BRITISH STANDARD

BS 5839-6:2004

Fire detection and fire alarm systems for buildings —

Part 6: Code of practice for the design, installation and maintenance of fire detection and fire alarm systems in dwellings

ICS 13.220.20; 13.320

BSI British Standards

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee FSH/12, Fire detection and alarm systems, to Subcommittee FSH/12/1, Installation and servicing, upon which the following bodies were represented:

British Cables Association
British Fire Consortium
British Fire Protection Systems Association
British Research Laboratories
Chartered Institution of Building Services Engineers
Co-opted Members
Department of Health — NHS Estates
Electrical Contractors Association
Energy Institute
Energy Industries Council
Engineering Industries Association
Institute of Fire Safety
Institute of Electrical Engineers
LPCB/BRE Laboratories
Maritime and Coastguard Agency
Ministry of Defence — UK Defence Standardization
National Inspection Council for Electrical Installation
Office of the Deputy Prime Minister
Professional Lighting and Sound Association
Security Systems and Alarms Inspection Board

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 17 September 2004

First published November 1995
Second edition September 2004

The following BSI references relate to the work on this British Standard:
Committee reference FSH/12/1
Draft for comment 03/119007 DC

ISBN 0 580 44100 8

Amendments issued since publication

Amd. No.	Date	Comments

Contents

Foreword

This part of BS 5839 has been prepared by Technical Committee FSH/12/1. It supersedes BS 5839-6:1995, which is withdrawn. Whereas BS 5839-1 provides recommendations for fire detection and fire alarm systems in buildings, other than dwellings, this part of BS 5839 provides guidance on fire detection and fire alarm systems in dwellings.

This new edition of BS 5839-6 takes into account changes in technology, custom and practice, and changes in guidance that supports national building regulations, since the publication of BS 5839-6:1995, and introduces some significant changes.

The principal changes made within the revision are as follows:

a) the minimum standard of protection recommended for new dwellings has been increased. Whereas the previous version of this standard recommended only that smoke alarms be provided within the circulation areas of most new single-family dwellings and small houses in multiple occupation, this standard now recommends that, in addition to these smoke alarms, heat alarms be provided in the kitchen and principal habitable room;

b) whereas the previous version of this standard accepted mains powered smoke alarms within new single-family dwellings and small houses in multiple occupation (HMOs), this standard now recommends that smoke alarms and heat alarms installed within new single-family dwellings and small HMOs should be mains powered with, in addition, a standby power supply in the form of a battery or capacitor;

c) the code of practice has been simplified by incorporating commentary on relevant principles, followed by short, succinct recommendations. This is intended to make the code of practice less ambiguous, simpler for the non-specialist to apply and compliance of installations more straightforward to audit;

d) an approach to risk assessment in dwellings, as a basis for determining appropriate system design criteria, has been removed from the body of the code of practice and set out in an informative annex;

e) the term “Category” (of system) is now used instead of “type” in the description of system objective/area of coverage (e.g. a comprehensive system installed throughout all circulation spaces, rooms and areas in which fire might start, other than toilets, bathrooms and shower rooms, was previously described as type LD1, but is now described as Category LD1); this is to distinguish this term from the less precise use of the term “type” to describe the principles of operation of the system (e.g. purely smoke alarms, mixture of smoke alarms and heat alarms, etc.);

f) carbon monoxide fire detectors are now recognized as a form of fire detection that may be used in certain parts of certain dwellings;

g) greater emphasis is placed on the need to limit the potential for false alarms;

h) recommendations for fire warning systems for deaf and hard of hearing people have been included;

i) the term “deviation” has been replaced with the term “variation”, to avoid any negative connotation associated with the term used to describe an aspect of system design that, for sound reasons, does not comply with the recommendations of this standard;

j) the single certificate of installation has, in the case of Grade A systems, been extended to define separately responsibilities for design, installation and commissioning.

In the United Kingdom, around 80 % of all fire deaths and injuries occur in dwellings, a total of 450 to 500 deaths and around 14 000 injuries per annum. Many of those who die are the most vulnerable in the community, namely elderly and socially deprived people. The installation of a fire detection and fire alarm system in a dwelling can substantially reduce the risk of death or serious injury from fire. Indeed, the overall downward trend in annual fire deaths in dwellings since smoke alarms in dwellings were first given recognition in BS 5839-1 in 1988 is almost certainly attributable in part to the increasing use of smoke alarms.

The level of deaths and injuries remains, however, above a level that society regards as acceptable. It has been estimated that, in dwellings without smoke detectors, a substantial proportion of the fatalities from fire could be avoided if smoke detectors were installed. The fatality rate in dwelling fires where there is no working smoke detector is between two and three times the fatality rate in dwelling fires where a smoke detector is present and functions correctly.

The installation of automatic fire detectors is, effectively, required in new dwelling houses, flats and maisonettes in order to satisfy building regulations. In existing houses in multiple occupation, the installation of an automatic fire detection and fire alarm system is normally required by the relevant enforcing authorities. This gives rise to the need for a suitable code of practice, as BS 5839-1 does not contain recommendations on domestic smoke alarms, nor does it address the special design requirements for fire detection and fire alarm systems in dwellings.

The guidance in this standard is intended for architects and other building professionals, enforcing authorities, designers and installers of fire alarm systems and others responsible for implementing fire precautions in dwellings. It has been assumed in the drafting of this part of BS 5839 that the execution of its provisions will be entrusted to appropriately qualified and competent people.

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

Clauses are arranged in two parts, namely commentary and recommendations. It is envisaged that, when fire detection and fire alarm systems in dwellings are audited (e.g. by enforcing authorities or third-party certification bodies), only the recommendations will form the basis for the audit, while the commentary is intended to provide an explanatory background to the recommendations, particularly if the recommendations might appear to be arbitrary.

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

Compliance with a British Standard does not of itself confer immunity from legal obligations. In particular, attention is drawn to building regulations and, in the case of houses in multiple occupation, to the relevant housing legislation. Guidance on building regulations is given in Approved Document B in England and Wales, the Technical Standards that support the relevant building regulations in Scotland, and in Technical Booklet E in Northern Ireland.

Summary of pages

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1 Scope

This part of BS 5839 gives recommendations for the planning, design and installation of fire detection and fire alarm systems in dwellings and dwelling units that are designed to accommodate a single family, and in houses in multiple occupation that comprise a number of self-contained units each designed to accommodate a single family. The recommendations apply to both new dwellings and existing dwellings. Recommendations for routine attention are also given.

The systems covered in this part of BS 5839 range from those comprising a single self-contained smoke alarm to systems of the type described in BS 5839-1. The recommendations of this part of BS 5839 may also be applied to the fire detection components of combined domestic fire and intruder alarm systems or fire and social alarm systems.

This part of BS 5839 applies to forms of dwelling including bungalows, multi-storey houses, individual flats and maisonettes, mobile homes, sheltered houses, housing providing NHS supported living in the community (as defined in Health Technical Memorandum 88 [1]), mansions, and houses divided into several self-contained single-family dwelling units. It does not apply to hostels, caravans or boats (other than permanently moored boats used solely as residential premises), or to the communal parts of purpose-built sheltered housing and blocks of flats or maisonettes. It does not apply to any premises used for purposes other than as a dwelling (e.g. small shops, factories or similar premises used solely as places of work).

This part of BS 5839 is intended for use by architects and other building professionals, enforcing authorities, contractors and others responsible for implementing fire precautions in dwellings. It is not intended for occupiers, for whom advice is published by the Government[1)]. However, recommendations are given for simple systems that may be installed by non-specialists.

The recommendations refer principally to fire detection and fire alarm systems installed for the purpose of life safety. However, recommendations are given for systems that are also intended to protect property.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the reference cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

BS 3955:1986, *Specification for electrical controls for household and similar general purposes.*

BS 5446-1:2000, *Fire detection and fire alarm devices for dwellings — Part 1: Specification for smoke alarms.*

BS 5446-2, *Fire detection and fire alarm devices for dwellings — Part 2: Specification for heat alarms.*

BS 5446-3, *Fire detection and fire alarm devices for dwellings — Part 3: Specification for smoke alarms for deaf and hard of hearing people.*

BS 5588-1:1990, *Fire precautions in the design, construction and use of buildings — Part 1: Code of practice for residential buildings.*

BS 5839-1:2002, *Fire detection and fire alarm systems for building — Part 1: Code of practice for system design, installation, commissioning and maintenance.*

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

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

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

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

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

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

1) The Office of the Deputy Prime Minister (in England and Wales), the Scottish Executive and the Department of Health, Social Services and Public Safety (Northern Ireland).

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 54-11, *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 — Optical beam detectors.*

BS EN ISO 13943, *Fire safety — Vocabulary.*

LPS 1265: Issue 1.0, *Requirements and testing procedures for the LPCB approval and listing of carbon monoxide fire detectors using electrochemical cells.* Garston: Building Research Establishment, 2004.

3 Terms and definitions

For the purposes of this part of BS 5839, the terms and definitions in BS EN ISO 13943 and the following apply.

3.1
access room
room through which passes the only escape route from an inner room

3.2
addressable system
system in which signals from detectors, manual call points, or any other devices are individually identified at the control and indicating equipment

NOTE Most addressable systems are of the analogue type, in which a signal from each detector representing the value of the sensed phenomenon is individually processed, usually at the control equipment, with a view to enabling more than two output states to be given, representing normal, fire and at least one other abnormal condition. The purpose of analysis of the signal from each detector is often identification of conditions that are not representative of fire but that can result in a false alarm from a simple non-analogue ("two state") system.

3.3
circulation area; circulation space
area or space (including a stairway) used mainly as a means of access between a room and an exit from the building or compartment

3.4
control and indicating equipment
CIE
component or components of a fire detection and fire alarm system through which other components may 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. input/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;

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 required, are able to pass on the fire alarm signal:

— to audible or visible fire alarm devices;

— through suitable transmission equipment to an alarm receiving centre;

— through further control equipment to an automatic fire extinguishing system.

3.5
detection zone
subdivision of the protected premises such that the occurrence of a fire within it will be indicated by a fire alarm system separately from an indication of fire in any other subdivision

NOTE A detection zone is separately indicated to assist in location of the fire, evacuation of the building and fire-fighting.

3.6
detector
part of a fire detection system that contains at least one sensor which constantly, or at frequent intervals, monitors at least one physical and/or chemical phenomenon associated with fire, and that provides at least one corresponding signal to initiate a warning

NOTE This definition is intended to include heat alarms and smoke alarms (see **3.18** and **3.31** respectively).

3.7
dwelling
unit of residential accommodation occupied (whether or not as a sole or main residence):

a) by a single person or by people living together as a family; or

b) by not more than six residents living together as a single household, including a household where care is provided for residents; or

c) by persons who do not live together as a family, but who live in self-contained single-family flats, maisonettes or bedsits within the unit

NOTE Parts a) and b) accord with the definition adopted under building regulations. The definition in c) relates only to some types of house in multiple occupation and specifically excludes hostel type accommodation, for which BS 5839-1 is more appropriate. It can, however, include houses with long term lodgers.

3.8
false alarm
fire signal resulting from a cause(s) other than fire

NOTE False alarms may be sub-divided into four categories:

a) unwanted alarms, in which a system has responded, either as designed or as the technology may reasonably be expected to respond, to any of the following:

— 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);

— accidental damage;

— inappropriate human action (e.g. operation of a system for test or maintenance purposes without prior warning to building occupants and/or an alarm receiving centre);

b) equipment false alarms, in which the 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.

3.9
final circuit
circuit connected to current-using equipment, or to a socket-outlet or socket-outlets or other outlet points for the connection of such equipment

3.10
final voltage
<of a battery> voltage at which the cell manufacturer considers the cells to be fully discharged at the specified discharge current

3.11
fire alarm device
component of a fire alarm system, not incorporated in the control and indicating equipment, which is used to give a warning of fire

NOTE For example, a sounder or visual indicator.

3.12
fire alarm sounder
audible fire alarm device

3.13
fire detection and fire alarm system
system that comprises a means for automatically detecting one of the characteristic phenomena of fire and a means for providing a warning to occupants

NOTE This definition is intended to include fire detection and fire alarm systems that comprise one or more smoke alarms, as well as systems that comprise separate detectors, alarm sounders and control equipment.

3.14
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

3.15
fire risk
combination of the probability of fire occurring and the magnitude of the consequences of fire

3.16
flat
dwelling, forming part of a larger building, that has all its rooms on one level or not more than half a storey height apart

3.17
habitable room
any room in a dwelling other than a kitchen, utility room, bathroom, dressing room or WC

3.18
heat alarm
device containing within one housing all the components, except possibly the energy source, necessary for detecting heat and for giving an audible alarm

3.19
house in multiple occupation
house that is occupied by persons who do not form a single household

3.20
inner room
room from which escape is possible only by passing through another room (the access room: see **3.1**)

3.21
maisonette
dwelling, forming part of a larger building, which includes rooms on two or more levels that are more than half a storey height apart

3.22
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 alarm receiving centre (if a facility for this is provided)

3.23
mixed system
arrangement whereby two different Grades of fire detection and fire alarm system are provided within one dwelling for the purpose of satisfying two different fire safety objectives

3.24
mobile home
transportable unit of living accommodation that does not meet the requirements for construction and use of road vehicles but that retains means for mobility

3.25
monitored wiring
wiring in which an open circuit will result in a fault warning (but not an alarm of fire), while a short circuit will result either in a fault warning or an alarm of fire

NOTE BS 5839-1 recommends that an open circuit or a short circuit both result in a fault warning but not an alarm of fire; for some systems, this part of BS 5839 recommends compliance with the recommendations of BS 5839-1.

3.26
multi-sensor fire detector
fire detector that monitors more than one physical and/or chemical phenomenon associated with fire

3.27
normal power supply
supply from which the fire detection and fire alarm system is expected to obtain its power under normal conditions

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

3.28
principal habitable room
habitable room (see **3.17**) that is normally the most frequently used room for general daytime living purposes

3.29
sheltered housing
block or group of dwellings, with each dwelling incorporating its own cooking and sanitary facilities, designed specifically for persons who might require assistance, e.g. elderly people, and where some form of assistance is available at all times

NOTE 1 This should not be taken as implying that assistance need be provided on the premises.

NOTE 2 Sheltered housing usually includes amenities common to all occupiers, such as living rooms, guest rooms, etc., which are outside the scope of this part of BS 5839.

3.30
smoke
particulate and aerosol products of combustion, whether this be of the smouldering or open flame type

3.31
smoke alarm
device containing within one housing all the components, except possibly the energy source, necessary for detecting smoke and for giving an audible alarm

3.32
social alarm system
system that provides facilities for alarm initiation, signal transmission, alarm reception, reassurance and assistance, for use by elderly and other persons considered to be living at risk

3.33
special tool
tool not likely to be carried by a member of the general public

NOTE Where this standard recommends the use of a battery that can be removed without the use of a special tool, the use of slot-headed screws would be an acceptable means of securing the battery, since various articles can be used as screwdrivers.

3.34
standby supply
electricity supply that provides power to the fire detection and fire alarm system when the normal supply fails

3.35
variation
intentional departure from a specific recommendation of this standard

NOTE 1 Since this part of BS 5839 is a code of practice, its contents take the form of recommendations, rather than requirements. Accordingly, variations might be appropriate in certain circumstances.

NOTE 2 Variations do not include errors in design, installation or commissioning.

NOTE 3 In many cases, variations will need the agreement of interested third parties, such as the authority enforcing fire safety legislation or the fire insurer.

4 Fire risk assessment

4.1 Commentary

A fire detection and fire alarm system, although it can do nothing to reduce the incidence of fire, can help to lessen the resultant loss in terms of injury to occupants or damage to property. However, the system needs to take into account the ability of the persons it is designed to protect to react to the warning and to make use of the time for escape that it is intended to give them, and needs to be regarded as just one component of a properly engineered approach to fire safety.

In order to maximize the cost-benefit of a fire detection and fire alarm system, it is essential that the system design be appropriate to the fire risk. Accordingly, the design of any fire detection and fire alarm system installed in accordance with this part of BS 5839 needs to be based on a good understanding of fire risk in dwellings.

A high fire risk demands high reliability in the early detection of fire and warning of occupants, regardless of where the fire starts, and high reliability on the part of the system to operate correctly when required; a low fire risk might not justify the cost, complexity and extent of such a system. For example, at one extreme, the single occupant of an existing small bungalow might be adequately protected at very low cost if the occupier installs one battery-operated smoke alarm, whereas the risk to which the families in a six-storey house in multiple occupation are exposed would warrant much greater expenditure on a more complex and comprehensive system.

It is therefore essential that the design of the system, particularly in respect of factors such as the number and siting of detectors and the form of power supply, takes into account the following probabilities:

a) the probability of fire occurring;

b) the probability of injury or death of occupants if fire occurs;

c) the probability of the system operating correctly at the time of a fire;

d) the probability of early detection and warning of occupants in the event of fire.

*NOTE 1 The combination of a) and b) may be regarded as the fire risk (see **3.15**).*

NOTE 2 c) may be regarded as the system reliability.

NOTE 3 d) may be regarded as a form of success rate for the system.

NOTE 4 A significant increase in c) or d) is likely to involve additional cost and system complexity.

It is important that system design ensures that there is an appropriate balance between the fire risk and the system reliability and success rate (see Figure 1).

