied, to obtain sufficient information to be documented for effective future servicing of the system.
- b) Major areas of non-compliance with this standard should be documented and identified to the premises management. The classification of a non-compliance as major is subjective, but the following non-compliances should be regarded as major:

NOTE 1 It is not implied that non-compliances need to be rectified; this is a matter for the user to determine, based on the advice of the servicing organization, the enforcing authorities, the insurer and any third-party advisers engaged by the user, as appropriate.

- 1) an inadequate number of call points to conform to 20.2;
- 2) inadequate provision of fire detection to conform to this standard for the category of system that the system was designed to meet;
- 3) sound pressure levels that fail to conform to the recommendations of 16.2.;
- 4) standby power supplies that fail to conform to 25.4 The absence of any standby power supply should be highlighted to the premises management.
- 5) cabling with fire resistance that fails to conform to 26.2c);

NOTE 2 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.

- 6) monitoring of circuits that fail to conform to 12.2.1;
- 7) standards of electrical safety such that the recommendations of Clause 29 are not satisfied;
- 8) exposure to, or experience of, false alarms, such as to preclude compliance with Section 3:
- 9) changes in the use, layout and construction of the protected premises that might impact on the effectiveness of the system;
- 10) the absence of a zone plan or other suitable diagrammatic representation of the premises [see 23.2.2e)].

- c) If no logbook suitable for enabling compliance with 48.2 exists, a suitable logbook should be provided by the servicing organization.

46.3 Recommendations for arrangements for repair of faults or damage

The following recommendations are applicable.

Where maintenance is carried out by a third party, such as a fire alarm maintenance organization, there should be an agreement for emergency call out to deal with any fault or damage that occurs to the system.

The agreement should be such that, on a 24 h basis, a technician of the maintenance organization can normally attend the premises within 8 h of a call from the user.

NOTE It is accepted that this might not be possible in very remote areas in which case this ought to be regarded as a variation from the recommendations of this standard in respect of maintenance arrangements. Such a variation would need to be recorded in the system logbook.

The name and telephone number of any third party responsible for maintenance of the system should be prominently displayed at the main CIE, and the records and documentation as identified in Clause 40 should be kept updated.

The user should record all faults or damage in the system logbook. and should arrange for repair to be carried out as soon as possible.

46.4 Modifications to the system

46.4.1 Commentary

Modifications to the system can arise for a number of reasons. Examples include:

- extension of the system to protect areas of the building previously unprotected or newly constructed;
- change of detector type as a result of changes in occupancy or the occurrence of false alarms;
- re-siting of, or increase in the number of, detectors and/or fire alarm devices to take account of changes in the layout of the building; and
- reconfiguration of the system (in hardware, software or both) to change the cause and effect logic in order to facilitate filtering of false alarms.

Since modification of a system effectively involves an element of re-design, responsibility for modification of a system needs to rest with a person who has a sufficient degree of design competence.

Even simple modifications can give rise to the need for significant re-testing of the system. This is particularly true of software-controlled systems. For example, a software change to facilitate a different cause and effect for a single automatic fire detector can result in the introduction of software errors that affect the operation of entirely non-related parts of the system.

It is possible, in some systems, for modification of the system configuration to be carried out remotely, via a modem. Great care needs to be taken, regardless of whether modifications are undertaken on site or remotely, to ensure that:

- the system continues to conform in full to this standard, or that existing non-compliances are not made more non-compliant; if new variations are introduced, it needs to be ensured that a new certificate, reflecting the variations, is issued;
- suitable tests are carried out at the protected premises to confirm that, after modification, the system operates as intended and that errors have not resulted in changes to other parts of the system;
- as-fitted drawings and other records are updated as appropriate; and
- details of the modification are documented and provided to the premises management [see 47.2)].

Although the modifications can often be carried out remotely by the maintenance organization, it is appropriate for a competent person from the maintenance organization to visit the premises before the modification is carried out, to confirm the validity of the modification and consider its effect on compliance with this part of BS 5839. It might also be necessary to visit the premises to undertake certain tests immediately after the modification has been carried out.

46.4.2 Recommendations applicable to all modification work

The following recommendations apply to all modification work, regardless of whether it is carried out on site or remotely.

- a) Responsibility for modification of a fire detection and fire alarm system should rest, ultimately, with a person who is competent in fire detection and fire alarm system design and is conversant with this standard

NOTE 1 This person might, for example, be the original designer; or might be a competent representative of the user or maintenance organization.
- b) Before modifying a fire detection and fire alarm system, care should be taken to ensure that the proposed modifications do not detrimentally affect the compliance of the system with fire safety legislation; where doubt exists, there should be consultation with the relevant enforcement authority.
- c) The user (see Clause 47) should be aware of, and agree, in writing, any modifications proposed for the system. Where appropriate, modifications should also be subject to the agreement of the enforcing authorities and/or insurers.
- d) All components, circuits, system operations and site-specific software functions known to be affected by the modifications should be tested for correct operation following the modifications.
- e) In addition to the tests recommended in 46.4.2d), the following tests should be carried out to ensure that there is no adverse effect on the overall system:

- 1) if one or more devices have been added to or removed from a circuit, at least one other device on the same circuit should be tested;
- 2) if the control equipment has been modified, at least one device on every circuit should be tested;
- 3) if any additional load has been placed on the system, tests should be carried out to prove that the rating of the power supply unit and the capacity of the standby batteries remain adequate, see 45.3e) and f); and
- 4) if software has been modified, further random testing of other parts of the system should be carried out to ensure that seemingly unrelated parts of the system have not been adversely affected.

NOTE 2 *The nature and extent of these tests cannot be specified in this standard; this depends on the nature and extent of the software changes and ought to be defined by the organization responsible for the software changes.*

- f) On completion of the modifications, all as-fitted drawings and other relevant system records should be updated as appropriate and made available with the system documentation (see Clause 40).
- g) On commissioning of the work and completion of the tests, a modification certificate should be issued, confirming that the work has been carried out in accordance with the recommendations of this standard, or identifying any variations. A model modification certificate is set out in Annex G. Where responsibility for the conformity, or otherwise, of the modified system with Section 2 of this standard rests with any person other than the organization carrying out the modification, that person should sign the appropriate section of the modification certificate and ensure it is made available with the system documentation (see Clause 40).