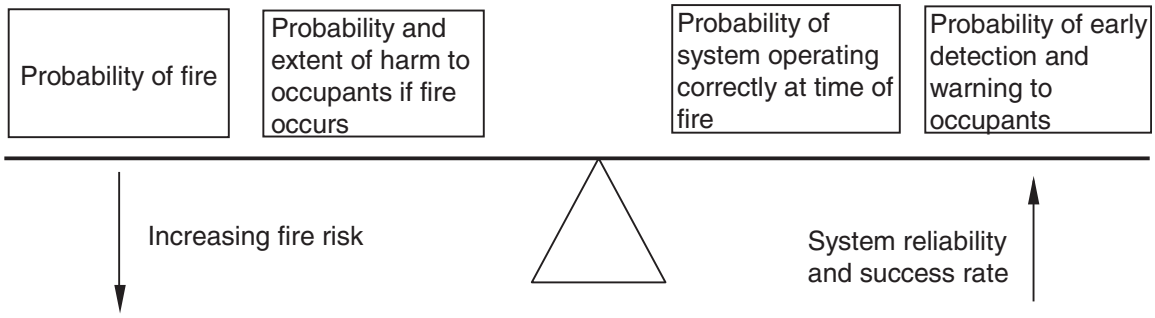

Figure 1 — Balance between fire risk and system reliability and success rate

*The factors that are relevant to consider in a qualitative assessment of fire risk are discussed in Annex A; the implications of the various factors on system design are also described. Clause **9** contains recommendations on the Grades and Categories of system (see Clauses **7** and **8**) that are considered generally appropriate for generic types of dwelling covered by this part of BS 5839.*

Although this standard advocates that, where practicable, the actual design of a fire detection and fire alarm system be based on a fire risk assessment, it is considered that the level of fire risk in dwellings covered by this part of BS 5839 is unlikely ever to be sufficiently low to obviate the need for some form of fire detection and fire alarm system.

4.2 Recommendations

The following recommendations are applicable.

a) A fire detection and fire alarm system, complying with the recommendations of this part of BS 5839, should be installed in all dwellings described in Clause **1**, whether new or existing.

NOTE 1 The recommendation for retrospective installation of a fire detection and fire alarm system in an existing dwelling relates primarily to dwellings in which there is no, or no appropriate, fire detection and fire alarm system. It is not specifically recommended that an existing fire detection and fire alarm system installed in accordance with BS 5839-6:1995 be upgraded to meet the recommendations of this current version of BS 5839-6.

b) Final design of a fire detection and fire alarm system for any particular dwelling should, where reasonably practicable, be based on a form of fire risk assessment, particularly if it is proposed to deviate from the guidance given in Clause **9** or if there are risk factors additional to those encountered in typical examples of the dwelling types defined in Clause **9**.

NOTE 2 The information contained in Annex A is likely to be of value in any such fire risk assessment and in determining the basic principles for system design, particularly the appropriate Grade and Category of system (see Clauses **7** and **8**).

c) In many situations, occupant characteristics and other relevant factors are not known to the designer or specifier (e.g. in the case of new dwellings). In such cases, design should follow the recommendations given in Clause **9**.

NOTE 3 At the stage at which approval of system design is granted under building regulations, occupant characteristics and other relevant factors are generally unknown.

5 System components

5.1 Commentary

The reliability of whatever form of fire detection and fire alarm system is installed to perform its functions on demand will, to a significant degree, be governed by the reliability of individual components. In general, it is advisable that all components, such as manual call points, detectors, control and indicating equipment (if incorporated in the system) and fire alarm devices, comply with relevant British Standards, and 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 system against BS EN ISO 9000).

Where there is no relevant British, European 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.

Compliance of an individual component with a recognized standard does not necessarily ensure that it will operate satisfactorily in conjunction with another component that complies with the relevant standard for that component. It is essential that compatibility between components is taken into account by the designer of the system.

5.2 Recommendations

The following recommendations are applicable.

a) Smoke alarms should conform to the requirements of BS 5446-1:2000.

b) Heat alarms should conform to the requirements of BS 5446-2.

c) Smoke alarm systems intended to warn deaf or hard of hearing people in the event of fire should conform to the requirements of BS 5446-3.

d) Manual call points should conform to the requirements of BS EN 54-11 for Type A ("single action") manual call points.

e) Point smoke detectors should conform to the requirements of BS EN 54-7.

f) Point heat detectors should conform to the requirements of BS EN 54-5 for Class A1 or A2 detectors.

g) Carbon monoxide fire detectors should, in the absence of any relevant British, European or International Standard, be capable of satisfying the requirements of LPS 1265.

h) Beam type smoke detectors should conform to the requirements of BS EN 54-12.

i) Control and indicating equipment for Grade A systems should conform to the requirements of BS EN 54-2.

j) Control and indicating equipment for Grade B systems should either conform to the requirements of BS EN 54-2 or comply with the recommendations of Annex C.

k) Audible fire alarm devices for Grades A and B systems should conform to the requirements of BS EN 54-3.

l) Power supply equipment for Grade A systems should conform to the requirements of BS EN 54-4.

m) Cables for Grade A systems should comply with the recommendations of Clause **16**.

6 Monitoring of circuits

6.1 Commentary

In many simple systems that incorporate interconnecting wiring for the supply of power to detectors, or for the interconnection of smoke alarms and heat alarms, the wiring is unmonitored. However, monitoring of wiring reduces the amount of time for which a system is likely to be disabled before a fault in the wiring is discovered. If the risk to life from fire is high, or the wiring is likely to be subject to mechanical damage or damage by rodents, systems that incorporate monitored wiring are of benefit.

Similarly, in simple systems, monitoring of the state of power supplies is not generally warranted. In more complex systems, which tend to be used in premises in which the risk to life is greater, the additional complexity associated with monitoring of power supplies is likely to be justified.

6.2 Recommendations

The following recommendations are applicable.

a) In Grade A systems, monitoring of power supplies and circuits external to control and indicating equipment should comply with the recommendations of **12.2.1** of BS 5839-1:2002.

b) In Grade B systems, monitoring of power supplies and circuits external to control and indicating equipment should comply with **C.8** of Annex C.

c) In Grade C systems, an open or short circuit fault in any circuit, external to control and indicating equipment, serving manual call points (if present), fire detectors or fire alarm devices should result in a fault warning at the control and indicating equipment (see Clause **17**), or in a fire alarm signal in the dwelling, within 100 s of the occurrence of the fault.

d) In Grade C systems, failure or disconnection of the normal power supply (see **3.27**) should result in a visual indication at the control and indicating equipment (see Clause **17**) within 30 min of the occurrence of the fault or disconnection. The indication may take the form of either of the following:

1) a normally illuminated indicator is extinguished; or

2) a fault indicator is illuminated.

NOTE This standard contains no recommendations for monitoring of wiring or power supplies in Grades D, E or F systems. However, BS 5446-1:2000 requires that mains-powered smoke alarms (which are used in Grades D and E systems) incorporate a power supply indicator, which is continuously illuminated when mains power is present. BS 5446-2 makes the same requirement for heat alarms.

7 Grades of system

7.1 Commentary

*This standard covers many types of fire detection and fire alarm system, which differ widely in cost, complexity, reliability and level of self-monitoring (see Clause **6**). Some of the simpler forms of system are not suitable for dwellings in which the fire risk is judged to be high, while expenditure on the most complex systems might be inappropriate for low-risk dwellings (see Clause **4**).*

For the purpose of specifying a fire detection and fire alarm system and the associated engineering design parameters, this part of BS 5839 groups systems into six Grades. Some of the recommendations of this part of BS 5839 apply to all Grades of system, while other recommendations apply only to particular Grades.

The Grades are defined as follows.

Grade A: *A fire detection and fire alarm system, which incorporates control and indicating equipment conforming to BS EN 54-2, and power supply equipment conforming to BS EN 54-4, and which is designed and installed in accordance with all the recommendations of sections 1 to 4 inclusive of BS 5839-1:2002, except those in the following clauses, for which the corresponding clauses of this part of BS 5839 should be substituted.*

Clause/subclause of BS 5839-1:2002	***Corresponding clause/subclause of BS 5839-6***
***16** (Audible alarm signals)*	***13** (Audible fire alarm devices and audibility)*
***18** (Fire alarm warnings for people with impaired hearing)*	***14** (Fire alarm warnings for deaf and hard of hearing people)*
***20** (Manual call points)*	***18** (Manual call points)*
***25.4**e) (Capacity of standby batteries)*	***15.2**c) (Capacity of standby batteries)*
***27** (Radio-linked systems)*	***21** (Radio-linked systems)*

Grade B: *A fire detection and fire alarm system comprising fire detectors (other than smoke alarms and heat alarms), fire alarm sounders, and control and indicating equipment that either conforms to BS EN 54-2 (and power supply complying with BS EN 54-4) or to Annex C of this part of BS 5839.*

Grade C: *A system of fire detectors and alarm sounders (which may be combined in the form of smoke alarms) connected to a common power supply, comprising the normal mains and a standby supply, with central control equipment.*

Grade D:	*A system of one or more mains-powered smoke alarms, each with an integral standby supply. (The system may, in addition, incorporate one or more mains-powered heat alarms, each with an integral standby supply.)*
Grade E:	*A system of one or more mains-powered smoke alarms with no standby supply. (The system may, in addition, incorporate one or more heat alarms, with or without standby supplies.)*
Grade F:	*A system of one or more battery-powered smoke alarms. (The system may, in addition, also incorporate one or more battery-powered heat alarms.)*

*In the case of Grade D, Grade E and Grade F systems, where more than one smoke alarm is installed the smoke alarms normally need to be interlinked (see **13.2**). Any heat alarms also need to be interlinked with the smoke alarms.*

Guidance documents supporting legislation, and written requirements produced by enforcing authorities, often specify only a minimum level of system engineering, rather than a particular form of system. These Grades are defined in such a way that a requirement for one Grade of system can be satisfied (normally at higher cost) by the installation of a higher Grade of system; for example, if the fire risk justified the installation of a Grade D system, it would be acceptable to install a Grade A, Grade B or Grade C system.

Because of the wide range of systems covered by the recommendations of this part of BS 5839, the specification of requirements for a system by a purchaser, user, enforcing authority or insurer, or the description of a system by a designer or installer, by reference to this standard, without a reference to system Grade, will have little meaning.

Annex B provides further information on each Grade of system, including the advantages and disadvantages of each Grade.

7.2 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 for a dwelling should clearly state the Grade of system required.

b) If any party is instructed to design a fire detection and fire alarm system for a dwelling (e.g. by means of a purchase or tender specification), the instruction should include a clear reference to the Grade of system required.

c) The relevant system certificate (see Clause **23**) should clearly state the Grade of system that has been designed or installed.

NOTE In the case of a Grade A system, there will be a separate design certificate, which will indicate the Grade of system that has been designed (see Annex E). In other Grades of system, a single certificate will normally be issued, indicating the Grade of system that has been designed, installed and commissioned (see Clause **23** and Annex F.)

8 Categories of system

8.1 Commentary

8.1.1 *General*

*Fire detection and fire alarm systems are usually installed in dwellings to protect life. However, the level of protection afforded to occupants needs to be related to the fire risk (see Clause **4**). The appropriate level can therefore vary considerably. For the purposes of this standard, systems are classified as follows, according to the level of protection that they afford.*

Category LD: a fire detection and fire alarm system intended for the protection of life.

NOTE 1 The designation "LD" is used to distinguish these systems, which are intended only for dwellings, from Category L systems as defined in BS 5839-1, which are intended for the protection of life in any type of building.

Category LD systems are subdivided into:

Category LD1:	*a system installed throughout the dwelling, incorporating detectors in all circulation spaces that form part of the escape routes from the dwelling, and in all rooms and areas in which fire might start, other than toilets, bathrooms and shower rooms;*
Category LD2:	*a system incorporating detectors in all circulation spaces that form part of the escape routes from the dwelling, and in all rooms or areas that present a high fire risk to occupants (see Clause **4**);*
Category LD3:	*a system incorporating detectors in all circulation spaces that form part of the escape routes from the dwelling.*

Category PD: a fire detection and fire alarm system intended for the protection of property.

NOTE 2 The designation "PD " is used to distinguish these systems, which are intended only for dwellings, from Category P systems as defined in BS 5839-1, which are intended for the protection of property in any type of building.

Category PD systems are subdivided into:

Category PD1:	*a system installed throughout the dwelling, incorporating detectors in all rooms and areas in which fire might start, other than toilets, bathrooms and shower rooms;*
Category PD2:	*a system incorporating detectors only in defined rooms or areas of the dwelling in which the risk of fire to property is judged to warrant their provision.*

A system is rarely installed solely for the protection of property. Accordingly, Category PD systems will normally be designed to comply with the recommendations of this part of BS 5839 for a Category LD system, thereby constituting a combined Category LD and Category PD system.

Because of the wide range of systems covered by the recommendations of this part of BS 5839, the specification of requirements for a system by a purchaser, user, enforcing authority or insurer, or the description of a system by a designer or installer, by reference to this standard, without a reference to system Category, will have little meaning.

8.1.2 *Systems for the protection of life (Category LD)*

All dwellings need to be provided with an appropriate fire detection and fire alarm system. The greatest benefit to life safety is given by a full-coverage system (Category LD1). Such a system will give the earliest practicable warning of fire to occupants, wherever ignition occurs.

However, a good level of protection can normally be obtained from a Category LD2 system, in which detection is only provided at points where the fire risk is high or where combustion products would present a significant hazard to life. A Category LD2 system might, for instance, have detectors only in the circulation areas of the dwelling, the living room and the kitchen; other areas might be left without detector coverage. The areas protected by a Category LD2 system include escape routes, i.e. those areas that would be protected by a Category LD3 system.

A Category LD3 system is intended only to protect circulation areas that would be used as escape routes, by giving a warning if smoke is detected in these areas, so that occupants can escape before heat or smoke make this impossible. A Category LD3 system cannot be expected, with any degree of reliability, to protect people who might be involved with the fire at ignition or in its early stages. This Category of system might not therefore prevent the death or serious injury of occupants in the room where the fire originates; it is intended only to ensure escape for those not immediately involved. If no detector is installed in the room in which fire starts, the time available for evacuation of other areas once fire is detected in the circulation area might be quite short.

*In a large family house adapted to provide accommodation for several households in separate self-contained units (a house in multiple occupation), a fire in one dwelling unit can be a hazard to occupants of other units. In this case, the fire detection and fire alarm system normally needs to extend across the boundaries between occupancies or be interconnected with systems in other occupancies. In practice, it is often appropriate for there to be a single integrated fire detection and fire alarm system that will alert all occupants before a fire in any dwelling threatens the communal escape routes, and that will provide early warning of any fire that starts in these escape routes. This objective is additional to that of enabling occupants of the dwelling in which fire starts to escape before their escape routes become impassable owing to heat or smoke (see also **9.1.5**).*

In the case of purpose-built flats or sheltered housing, the degree of compartmentation between occupancies is normally sufficient to ensure that fire is contained in the dwelling of origin for a prolonged period. During this time, other occupants can remain in reasonable safety within their own dwellings. Accordingly, this part of BS 5839 does not provide recommendations for fire detection and fire alarm systems that incorporate detectors in the communal areas or ancillary accommodation (e.g. plant rooms) within purpose-built flats or sheltered housing. If, however, the provision of detection in these areas is considered desirable, it is essential to refer to the guidance contained in BS 5588-1, and it is appropriate that such fire detection and fire alarm systems comply with the recommendations of BS 5839-1.

8.1.3 *Systems for the protection of property (Category PD)*

*A fire can start virtually anywhere in a dwelling, although the probability of fire varies significantly from one room to another (see Annex A, Table A.1). If the fire is not detected at an early stage, it can grow until it becomes difficult or impossible to extinguish. The highest level of property protection will therefore be given by a Category PD1 system (giving full coverage of all parts of the dwelling). In a large house of high value, or with contents of high value, such a system is generally the only Category acceptable to fire insurers. The system will normally have a facility for automatic transmission of fire alarm signals to an alarm receiving centre (see Clause **20**).*

A lower level of protection, still giving a useful reduction in fire risk, can sometimes be obtained by the installation of fire detectors only in those parts of the building in which there is significant potential for ignition. A Category PD2 system provides partial cover of this nature.

8.2 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 for a dwelling should clearly state the Category of system required.

b) If any party is instructed to design a fire detection and fire alarm system for a dwelling (e.g. by means of a purchase or tender specification), the instruction should include a clear reference to the Category of system required.

c) If a fire detection and fire alarm system is intended to protect both life and property, and specific recommendations for the two Categories of system differ, then the system should comply with the recommendations for each of the Categories.

NOTE 1 For example, a system whose sole purpose is to provide full-coverage property protection (Category PD1) need only have a small number of sounders, but if it is also used to provide coverage of the circulation areas for life safety (Category LD3), the number of sounders should be sufficient to give warning throughout the dwelling.

NOTE 2 The combined system should be described as a Category X/Y system (e.g. LD2/PD2 or LD3/PD2, etc.).

d) Any requirement for a Category LD2 system (e.g. in a statutory notice issued by an enforcing authority or in a purchase specification) should be supplemented by information regarding the rooms in which fire detectors are to be installed (over and above the fire detectors in the circulation areas required to satisfy the recommendations of this standard for a Category LD3 system). Similarly, any requirement for a Category PD2 system should be supplemented by information regarding the areas of the dwelling that are to be protected by automatic fire detectors.

e) The relevant system certificate (see Clause **23**) should clearly state the Category of system that has been designed and should, in the case of a Category LD2 or PD2 system, provide a brief description of the areas of the dwelling that are protected by fire detectors.

NOTE 3 In the case of a Grade A system, there will be a separate design certificate, which will indicate the Category of system that has been designed (see Annex E). In other Grades of system, a single certificate will normally be issued, indicating the Category of system that has been designed, installed and commissioned (see Clause **23** and Annex F).

9 Choice of system

9.1 Commentary

9.1.1 *Grade of system*

System Grade relates to the engineering aspects of the fire detection and fire alarm system. Higher Grades of system tend to provide a greater level of control and monitoring of the system, or greater reliability and availability to perform correctly in the event of fire. The Grade of system that needs to be installed depends on the nature of the dwelling, the level of fire risk and the characteristics of the occupants.

Grade F systems, comprising one or more battery-operated smoke alarms, are the least reliable in the long term because of the need for battery replacement. For new dwellings, a Grade D system (in which the normal power supply for each smoke alarm is derived from the mains electricity supply and a standby supply is provided) or higher is justified.

However, because of their low cost and ease of installation, Grade F systems (comprising battery-powered smoke alarms) may be considered for installation in existing dwellings. Their reliability can be improved by use of batteries that have a long anticipated life and that cannot be removed without the use of a tool. Nevertheless, Grade F systems are not appropriate in dwellings in which the fire risk to occupants is high nor where there cannot be a reasonable certainty that, when the dwelling is occupied, batteries will be replaced within a short time (typically no more than five days) of a battery fault warning indication. Otherwise, a system in which the normal supply is derived from the mains needs to be used (e.g. a Grade D system).

If, in an existing dwelling, a Grade F system would be acceptable, it is acceptable to install a Grade E system (comprising mains powered smoke alarms). However, if there are likely to be periodic interruptions to the mains supply, whether due to the inability of the occupier to pay for supplies or due to unreliability of the mains electricity supply, a Grade D system or higher (in which there is a standby supply) is then necessary. Where there is a need for readily accessible control of the fire detection and fire alarm system, a Grade C system or higher might be provided. Where the fire risk calls for a high standard of system monitoring and availability, it might be appropriate to install a Grade B system. If the dwelling is very large, or is subdivided into a significant number of dwelling units, a Grade A system is likely to be appropriate.

If the purpose of the system is property protection, fire insurers might require a Grade A system. However, for smaller properties, a Grade B or Grade C system might be sufficient.

9.1.2 *Category of system*

*System Category relates to the level of protection afforded to occupants. The Category of system that is appropriate depends primarily on the fire risk (see Clause **4**). All dwellings need to be protected to at least the standard afforded by a Category LD3 system. However, for new dwellings, a Category LD2 system is appropriate. If the risk to occupants from fire in any part of the dwelling is deemed to be high, a Category LD2 or Category LD1 system is always appropriate. For example, a Category LD2 or Category LD1 system needs to be considered if the occupants suffer from any disability (mental or physical) that could delay their escape from fire. If it is intended to protect reliably any occupant in the room where a fire originates, a suitable Category LD2, or a Category LD1, system needs to be provided.*

In a house in multiple occupation divided into a number of separate units of accommodation, there might not be the same degree of compartmentation as in purpose-built blocks of flats. As it is impossible to control occupants' activities, and there is no overall supervision of the entire dwelling, it is essential that all occupants are warned before a fire in any self-contained dwelling unit threatens their safety. In order to meet this objective, in all except the smallest such houses in multiple occupation, communal areas need to be protected by siting detectors generally in accordance with the recommendations of BS 5839-1 for a Category L2 system; these are similar to, but more onerous than, the recommendations of this part of BS 5839 for a Category LD2 system (see Table 1).

9.1.3 *Appropriate systems for typical dwellings*

Dwellings covered by this part of BS 5839 can be divided into a number of broad classes. Table 1 shows the minimum Grades and Categories of system recommended for the protection of life in typical dwellings in each class. Attention is, however, drawn to building regulations, which govern fire precautions in new dwellings, and to other legislation concerning fire precautions in certain types of existing dwelling (such as houses in multiple occupation). Where fire precautions are subject to legislative control, the enforcing authority, or the guidance that supports the legislation, needs to be consulted before a decision on the appropriate Grade and Category of system is reached.

Table 2 shows the minimum Grades and Categories of system appropriate for the protection of property in typical dwellings. In the case of large dwellings, the installation of a fire detection and fire alarm system might be required by fire insurers or might be taken into account by the insurer. In this case, the insurer needs to be consulted before a decision on the Grade and Category of system is reached.

*It is important to note that Table 1 and Table 2 relate only to typical dwellings in each class, and these examples of dwellings are not intended to be comprehensive. If any doubt exists as to the appropriate system for any dwelling, the advice of specialists, such as the fire and rescue service, fire consultants or, if appropriate, the fire insurer, needs to be sought, and the choice of system needs to be based on a risk assessment (see Clause **4**). In some circumstances, this might determine that a higher standard of protection (i.e. with additional detectors) is warranted.*

9.1.4 *Specification of systems*

When specifying a system by reference to this part of BS 5839, the Grade and Category of system always need to be stated.

*The specification for a Category PD2 or LD2 system always needs to include details of the areas and rooms of the dwelling that are to be protected. Where mixed or combined Grades or Categories of system are required in a dwelling, the Grade(s) or Category(ies) of system required in each part of the dwelling need to be specified (see also **9.1.5**).*

9.1.5 *Mixed systems*

Normally, even in the largest of dwellings, a single fire detection and fire alarm system serves the entire dwelling. However, exceptions might arise in some dwellings in order to meet different objectives.

An example of such an exception is a house in multiple occupation that has three or more storeys. One objective of installing a fire detection and fire alarm system is to warn all occupants before a fire in any one dwelling threatens the communal escape routes. This objective could be met by complying with the recommendations of BS 5839-1 for a Category L3 fire detection and fire alarm system, which involves the installation of smoke detectors within the communal escape routes and either heat, smoke or carbon monoxide detectors in rooms or areas adjoining the communal escape routes.

The purpose of the detectors in the accommodation adjoining the escape routes is only to give a warning to occupants of other dwellings before the fire breaks through the door of the dwelling in which it originates. The detectors within dwellings may be sited on the ceiling or wall close to the dwelling entrance door. The siting and type of detector might not therefore be such as to provide a sufficiently early warning for occupants in the dwelling of fire origin to escape. These occupants could be adequately protected by installing smoke alarms within the circulation areas of self-contained dwelling units, following the principles adopted in purpose-built flats. (If necessary, these smoke alarms could also be supplemented by interlinked heat or smoke alarms in specific rooms.)

An advantage of this arrangement is that false alarms due to, for example, cooking activities in one dwelling, are unlikely to result in disturbance of all occupants, particularly if heat detectors are installed in areas adjoining escape routes for the purpose of complying with the recommendations of BS 5839-1.

*Although this arrangement (a "mixed system") results in a mixture of system Grades, it meets both life safety objectives. Alternatively, the objectives could be met by a single system which has detectors sited in accordance with BS 5839-1 and that incorporates smoke detectors in communal escape routes and in the circulation spaces within dwellings (and detectors in any rooms in which protection is necessary) within dwellings. Other means might then be incorporated to prevent unnecessary disruption to all residents as a result of a false alarm in one dwelling unit (see Clause **12**). This arrangement can also simplify maintenance of the system. Similarly, in sheltered housing or blocks of flats, detectors installed within the dwellings are not intended to give a warning in other dwellings (other than, in the case of sheltered housing, a warden's flat: see BS 5588-1). If, nevertheless, fire detection in either communal escape routes or selected high-risk areas such as plant rooms or communal living rooms, is required, an entirely separate system could be installed in these areas (see **8.1.2**).*

Mixed systems might also be acceptable where, for example, a Grade B Category PD2 system is installed for property protection in one part of a dwelling, while, for protection of life, a Grade D Category LD3 system is installed throughout the circulation areas of the dwelling.

If two separate systems are installed (e.g. a BS 5839-1 system supplemented by smoke alarms), it is essential that occupiers are aware of the separate nature of the systems. For example, occupiers of a house in multiple occupation need to be aware of the need to maintain any smoke alarms provided in individual dwellings, even though a separate system is installed for protection of escape routes.

9.2 Recommendations

The following recommendations are applicable.

a) Where there is a need to specify a fire detection and fire alarm system for a dwelling in which the characteristics of the occupants are unknown (e.g. for a new dwelling under building regulations), or for a group of dwellings in which occupant characteristics will vary (e.g. when specifying requirements for retrofitting of smoke alarms throughout the properties of a local authority), the recommendations given in Table 1 should be followed.

NOTE Where Table 1 refers to a house with a specific number of storeys (e.g. a two-storey house), basement storeys can be ignored.

b) Where there is a need to specify a fire detection and fire alarm system for a single, specific dwelling, in which occupant characteristics are known or can be anticipated (e.g. when imposing requirements for a house in multiple occupation under legislation, or designing a system on behalf of a specific occupier), the recommendations in Table 1 should be followed, but may be modified on the basis of a fire risk assessment (see Clause **4**).

c) If a fire detection and fire alarm system is required under legislation, before selecting the Grade and Category of system, there should be appropriate consultation with the relevant enforcing authorities and/or appropriate reference to guidance documents that support the legislation in question.

d) Table 2 provides recommendations for the minimum Grade and Category of system that should be installed for property protection in typical dwellings. However, if a fire detection and fire alarm system is intended to satisfy the requirements of fire insurers, before selecting the Grade and Category of system, there should be appropriate consultation with the fire insurers.

e) Any specification for a system that is intended to satisfy the recommendations of this part of BS 5839 should identify the Grade and Category of system required.

f) It is acceptable to install a mixed system (see **3.23**) in a dwelling in any situation in which there is more than one fire safety objective that can be satisfied by more than one Grade of fire detection and fire alarm system.

Table 1 — Minimum Grade and Category of fire detection and fire alarm system for protection of life in typical dwellings

Class of dwelling	Minimum Grade and Category of system for installation in:					
	New or materially altered dwellings complying with the recommendations of BS 5588-1 or guidance that supports national building regulations[a]		Existing dwellings complying with the recommendations of BS 5588-1 or guidance that supports national building regulations[a]		Existing dwellings where structural fire precautions are of a lower standard than those recommended in BS 5588-1 or guidance that supports national building regulations[a]	
	Grade	Category	Grade	Category	Grade	Category
Single-family dwellings[b] ***and shared houses***[c] ***with no floor greater than 200 m²*** ***in area***						
Owner-occupied bungalow, flat or other single-storey unit	D	LD2[d]	F[e]	LD3[f]	D	LD2[g]
Rented bungalow, flat or other single-storey unit	D	LD2[d]	F[e h]	LD3[f]	D	LD2[g]
Owner-occupied maisonette or owner-occupied two storey house	D	LD2[d]	F[e]	LD3[f]	D	LD2[g]
Rented maisonette or rented two storey house	D	LD2[d]	D	LD3[f]	D	LD2[g]
Three-storey house	D	LD2[d]	D	LD3[f]	D	LD2[g]
Four- (or more) storey house	B	LD2[d]	D	LD2[d l]	B	LD2[d g]
Single-family dwellings[b] ***and shared houses***[c] ***with one or more floors greater than 200 m²*** ***in area***						
Bungalow, flat or other single-storey unit	D	LD2[d]	D	LD3[f]	D	LD2[g]
Maisonette or two-storey house	B	LD2[d]	B	LD2[d i]	B	LD2[d g]
Three- (or more) storey house	Grade A, Category LD2, with detectors sited in accordance with the recommendations of BS 5839-1 for a Category L2[d i j] system					
Houses in multiple occupation[k] ***(HMOs)***						
HMOs of one or two-storeys with no floor greater than 200 m² in area	D	LD2[d]	D	LD3[l f]	D	LD2[l g]
Other HMOs:						
Individual dwelling units, within the HMO, comprising two or more rooms	D[m]	LD2[d]	D[m]	LD3[n]	D[m]	LD2[g]
Communal areas of the HMO	Grade A, Category LD2, with detectors sited in accordance with the recommendations of BS 5839-1 for a Category L2 system[o]					

Table 1 — Minimum Grade and Category of fire detection and fire alarm system for protection of life in typical dwellings (*continued*)

Class of dwelling	Minimum Grade and Category of system for installation in:					
	New or materially altered dwellings complying with the recommendations of BS 5588-1 or guidance that supports national building regulations[a]		Existing dwellings complying with the recommendations of BS 5588-1 or guidance that supports national building regulations[a]		Existing dwellings where structural fire precautions are of a lower standard than those recommended in BS 5588-1 or guidance that supports national building regulations[a]	
	Grade	Category	Grade	Category	Grade	Category
Sheltered housing (individual dwelling units only)[p]	C	LD2[d]	C[q]	LD3[f]	C[q]	LD2[g]
Housing providing NHS supported living in the community						
Dwellings of one-, two- or three-storeys occupied by no more than six residents	C	LD1	C	LD1	C	LD1
Other dwellings	Grade A, Category LD1, with detectors sited in accordance with the recommendations of BS 5839-1 for a Category L1 system					

[a] In England and Wales, Approved Document B published by the Office of the Deputy Prime Minister. In Scotland, the Technical Standards published by the Scottish Executive. In Northern Ireland, Technical Booklet E published by the Department of Finance and Personnel.

[b] Including dwellings with long-term lodgers, but not boarding houses, the latter of which are outside the scope of this part of BS 5839.

[c] Houses shared by no more than six persons, generally living in a similar manner to a single family (e.g. houses rented by a number of students).

[d] Heat detectors should be installed in every kitchen and the principal habitable room (see **3.28**). Where more than one room might be used as the principal habitable room, a heat detector should be installed in each of these rooms. The detector in the principle habitable room (but not the kitchen) may alternatively be a smoke or carbon monoxide fire detector. However, a heat detector is preferred in view of its lower potential for false alarms and the lesser need for maintenance.

[e] Grade E if there is any doubt regarding the ability of the occupier to replace batteries in battery-operated smoke alarms soon after a battery warning is given (see **9.1.1**) but Grade D, if, in addition, there is a significant likelihood of the electricity supply being disconnected because the occupier is unable to pay for supplies.

[f] Category LD2 if a risk assessment justifies the provision of additional detectors (see Clause **4**).

[g] Detectors should be of a type and be so located as to compensate for the lower standard of structural fire precautions (for example, a smoke detector should be installed in the access room to a habitable inner room that has no door or window through which escape is possible). Further detectors might be necessary if a risk assessment justifies their provision. In some cases, a Category LD1 system might be necessary.

[h] The batteries in the smoke alarm(s) should have an anticipated life (taking into account monthly testing and fire alarm signals with an aggregate duration of 100 minutes per annum) of at least five years. Removal of batteries should necessitate the use of a tool.

[i] Further detectors might be necessary if a risk assessment justifies their provision.

[j] BS 5839-1 recommends that detectors are installed in escape routes and, generally, in rooms opening onto escape routes. Notwithstanding the recommendations of BS 5839-1, detectors may be omitted from rooms opening directly onto staircase landings and opening onto escape corridors of six metres or less in length.

[k] Other than houses with long-term lodgers and houses shared by no more than six persons, generally living in a similar manner to a single family (e.g. houses rented by a number of students).

[l] Detectors should be installed in communal circulation routes and within any circulation spaces in individual dwelling units comprising two or more rooms (e.g. in hallways and on staircase landings).

[m] The detectors in individual dwelling units may be incorporated within the system installed in communal areas.

[n] Category LD2 if a risk assessment justifies the provision of additional detectors (see Clause **4**). For example, the conditions in a single room bedsit might be such that the provision of a heat or smoke detector in the bedsit is justifiable.

[o] Heat detectors should be installed in every communal kitchen. Heat or smoke detectors, as appropriate (taking into account the fire risk and the potential for false alarms), should be installed in every communal lounge.

[p] See also **20.2**q).

[q] Many social alarm systems installed in sheltered housing have facilities for connection, monitoring and separate identification of signals from smoke alarms. If an existing social alarm system does not provide such a facility, it might be acceptable to install a Grade D system, provided that any fire signal is relayed to the warden's accommodation [see recommendation **20.2**q)].

Table 2 — Minimum Grade and Category of fire detection and fire alarm system for protection of property in typical dwellings

Class of dwelling	Grade	Category
Single-storey and two-storey dwellings	C	PD2
Other dwellings	A system conforming to the recommendations of BS 5839-1 for a Category P1 system[a]	
[a] May be reduced to P2 if the risk to property from fire, and the maximum potential loss, do not warrant a Category P1 system.		

10 Types of fire detector and their selection

10.1 Commentary

10.1.1 *General*

Fire detectors are designed to detect one or more of four characteristics of a fire, namely smoke, heat, combustion gas (normally carbon monoxide) and flame. These characteristics can be detected in various ways. No single type of detector is the most suitable for all applications and the final choice depends on individual circumstances. Particularly in the case of Category LD2 and LD1 systems, it can be appropriate to use a mixture of types of detector.

All fire detectors will respond to some extent to phenomena other than fire. Recommendations for reducing the incidence of such false alarms are given in Clause ***12****.*

10.1.2 *Smoke detectors*

Two classes of smoke detector are commonly used:

a) ionization chamber smoke detectors, which operate on the principle that the electrical current flowing between electrodes in an ionization chamber is reduced when smoke particles enter the chamber;

b) optical smoke detectors, which operate by detecting the scattering or absorption of light by smoke particles.

Some detectors combine both types of sensor, so ensuring that the earliest possible warning is given, regardless of the type of fire.

Smoke detectors installed in dwellings are normally of the point type, which detect smoke at one position; these detectors may operate on optical or ionization chamber principles. Other types of smoke detector include those of the aspirating type, in which air is drawn from a number of positions to a central detector, and the beam type, which work on the optical obscuration principle. Each sampling point in an aspirating detection system can be regarded as a "point" detector, but aspirating detection systems can also benefit from the "cumulative effect" of sampling the environment within a large area via a number of sampling points in that area; this can enable detection of low concentrations of smoke over a wide area, sooner than in the case of point detectors. Some aspirating detectors provide "Enhanced" or "High" sensitivity and staged alarms, which further add to their early warning capabilities. Beam detectors are effectively "line" detectors, since they can detect the presence of smoke in a small part of the beam. Some optical beam smoke detectors can also sense thermal turbulence from a fire, by detecting the refraction of the beam at turbulent interfaces between hot and cold air.

Ionization chamber smoke detectors are particularly sensitive to smoke containing small particles, such as are produced in rapidly burning, flaming fires. However, they are likely to be less sensitive to the larger particles found in optically dense smoke, which can be produced by smouldering materials. Optical smoke detectors are sensitive to the larger, optically active particles found in optically dense smoke, but are less sensitive to the small particles found in clean-burning fires.