46.4.3 Recommendations applicable to modifications carried out remotely

In addition to the recommendations of 46.4.2, the following recommendations are applicable.

- a) Any person carrying out modifications remotely should have access to current as-fitted drawings of the system and to the current system configuration, indicating full details of cause and effect logic, available with the system documentation (see Clause 40).
- b) Any person carrying out modifications remotely should be conversant with this standard.

46.4.4 Recommendations for action to address an unacceptable rate of false alarms

The following recommendations are applicable.

- a) Any investigation into an unacceptable rate of false alarms, and any subsequent modifications to the system, should take into account the guidance contained in Section 3 of this standard. Where causes of false alarms cannot be determined, each of the recognized causes discussed in Clause 33 should be formally considered.
- b) Following any modifications, the system should either continue to conform to this standard, or should not be more non-compliant than prior to the modifications unless agreed with all interested parties.
- c) Any relevant documentation should be made available with the system documentation (see Clause 40).

46.4.5 Recommendations for inspection and test of the system following any fire

The following recommendations should be carried out as soon as possible after any fire.

- a) Every manual call point, automatic fire detector, and fire alarm device that might have been affected by

the fire or fire-fighting action should be inspected and tested in accordance with 45.4.

- b) A visual examination and suitable tests should be carried out on any other part of the system that lies within the fire area and other areas affected by corrosive smoke from the fire and that might have been damaged by the fire (e.g. power supplies, control equipment and cable), extinguishing media (e.g. water or fire-fighting action). Where there is evidence of damage, suitable action should be taken.
- c) Circuits external to the CIE that could have been affected by the fire should be tested for correct operation.
- d) On completion of the work, any defects found should be recorded in the system logbook, and the premises management should be notified accordingly.

46.4.6 Recommendation for inspection and test of the system following long periods of disconnection

The recommendations for inspection and test of the system over a 12 month period (see 45.4) should be undertaken.

NOTE If there is a major change in occupation or use of a building it might be appropriate for the cause and effects of the system to be checked.

Section 7: User's responsibilities

47 Premises management

47.1 Commentary

The user or landlord needs to appoint a single, named member of the premises management to supervise all matters pertaining to the fire detection and fire alarm system. The role of this person is to ensure that the system is tested and maintained in accordance with the recommendations of this standard, that appropriate records are kept and that relevant occupants in the protected premises are aware of their roles and responsibilities in connection with the fire detection and fire alarm system. This person also needs to ensure that necessary steps are taken to avoid situations that are detrimental to the standard of protection afforded by the system and to ensure that the level of false alarms is minimized.

47.2 Recommendations

A single, named member of the premises management should be appointed to supervise all matters pertaining to the fire detection and fire alarm system. This person should normally be the keeper of the documentation as described in Clause 40 and should be given sufficient authority to carry out the following duties.

- a) Ensuring that the CIE is checked at least once every 24 h to confirm that there are no faults on the system.
- b) Ensuring that arrangements are in place for testing and maintenance of the system in accordance with Section 6 of this standard.
- c) Ensuring that the system logbook (see Clause 48) is kept up-to-date and is available for inspection by any authorized person (e.g. representatives of enforcing authorities and property insurers).
- d) Ensuring that all relevant occupants of the protected premises are instructed in the proper use of the system. Particular care should be taken to ensure that relevant occupants are able to interpret fire, pre-alarm (see 47.3) and fault indications, and that they are adequately familiar with the appropriate controls, including those associated with initiation of fire alarm signals, silencing of fire alarm signals and resetting the system. It should also be ensured that all occupants are aware of the measures necessary to avoid the generation of false alarms. Relevant occupants should also be instructed in the facilities for disablement and the circumstances in which they should, and should not, be used. In premises in multiple occupation, it should be ensured that sufficient representatives of each occupier are instructed.

NOTE 1 Different levels of instruction might be necessary for different occupants.

- e) Ensuring that appropriate action is taken to limit the rate of false alarms [see 30.2g), 30.2h) and 35.2.7.3].
- f) Ensuring that a clear space of at least 500 mm is preserved in all directions around and below every fire detector and that all manual call points remain unobstructed and conspicuous.
- g) Establishing a liaison between those responsible for changes in, or maintenance of, the building fabric (including redecoration, etc.) to ensure that the work does not unnecessarily compromise the protection afforded by the system, create system faults or cause false alarms (see Section 3), If structural or occupancy changes occur or are planned, it should be ensured that any necessary changes to the fire alarm system are considered at an early stage.
- h) Ensuring that, when changes are made to the system, record drawings and operating instructions, supplied in accordance with 40.2b) and 40.2c) respectively, are updated.
- i) Ensuring that, where necessary, a suitable zone plan is displayed and is kept up-to-date [see 23.2.2e)].
- j) Ensuring that the following spare parts are held within the premises:
 - 1) six frangible elements and appropriate tools for manual call points, unless there are less than twelve manual call points in the protected premises, in which case only two spare frangible elements with appropriate tools need be held; and
 - 2) such other spare parts agreed between the user and the organization responsible for servicing the system.

NOTE 2 It would be of value for the premises management to be aware of the policy of the relevant fire and rescue service with regard to response to calls from the premises and/or any ARC, in the event of operation of the fire detection and fire alarm system.

47.3 Action in the event of pre-alarms

A pre-alarm can be a response to a slow growing fire or to indicate detector contamination. Whatever the reason, the following actions should be taken:

- a) determine and thoroughly inspect the area from whence the pre-alarm has originated;
- b) if a fire is discovered, carry out the predetermined fire routine; and
- c) if no fire is discovered, record the events or activities near the suspect detector in the logbook and, if there is need for work to be undertaken on the fire detection and fire alarm system, inform the maintenance company.