*Where this part of BS 5839 recommends the use of smoke detectors, either type of detector is generally suitable for detection of fire, particularly if the objective is property protection. However, choice of detector type needs to take into account both the type of fire that might be expected and the need to avoid false alarms (see Clause **12**). When certain materials, such as polyurethane foam, smoulder, they produce relatively large smoke particles to which ionization chamber detectors are comparatively insensitive. Ionization chamber detectors are also less sensitive to smoke that has travelled some distance from the seat of the fire, during which time smoke particles have coalesced to form larger particles. In general, therefore, optical smoke detectors are appropriate in circulation spaces, such as hallways and landings. Optical detectors are also appropriate in areas in which a likely cause of fire is ignition of furniture or bedding by a cigarette. Ionization chamber detectors might be appropriate in rooms, such as the living room or dining room, where a fast-burning fire might present a greater danger to occupants than a smouldering fire, subject to consideration of the potential for unwanted alarms (see **3.8**).*

Aspirating and beam type smoke detectors are usually only appropriate for the protection of mansions and properties of historic importance. In these properties, such detectors are often suitable for protection of large or high spaces, such as entrance halls, banqueting halls, etc. Aspirating detectors, and in some cases beam detectors, are also suitable for protecting areas in which aesthetic considerations preclude the installation of normal point type detectors on ornately decorated ceilings. For high risk properties, or those with contents of high value (such as works of art), the early warning benefits that are possible with "Enhanced" or "High" sensitivity aspirating detectors can be used to facilitate early intervention.

10.1.3 *Heat detectors*

There are two main types of heat detector:

a) point detectors, which respond to the temperature of the gases in the immediate vicinity of a single point;

b) line detectors, which respond to the temperature of the gases in the vicinity of a line.

Only point heat detectors are likely to be appropriate for installation in most dwellings. Line heat detectors are only likely to be appropriate for consideration in, for example, a long, relatively narrow structure, such as a cellar or cable tunnel.

Both point and line detectors can be categorized as follows:

1) those using fixed-temperature (static) elements, which operate when they reach a preselected threshold temperature;

2) those using rate-of-rise of temperature elements, which operate when their temperature rises at an abnormally fast rate.

Heat detectors with fixed-temperature elements are used where ambient temperatures are likely to fluctuate rapidly over short periods (e.g. kitchens). Either rate-of-rise heat detectors, incorporating fixed-temperature elements, or fixed-temperature heat detectors, can be used in all other situations.

*Heat detectors respond much more slowly to fire than smoke detectors (see **10.1.2**), but are significantly less likely to give false alarms. They also require less maintenance than smoke detectors (see Clause **26**). They are not suitable for installation in circulation areas that form the escape routes from a dwelling. The application for heat detectors depends on the system Category.*

A sprinkler head is a form of heat detector. Sprinkler protection of dwellings is becoming more common. If a dwelling is protected by an automatic sprinkler system, the sprinkler system can be interfaced with the fire detection and fire alarm system (e.g. by means of a flow switch), so that a fire alarm signal is given by the system's fire alarm devices when a sprinkler head operates. Each sprinkler head can then be regarded as a heat detector, provided that, during a period of mains failure, operation of a single head can still cause the fire alarm devices to operate.

10.1.4 *Carbon monoxide fire detectors*

Carbon monoxide fire detectors are point-type detectors that respond to the carbon monoxide that is produced in most fires when incomplete combustion occurs as a result of restriction of the amount of oxygen available to support the combustion process. These detectors are not, therefore, equivalent to smoke detectors in their response to fire.

Carbon monoxide fire detectors are most sensitive to smouldering fires and fires in which the rate of burning is controlled by the supply of air. They can be relatively insensitive to free burning fires supported by a plentiful supply of oxygen. However, this is not the most common form of fire to occur in a dwelling.

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

Electrochemical cells, which are used as sensors within carbon monoxide fire detectors, have a finite life (typically seven years), after which replacement is necessary. It is important that the user is made aware of the likely lifetime of any carbon monoxide fire detectors used in a fire detection and fire alarm system. Owners and occupiers of dwellings, particularly single-family dwellings in which there are not normally any formal arrangements to ensure periodic maintenance of the fire detection and fire alarm system on a long term basis, might not appreciate the need for replacement of the electrochemical cell some years after carbon monoxide fire detectors were first installed. Accordingly, these detectors might not be suitable for dwellings, unless the detectors are incorporated in a system that is likely to be subject to periodic maintenance for the entire life of the system.

*Carbon monoxide detectors conforming to BS 7860 are intended only to detect carbon monoxide from faulty, or inadequately ventilated, gas appliances. Since these detectors are intended to give an alarm signal at much higher carbon monoxide levels than those to which carbon monoxide fire detectors complying with **5.2**g) are sensitive, they are not suitable for giving early warning of fire. Carbon monoxide detectors conforming to BS EN 50291:2001 are intended for the same purpose, but are sensitive to lower carbon monoxide levels than those conforming to BS 7860. Such detectors would, however, still operate much too late in a fire to protect occupants. Accordingly, BS EN 50291 excludes from its scope carbon monoxide detectors that are intended to detect fire.*

10.1.5 *Flame detectors*

Flame detectors detect the infrared or ultraviolet radiation from flame. They cannot detect smouldering fires, and their response to such fires will be delayed until the onset of flaming. As they use radiative transfer of energy from the fire, instead of the convective transfer of combustion products required by heat or smoke detectors, they can be wall-mounted and do not need to be on the ceiling.

In general, flame detectors are not suitable for the protection of life in domestic buildings. However, in some applications, particularly under high ceilings in mansions or historic properties, their ability to detect fire when mounted on walls can be used to advantage, usually in combination with smoke detectors. Such applications can require specialized knowledge.

10.1.6 *Multi-sensor fire detectors*

In a multi-sensor fire detector, there is, within the detector, 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 detector in detection of fire, or its resistance to at least certain categories of false alarm, or both. For example, in some fire detection and fire alarm systems of the type to which BS 5839-1 applies (and that, hence, can be used in Grade A systems), by analysing the signals from more than one sensor within each detector, there can be significant potential for reduction of many types of false alarm.

It is possible to incorporate an ionization chamber smoke sensor and an optical smoke sensor within a single domestic smoke alarm. Although this type of smoke alarm is not, strictly, a multi-sensor detector since it is sensitive only to smoke, it can provide earlier warning of a broader spectrum of fires than a smoke alarm that contains only one of these two types of smoke sensor.

10.2 Recommendations

The following recommendations are applicable.

a) Smoke detectors may be used in any room or area of a dwelling, other than kitchens, bathrooms and shower rooms. However, other than in the case of circulation areas (i.e. hallways, staircase landings and corridors), their use should be avoided in any room or area in which smoke detectors would have a high potential for false alarms (see Clause **12**), 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.

b) Smoke detectors installed within circulation areas, such as hallways, staircase landings and corridors, should be of the optical type, unless the use of optical detectors would significantly increase the rate of false alarms above that anticipated in the case of ionization chamber smoke detectors (see also Clause **12**), or unless (unusually) there is evidence that there is a significant risk of a fast, clean burning fire in these areas.

NOTE 1 Custom and practice has been to use ionization chamber smoke alarms in the above circulation areas. This practice is now deprecated in view of the greater potential for ionization chamber smoke detectors to generate false alarms when exposed to fumes from kitchens, and in view of their poorer response to smouldering fires and smoke that has drifted some distance from its source.

c) Heat detectors should not be used within circulation areas, such as hallways, staircase landings and corridors (i.e. heat detectors should not be used in any Category LD3 system).

NOTE 2 In the case of Grade A systems and systems complying with the recommendations of BS 5839-1 for a Category L3 system, it might be necessary to install detectors in rooms or areas opening onto escape routes; heat detectors may be used for this application.

d) In Category LD1, LD2 and PD systems, heat detectors may be installed within any room in a dwelling, unless it is necessary to give the earliest possible warning of a fire within the room (e.g. to protect sleeping occupants within the room or to protect high value properties or their contents).

NOTE 3 A heat detector is unlikely to operate early enough to save the life of anyone asleep in the room in which it is installed. Moreover, a heat detector in the room of fire origin might not give sufficient warning for occupants elsewhere in the dwelling to escape safely if the door to that room is open.

NOTE 4 If a dwelling is protected by an automatic sprinkler system, and, on operation of any single sprinkler head, the fire detection and fire alarm system in the dwelling is activated (even if the mains power supply within the dwelling has failed), each sprinkler head may be regarded as a heat detector for the purpose of this part of BS 5839.

e) Carbon monoxide fire detectors, or multi-sensor detectors incorporating a carbon monoxide sensor, should not be used within dwellings, unless:

i) the detectors are incorporated within a Grade A, B or C system and there is a high likelihood that the system will be subject to periodic maintenance by a competent person at periods not exceeding 12 months; or

ii) a fault warning is given to indicate the need to replace the electrochemical cell of the detector before it reaches the end of its anticipated life.

f) Subject to compliance with **10.2**e), carbon monoxide fire detectors may be installed within the circulation areas of a dwelling in conjunction with an equal number of optical smoke detectors.

g) Subject to compliance with **10.2**e), carbon monoxide fire detectors may be installed in any rooms within a dwelling, other than kitchens.

NOTE 5 If, in any room of dwelling, a heat detector could provide adequate fire protection, a carbon monoxide detector may be used instead.

h) If a multi-sensor fire detector conforms to the requirements of BS EN 54-7, it may be used in any circumstances in which the use of a smoke detector would provide adequate fire protection. However, if a multi-sensor fire detector incorporates an ionization chamber smoke sensor, it should only be used in circulation areas into which kitchens open if the system incorporates suitable measures to limit the potential for false alarms during cooking processes.

11 Location and siting of fire detectors

11.1 Commentary

11.1.1 *Category LD systems*

In a Category LD3 system, smoke detectors are sited in the circulation areas (normally hallways and staircases) that form the escape routes. In a typical single-storey dwelling, only one detector is necessary. At least one smoke detector generally needs to be located between the sleeping area(s) and the most likely sources of fire (living room and kitchen). In a typical two- or three-storey dwelling, a Category LD3 system normally comprises two or three smoke detectors respectively (i.e. one on each level). If there are long hallways or corridors, the installation of additional smoke detectors might be necessary. However, where smoke alarms are installed, it is important that siting also takes into account the need for the sound level of the smoke alarm(s) to be sufficient in all bedrooms (see Clause ***13****).*

In a Category LD2 system, in addition to the smoke detectors required to comply with the recommendations for a Category LD3 system (i.e. one or more detectors in the circulation routes at each floor level), detectors are installed in certain rooms. For example, a heat detector is often installed in each kitchen, and a detector (possibly a heat detector) might be installed in the living room. The rooms in which the additional detectors are installed need to be determined, where practicable, by a risk assessment (see Clause ***4****). In selecting the appropriate type of detector for any room, consideration needs to be given to the speed of detection required, the likely type of fire and the need to avoid false alarms (see Clause* ***12****).*

In a Category LD1 system, detectors are installed in all circulation areas and all rooms or areas in which fire might start, other than toilets, bathrooms or shower rooms. Such areas include roof voids, unless it can be determined that there are no significant sources of ignition within the void and no readily combustible materials such as stored items. Category LD1 systems might be appropriate as part of a fire engineering solution, in which, for example, structural fire precautions are less than normally required in order to satisfy building regulations or other fire safety legislation.

11.1.2 *Category PD systems*

In a Category PD1 system, detectors are installed in every room and area of the dwelling, although toilets, bathrooms and shower rooms need not have independent coverage. However, even in the case of a Category PD1 system, it might, exceptionally, be acceptable to omit detectors from areas in which there is no combustible material and no source of ignition (e.g. a disused cellar or attic in which all electricity supplies are permanently disconnected).

In a Category PD2 system, detectors are installed in only parts of the dwelling. Detectors need to be installed in areas where ignition sources or easily ignitable materials are present, where fire could spread rapidly, where supervision is absent, or where the consequences of loss or damage would be serious. Detectors are not essential in areas that contain few combustibles or ignition sources, have frequent supervision and have good structural fire separation from the remainder of the dwelling. It cannot, however, be assumed that a Category PD2 system need only include detectors in rooms containing high-value articles, such as works of art. Detectors are likely to be necessary in all areas in which fire might start and develop to an extent where it cannot be extinguished before loss of the high-value contents occurs.

In areas protected by a Category PD2 system, the spacing and siting of detectors is generally the same as for a Category PD1 system. If a fire starting outside the protected area spreads into it, the fire growth rate in the protected area is likely to be much higher than if the fire had been started in the protected area by a small ignition source. Although the system in the protected area would respond quickly, the rate of growth would probably be such that a high loss would ensue before fire-fighting could start. In order to prevent such spread, areas protected by a Category PD2 system need to be separated from unprotected areas by construction that will resist, to some degree, the spread of fire, although it might not have a recognized standard of fire resistance.

11.2 Recommendations

The following recommendations are applicable.

a) In a Category LD3 system, at least one smoke detector should be sited in each hallway or corridor and on each main landing of every staircase. In hallways or corridors exceeding 7.5 m in length, no point within the hallway or corridor should exceed 7.5 m from the nearest detector.

b) Where smoke alarms are installed, no bedroom door should be further than approximately three metres from the nearest smoke alarm.

c) At least one smoke detector should be located between every bedroom and every other room in the dwelling, other than a toilet, bathroom or shower room. In a single-storey dwelling protected by a single detector, the detector should be as close as possible to living accommodation. However, where such rooms are located on both sides of any bedroom, a smoke detector should be sited mid-way between the doors to these rooms.

d) Subject to compliance with b), in a multi-storey house, at least one smoke detector should be located on the ground floor between each staircase and every room, other than a toilet, bathroom or shower room. However, where such rooms are located on both sides of a staircase, a smoke detector should be sited mid-way between the doors to these rooms.

e) In open plan accommodation where a stair is open to a living/dining area (or any other room in which fire might start), the living/dining area (or other room) should be treated as a circulation area and be protected by a smoke detector.

f) In Category LD2 systems, detectors should be located and sited in circulation areas in accordance with the recommendations for a Category LD3 system. In addition, heat or smoke detectors (as appropriate) should be sited in all rooms in which protection is deemed necessary. Alternatively, subject to **10.2**e) and **10.2**g), carbon monoxide fire detectors may be installed in these rooms.

g) In Category LD1 systems, detectors should be located and sited in circulation areas in accordance with the recommendations for a Category LD3 system. In addition, heat or smoke detectors (as appropriate) should be sited in all rooms and other areas of the dwelling, including lofts. Alternatively, subject to **10.2**e) and **10.2**g), carbon monoxide fire detectors may be installed in these rooms and areas.

h) In Category LD1 and LD2 systems, and Category PD systems, detectors within rooms should be sited such that no point is further than 7.5 m from the nearest smoke detector or, in rooms protected by heat detectors, no further than 5.3 m from the nearest heat detector.

i) Detectors should preferably be mounted on ceilings and should be located at least 300 mm horizontally from any wall or light fitting unless, in the case of light fittings, there is test evidence to prove that the proximity of the light fitting will not adversely affect the efficiency of the detector.

j) Ceiling-mounted detectors should be located such that their sensitive elements are between 25 mm and 150 mm below the ceiling in the case of heat detectors, or between 25 mm and 600 mm below the ceiling in the case of smoke detectors.

k) If ceiling mounting is impracticable, in rooms and hallways not exceeding 10 m in both length and breadth, and not exceeding 50 m^2 in area, detectors may, alternatively, be mounted on a wall provided that:

i) the top of the detection element is between 150 mm and 300 mm below the ceiling; and

ii) the bottom of the detection element is above the level of any door opening; and

iii) the manufacturer's instructions state that the detector is suitable for wall mounting.

l) Detectors should not be mounted adjacent to, or directly above, heaters or air-conditioning vents.

m) Detectors should be mounted in positions that are reasonably accessible for maintenance.

NOTE This is particularly important in the case of smoke alarms that incorporate a battery or that have a routine testing or alarm silence facility. Such detectors should not, for example, be mounted above a stairwell.

n) Where the use of carbon monoxide fire detectors is appropriate (see **10.2**), location and siting of these detectors should comply with the recommendations for the location and siting of smoke detectors.

12 Limitation of false alarms

12.1 Commentary

False alarms are common in fire detection and fire alarm systems installed in dwellings, to an extent that they are one factor in the reluctance of a small proportion of the population to install smoke alarms in existing dwellings. A more serious problem is that there is abundant anecdotal evidence of deaths and serious injuries from fires in dwellings in which smoke alarms have been disabled by householders because of frequent false alarms. Thus, false alarms are not simply a nuisance; they are seriously detrimental to fire safety. For this reason, this part of BS 5839 now places great emphasis on the need to limit false alarms.

*In dwellings, false alarms with good intent and malicious false alarms (see **3.8**) are rare. Equipment false alarms (see **3.8**) do sometimes occur, but can be minimized by use of good quality equipment that satisfies relevant standards and has third-party certification (see **5.1**).*

*However, since these and a small proportion of unwanted alarms (see **3.8**), including those caused by dust within smoke detectors, can result in a prolonged false alarm, it is important that users have some means of silencing such false alarms and/or disabling fire detectors. A facility to disable, or reduce the sensitivity of, smoke detectors at times when false alarms are likely (e.g. whilst cooking) can also be of benefit.*

*The overwhelming majority of false alarms are those described in this standard as "unwanted alarms" (see **3.8**). The most common causes of unwanted alarms in dwellings are:*

- *— fumes from cooking processes (including toasting of bread);*
- *— steam (from bathrooms, shower rooms and kitchens);*
- *— tobacco smoke;*
- *— dust (whether built up over a period of time or generated while cleaning);*
- *— insects;*
- *— aerosol spray (e.g. deodorants and cleaning fluids);*
- *— smoke from sources other than a fire in the building (e.g. from an external bonfire);*
- *— "hot work", such as burning off paintwork with a blowlamp;*
- *— processes that produce smoke or flame (e.g. flambéing of food);*
- *— incense;*
- *— candles;*
- *— high humidity;*
- *— water ingress.*

Most unwanted alarms occur during cooking activities. Ionization chamber smoke detectors are significantly more sensitive than optical smoke detectors to products that occur during toasting of bread, and during frying and grilling. Thus, optical smoke detectors are less likely than ionization chamber smoke detectors to respond to fumes from cooking. This makes the optical smoke detector much more suitable than ionization chamber detectors for installation in hallways and circulation spaces into which kitchens open. It is important that this information is conveyed to householders, particularly by those responsible for advising householders, including, for example, fire and rescue services.