48 Logbook

48.1 Commentary

A logbook needs to be kept for the purpose of recording all events that occur in respect of the system, including fire signals, fault-signals and work on the system. This information can be of value to the organization that services the system and if special action is taken to address false alarm problems. The logbook might provide evidence of compliance with fire safety standards and legislation

48.2 Recommendations

NOTE 1 A model format for a logbook is contained in annex E

The following information should be recorded in the logbook

- a) the name(s) of the member(s) of the premises management to whom responsibility for the fire detection and fire alarm system is delegated;
- b) brief details of maintenance arrangements;
- c) dates and times of all fire alarm signals (regardless of whether the signal is a false alarm or is initiated as the result of a test, fire drill or genuine fire); if the fire alarm signal has resulted from the operation of a manual call point or fire detector, the device and its location should be recorded;
- d) causes, circumstances surrounding and category of all false alarms (see Section 3); dates, times and types of all tests;
- e) dates, times and types of all faults and defects; and
- f) dates and types of all maintenance (e.g. service visit or non-routine attention).

NOTE 2 The logbook may be kept in electronic form but needs to be accessible for all interested parties.

Annex A (normative)

Choice of appropriate category of fire detection and fire alarm system and frequency of servicing fire alarm systems

This annex describes the category of system that is typically installed in various types of premises, see Table A.1. The information in this annex is mandatory, and on the interpretation of fire safety standards and legislation. Decisions regarding the appropriate category of system for any specific building rest with the authorities responsible for enforcing legislation in the building: there can be more than one such enforcing authority, like fire prevention department and fire chief.

Table A.1 — Choice of appropriate category of fire detection and fire alarm system and frequency of servicing fire alarm systems

Type of premises	Typical category of system	Comments	Frequency of servicing
Common places of work, such as offices, shops, factories, warehouses and restaurants	M or P2/M A or P1/M	Category M system normally satisfies the requirements of legislation. It is, however, often combined with a Category P system to satisfy the requirements of insurers, as company policy for protection of assets, or to protect against business interruption.	Bi-annual
Hotels, hostels, student accommodation, houses in multiple occupation and similar premises with sleeping accommodation	L1 or L2	In bedroom areas, the design requirements are usually based on the recommendations for a Category L3 system. Detectors are, however, typically installed in most other rooms and areas, as a fire in almost any area of the building could pose a threat to sleeping occupants; the system category is, therefore, at least L2. In practice, few, if any, areas are left unprotected and the system category is effectively L1, except that a variation from the recommendations applicable to a Category L2 system might apply to the siting of heat, smoke or carbon monoxide detectors in bedrooms; this often follows the recommendations of 22.3e) for detectors in a Category L3 system.	Quarterly
Large public houses (No residential accommodation)	M	-	Quarterly
Public houses with residential accommodation	L2	-	Quarterly

Table A. 1 — Choice of appropriate category of fire detection and fire alarm system and frequency of servicing fire alarm systems (*Continue*)

Type of premises	Typical category of system	Comments	Frequency of servicing
Schools, other than small single-story schools with less than 160 pupils	M or M/P2 or M/P2/ L4 or M/P2/L5	System category is normally based on a fire risk assessment. In many schools, a Category P system is installed to combat the hazard of arson. In schools that are partly occupied at certain times (e.g. during evening classes or community use), a Category L4 or L5 system is sometimes considered appropriate	Quarterly
Hospitals	L1 (with possible minor variations)	-	Monthly
Places of assembly, (e.g. cinemas, theatres, nightclubs, exhibition halls, museums and galleries, leisure centres and casinos): Small premises (e.g. accommodating less than 300 persons) Other premises	L1 to L4	L1 is regarded as appropriate for large premises	Quarterly
Transportation terminals	M/L5	-	Quarterly
Covered shopping centres	L1 to L3	The exact design needs to be "tailor made" and often forms part of a fire engineering solution.	Quarterly
Residential care premises	L1 to L3	L1 systems are often provided in large or complex buildings.	Quarterly
Prisons	M/L5	-	Quarterly
Phased evacuation buildings	L3	-	Quarterly
Buildings in which other fire precautions, such as means of escape, depart from recognized guidance	M/L5	Automatic fire detectors are sited in such a way as to compensate for the lower standard in other fire precautions	Quarterly

Table A.1 — Choice of appropriate category of fire detection and fire alarm system and frequency of

servicing fire alarm systems (Continue)

Type of premises	Typical category of system	Comments	Frequency of servicing
Buildings with "inner rooms", from which escape is possible only by passing through another ("access") room, where there is inadequate vision between the inner room and the access room	M/L5	Smoke detectors are sited in the access room.	Quarterly
Buildings in which automatic fire detection is required to operate other fire protection systems (e.g. magnetic door holders)	M/L5	Care is necessary to ensure that automatic fire detectors are sited such that cool smoke cannot pass below the level of the detectors that cause release of the magnetic door holders, and through the (still open) doors.	Quarterly
Situations in which fire could readily spread from an unoccupied area and prejudice means of escape from occupied areas	M/L4 or M/L5	Custom and practice does not involve siting automatic fire detectors in all unoccupied areas, such as plant rooms and storage areas.	Quarterly
Any building in which automatic fire detection is provided as a requirement of a property insurer or to attract an insurance premium discount	M/P1 or M/P2		Quarterly
Flammable depots LPG, Depots	P1 or P2	Flammable	Monthly
Filling stations	P1 or P2	Flammable	Quarterly

Annex B (informative)

Typical noise levels in buildings

Table B.1 gives typical expected background noise levels for a range of building types. It needs to be borne in mind, however, that background noise levels can vary significantly from building to building of the same occupancy; likewise, occupancy can vary in any given building. Sound level readings for the table were taken, as far as possible, at the busiest periods and short-term bursts of very high-level or very low-level noise were ignored, for each type of building a typical range of background noise sound pressure levels is given.

On the whole, measurements for the table were made in large buildings. In some buildings, the range of background noise levels is very wide, and the type of occupancy has been subdivided into, for example, quiet and noisy categories. The table is intended only as a guide but where it is used to assess fire alarm system requirements, the higher of the two dB(A) figures in the appropriate range ought always to be used. Wherever possible, "real" measurements ought to be made in the building where the fire alarm system is to be installed.

Table B.1 — typical expected background noise levels for a range of building types

Area		Lp dB(A)
Airport terminals:	check in, arrivals and departures concourses	59 to 72
	gate rooms and pier walkways	54 to 64
	customs - baggage reclaim	63 to 71
	- channels	59 to 70
	- departure lounge	49 to 64
Arenas, auditoria: ^A	concert halls, cinemas, theatres, etc.	60 to 75
Banks, building societies:	public areas	50 to 64
Bus stations:	Quiet	58 to 68
	Noisy	63 to 73
Cafeterias:	Quiet	55 to 65
	Noisy	68 to 78
Classrooms:	Quiet	56 to 68
	Noisy	64 to 72
Conference/ meeting rooms:		40 to 45
Corridors:	uncarpeted: - quiet	45 to 55
	- noisy	66 to 76
	carpeted:	28 to 32
Court rooms:		40 to 50
Dealing rooms:	computerized	60 to 70
	traditional	80 to 90
Exhibition halls:		63 to 73

Table B.2 — typical expected background noise levels for a range of building types
(continued)

Area		Lp dB(A)
Factories:	control rooms	70 to 75
	light assemblies	80 to 85
	heavy engineering	95 to 105
Hospitals:		See note
Hotel bedrooms:	TV off	28 to 35
	TV on	60 to 70
Kitchens (commercial):		65 to 75
Leisure centres:	squash courts	65 to 80
	ice-rinks (public sessions)	69 to 80
	swimming/diving pools	72 to 79
	fun pools	81 to 87
	Bowling	78 to 85
Libraries:	book/reading areas - quiet	35 to 45
	- noisy (e.g. heavily air-conditioned)	50 to 60
	Receptions	50 to 60
Museums, galleries:	Quiet	48 to 60
	Noisy	60 to 73
Offices:	Cellular	40 to 50
	open-plan	50 to 70
	noisy	70 to 85
Plant rooms:	boiler - quiet	66 to 72
	- noisy	76 to 86
Railway stations (surface):	waiting rooms	54 to 65
	concourses	60 to 66
	platforms – Electric trains	60 to 72
	Diesel trains	75 to 85
Restaurants:		72 to 75
Shop stores:	quiet	50 to 60
	noisy	65 to 75
Shopping malls:		70 to 75

Table B.1 — typical expected background noise levels for a range of building types
(continued)

Area		Lp dB(A)
Sport Shops	quiet	60to 72
	noisy	72 to 82
	Loud ball games	78 to 93
Warehouses	quiet	47 to 63
	noisy	63 to 80
<p>^{A)} In these occupancies, management procedures are normally that performances cease prior to a general "Evacuate" signal being given; the background noise is then significantly lower than that occurring during the performance. It is the latter noise level, as given here, that is to be used for designing the system.</p> <p>NOTE Special considerations apply in the case of hospitals because, for example, in many areas the fire signal is intended primarily for staff rather than patients. The staff shall have been trained in fire Marshall including basic fire fighting. Fire Marshall shall be in charge of monitoring, managing the system together with installing company</p>		

Annex C (normative)

Control and transmission equipment for tactile alarm devices provided for people who are Deaf and hard of hearing

C.1 Control and transmission equipment for tactile alarm devices provided for people who are Deaf and hard of hearing should be designed in accordance with the principles of BS EN 54-2, other than in respect of the colours used for visual indicators.

C.2 The control and transmission equipment should conform to the relevant requirements of BS EN 54-2:1997+A1.

- 5.1
- 5.2
- 5.3
- 5.4
- 5.6
- 6
- 7.6

NOTE 1 This subclause does not apply if resetting of the control and transmission equipment is achieved by receipt of a data signal from, or by the operation of relay dedicated to this function (i.e. not the relay that indicated the fire signal) at the fire alarm CIE.

- 8.2.1
- 8.2.2
- 8.2.3
- 8.2.4b)
- 8.2.4d)
- 8.2.4e)
- 8.2.6a)
- 8.5
- 8.6.1
- 8.6.2
- 8.6.3
- 8.7
- 8.8
- 10.2a)

Note 2 This subclause is applied except that, instead of a separate light emitting indicator, visual indication of the test condition may be given by a combination of a fault indication and an appropriate text display.

- 12.3
- 12.4.3
- 12.4.4
- 12.5.1
- 12.5.4

- **12.6**
- **12.7**
- **12.8**
- **12.9**
- **12.10**
- **12.11**
- **13 (excluding 13.2.and 13.7)**
- except that in 14a) the equipment should be marked as compliant with Annex C of BS 5839-1:2017, and not with BS EN 54-2:1997+A1.
- **15**

NOTE 3 Where Clause 15 refers to a fire detection circuit, this is to be regarded as the circuit that interconnects the control and transmission equipment with the fire detection and fire alarm system CIE.

C.3 Since BS EN 54-2:1 997+AI was not drafted to take account of tactile alarm devices provided for people who are Deaf and hard of hearing, care should be taken to ensure that each of the requirements listed in are met.

C.4 Special attention should be given to the following design considerations.

- a) Mains failure or low battery condition at the control and transmission equipment should result in a suitable fault warning at the fire alarm CIE within 30 min of its occurrence.
- b) All other fault conditions that are required to be identified at the control and transmission equipment in order to satisfy the recommendations of 18.2 should result in a fault warning at the fire alarm CIE within 100 s of their occurrence.
- c) A visible indication should be given at the equipment by means of an independent light-emitting indicator while the equipment is supplied with power.
- d) Multiple fire signals received at the equipment should not stop, or inhibit, the transmission of fire warning signals.
- e) Any controls that cause transmission of fire alarm signals to cease should be capable for use

Any controls that cause transmission of fire alarm signals to cease should be capable of use only at access level 2, as defined in BS EN 54-2.

Repeat transmission of fire alarm signals should continue until either manual action is taken or a reset signal is received from the fire alarm CIE; repeat transmissions should not cease automatically after any predetermined period or number of transmissions.