On the other hand, optical smoke detectors are much more prone than ionization chamber smoke detectors to produce false alarms if exposed to steam. Optical smoke detectors are also generally more likely to produce false alarms when exposed to dense tobacco smoke. Ingress of dust can also cause instability of optical smoke detectors, and result in constant false alarms. Thus, if optical smoke detectors are installed close to poorly ventilated bathrooms, shower rooms, kitchens or rooms in which people smoke heavily, false alarms might occur; in each of these cases, other than close to kitchens, ionization chamber smoke detectors would be less likely to produce false alarms. False alarms can also occur if smoke detectors are installed in dusty spaces, such as roof voids, and, in such situations, if smoke detectors are necessary, ionization chamber smoke detectors are preferable.

Heat detectors rarely produce false alarms. They are, however, much less sensitive than smoke detectors. The need to avoid false alarms should never take priority over an established need for early detection of fire. If heat detectors are installed within rooms, it must be accepted that a warning will be given only when a significant fire exists (typically with, as a rule of thumb, flame height equivalent to around one-third of the ceiling height within the room). Nevertheless, if the door of the room is closed (as is good practice during the night if the door opens onto a circulation space), earlier warning might be given by a heat detector in the room than by a smoke detector in the adjacent circulation space.

Carbon monoxide fire detectors are relatively immune to the most common causes of unwanted alarms in dwellings, such as cooking processes, steam, dust and tobacco smoke. False alarms can occur if a carbon monoxide detector is exposed to vehicle exhaust fumes or is installed in a poorly ventilated kitchen.

*Where a sophisticated fire detection and fire alarm system is warranted, such as in a very large property, analogue smoke detection systems (i.e. those of the addressable type: see **3.2**) 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.*

Similarly, certain multi-sensor fire detection systems have the potential to reduce significantly many common causes of unwanted alarms. Again, however, their use is likely to occur only in properties in which an expensive, sophisticated fire detection and fire alarm system is appropriate. There is some evidence, however, that, in, for example, sheltered housing, the use of such systems can significantly reduce the level of false alarms.

In some stately houses and large mansions, aspirating smoke detection systems are sometimes used, because the pipework through which air samples are transported to the central detector can be hidden within floor voids; one or more capillary tubes then sample air from each protected room below via a small hole(s) drilled in the ceiling, thus providing relatively "invisible" fire detection. Many such systems tend to operate at a level of sensitivity much higher than that of normal point-type smoke detectors. However, such high sensitivity might not be necessary in the case of a dwelling, and could, if utilized inappropriately, lead to unnecessary false alarms. It is, therefore, necessary to ensure that the sensitivity of the system is set at a level appropriate for the environment. In some cases it is, therefore, often necessary to consider de-sensitizing the system to make it equivalent to the sensitivity of normal point-type smoke detectors. However, great care is necessary, when de-sensitizing a system that covers large areas, to ensure that individual sampling points are sufficiently sensitive to match the minimum requirements of BS EN 54-7.

*In some (usually larger) houses in multiple occupation, high levels of false alarms sometimes occur, simply as a result of the number of different occupants, each of whom carry out activities, such as cooking, that can lead to false alarms. In such circumstances, occupiers have been known to compromise, or even cause damage to, the fire detection and fire alarm system, or to ignore fire alarm signals. This makes it important to minimize, as far as practicable, the extent to which occupiers are disrupted by false alarms in other occupiers' accommodation. This might, for example, be achieved by use of a mixed system (see **9.1.5**). Alternatively, other measures might be adopted; for example, in the event of a fire alarm signal in one dwelling unit, a short time delay might be incorporated for the occupier to investigate the cause and, if appropriate, reset the system before a fire alarm signal is given in other dwelling units.*

*The much higher rate of false alarms generated by fire detection and fire alarm systems in dwellings, compared with the systems used in industrial and commercial premises, makes it generally inappropriate for such systems to result in automatic transmission of fire alarm signals to the fire and rescue service. In a typical dwelling, such automatic transmission cannot, in any case, be justified on the grounds of life safety. It might, however, be justifiable in the case of dwellings occupied by people suffering from disabilities that might make escape difficult in the event of fire. Some householders, or their insurers, might also wish such a facility to be provided for protection of their property. If facilities for automatic transmission of fire signals to the fire and rescue service (usually via a commercially operated alarm receiving centre) is provided, adequate measures need to be taken to minimize the level of false alarms transmitted to the fire and rescue service (see Clause **20**).*

12.2 Recommendations

The following recommendations are applicable:

a) All fire detection and fire alarm systems complying with this part of BS 5839 should have accessible means of silencing fire alarm signals, suitable for use by the occupiers of the dwelling. The silencing facilities should comply with the following:

i) Grade A systems should be provided with silencing facilities that comply with the recommendations of **16.2.1**g) and **16.2.1**h) of BS 5839-1:2002.

ii) Grade B systems should be provided with silencing facilities that comply with the recommendations of **12.2**a)i) or with **C.4** and **C.5** of Annex C.

iii) In a Grade C system, the silencing facilities should be capable of silencing both unwanted alarm signals (see **3.8**) and permanent fire alarm signals that arise from, for example, a fault in a fire detector. The facilities may comprise a means of disabling a fire detector(s), a means for disabling fire alarm sounders, or any other facility that complies with the recommendations of this clause.

iv) In Grade D and Grade E systems, means should be provided for silencing short term unwanted alarms (see **3.8**). This may comprise an alarm silence facility conforming to the requirements of Clause **27** of BS 5446-1:2000, provided the facility can be operated by occupiers of the dwelling when standing at floor level. Alternatively, this recommendation may be satisfied by suitable means for isolation of all power to the detector(s) without the use of a tool and without isolation of power to other electrical equipment, such as lighting, in the dwelling.

NOTE 1 The provision of an alarm silence facility is preferable, since the detector may still retain some sensitivity to fire, and normal sensitivity is restored automatically within 15 min. In addition, the facility can be used to prevent the occurrence of false alarms, as opposed to merely silencing false alarms when they occur. Moreover, in a Grade D system, constant removal and replacement of a battery in order to silence false alarms is undesirable.

NOTE 2 A circuit breaker on a circuit supplying smoke alarms, but supplying no other electrical equipment, is, for the purpose of this recommendation, a suitable, readily accessible, means of isolating mains power to smoke alarms. A fuse does not constitute a suitable means of isolation, since its removal and replacement involve a degree of skill.

NOTE 3 In practice, if a Grade D system is supplied with mains power from a lighting circuit, or if the battery in each detector cannot be readily removed without the use of a tool, each detector will normally need to incorporate an alarm silence facility.

v) In Grade D and E systems, means should be provided for silencing fire alarm signals that result from, for example, a fault in a detector. This may comprise a means for isolation of all power to the detector. Since such faults are likely to be relatively rare, it is acceptable for the means of isolation to involve the use of a tool. However, isolation of power to any detector should not result in isolation of power to other electrical equipment, such as lighting, in the dwelling.

vi) In Grade F systems, each detector should incorporate an alarm silence facility unless the detector's battery can be removed without the use of a special tool (see **3.33**).

b) In large houses in multiple occupation, subject to the agreement of the enforcing authority, a short time delay (typically no more than two minutes) may be incorporated between operation of a smoke detector in one dwelling unit and a fire alarm signal in other dwelling units. During this delay period, a fire alarm signal should be given in the dwelling unit in which the smoke detector is located, but if the system is reset before expiry of the delay period, no alarm signal need be given in other dwelling units.

NOTE 4 It is acceptable for a reset control to be installed in each dwelling unit, provided this control only resets alarm signals generated within that unit.

NOTE 5 The provision of a reset control in each dwelling unit gives rise to a need for clear instruction of occupants regarding procedures for the use of the control.

c) All smoke detectors within areas, such as hallways and corridors, into which kitchens open should be of the optical type, unless there are overriding considerations that preclude the use of optical smoke detectors [see also **10.2**b)].

NOTE 6 In a typical two-storey house, this recommendation applies to the detector installed on the upstairs landing, as well as the detector in the ground floor hallway, as natural circulation is likely to transport fumes from a downstairs kitchen to the detector.

d) Optical smoke detectors should not be sited in close proximity to rooms from which steam may issue, such as poorly ventilated bathrooms, shower rooms and certain kitchens.

e) Fire detectors should not be installed in bathrooms and shower rooms.

f) If fire detectors are installed within kitchens, only heat detectors should be used.

g) If it is necessary to install a smoke detector in a room or area in which significant quantities of dust or dense tobacco smoke are likely to occur, an ionization chamber smoke detector should be used in preference to an optical smoke detector, unless there are overriding considerations to the contrary.

h) Before smoke detectors are specified for installation in any room within a dwelling, it should be confirmed that their use is necessary in order to satisfy the objective(s) of the system, based on, for example, a fire risk assessment (see Clause **4**).

i) 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. Such areas include badly ventilated kitchens and areas in which vehicle or other exhaust fumes occur.

j) In a very large property, in which more than 50 smoke detectors are necessary, only systems of the analogue type should be used.

NOTE 7 In such properties, if it is considered that there is potential for a high number of false alarms, consideration could be given to the use of multi-sensor systems with detection algorithms that are intended to minimize the occurrence of false alarms.

k) In some large mansions and historic houses in which aspirating fire detection systems are used, high sensitivity is not required in order to satisfy the objective of the system. In such cases, aspirating fire detection systems that can be arranged to provide sensitivity equivalent to that of point smoke detectors conforming to BS EN 54-7 should be used.

l) Other than in the case of sheltered housing, automatic transmission of fire alarm signals to an alarm receiving centre (or direct to the fire and rescue service) should not be specified for a fire detection and fire alarm system in a dwelling unless the specifier has confirmed that such a facility is necessary in order to satisfy the objectives of the system (e.g. property protection or protection of occupants at special risk from fire). Where such facilities are provided, they should comply with Clause **20**. Before remote monitoring of fire alarm signals is put in place, occupiers should be given formal, written instructions regarding the need to avoid transmission of false alarms to the fire and rescue service and appropriate means whereby such false alarms can be avoided (see Annex D).

13 Audible fire alarm devices and audibility

13.1 Commentary

13.1.1 *Audible fire alarm devices*

Smoke alarms and heat alarms, by definition, include an integral sounder. In systems other than those incorporating smoke alarms and heat alarms, reliable audible alarm devices, such as bells or electronic sounders, are necessary.

Many commercially available electronic sounders produce a greater sound output than a bell. However, the sound output of electronic sounders tends to be more direction-dependent than that of a bell, and the high output on the axis of the electronic sounder is not always achieved at right angles to the axis. Whatever the audible alarm device used, the fire alarm signals need to be clearly distinguishable from any other alarm signals.

13.1.2 *Audibility*

A fire detection and fire alarm system only provides satisfactory protection of life if it is capable of rousing the principal occupants of the dwelling from sleep (e.g. the adult occupants in a typical single-family dwelling). No particular sound pressure level is certain to rouse all occupants of a dwelling in all circumstances. Depth of sleep varies during the course of the sleep period and also varies from one person to another. Greater sound pressure levels are often required to rouse children from sleep than are necessary in the case of adults. BS 5839-1 recommends that, if an audible alarm is intended to rouse sleeping persons, a sound level of 75 dB(A) should be achieved at the bedhead when all doors are shut, although this will not guarantee that every person will be awakened, particularly if they are under the influence of alcohol or drugs.

Most fire detection and fire alarm systems in dwellings comprise smoke alarms, which are usually fitted in, at least, the circulation areas, such as hallways and landings. BS 5446-1:2000 requires that the sound output of a smoke alarm be at least 85 dB(A) at three metres. Most domestic doors attenuate sound by around 20 dB; greater attenuation can occur in the case of solid doors, such as fire doors. It is therefore unlikely that a smoke alarm on, for example, the upstairs landing of a two-storey house will produce a sound level of 75 dB(A) at the bedhead in each bedroom, particularly if the bedroom doors are shut; levels of 55 dB(A) to 65 dB(A) are more likely. There appears to be no evidence to show that lives are being lost due to inadequate audibility of the fire alarm signal from smoke alarms, except where people are incapacitated to such a degree that even much higher sound levels would not waken them. This might be because, in their own homes, people can be roused by an unusual sound of relatively low level compared with the sound level that may be required to wake them in premises with which they are unfamiliar (e.g. a hotel).

13.1.3 *Frequency*

*The integral sounder of most smoke alarms produces a sound with a frequency in excess of 2 000 Hz. The major frequencies of bells and electronic sounders used in fire alarm systems are often at least one octave lower. Age and damage to hearing reduce the sensitivity of the ear, particularly to frequencies above 2 000 Hz (see also Clause **14**). High-frequency sounds are also subject to greater attenuation by partitions, dividing walls and doors. An increase in frequency by one octave (so doubling it) can increase the attenuation by walls by around 5 dB, although the corresponding change in attenuation by doors is not as great.*

13.2 Recommendations

The following recommendations are applicable:

a) Other than in the case of smoke alarms and heat alarms, the frequency(ies) produced by fire alarm sounders should be in the range of 500 Hz to 1 000 Hz. The frequency produced by smoke alarms and heat alarms should not exceed 3 500 Hz.

b) The fire alarm warning should be clearly distinguishable from the sound produced by any other alarm system in the dwelling (e.g. an intruder alarm system or a carbon monoxide warning system). All fire alarm sounders in a single dwelling should produce a similar alarm signal. However, if smoke alarms are installed in the same dwelling as a Grade A, B or C system (to form a mixed system), the smoke alarms need not produce the same alarm signal as the sounders in the Grade A, B or C system.

c) In the following dwellings, all smoke alarms and heat alarms (if provided) in Grades D, E and F systems should be interlinked, such that, when fire is detected by any smoke alarm or heat alarm, an audible fire alarm warning is given by all smoke alarms and heat alarms (if provided) in the dwelling.

i) All new dwellings.

ii) All houses in multiple occupation, other than houses with long-term lodgers and houses shared by no more than six persons, generally living in a similar manner to a single family (e.g. houses rented by a number of students).

iii) All rented maisonettes and rented two (or more) storey houses.

iv) All houses of three (or more) storeys.

NOTE 1 It is preferable that, in all dwellings (including dwellings other than those described above), all smoke alarms and heat alarms (if provided) are also interlinked; this advice should be incorporated in instructions to householders (see Clause **24**).

NOTE 2 The above recommendation does not apply to smoke alarms or heat alarms in a mixed system (see **9.1.5**) installed within a house in multiple occupation if the smoke alarms and heat alarms are only intended to give a warning to occupants of the unit of accommodation in which fire occurs; under these circumstances only the smoke alarms and heat alarms (if provided) in that unit need be interlinked.

d) In a Grade A, B or C system, all fire alarm sounders in the dwelling should give a fire alarm signal, regardless of where fire is detected in the dwelling.

e) Unless there is, within the bedroom, a fire alarm sounder or a smoke alarm (or heat alarm) that will give a fire alarm signal whenever fire is detected anywhere in the dwelling, in all Category LD systems the sound pressure level of fire alarm signals, if measured at the doorway of each bedroom (with the door open), should be at least 85 dB(A), irrespective of where fire is detected in the dwelling.

NOTE 3 A higher sound pressure level might be necessary if occupants are hard of hearing (see also Clause **14**) or if bedroom doors attenuate sound by significantly more than 20 dB.

f) The recommendation of **13.2**e) applies to many houses in multiple occupation of limited size and with straightforward means of escape. However, in some houses in multiple occupation, ambient noise levels or other factors might justify the need for a sound pressure level of 75 dB(A) at the bedhead of each bedroom within a dwelling unit, particularly in the event of a fire in an area beyond the dwelling unit, as is recommended by BS 5839-1 for premises such as hotels. The need for this significantly higher sound pressure level within any or all bedrooms should be determined as part of a fire risk assessment (see Clause **4**).

NOTE 4 Experience has shown that, to achieve 75 dB(A) at the bedhead in any bedroom, a fire alarm sounder or smoke alarm (or heat alarm) needs to be installed in the bedroom.

NOTE 5 A fire risk assessment might determine that a sound pressure level of 75 dB(A) is appropriate in only certain bedrooms within the dwelling.

NOTE 6 Specification of a requirement for compliance with this part of BS 5839 (e.g. by an enforcing authority or consulting engineer), without any further requirements in respect of sound pressure level, will only ensure that the recommendations of **13.2**e) are satisfied. If sound pressure levels higher than recommended in **13.2**e) are required [e.g. as described in **13.2**f)], explicit information to this effect will be necessary in any specification, enforcement notice, etc.

g) In areas of the house, other than those to which the recommendations of **13.2**e) or **13.2**f) apply, it should be ensured that the occupants are likely to be able to hear the fire alarm signal under most foreseeable circumstances in all areas of the dwelling in which it is necessary to provide a warning. However, it should be ensured that the sound level in the vicinity of any telephone likely to be used to summon the fire and rescue service is not so high that it could interfere with the making of an emergency call to the fire and rescue service.

NOTE 7 The areas in which it is necessary to provide a warning might be determined as part of a fire risk assessment.

14 Fire alarm warnings for deaf and hard of hearing people

14.1 Commentary

People who are hard of hearing are not necessarily completely insensitive to sound. Even people who are severely hard of hearing might clearly perceive some conventional alarm sounders, although it is unfortunate that the higher frequencies produced by most smoke alarms and heat alarms will be less perceptible. Moreover, in some dwellings, a person(s) with normal hearing might always be present to alert a deaf or hard of hearing person in the event of fire (e.g. when the deaf or hard of hearing person is a young child or an infirm adult who never remains alone in the dwelling).