C.5 Power supplies should conform to the requirements of BS EN 54-4. repeat transmission of fire alarm, signal

Annex D (normative)

Method for calculating standby battery capacity

D.1 Valve regulated lead acid batteries

- D.1.1** The minimum capacity of valve regulated lead acid batteries should be calculated in accordance with following fomula:

$$C_{min} = 1.25(T_1 I_1 + \frac{D I_2}{2})$$

where

- C_{min} minimum capacity of the battery when new at the 20 h discharge rate and at 20°C in ampere hours;
- T_1 total battery standby period in hours;
- I_1 total battery standby load in amperes;
- I_2 total battery alarm load in amperes; and
- D a derating factor

- D.1.2** Where $C_{min} / 20$ is equal to or greater than I_2 , it can be assumed that $D = 1$. When $C_{min} / 20$ is less than I_2 the value of D should either be based on the battery manufacturer's data or should be 1.75.
- D.1.3** In practice, C_{min} is unlikely to correspond exactly to an available battery capacity and therefore the next highest available capacity size should be used.

D. 2 Batteries other than valve-regulated lead acid batteries

The minimum capacity of batteries, other than valve regulated lead acid batteries, should be determined by consultation with the battery manufacturer and should take into account the standby load, the alarm load, any required derating to take account of the higher current drawn in the alarm condition and a derating factor to take account of battery ageing during the anticipated life of the battery.

Annex E
(informative)

The Selection and Application of Fire Detectors

During the design of a fire system, consideration is given to the fire risk(s) and the false alarm risk(s). Fire detectors are selected depending on the nature of the protected area and the risks associated with it. Often, this involves utilizing different fire detector technologies in order to meet the diverse needs of both fire detection and false alarm rejection in each scenario.

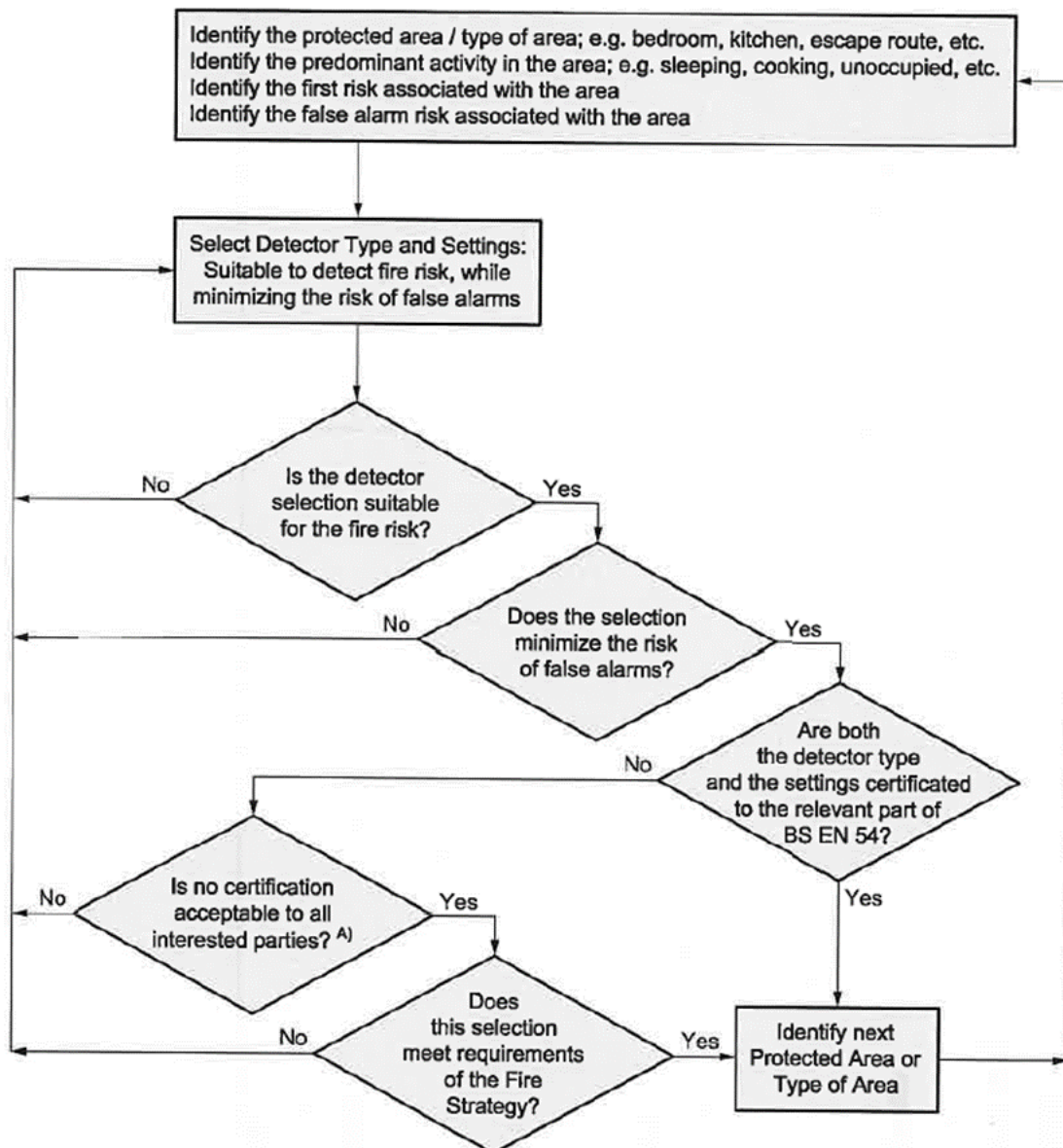
Single sensor detectors (e.g. optical smoke detectors, heat detectors) are suited to the detection of certain fire risks. Selection choices need to be made carefully to optimize the detection of fire but minimize the occurrence of false alarms. The deployment of multi-sensor detectors means that the system could potentially detect fires earlier and yet avoid troublesome false alarms to a greater extent too.

The choices and decisions concerning which detector types to use are initially made during fire system design, but are also sometimes re-visited and even modified during commissioning and/or maintenance. They are not always well recorded, nor is the rationale behind them. At a later time e.g. during a maintenance visit, this can give rise to confusion. A clear understanding of the original reasons behind the choice of detectors and how they are configured is needed in order to verify continued suitability.

Aside from multi-sensor detectors, a visual inspection of a fire detector can often provide sufficient information to a maintenance technician to allow in-situ functional testing to be undertaken (e.g. in the case of a smoke detector or a heat detector). However, in the case of multi-sensor fire detectors, the type of detection employed within it and its settings, modes or specific configuration which govern its detection performance to the risk, are not apparent from a visual inspection. This information might not even be available from the CIE. In all cases, however, there remains the need to know the detection principles and to understand the reason for the choice of that detection, relative to the risks perceived in the protected area.

Annex E is intended to assist with the task of selecting and clearly recording the type, sensitivity and settings selected for all detectors, including multi-sensor detectors, relating to the perceived risks. A detector selection table is shown in Table E.1. It is a template to allow the documentation of the main risks, and all decisions and reasoning behind the detection choices made either during system design or at the time of any subsequent change to the fire detection. It is intended to assist designers, commissioning engineers and service/maintenance technicians to keep good records of their detection choice decisions and rationale.

A flowchart is also provided in Figure E.1 which demonstrates the process of detector choice and is provided as a guide for completing Table E.1. The notes in Table E.1 give further guidance on its completion, including reference to relevant recommendations within BS 5839-1.



^{A)} See Clause 6 and Clause 11. Agreement to use an un-certificated device should be recorded as a variation to Clause 7. When referring to the agreed variation it is advisable to record all documented communication between the interested parties in support of the variation.

Figure E 1 Flow chart for the selection of detector and application verification

Record the responses to the questions given in Figure E.1 in Table E.1, For guidance on completion of this-table, see the table footnotes

Table E.1 — Detector Selection

Protected area/type of area ^A	Choose from: Hotel bedroom en-suite Hotel bedroom non en-suite Hotel suite Bedroom dormitory style Office cellular Office open plan Kitchen (main) Kitchenette Restaurant/ Canteen Corridor Escape route Reception area Lobby Workshop (clean) Workshop (moderate) Workshop (dirty) Warehouse / storage	Others: please specify
Predominate use of area ^B	Choose from: Sleeping Cooking Unoccupied Storage non-flammable Storage flammable General office work Meetings Circulation route Escape route Manufacturing Manufacturing (hot works) Assembly	Others: please specify
Fire phenomenon ^C	Choose from: Smouldering white smoke Smouldering dark smoke Smouldering changing to flaming Flaming (clean burn) Flaming (dirty)	Others: please specify

Table E.1— Detector selection (*continued*)

False alarm risk (S) ^D	Choose from: None Steam toaster Oven usage Cooking Dust Smoking Aerosol spray Hot works	Others: please specify
Detector type ^E	Choose from Optical Heat (static) Heat (RoR) Ionization Multi-sensor Optical/ Heat Heat/CO Optical/CO Optical/ Heat/CO Optical beam Linear heat ASD Class C ASD Class B ASD Class A Flame Video CO	Other please specify
Detector setting ^F	Please specify detail of detector setting(s)	
Certificated mode(s) chosen? ^G	Choose from: Yes No	
Acceptable to interested parties? ^H	Choose from Yes No – then specify	

Table E.1— Detector selection (*continued*)

Fire strategy met?'^A	Choose from Yes No – then specify	
Fire strategy met?'^A	Choose from Yes No – then specify	
Detector type/ setting choice rationale'^J	Please specify in detail	
Comments/ Action'^K	Details as appropriate	

Table E.1— Detector selection (*continued*)

<p>^A Protected area needs to be related to the system category as defined in Clause 5. In the case of time-related settings (e.g., day/night mode), a new selection process needs to be undertaken and recorded for each setting.</p> <p>^B Anticipated use(s) of the protected area - does not need to be an exhaustive list but needs to cover the main use(s).</p> <p>^C Risks anticipated in the protected area. This can either be described as the fire type or in terms of the expected causes of fire. Only the main fire risks need to be identified in Table E.1 - this need not be an exhaustive list.</p> <p>^D Only the predominant false alarm risks need to be identified in Table E.1 - this does not need to be an exhaustive list. These needs to be described in terms of the expected causes of false alarms. See Clause 35 for assistance with selection of detector types for the minimization of false alarms.</p> <p>^E See Clause 21 for further information on detection types and their selection.</p> <p>^F Different detector settings can include various response speeds, delays, variations of sensor performance, sensitivity of alarm level, etc. Other risks (e.g. evacuation strategy/ timescales) need to be considered when choosing these settings.</p> <p>^G Some detectors might have modes of operation which are not certificated to the relevant BS EN 54 standards. These modes are to be avoided if at all possible but where such modes are used, that decision needs to be agreed in writing by all interested parties following a fire risk assessment, noted here and explained in the rationale in Table E 1. Information concerning non-compliance of a specific mode has to be provided by the manufacturer by clearly marking the detector or within the associated data (as per BS EN 54 standards, On-site adjustment of response behaviour).</p> <p>^H Refer to Clause 6 for the definition of relevant interested parties.</p> <p>^I The implications of future changes to the detection type or setting need to be understood and continue to support the fire strategy.</p> <p>^L The reasoning behind decisions concerning the choice of detector technology, type, setting, sensitivity, etc. need to be given here.</p> <p>^K Any additional, relevant information concerning the detector selection needs to be given here, including required or agreed actions.</p>		
--	--	--

To assist in completion of the fire phenomena column in Table E.1. the following summary of individual sensor detection performance (as found within point type fire detectors) is provided in Table E.2. It also shows some indication of how a typical multi-sensor detector can be used to improve detection.

Table E.1— Example of fire risks

Fire phenomenon	Smouldering white smoke		Smouldering dark smoke	Smouldering changing to flaming	Flaming (clean burn)	Flaming (dirty)
Example fire(s)	Smouldering electrical fire	Smouldering wood	Smouldering furnishings	Wastepaper bin fire	Burning solvents	Burning oils
Ionization detection	**	***	**	****	*	**
Optical (scatter) detection	*****	*****	****	****	*	***
CO detection	*	****	*****	**	*	**
Heat detection	*	*	*	**	***	***
Flame detection	*	*	*	***	*****	*****
Typical multi-sensor detection e.g. optical-heat A	*****	*****	****	****	***	****
Typical multi-sensor detection e.g. optical-heat- COA	*****	*****	*****	****	****	****

Key to fire hazard detection: very good = ***** good = **** moderate = *** poor = ** very poor = *

^A Multi-sensor detector responses could be a combination of the single-sensor responses, but the behaviour of a multi-sensor is dependent on the manner in which the sensors are combined within the detector. The combination of sensors within a multi-sensor detector could provide an enhancement to performance overall and cannot be considered to be the linear sum of the individual sensor responses. The response of multi-sensors is not common across all detector manufacturers due to differences in construction and internal algorithms. The response of a chosen multi-sensor, including its mode and settings, should be properly understood to ensure that the risks are adequately covered. This table shows some typical examples of multi-sensor responses and does not represent an exhaustive list of all possible sensor combinations and algorithms.