*However, if occupants are deaf or seriously hard of hearing, audible alarms might be insufficient to alert them in the event of fire, particularly if they are asleep. If, then, they can be alone in the dwelling at any time, other suitable means of giving warning in the event of fire will be necessary. If, in this case, smoke alarms are a satisfactory means of giving warning to occupants (i.e. a Grade F, E, D or, possibly C, system is appropriate: see Clause **9**), a system of smoke alarms conforming to the requirements of BS 5446-3 will be appropriate for giving warning to deaf or hard of hearing occupants.*

If a Grade A or Grade B system is necessary to protect occupants from fire, BS 5839-1 contains appropriate recommendations for giving warning to deaf or hard of hearing people in the event of fire. If vibrating devices triggered by radio signals are used in Grade A or Grade B systems, appropriate recommendations for the associated control and transmission equipment are also given in BS 5839-1.

Regardless of the Grade of system installed, great care is necessary to ensure that any fire alarm devices provided for deaf or hard of hearing people are suitably located, such that no deaf or hard of hearing person is exposed to undue risk from fire as a result of inadequate means of warning in any room or area of the dwelling. A fire risk assessment would be an appropriate means of determining the specific design requirements.

14.2 Recommendations

The following recommendations are applicable.

a) It should be ensured that any fire warning system intended for warning deaf or hard of hearing people in the event of fire is of the appropriate Grade (see Clause **9**).

NOTE 1 If, for example, a Grade A or Grade B system is appropriate for protection of occupants, it is not acceptable to install a Grade D (or lower) system to protect deaf or hard of hearing people in order to minimize cost.

b) The nature of any fire warning system for deaf or hard of hearing people should take into account the individual needs of each person for whom it is intended. In particular, an assessment is necessary, by consultation with each person for whom the system is intended, or their parents or carers, to ensure that an adequate warning is given in all appropriate rooms and areas in the dwelling. Both visual alarm devices and vibrating devices (vibrating pads and vibrating pagers) are acceptable forms of warning device.

NOTE 2 It might be appropriate, in some cases, to incorporate means by which deaf or hard of hearing people are alerted to a fire in a dwelling when they are within, for example, the garden of the dwelling (e.g. by means of a vibrating pager). In this case, it should be ensured that the range of the warning device is sufficient.

c) Where the system needs to warn a deaf or hard of hearing person who is awake, at least the room normally occupied by the person should be provided with a visual alarm device. If there is a need to rouse the person when they are asleep, a vibrating pad should be located under the person's mattress or pillow.

d) Where smoke alarms are an adequate form of fire detection and fire alarm system (see Clause **9**), and a means of giving warning to one or more deaf or hard of hearing people is necessary, a hearing impaired fire alarm kit conforming to the requirements of BS 5446-3 should be provided.

e) Visual alarm devices, vibrating pads and vibrating pagers used in any Grade of system should conform to the relevant requirements of BS 5446-3.

f) If a Grade A or Grade B system is intended to provide warning to any deaf or hard of hearing person in the event of fire, the system should comply with Clause **18** of BS 5839-1:2002. Any control or transmission equipment used as part of a vibrating pager system should, in these circumstances, comply with the recommendations of Annex C of BS 5839-1:2002.

15 Power supplies

15.1 Commentary

Fire detection and fire alarm systems designed in accordance with this part of BS 5839 rely on electrical power for their operation. No source of electrical power is totally reliable; every source will fail at some time, even if only for a limited period. If the fire detection and fire alarm system has only a single source of supply (as in the case of Grade E and Grade F systems), the system will be totally disabled when this supply fails. Provided action is taken to rectify the failure soon after it occurs, the probability of a fire occurring during the relatively short period of disablement might be low. However, in the case of Grade E systems, if the failure has arisen as a result of a failure in the mains power supply within the dwelling (e.g. as a result of failure in the supply from the electricity supply authority), the occupants might resort to the use of forms of lighting or heat that increase the fire risk (e.g. candles).

*In view of the considerations outlined above, a system with a single source of supply is only suitable for retrofitting in existing dwellings in which the number of storeys is limited and the nature of the occupants is such that they are not those at greatest risk from fire. In new dwellings, and in existing dwellings in which the fire risk (see Clause **4**) is high or the frequency or duration of power supply failures is significant, the provision of systems with a standby supply (e.g. a Grade D system) is appropriate.*

In general, a high reliability is given by a normal supply from mains electricity, backed up by a battery-powered standby supply, which is connected automatically in the event of mains failure. The standby supply may, however, comprise another source of power, such as a capacitor. In general, batteries can supply power to the system for an appreciably longer period than a capacitor. However, capacitors do not need to be replaced at regular intervals and can be recharged to full capacity in a relatively short period of time. Some forms of standby battery (e.g. lithium type) will also last for several years before they need to be replaced. Some rechargeable batteries are likely to last for the full service life of the smoke alarm.

*The standby supplies recommended in **15.2**, **15.3**, **15.4** and **15.5** are likely to be satisfactory in virtually all dwellings. Only exceptionally, such as in the case of dwellings in which occupants could be deprived of mains electricity for periods greater than 72 h because they cannot pay for supplies, are greater capacities likely to be required.*

*In the case of systems that incorporate batteries, the manufacturer's recommendations regarding use and disposal of batteries need to be followed. It is essential that user instructions for the system (see Clause **24**) include any relevant advice regarding the hazards of lithium batteries and the appropriate methods of disposal. Lithium batteries can present an explosion hazard if they are subject to severe overheating.*

15.2 Recommendations for power supplies for Grade A systems

The following recommendations are applicable.

a) Power supplies for Grade A systems should comply with the recommendations of Clause **25** of BS 5839-1:2002, with the exception of **25.4**e).

b) The circuit serving the fire detection and fire alarm system should be such that it is not isolated within the dwelling, except in the event of deliberate isolation of the supply by the occupier (e.g. by use of an isolating device complying with the recommendations of **25.2**a) of BS 5839-1:2002) or in the event of fault conditions. It is not, for example, acceptable for the mains supply to be connected via a card-operated meter or similar.

c) The standby supply should be capable of automatically maintaining the system in normal operation (whilst giving an audible and visual indication of mains failure) for a period of 72 h, after which sufficient capacity should remain to supply the maximum alarm load (see **3.22**) for at least 15 min. However, if a dwelling is never left unattended (e.g. a mansion in which staff are always present and can arrange for rectification of a supply failure), the period of normal operation sustained by the standby supply may be reduced from 72 h to 24 h.

NOTE 1 It is not recommended that the standby period be reduced in dwellings on the grounds that an automatically started emergency generator is present.

NOTE 2 To provide a battery that will operate a Grade A system for 72 h in the event of mains failure will normally necessitate relatively large batteries, which might need to be housed in a separate supply unit. Any external cabling between the power supply unit and the CIE needs to be duplicated for compliance with BS 5839-1 and needs to be fire-resisting.

15.3 Recommendations for power supplies for Grade B systems

The following recommendations are applicable.

a) The normal supply for a Grade B system should be derived from the public electricity supply, transformed or modified as necessary. The mains power should be supplied from an independent circuit at the dwelling's main distribution board. No other electrical equipment should be connected to this circuit.

b) The mains supply to 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 dwelling. The isolating protective device should be labelled "FIRE ALARM: DO NOT ISOLATE".

c) The circuit serving the fire detection and fire alarm system should be such that it is not isolated within the dwelling, except in the case of deliberate isolation of the supply by the occupier (e.g. by use of an isolating device complying with the recommendations of **25.2**a) of BS 5839-1:2002) or in the event of fault conditions. It is not, for example, acceptable for the mains supply to be connected via a card-operated meter or similar.

d) The circuit serving the fire detection and fire alarm system should preferably not be protected by any residual current device (r.c.d.). If r.c.d. protection is required for reasons of electrical safety (e.g. in an installation forming part of a TT system), either of the following conditions should be satisfied:

i) The r.c.d. should serve only the circuit supplying the fire detection and fire alarm system.

ii) The r.c.d. protection of the fire detection and fire alarm system circuit should operate independently of any r.c.d. protection for circuits supplying socket outlets or portable equipment.

NOTE For example, **15.3**d)ii) would be satisfied if, say, a time delayed 100 mA r.c.d. served the entire electrical installation in the dwelling, including the circuit serving the fire detection and fire alarm system, while a 30 mA r.c.d. served all circuits supplying socket outlets or portable equipment.

e) The mains supply should be backed up by a standby supply, comprising a secondary battery with an automatic charger, that is capable of automatically maintaining the system in normal operation (whilst giving an audible and visual indication of mains failure) for a period of 72 h, after which sufficient capacity should remain to support the maximum alarm load (see **3.22**) for 15 min.

f) The normal and standby supplies should each be capable of supplying the maximum alarm load irrespective of the condition of the other supply.

g) Batteries used in Grade B systems should be of a type that have an expected life of at least four years under the conditions of use likely to be experienced in the system. Automotive lead-acid batteries (i.e. the type normally used for starting service in cars) are not suitable for fire alarm service and should not be used.

h) The battery charger for the standby supply should be compatible with the batteries used, and should be capable of re-charging a battery from its final voltage (see **3.10**) to a capacity sufficient to comply with the recommendations of **15.2**e) within a charging period of 24 h.

15.4 Recommendations for power supplies for Grade C systems

The following recommendations are applicable.

Power supplies for Grade C systems should comply with the recommendations of **15.3** except that:

a) the wording of the label described in **15.3**b) may be amended to indicate the nature of any other system with which the fire detection and fire alarm system is integrated (e.g. to read "FIRE/INTRUDER ALARM: DO NOT ISOLATE");

b) the standby supply should be capable of automatically maintaining the system in normal operation for a period of 72 h (whilst giving the fault warnings recommended in **17.4**), after which sufficient capacity should remain to support the maximum alarm load (see **3.22**) for four minutes or to maintain fault warnings of the form and duration recommended in **17.4**, whichever load is the greater.

NOTE For intruder alarm systems, BS EN 50131-1:1997 recommends a standby capacity of less than 72 h. Modifications to an intruder alarm system are, therefore, likely to be necessary if it is to incorporate a fire detection and alarm facility complying with the recommendations of this standard for a Grade C system. If a system is incapable of complying with the recommendations of this clause, it might be appropriate to regard it as a Grade E system, or to consider the possibility of a variation (see **3.35**) in respect of standby power supply duration, subject to agreement of the relevant interested parties (e.g. the authority responsible for enforcing any relevant fire safety legislation). For example, a variation might be considered in the case of an intruder alarm system with a facility for transmission of a mains failure condition to an alarm receiving centre.

15.5 Recommendations for power supplies for Grade D systems

The following recommendations are applicable.

a) The normal supply for smoke alarms and any heat alarms in a Grade D system should be derived from the public electricity supply to the dwelling. The mains supply to the smoke alarms and heat alarms should take the form of either:

i) an independent circuit at the dwelling's main distribution board, in which case no other electrical equipment should be connected to this circuit (other than a dedicated monitoring device installed to indicate failure of the mains supply to the smoke alarms and any heat alarms); or

ii) a separately electrically protected, regularly used local lighting circuit.

b) If smoke alarms and any heat alarms are of a type that can be interconnected by wiring, all smoke alarms and heat alarms should be connected on a single final circuit.

NOTE This recommendation does not apply if the form of interconnection is not capable of conducting current, e.g. if the means of interconnection comprises radio communication rather than wiring.

c) The standby supply for smoke alarms and heat alarms may take the form of a primary battery, a secondary battery or a capacitor.

d) The capacity of the standby supply should be sufficient to power the smoke alarm(s) and any heat alarms in the quiescent mode for at least 72 h whilst giving an audible or visual warning of power supply failure, after which there should remain sufficient capacity to provide a fire warning for a further four minutes, in the absence of a fire, a fault warning for at least 24 h.

15.6 Recommendations for power supplies for Grade E systems

The following recommendations are applicable.

a) The mains supply to smoke alarm(s) and any heat alarms in a Grade E system should comprise a single independent circuit at the dwelling's main distribution board. No other electrical equipment should be connected to this circuit (other than a dedicated monitoring device installed to indicate failure of the mains supply to the smoke alarms and heat alarms).

b) If smoke alarms and any heat alarms are of a type that can be interconnected by wiring, all smoke alarms and heat alarms should be connected on a single final circuit.

NOTE 1 This recommendation does not apply if the form of interconnection is not capable of conducting current, e.g. if the means of interconnection comprises radio communication rather than wiring.

c) The circuit serving the smoke alarm(s) and any heat alarms should preferably not be protected by any residual current device (r.c.d.). If r.c.d. protection is required for reasons of electrical safety (e.g. in an installation forming part of a TT system), either of the following conditions should be satisfied.

i) The r.c.d. should serve only the circuit supplying the smoke alarm(s) and heat alarms.

ii) The r.c.d. protection of a smoke alarm circuit should operate independently of any r.c.d. protection for circuits supplying socket outlets or portable equipment.

NOTE 2 For example, **15.6**c)ii) would be satisfied if, say, a time delayed 100 mA r.c.d. served the entire electrical installation in the dwelling, including the circuit serving the smoke alarms, while a 30 mA r.c.d. served all circuits supplying socket outlets or portable equipment.

15.7 Recommendations for power supplies for Grade F systems

The following recommendations are applicable.

a) The batteries of smoke alarms and any heat alarms in Grade F systems should be capable of supplying the quiescent load of the smoke alarm or heat alarm, together with the additional load resulting from routine weekly testing, for at least one year before the battery fault warning is given.

b) At the point at which the battery fault warning commences, the battery(ies) should have sufficient capacity to give a fire alarm signal for at least 4 min or, in the absence of a fire, a battery fault warning for at least 30 days.

16 Wiring

16.1 Commentary

*A fire detection and fire alarm system in which components are interconnected will not fulfil its functions unless these interconnections operate correctly. In most systems, the interconnections take the form of wiring, but other means, such as radio signals, may be used. Recommendations for radio-linked systems are given in Clause **21**.*

In most single-family dwellings, any interconnections between components are not required to function for prolonged periods during a fire. Accordingly, the use of fire-resisting cables might not be necessary. However, wiring needs to be protected from exposure to mechanical damage, particularly if the wiring is unmonitored.

16.2 Recommendations for wiring in Grade A systems

Cables systems used in Grade A systems should, as a minimum, comply with all the recommendations of **26.2** of BS 5839-1:2002 for standard fire-resisting cables.

16.3 Recommendations for wiring in Grade B systems

Cables systems used in Grade B systems should, as a minimum, comply with all the recommendations of **26.2** of BS 5839-1:2002 for standard fire-resisting cables, with the exception of recommendations **26.2**k) and **26.2**o).

16.4 Recommendations for wiring in Grade C systems

The following recommendations are applicable.

a) The electrical characteristics of the cables used in Grade C systems should be in accordance with the relevant recommendations of BS 7671. The cables should be suitable for the current and voltage of the circuits concerned.

b) The types of cable used in Grade C systems should not be readily susceptible to mechanical damage under the conditions in which they are installed. If cables are not sufficiently robust to withstand the likely effects of foreseeable impact, abrasion or rodent attack, additional protection against mechanical damage should be provided. Protection against mechanical damage may be provided by the building construction (e.g. by capping under plaster) or by installation in conduit, ducting or trunking.

16.5 Recommendations for wiring in Grade D and Grade E systems

The following recommendations are applicable.

a) Cables used for the mains supply to smoke alarms and any heat alarms, and any interconnecting wiring between all smoke/heat alarms, may comprise any cable suitable for domestic mains wiring.

b) The cables in Grade D and Grade E systems should be installed in accordance with the relevant recommendations of BS 7671.

c) Conductors used for interconnection of smoke/heat alarms should be readily distinguishable from those supplying power (e.g. by colour coding).

d) Cables used for wiring of any unmonitored circuits in Grade D and Grade E systems should be protected against damage in any areas where it might be subject to impact, abrasion or rodent attack. Protection against mechanical damage may be provided by the building construction (e.g. by capping under plaster) or by installing the wiring in conduit, ducting or trunking.

16.6 Recommendations for wiring in Grade F systems

The following recommendations are applicable.

a) If battery-operated smoke/heat alarms are interconnected, any type of cable suitable for the voltage and current concerned may be used.

b) Cables used for wiring of any unmonitored circuits in Grade F systems should be protected against damage in areas where it may be subject to impact, abrasion or rodent attack. Protection against mechanical damage may be provided by the building construction (e.g. by capping under plaster) or by installing the wiring in conduit, ducting or trunking.

17 Control and indicating equipment

17.1 Commentary

Grade A systems incorporate equipment for the reception, indication, control and relaying of signals originating from fire detectors and any manual call points connected to the equipment, and for the activation of fire alarm devices. The control and indicating equipment is of an identical nature to that used in systems designed in accordance with BS 5839-1 for protection of non-domestic premises, such as offices, shops and other commercial premises.

Grade B systems also incorporate control and indicating equipment, which performs very similar functions to that in a Grade A system. However, in this case, the control and indicating equipment can be much simpler, and be designed to a less onerous standard, than control and indicating equipment for Grade A systems. There is, however, nothing to preclude control and indicating equipment of a type used in Grade A systems from being used in a Grade B system.

Grade C systems can incorporate even simpler control and indicating equipment, providing a source of power for either a number of smoke alarms (and, possibly, heat alarms) or a number of fire detectors, with a very basic form of control and indication. Such equipment can comprise, for example, equipment specifically intended to provide a central source of power and control for interconnected smoke alarms, or can, for example, comprise the control and indicating equipment of an intruder alarm system or social alarm system, to which a number of fire detectors and fire alarm devices are connected. Facilities provided by the control and indicating equipment in a Grade C system may also include some facilities that are, more typically, provided in the control and indicating equipment of Grade A and Grade B systems, which will satisfy all recommendations in respect of control and indicating equipment for Grade C systems.