False Alarm phenomenon	Example False Alarm fire(s)	Ionization detection	Optical (scatter) detection	CO detection	Heat detection	Flame detection	Typical multi-sensor detection e.g. optical-heat ^A	Typical multi-sensor detection e.g. optical-heat CO ^A
Steam	Shower or bathroom	****	**	*****	*****	*****	***	***
Smoke	Smoking kitchen/cooking fumes	*	***	****	*****	*****	***	****
Dust	Warehouse	***	**	*****	*****	*****	***	***
Other particular	Aerosol canister product, artificial smoke	*	*	*****	*****	*****	***	****
Sparks/naked flames	Welding	**	**	***	***	*	****	****
Substance ingress	Insects	***	***	*****	*****	*****	****	****
High ambient air flow	Air conditioning open doors/, window	**	*****	*****	*****	*****	*****	*****
Rapid thermal Change	Opening of ovens	**	*****	*****	*	*****	****	****
Key choice to avoid false alarms: very good = ***** good = **** moderate = *** poor = ** very poor = *								
^A Multi-sensor detector responses could be a combination of the single-sensor responses, but the behaviour of a multi-sensor is dependent on the manner in which the sensors are combined within the detector. The combination of sensors within a multi-sensor detector could provide an enhancement to performance overall and cannot be considered to be the linear sum of the individual sensor responses. The response of multi-sensors are not common across all detector manufacturers, due to differences in construction and internal algorithms. The response of a chosen multi-sensor, including its mode and settings, should be properly understood to ensure that the risks are adequately covered. This table shows some typical examples of multi-sensor responses and does not represent an exhaustive list of all possible sensor combinations and algorithms.								

Annex F
(normative)

Model format for system logbook

Logbook

It is mandatory that this logbook be maintained by a relevant member of the premises management, to ensure that every entry is properly recorded. It is also mandatory that installing company provide logbook and monitor this entry during their visits. This is necessary to satisfy the requirements of this standard, conformity to which might be a requirement of legislation.

In order to satisfy the requirements of this standard, the following need be recorded.

- The names of the members of the premises management.
- Brief details of the maintenance arrangements.
- Dates and times of all tests, including fire drills.
- Dates and times of all fires to which the system responds.
- Dates and times of all false alarms.
- Causes, circumstances surrounding, and category, of all false alarms (if known).
- The identity of any manual call point or automatic fire detector that triggers any of the above fire alarm signals (if known).
- Dates, times and types of all faults and defects.
- Dates and types of all maintenance (e.g. service visit or non-routine attention).

Reference data

Address of protected premises:

.....

Person within premises management responsible for the fire detection and fire alarm system:

.....

The system was designed by:

The system was installed by:

The system was comissioned by:

The system was accepted by:

Verification was undertaken by:

The system is maintained under contract by :..... until:

Telephone number:, who should be contacted if maintenance is required.

Normal maximum attendance time for a maintenance technician is :.....

Expendable component replacement periods (list):

.....

.....

This fire detection and fire alarm system comprises the following devices:

- Manual call points:
- Smoke detectors:
- Heat detectors;
- Beam detectors
- Aspirating detectors:
- Other detectors (specify)
- Shut down devices:
- Interface units:

Table F-1- Events other than false alarms or maintenance work

Date	Time	Event ^A	Zone ^B	Device ^B	Action required ^B	Date completed ^B	Initials
<div><div>^A For example test, fire alarm signal, fault.</div><div>^B Where applicable.</div></div>							

False alarms										
Date	Time	Zone	Device that triggered alarm signal	Cause (if known) ^A	Brief circumstances	Maintenance visit required? (Yes / No)	Findings of maintenance technician ^B	Category of false alarm	Further actions required ^B	Action Completed ^B
<div><div>^A Where cause is unknown, record activities in this area</div><div>^B Where applicable</div></div>										

Maintenance Work							
Date	Time	Zone	Device	Reason for work	Work carried out	Further Work required ^B	Signature
<div>^B Where applicable</div>							

Annex G
(informative)

Model certificates

G.1 Design certificate

Certificate of design for the fire detection and fire alarm system at:

Address :.....

.....

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the design of the fire detection and fire alarm system, particulars of which are set out below, CERTIFY that the said design for which I/we have been responsible complies to the best of my/our knowledge and belief with the recommendations of Section 2 of this standard for the system category described below, except for the variations, if any, stated in this certificate.

Name (in block letters) :..... Position:

Signature: Date:

For and on behalf of:

Address:.....

.....

..... Postcode:

The extent of liability of the signatory is limited to the system described below.

System category (see Clause 5):.....

Variations from the recommendations of Section 2 of this standard

.....

.....

Extent of system covered by this certificate:

.....

.....

Brief description of areas protected (not applicable for Category M, L1 or P1 systems):

.....

.....

.....

.....

Design certificate(continued)

Measures incorporated to limit false alarms. Account has been taken of the guidance contained in Section 3 of this standard and, more specifically (tick as appropriate):

- ☐ The system is manual Type and siting of manual call points takes account of the guidance contained in Section 3 of this standard.
- ☐ The system incorporates automatic fire detectors, and account has been taken of reasonably foreseeable causes of unwanted alarms, particularly in the selection and siting of detectors.
- ☐ An appropriate analogue system has been specified.
- ☐ An appropriate multi-sensor system has been specified.
- ☐ A time-related system has been specified. Details:.....
.....
- ☐ Fire signals from automatic fire detectors result initially in a staff alarm, which delays general alarm /transmission of signals to an alarm receiving centre (delete as applicable) formin
- ☐ Appropriate guidance has been provided for the user to enable limitation of false alarms .
- ☐ Other measures as follows:
.....