One benefit of Grades A, B and C systems, is a level of control over the system by occupiers of the dwelling, which is not possible in the case of Grades D, E and F systems. In addition, the provision of control and indicating equipment enables better information for the occupier(s) regarding the status of the system. This additional control and indication does, however, result in a possible need for an occupier to go to the control and indicating equipment when a fire alarm signal occurs. Care needs to be taken to ensure that, if this action is followed (regardless of whether the action is appropriate or inappropriate), the occupant is not placed at significant risk from a fire. There is also a need to ensure that the system is not compromised as a result of casual tampering with the control and indicating equipment.

17.2 Recommendations applicable to all control and indicating equipment.

The following recommendations are applicable.

a) Control and indicating equipment should be sited on the same level as the normal entrance to the dwelling, close to the normal entrance.

b) In single-family dwellings, including dwellings with long-term lodgers, and houses shared by no more than six persons, generally living in a similar manner to a single family (e.g. houses rented by a number of students), control and indicating equipment may be hidden from view (e.g. in a cupboard). In other dwellings (i.e. those in multiple occupation), control and indicating equipment should be sited within a common circulation area, close to the door by which the fire and rescue service will normally enter the dwelling when summoned to a fire.

c) Unless it is situated in a secure area or enclosed within a secure cabinet, control and indicating equipment should normally be sited so that all controls are at least 1.5 m above floor level, to prevent casual tampering by children. A lower mounting height is, however, acceptable in dwellings occupied by people who are confined to wheelchairs.

17.3 Additional recommendation applicable to control and indicating equipment for Grade A and Grade B systems

The following recommendation is applicable.

Control and indicating equipment for Grade A and Grade B systems should comply with the recommendations of **5.2**i) and **5.2**j), respectively. In addition, other than in the case of single zone systems (see Clause **19**), in Grade A systems control and indicating equipment should incorporate zonal indicators, comprising a separate light-emitting indicator for each detection zone of the system (e.g. a LED matrix or illuminated mimic diagram), such that the equipment is capable of simultaneous display of fire signals on every detection zone.

17.4 Additional recommendations for control and indicating equipment for Grade C systems

The following recommendations are applicable.

a) Control and indicating equipment for Grade C systems should incorporate a facility for silencing alarm signals.

NOTE 1 The operation of this facility may disable the system, by, for example, isolating smoke alarms from the power supply or by disabling a sounder circuit.

b) The equipment should provide a visual indication of failure or disconnection of the normal power supply. The indication should take the form of either of the following:

i) a normally illuminated indicator is extinguished; or

ii) a fault indicator is illuminated.

The system should be capable of maintaining the visual indication for at least 15 days.

c) An audible warning should be given at the control and indicating equipment when (or before) the standby battery capacity falls below that required to comply with the recommendations of **15.4**b). If the audible warning is intermittent, it should sound at least once every minute and should persist for at least 72 h after the standby battery no longer has the capacity to perform in accordance with **15.4**b).

NOTE 2 The audible warning may be given as soon as the mains supply fails.

d) All visual indicators provided on control and indicating equipment for Grade C systems should be clearly labelled to identify their function.

e) The operation of any fire alarm device circuit should not be prevented by any defect in a visual indicator and should not depend on the operation of any indicator.

f) An audible and visual fault indication should be given in the event of an open circuit or short circuit on the wiring to manual call points, smoke and heat alarms or fire detectors, and to fire alarm devices, unless the fault causes a fire signal to be given [see **6.2**e)]. If the audible warning is intermittent, it should sound at least once every minute. The audible warning may be silenced by operation of a manual control. The visual indication should persist until the fault has been rectified.

18 Manual call points

18.1 Commentary

In most single-family dwellings, the provision of manual call points is not necessary. If persons discover a fire, normally they can alert other occupants by word of mouth. In these dwellings, the role of the fire detection and fire alarm system is to provide automatic detection and warning of a fire that would not be detected by occupants until a much later stage in its development, when it would present a more serious danger to occupants, particularly those who are asleep.

However, if people are present in the room where a fire originates, they will normally detect the fire before it is detected automatically. In a very large property, such as a country house or a mansion, and in most houses in multiple occupation, manual call points are of benefit, so that a warning of fire can be initiated before it is detected by automatic fire detectors.

*Generally, the incorporation of manual call points in the fire detection and fire alarm system will only be necessary in certain dwellings that warrant the provision of a Grade A or Grade B system. Manual call points can, however, readily be incorporated within a Grade C system. Grades D, E and F systems normally have no facility for incorporation of manual call points, nor are manual call points necessary in the types of dwelling for which these Grades of system are suitable. However, some smoke alarms do have a facility for connection of one or more manual call points, which can then be useful to test the operation of the system (see Clause **25**).*

It is necessary for any manual call points installed within a dwelling to be simple and safe to operate by persons who are likely to have received no special instruction in their use. It is also necessary for any delay between operation of a manual call point and the sounding of the fire alarm signal to be kept to a minimum, so that there can be no doubt on the part of any person operating a manual call point that its operation has successfully resulted in the sounding of the fire alarm signal. Any significant delay in the sounding of the fire alarm signal might result in confusion, such as an impression that the system is defective, leading to inappropriate action.

Siting of manual call points is generally based on the principle that a person cannot leave any storey of the dwelling, or leave the dwelling by means of an exit to open air, without, first, passing a manual call point. For the call points to be of benefit, there is a need to ensure that sufficient call points are provided to minimize, to a reasonable extent, the delay between discovery of a fire and the sounding of the alarm.

18.2 Recommendations

The following recommendations are applicable.

a) Manual call points should be installed in very large single-family dwellings (including dwellings with long-term lodgers), and very large dwellings shared by no more than six persons, generally living in a similar manner to a single family (e.g. houses rented by a number of students), if a verbal fire warning, shouted by a person on the ground floor, is unlikely to be heard by all occupants of the dwelling.

NOTE 1 This situation is only likely to apply in the case of houses with four or more storeys above ground floor level and large, multi-storey mansions, country houses, etc. However, it will generally be appropriate to, at least, consider the need for incorporation of manual call points in any Grade A system that is installed.

NOTE 2 This recommendation applies to both Category LD and Category PD systems.

b) Manual call points should be provided in all houses in multiple occupation, other than the following:

i) single-family dwellings with long-term lodgers;

ii) houses shared by no more than six persons, generally living in a similar manner to a single family (e.g. houses rented by a number of students);

iii) houses of only one or two storeys, with no floor greater than 200 m^2 in area.

NOTE 3 In the case of i) and ii), there might be a need for manual call points in order to satisfy the recommendations of **18.2**a).

c) The method of operation of all manual call points in a system should be that of type A as specified in BS EN 54-11. All manual call points should be identical.

NOTE 4 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."

d) The delay between operation of a manual call point and the sounding of the fire alarm signal should not exceed three seconds.

e) In dwellings in which manual call points are appropriate, the manual call points should be located on escape routes (e.g. in the case of a house in multiple occupation, the common parts) and, in particular, at all storey exits and all principal exits to open air. Those located at storey exits may be sited close to a door leading onto a protected stairway or on the landing of the stairway.

NOTE 5 A principal exit to open air includes a "back door" (e.g. located in a kitchen), but does not include all exits between rooms and open air (e.g. French doors leading from a living room to a garden).

f) Where manual call points are appropriate, from any point in the dwelling, it should not be necessary to travel more than 45 m to reach the nearest manual call point.

g) Manual call points should be fixed at a height of 1.2 m above finished floor level.

NOTE 6 The figure of 1.2 m should be measured between finished floor level and the centre point of the frangible element of the manual call point.

h) Manual call points may be flush mounted, but, in houses in multiple occupation, manual call points sited in locations where they will be viewed from the side (e.g. corridors) should be surface mounted or only semi-recessed with the front face proud of the mounting surface by no less than 15 mm.

19 Zoning and other means for identification of the source of alarm conditions

19.1 Commentary

In a Grade A, B or C system, multi-zone control and indicating equipment can, in principle, provide an indication of the area of the dwelling from which an alarm signal originates; since Grade D, E and F systems do not incorporate control and indicating equipment, this is not possible.

In most typical single-family dwellings, the sub-division of the dwelling into detection zones for indication purposes is unnecessary. In a large dwelling, particularly if the layout is complex, it is desirable that the fire alarm indicating equipment indicates the area of the dwelling from which the alarm originates. Even in the case of an addressable system, detection zone indication can assist the fire and rescue service, and others unfamiliar with the layout and designation of rooms, to locate the fire quickly and efficiently.

In the case of a house in multiple occupation, it is important that those responding to a fire alarm signal can identify readily the location of a fire. If the individual occupancies into which the house is divided are multi-roomed dwelling units, the allocation of a detection zone for each dwelling unit might be appropriate. The use of an addressable system in these circumstances can be of benefit. However, other methods of identification may be adopted, particularly when the individual occupancies are small in area.

19.2 Recommendations for Grade A systems

The following recommendations are applicable.

a) In Grade A systems, the dwelling should be sub-divided into detection zones in accordance with the recommendations of Clause **13** of BS 5839-1:2002.

b) In the case of a house in multiple occupation, there should, in addition, be means of identifying the dwelling unit from which a fire alarm signal originates. This may comprise any of the following:

i) the allocation of a detection zone for each dwelling unit; or

ii) the use of an addressable fire alarm system, so that, at the control and indicating equipment, the identity of the dwelling unit is described on a text display; or

iii) the provision of remote indicator lights outside each dwelling unit.

19.3 Recommendation for Grade B systems

The following recommendation is applicable.

In a two-storey dwelling with one or both floors exceeding 200 m^2 in area, each floor should be treated as a separate detection zone. Other dwellings for which Grade B systems are generally suitable (see Clause **9**) may be subdivided into zones, but, in most cases, this is unlikely to make a significant contribution to life safety.

19.4 Recommendation for Grade C systems

The following recommendation is applicable.

Dwellings in which Grade C systems are installed do not normally need to be subdivided into detection zones.

20 Remote transmission of alarm signals

20.1 Commentary

For a fire detection and fire alarm system to give the maximum benefit, particularly in the case of high risk to life, or in the case of Category PD systems installed within properties of high value, the fire and rescue service needs to be summoned as quickly as possible in the event of fire. However, it is essential that false alarms are not unnecessarily passed to the fire and rescue service.

*In most dwellings, automatic transmission of fire alarm signals to the fire and rescue service (e.g. via an alarm receiving centre) is unnecessary [see **12.2**l)]. It is sufficient for the fire and rescue service to be summoned by occupants, using the 999 (or 112) public emergency call system. Most dwellings have a telephone that can be used for this purpose. If access to the telephone is not available, many people now have mobile telephones that can be used, or the emergency call can be made from the home of a neighbour. Unless use of a telephone within the dwelling would put occupants at risk from fire, dependence on a mobile telephone is, however, less appropriate than use of a fixed line telephone within the dwelling; poor mobile telephone reception can result in lack of clarity in the call received by the fire and rescue service, while, in areas close to the boundaries between different fire and rescue services, the emergency call might be routed to the wrong fire and rescue service, resulting in a delay in the dispatch of fire appliances.*

Even if there is a means for automatic transmission of fire signals to the fire and rescue service, the primary means for summoning the fire and rescue service needs to comprise a call to the fire and rescue service by occupants, as any automatic system can fail at the time it is required to operate.

*The combined number of false alarms from fire detection and fire alarm systems in non-domestic and domestic premises received each year by fire and rescue services is now regarded as unacceptable by Central Government, fire and rescue services and the committee responsible for this part of BS 5839 (see Clause **12**). Although the majority of these false alarms emanate from non-domestic premises, this is because most dwellings have no facility for automatic transmission of fire alarm signals to the fire and rescue service. However, the rate of false alarms generated by fire detection and fire alarm systems in dwellings (e.g. expressed as number of false alarms per detector per annum) is normally much higher than in the case of systems in non-domestic premises. If all domestic fire detection and fire alarm systems had facilities for automatic transmission of fire alarm signals to the fire and rescue service, false alarms would impose a totally unacceptable burden on fire and rescue services, albeit that, if occupants suspect that a fire alarm signal might have resulted from a fire, the fire and rescue service needs to be summoned without delay. Indeed, there is already evidence that the increasing number of dwellings that are provided with automatic transmission facilities is leading to a commensurate increase in the number of false alarms received by fire and rescue services from domestic systems.*

There are, however, certain circumstances in which automatic transmission of fire signals to the fire and rescue service is warranted. The most common of these situations is one in which a Category PD system is installed for protection of property, particularly in the case of properties of very high value (e.g. a stately home) or that contain contents of very high value (such as works of art); in these cases, the property insurer often requires the installation of a fire detection and fire alarm system with automatic transmission facilities, as a condition of insurance. Automatic transmission could also be appropriate if occupants are mobility impaired to a degree that would cause them to be at high risk in the event of fire, or if occupants suffer from speech impairment to a degree that would preclude communication by telephone with the fire and rescue service. In other dwellings, if means of automatic transmission to the fire and rescue service are provided, additional precautions are necessary to minimize the likelihood of transmission of false alarms to the fire and rescue service. In these dwellings, there is a need for occupants to be aware that, if a false alarm occurs when the dwelling is unoccupied, automatic transmission of the fire alarm signal to the fire and rescue service might result in damage to their property if the fire and rescue service considers that forced entry is appropriate.

In sheltered housing, early assistance to occupants in the event of fire can be important. Where a social alarm system is installed in dwelling units, such as sheltered housing, it will often be appropriate for fire alarm signals to be relayed to the same location as alarm signals from the social alarm system. However, in the first instance, it might not always be appropriate to summon the fire and rescue service on receipt of a fire alarm signal at an on-site warden's facility or social alarm monitoring centre. If the fire detection and fire alarm system is integrated with the social alarm system (or any other alarm system, such as an intruder alarm system), and both systems share a single communications link to an alarm receiving centre, it is important to ensure that fire alarm signals can be distinguished from other alarm signals at the alarm receiving centre.

If automatic transmission of fire signals to the fire and rescue service is deemed necessary, in a large "managed" property consideration might be given to the use of a system with staged warnings, to permit an investigation before summoning of the fire and rescue service. Some systems can also provide a pre-alarm signal, to warn of an impending alarm signal.

If automatic transmission of fire signals to the fire and rescue service is essential, the reliability of the transmission system needs to be subject to consideration. Methods for automatic transmission may generally be grouped into four categories, according to the means of communication with the alarm receiving centre:

— "carrier" systems, in which alarm (and usually line monitoring) signals are transmitted over normal telephone lines, which can be used for normal speech telephony without interfering with the alarm transmission function;

— systems that use public or private cellular radio communication;

— private communication circuits between the protected premises and the alarm receiving centre (these are unlikely to be appropriate for dwellings);

— systems that use the public switched telephone network ("digital communicators").

If the facility for automatic transmission is considered essential, systems in which the transmission path is continuously monitored are preferred. In these systems, failures in the transmission path can be identified quickly and action taken (see BS EN 50131-1:1997), so minimizing the "down time" of the system. Monitored systems might not, however, be available in all areas of the United Kingdom.

If the services of an alarm receiving centre are used, it needs to be ensured that the alarm receiving centre has a formal arrangement with the fire authority in whose area the dwelling is situated for rapid communication with the fire and rescue service by reliable means. If the automatic transmission facility is considered essential, the effect of fire on the reliability of the automatic transmission facility also needs to be considered (e.g. the effect of fire on communication lines and equipment).

20.2 Recommendations

The following recommendations are applicable.

a) In Category LD systems, provision of facilities for automatic transmission of fire alarm signals to the fire and rescue service should be considered under the following circumstances:

i) if the occupants are mobility impaired to a degree that would be likely to result in high risk (see Clause **4**) in the event of fire; or

ii) if the occupants suffer from a disability (e.g. speech impairment) that would preclude communication by telephone with the fire and rescue service.

b) In Category PD systems, facilities for automatic transmission of fire alarm signals to the fire and rescue service should be provided if there is a need for early attendance of the fire and rescue service when the dwelling is unoccupied.

NOTE 1 The need for this facility should normally be determined by consultation with the fire insurer.

c) Before any facility for automatic transmission of fire signals to the fire and rescue service becomes operational, the organization monitoring the fire detection and fire alarm system (whether this is the fire and rescue service or an alarm receiving centre) should obtain written confirmation from the occupier (or, in the case of a house in multiple occupation, the landlord) that they have received, and read, written guidance regarding the importance of avoiding false alarms, suitable measures to avoid false alarms, and the possible need for the fire and rescue service to force entry to the dwelling in the event of a false alarm when the dwelling is unoccupied (see Clause **24** and Annex D). In the case of houses in multiple occupation, the landlord should confirm that the relevant guidance has been passed onto every occupier.

d) If a system has a facility for automatic transmission of fire signals to the fire and rescue service, the guidance described in **20.2**c) should be provided in writing to the occupier (or the landlord in the case of a house in multiple occupation) at periods not exceeding twelve months (e.g. at the time of renewal of a contract for monitoring alarm signals).

e) Facilities for automatic transmission of fire signals should be provided only in the case of Grade A, B or C systems. Fire alarm signals from Grades D, E and F systems should not be transmitted automatically to the fire and rescue service.

f) Other than in the case of smoke alarms connected to social alarm systems, fire alarm signals should not be transmitted automatically to the fire and rescue service unless a contract is in place for maintenance of the system, at periods not exceeding six months, in accordance with the recommendations of Clause **26**. It is the responsibility of the organization that monitors the fire alarm signals to ensure, at periods not exceeding twelve months, that such a contract is in place.

g) If a facility is provided for automatic transmission of fire signals to the fire and rescue service in circumstances other than those described in **20.2**a) and **20.2**b), a form of alarm filtering should be incorporated, whereby either:

i) if fire alarm signals are transmitted to an alarm receiving centre, on receipt of a fire alarm signal at the alarm receiving centre the alarm receiving centre endeavours to contact the dwelling by telephone to determine whether the alarm signal is a false alarm or has arisen as a result of a fire (alarm verification). If it cannot be established that the alarm signal is a false alarm within two minutes of the point at which the alarm receiving centre operator completes the dialling process, the alarm signal should then be passed to the fire and rescue service without further delay; or

ii) the alarm signal is not transmitted to the alarm receiving centre for two minutes after the audible fire alarm signal is given within the dwelling. If, within this two minute period, the occupier determines that the alarm signal is a false alarm and operates a manual control (usually at the control and indicating equipment), no signal is automatically transmitted to the alarm receiving centre (or the fire and rescue service).