Installation and commissioning

It is strongly recommended that installation and commissioning be undertaken in accordance with the recommendations of Section 4 and Section 5 of this standard respectively.

Soak test

- ☐ In accordance with the recommendations of 35.2.6 of this standard, it is recommended that, following commissioning, a soak period of should follow. (Enter a period of not less than one week.)
- ☐ As the system incorporates no more than 50 automatic fire detectors, no soak test is necessary to satisfy the recommendations of this standard.

Verification

Verification that the system complies with this standard should be carried out, on completion, in accordance with Clause 43

Yes ☐ No ☐ To be decided by the purchaser or user ☐

Maintenance

It is strongly recommended that, after completion, the system is maintained in accordance with Section 6 of this standard

User responsibilities

The user should appoint a relevant member of the premises management to supervise all matters pertaining to the fire detection and fire alarm system in accordance with the recommendations of Section 7 of this standard

G.2 Installation certificate

Certificate of Installation for the fire detection and fire alarm system at:

Address:.....
.....

We being the competent installing company responsible (as indicated by my /our signatures below) for the installation of the fire detection and fire alarm system, particulars of which are set out below, CERTIFY that the said installation for which we have been responsible complies to the best of our knowledge and belief with the specification described below and with the recommendations of Section 4 of this standard except for the variations, if any, stated in this certificate.

Name (in block letters) :..... Position:

Signature :.....Date:

For and on behalf of:

Address.....
.....

Postcode:

The extent of liability of the signatory is limited to the system described below.

Extent of installation work covered by this certificate:
.....
.....
.....
.....

Specification against which system was installed:
.....
.....
.....
.....

Variations from the specification and/or Section 4 of this standard (see Clause 7):
.....
.....
.....
.....

Wiring has been tested in accordance with the recommendations of Clause 38 of this standard
Test results have been recorded and provided to:

Unless supplied by others, the as-fitted drawings have been supplied to the person responsible for commissioning the system.
.....

G3 Commissioning certificate**Certificate of Commissioning for the fire detection and fire alarm system at:**

Address :

.....

We being the competent installing company responsible (as Indicated by our signatures below) for the commissioning of the fire detection and fire alarm system, particulars of which are set out below, CERTIFY that the said work for which we have been responsible complies to the best of our knowledge and belief with the recommendations of Clause 39 of this standard except for the variations, if any, stated in this certificate.

Name(in block letters):..... Position:

Signature: Date:

For and on behalf of:

Address:.....

.....

..... Postcode:

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by this certificate

.....

.....

.....

.....

Variations from the recommendations of Section 39 of this standard

.....

.....

.....

☐ All equipment operates correctly

☐ Installation work is, as far as can reasonably be ascertained, of an acceptable standard.

☐ The entire system has been inspected and tested in accordance with the recommendations of 39.2c) of this standard

☐ The system performs as required by the specification prepared by a copy of which I/we have been given.

☐ Taking into account the guidance contained in Section 3 of this standard, we have not identified any obvious potential for an unacceptable rate of false alarms

☐ The documentation described in Clause 40 of this standard has been provided to the user

Commissioning certificate(continued)

The following work should be completed before/after (delete as applicable} the system becomes operational:

.....
.....
.....
.....

The following potential causes of false alarms should be considered at the time of the next service visit:

.....
.....
.....
.....

Before the system become operational, it should be soak tested In accordance with the recommendations of 35.2.6 of this standard for a period of: (Enter a period of either one week, such period as required by the specification, or such period as recommended by the signatory to this certificate, whichever is the greatest, or delete if not applicable.)

Acceptance certificate**Certificate of acceptance for fire detection and fire alarm system:**

Address.....

We being the competent installing company responsible (as indicated by my/our signatures below) for the acceptance of the fire detection and fire alarm system, particulars of which are set out below, ACCEPT the system on behalf of

Name (in block letters):..... Position:

Signature: Date:

For and on behalf of:

Address:.....

..... Postcode:

The extent of liability of the signatory is limited to the systems described below.

Extent of system covered by this certificate:

.....

.....

- ☐ All installation work appears to be satisfactory
- ☐ The system is capable of giving a fire alarm signal.
- ☐ The facility for remote transmission of alarms to an alarm receiving centre operates correctly.
- ☐ A suitable zone plan (or other suitable diagrammatic representation) of the premises is provided on or adjacent to all control and Indicating equipment (Delete if not applicable.)

The following documents have been provided to the purchaser or user:

- ☐ As-fitted drawings
- ☐ Operating and maintenance instructions.
- ☐ Certificates of design, installation and commissioning
- ☐ A logbook.
- ☐ Electrical Installation Certificate in accordance with BS 7671 for the supply to all mains related wiring
- ☐ Sufficient representatives of the user have been properly instructed in the use of the system, including, at least, all means of triggering fire signals, silencing and resetting the system and avoidance of false alarms.
- ☐ All relevant tests, defined in the purchasing specification, have been witnessed. (Delete if not applicable.)

The following work is required before the system can be accepted:

.....

.....

G.5 Verification certificate (optional)**Certificate of commissioning for the fire detection and fire alarm system at:**

Address

.....

.....

.....

We being the competent person(s) responsible (as indicated by our signatures below) for the verification of the fire detection and fire alarm system, particulars of which are set out below, CERTIFY that the verification work for which we have been responsible complies to the best of our knowledge and belief with the recommendations of Clause 43 of this standard

Name (in block letters):..... Position:

Signature: Date:

For and on behalf of:

Address:.....

.....

..... Postcode:

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by this certificate:

.....

.....

.....

Scope and extent of the verification work:

.....

.....

.....

.....

☐

In my/our opinion, that as far as can reasonably be ascertained from the scope of work described above, the system complies with, and has been commissioned in accordance with, the recommendations of this standard, other than in respect of variations already identified in the certificates of design, installation, or commissioning,

☐

The entire system has been inspected and tested in accordance with the recommendations of 39.2c) of this standard .

The following non-compliances with the recommendations of this standard, have been identified (other than those recorded as variations in the certificates of design, installation or commissioning):

.....

.....

.....

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