NOTE 2 If, in the case of **20.2**g)i), the first attempt at dialling the telephone number of the dwelling fails (e.g. because the telephone at the dwelling is engaged), a further attempt(s) at dialling the number may be made, but the two minute delay period would still apply from the point at which the first attempt at dialling the telephone number is made.

NOTE 3 In the case of **20.2**g)ii), the period of two minutes is appropriate for the majority of typical dwellings. However, it might be appropriate to increase this, to no more than four min, in the case of a large dwelling, in which action by occupants to investigate the fire alarm signal and reach the appropriate manual control is likely to take longer than two minutes.

NOTE 4 The arrangement described in **20.2**g)ii) may also be incorporated within a Category PD system, but only if the system is considered to have a high potential for false alarms and if the time delay is agreed with the property insurers.

h) Where facilities are provided for automatic transmission of fire signals to the fire and rescue service, this should not comprise an arrangement whereby a pre-recorded speech message is automatically transmitted direct to the fire and rescue service via the public emergency call system.

i) If a facility for automatic transmission of fire signals to the fire and rescue service is provided, written instructions to the user should stress that, regardless of this transmission facility, the fire and rescue service should still be summoned from a safe location, either within the dwelling or external to the dwelling, as soon as possible in the event of fire (see Clause **24**).

j) Any alarm receiving centre to which fire alarms signals are relayed should comply with the recommendations of BS 5979.

NOTE 5 Schemes exist for third-party certification of alarm receiving centres to BS 5979.

k) Automatic transmission of fire 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.

l) Where an alarm transmission device is mounted in an enclosure separate from that of the fire alarm control and indicating equipment, the connection from the control and indicating equipment to the alarm transmission device should be monitored, so that an audible and visual fault signal is given, either at the fire alarm control and indicating equipment or at the alarm transmission device, in the event of an open or short circuit fault on the cable used for the connection.

m) Power supplies for any facility used for automatic transmission of fire alarm signals to the fire and rescue service should comply with the recommendations of Clause **15** for the appropriate Grade of system.

n) If the automatic transmission system is intended to satisfy the requirements of the property insurers, or will be taken into account in insurance underwriting, the method of transmission should be agreed with the property insurer.

o) In Category PD systems, the area in which the transmission equipment is installed should be protected by automatic fire detection unless it is installed in an area of low fire risk.

NOTE 6 An electrical distribution cupboard is not an area of low fire risk.

p) In Grade A systems, if there are facilities for automatic transmission of fire alarm signals to the fire alarm service, a means should be provided for disablement of the transmission facility, for use during periods of testing, maintenance or potential false alarms. Warning of disablement should conform to the requirements of BS EN 54-2.

q) In sheltered housing, fire alarm signals from individual dwelling units should be relayed to the same location as alarm signals from any social alarm systems installed in the dwelling units. If there is an on-site warden, fire alarm signals should be investigated by the warden (e.g. using a two-way speech communication facility between the warden's facility and the dwelling) prior to summoning of the fire and rescue service. If no on-site warden is present, and fire alarm signals are transmitted to an alarm receiving centre that has a direct two-way speech facility for communication with the dwelling (of the type normally provided in social alarm systems), the alarm receiving centre should endeavour to determine, by use of this facility, whether the alarm signal is a false alarm, or has arisen as a result of a fire, before the fire and rescue service is summoned.

NOTE 7 The recommendations in **20.2**q) assume that the on-site warden is readily available to respond immediately at all material times and that management standards at any alarm receiving centre comply with those recommended by BS 5979. If this cannot be ensured, consideration should be given to immediate summoning of fire and rescue services on each occasion that the fire alarm system operates.

r) If a fire detection and fire alarm system is integrated with another system (e.g. in the case of a Grade C system, with an intruder alarm system or social alarm system) and both systems share a single communications link to an alarm receiving centre, the transmission system should be designed so that the fire alarm signals can be separately identified at the alarm receiving centre.

s) In the case of sheltered housing, fire alarm signals from dwelling units should, at any site monitoring facility provided for use by a warden, be clearly distinguishable from other alarm signals that can be relayed from the dwelling, and distinguishable from alarm signals from any other dwelling.

NOTE 8 If smoke detectors are retrofitted to an existing social alarm system that has no facilities for discrimination between different types of alarm signal, the recommendation for distinguishable signals need not be followed, provided that the pre-planned response by the warden to signals from the fire detection and fire alarm system in any dwelling is identical to the pre-planned response to other alarm signals and is an appropriate action in the event of fire.

21 Radio-linked systems

21.1 Commentary

In Grade A, Grade B and Grade C systems, control equipment and other components of the fire detection and fire alarm system, such as detectors, manual call points and sounders, are normally interconnected by means of wiring. However, some or all of these interconnections may be made by radio-links.

In radio-linked systems, the normal power supply to the control and indicating equipment is derived from a mains supply in the normal way, while the power supply to detectors and manual call points is usually provided by a primary battery, with a second primary battery as a reserve. Signals from detectors and manual call points are transmitted to the control equipment by radio. Usually, the interconnection between the control equipment and the fire alarm sounders also comprises a radio-link, again with a primary battery as the power supply for the fire alarm sounder, and a second primary battery as a reserve power supply. However, the fire alarm sounders may be connected to the control equipment by a conventionally wired circuit, or, if a radio-link is used, the normal power supply to each fire alarm sounder may be derived from a mains supply, with a primary or secondary battery as a standby supply.

*In Grade D, Grade E and Grade F systems, radio may be used for interconnection of smoke and/or heat alarms, although this would be unusual. BS 5446-3 also permits a radio-link to be used as the interconnection between one or more smoke alarms and fire alarm devices intended to give warning to deaf or hard of hearing people in the event of fire (see Clause **14**).*

Radio-linked systems have both advantages and disadvantages. In the context of a dwelling, the major advantage is the ease of installation and the avoidance of the need to damage or disfigure décor in order to install wiring. The latter advantage is of particular benefit in historic buildings and buildings with ornate finishes; the use of radio-linked systems in historic buildings is now relatively common.

*The most significant disadvantage of radio-linked systems in dwellings is the need to replace batteries in each of the many battery-operated components that usually exist in a large installation. This might make a radio-linked system less suitable (but not necessarily unsuitable) for applications in dwellings in which occupants might not be able to replace batteries (e.g. owing to financial constraints, or to physical or mental disability) or in which occupants are not directly responsible for supervision of the fire detection and fire alarm system (e.g. a house in multiple occupation). However, the use of batteries, such as lithium type, which have a longer life than conventional batteries, can greatly reduce the frequency of battery replacement, and rechargeable lithium cells may be used (see **15.1**).*

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 control and indicating equipment.

In practice, no system 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. 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 dwelling.

Although a properly designed radio-linked system is not likely to be any more susceptible to false alarms than a wired system, frequent false alarms in a dwelling can reduce the life of radio-linked fire alarm sounder batteries, particularly in a house in multiple occupation in which there might be no overall supervision of the fire detection and fire alarm system. Automatic silencing of radio-linked sounders is sometimes employed to overcome the potential for undue discharge of sounder batteries. Sounders with this facility need to reactivate when any new fire signal arises. It is important that an automatic silencing facility does not impair the system's ability to provide an adequate audible warning to the occupants of the dwelling in the event of fire.

Other components of a radio-linked system may include radio relay units, which are installed remote from the control and indicating equipment, so as to extend the range of the system in a very large dwelling. Radio communication may also be used to link a small number of detectors and other components to what is essentially a wired system. The recommendations of this standard apply equally to integral radio-linked systems of this nature.

21.2 Recommendations

The following recommendations are applicable.

a) In the case of Grade A, B and C systems, radio-linked systems should comply with the recommendations of **27.2** of BS 5839-1:2002.

NOTE **27.2** of BS 5839-1:2002 places great emphasis on the need for a comprehensive radio survey to be undertaken, prior to the installation of a radio-linked system, and recommends that a copy of the signal levels measured should be kept in the premises along with the system log book.

b) If a radio-linked system is installed in a house in multiple occupation, all batteries used as the normal supply to manual call points and fire detectors should be capable of supplying the following loads for at least five years before warning of impending failure of the battery is given:

i) the quiescent load of fire detectors and manual call points;

ii) the additional load resulting from routine weekly testing; and

iii) the load from false alarms, each of five minutes duration, at the rate of two false alarms per smoke detector per annum.

c) If a radio-linked system is installed in a house in multiple occupation, all battery powered fire alarm sounders should silence automatically after 30 min, unless the premises are continuously supervised so enabling manual silencing by occupants at any time that false alarms can occur. The sounders should restart if, before the system is reset, a further fire alarm signal occurs.

d) The power supplies recommended in **15.5**, **15.6** and **15.7** may be used to power radio-links between smoke or heat alarms, provided that this does not reduce the life or duration of a battery or capacitor supply below those recommended in **15.5**, **15.6** and **15.7** as appropriate.

22 Electromagnetic compatibility

22.1 Commentary

Particular care needs to be taken in 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, lightning and power transients.

22.2 Recommendations

The following recommendations are applicable.

a) Grade A and Grade B systems should comply with Clause **28** of BS 5839-1:2002.

b) In the case of Grade C systems, care should be taken to ensure that any recommendations of the manufacturer of the system in respect of electromagnetic compatibility are taken into account in the design and installation of the system.

c) If, in a Grade D system, the normal power supply to smoke alarms is derived from a lighting circuit [see **15.5**a)], and the lighting circuit also serves fluorescent luminaires, it should be confirmed, at least by reference to the written instructions provided by the manufacturer of the smoke alarm(s), that the smoke alarms will not be affected when the fluorescent luminaires are switched on or off.

23 Installation, commissioning and certification

23.1 Commentary

This clause provides recommendations for the work associated with installation of a fire detection and fire alarm system in a dwelling, the subsequent commissioning of the system, and certification of the system. In the case of dwellings, design, installation, commissioning and certification will often be undertaken by a single organization, such as an electrical contractor. In the case of Grade F systems, however, the system is normally installed by the occupier or other non-specialist. Although different processes might be undertaken by different parties (e.g. installation by an electrical contractor, with commissioning by a fire alarm system manufacturer), it needs to be ensured that one organization is responsible for compliance with this standard and that this responsibility is agreed prior to the start of the installation contract.

The nature and quality of the installation work needs to be such as to maintain the integrity of the fire detection and fire alarm system, and to minimize the duration and extent of disablement of the system during maintenance or modifications. Except in the case of Grade F systems, installation practices and workmanship need to conform to the requirements of BS 7671. Penetrations of construction (e.g. for the passage of cables) need to be made good to avoid the free passage of fire or smoke, regardless of whether the construction has a recognized degree of fire resistance.

Except in the case of Grade F systems, on completion of wiring, the installer needs to carry out tests to ensure the integrity of cable insulation and adequacy of earthing. Further tests need to be carried out on completion of the system; in large, sophisticated systems, these tests might form part of a separate commissioning process, in which certain of the tests will be specified by the system manufacturer.

The process of commissioning simply involves thorough testing of the installed system to ensure that it operates correctly in accordance with the recommendations of this standard and with any specification produced by the purchaser. Usually, the organization or person responsible for commissioning the system is the same organization or person that designed and installed the system, but the responsibility for commissioning needs to be clearly defined prior to the start of the installation work. Where commissioning is carried out by a specialist commissioning engineer, part of this engineer's role is to verify that the system does not have any obvious potential for an unacceptable rate of false alarms.

*At commissioning, where practicable, the user ought to be given an opportunity to carry out a brief inspection of the system, have its operation demonstrated and receive the relevant documents. On completion of the system, it needs to be ensured that adequate records and instructions are provided to the user. Particular importance needs to be attached to the provision of specific operating instructions (see Clause **24**).*

An important part of the documentation provided to the user comprises a certificate(s) confirming compliance of the system, and the installation and commissioning work, with the recommendations of this standard. In many cases, a copy of this certificate(s) will be required by a relevant enforcing authority, such as that enforcing building regulations or, in the case of houses in multiple occupation, housing legislation. It is essential that the person who signs the certificate(s) is competent to verify whether the recommendations of this standard have, or have not, been satisfied. The purchaser might, subsequently, rely on the certificate(s) as, for example, evidence of compliance with legislation. Liability could arise on the part of any organization that issues a certificate(s) without due care in ensuring its validity. In the case of Grade A systems, the greater complexity of these systems warrants more detailed certification of the type recommended by BS 5839-1, and the certificates issued will take the form of the model certificates contained in BS 5839-1, suitably modified to reflect compliance with BS 5839-6.

23.2 Recommendations for installation, commissioning and certification of Grade A systems

The following recommendations are applicable.

a) Grade A systems should be installed, tested, commissioned and certificated in accordance with Sections 4 and 5 of BS 5839-1:2002.

b) Model certificates of design, installation, commissioning and acceptance are contained in Annex E.

NOTE 1 The certificate issued for any of these four processes may vary in format from that shown in Annex E but, as a minimum, the information and statements of compliance within the model certificates should be provided.

NOTE 2 The certificates in Annex E enable compliance with the relevant recommendations in respect of these certificates contained in BS 5839-1, as well as the recommendations of this standard.

23.3 Recommendations for installation, commissioning and certification of Grade B, Grade C, Grade D and Grade E systems

The following recommendations are applicable.

a) The responsibilities associated with the installation, commissioning and certification of the system should be clearly defined prior to the commencement of the installation work.

NOTE 1 Normally, a single organization will take responsibility for installation, commissioning and certification of the system, but the responsibilities should be defined by, or agreed with, the purchaser or specifier.

b) All variations from the recommendations of this standard (see **3.35**) should be agreed with the purchaser and, where the system is required to satisfy legislation or the requirements of the fire insurer, with the authority responsible for enforcing fire safety legislation (e.g. the building control authority or local authority) or the fire insurer respectively.

c) In the case of Grade B and C systems, 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.

d) The installer should provide the user with "as fitted" drawings indicating at least the positions of all control, indicating and power supply equipment and the positions of all manual call points, fire detectors and fire alarm devices.

e) The installation should conform to the requirements of BS 7671.

f) Cables that are directly fixed to surfaces should be neatly run and securely fixed at suitable intervals, in accordance with the recommendations of the cable manufacturer.

g) In the case of Grade B systems, methods of cable support should be such that circuit integrity will not be 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 2 In effect, this recommendation precludes the use of plastic cable clips, cable ties or trunking in Grade B systems, where these products are the sole means of cable support.

h) Joints in cables, other than those contained within the enclosures of equipment, should be avoided wherever practicable. 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.

i) Other than in the case of mineral insulated copper sheathed cables and steel wire armoured cables, cables should be given mechanical protection in any areas in which physical damage or rodent attack is likely (e.g. by installation in trunking).

j) Where a cable passes through a wall, a small clearance hole should be provided. If additional mechanical protection is necessary, a smooth-bore sleeve should be sealed into the wall. The hole surrounding the cable should be as small as reasonably practicable and made good with 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, or around any conduit or trunking.

k) Where a wiring system, such as conduit, cable ducting, or cable trunking penetrates walls, floors or ceilings of fire compartments (such as those enclosing individual dwelling units in an HMO), it should be internally sealed so as to maintain the fire resistance at the wall, floor or ceiling, as well as being externally sealed, to maintain the required fire resistance. However, a non-flame-propagating wiring system, having maximum internal cross-sectional area of 710 mm^2 need not be internally sealed.

l) Care should be taken to ensure that the ends of any sleeves are free from sharp edges that might damage cables during installation.

m) 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. The 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.

n) Earth continuity and, for mains supply circuits, earth fault loop impedance, should be tested to ensure compliance with BS 7671.

o) Any other tests specified by the manufacturer of the system should be carried out.

p) At commissioning, the entire system should be inspected and tested to ensure that it operates satisfactorily and that, in particular:

i) all manual call points and automatic fire detectors function correctly when functionally tested. 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. Heat detectors 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. The heat source should not have the potential to ignite a fire; live flame should not be used;

ii) in multi-zone Grade B or Grade C systems, 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;

iii) any facility for remote transmission of fire alarm signals (and, where appropriate, fault signals) to an alarm receiving centre operates correctly;

iv) in the case of Grade B and Grade C systems, all alarm, control, indicating, printing and ancillary functions of the system operate correctly and are adequately labelled or identified;

v) all fire alarm warning devices (including any provided for deaf or hard of hearing people) operate correctly;

vi) all relevant documentation (see Clause **24**) has been provided to the user.

q) In Grade B and Grade C systems, labels, visible when batteries are in their normal position, should be fixed to batteries, indicating the date of installation.

r) On completion of the installation and commissioning work, a certificate, confirming compliance of the system with the recommendations of this standard, or identifying any variations from these recommendations (see **3.35**), should be issued to the user. A model certificate is contained in Annex F.

NOTE 3 The certificate issued may vary in format from that shown in Annex F but, as a minimum, the information and statements of compliance within the model certificate should be provided.

23.4 Recommendations for installation, commissioning and certification of Grade F systems

The following recommendations are applicable.

a) Detectors should be rigidly fixed to permanent construction.

b) Any interconnecting wiring between detectors should be installed and routed so that mechanical damage is avoided.

c) On completion of installation, each detector should be tested to ensure that it operates correctly and that it correctly triggers signals from any interlinked detectors. If the system is installed by a professional installer (e.g. an electrical contractor), the method of test should be as described in **23.3**p)i). If the system is installed by the householder or landlord, it is sufficient to test each detector by use of an integral test button.

d) If a Grade F system is installed by a professional installer (e.g. an electrical contractor), a certificate confirming compliance of the system with this standard, or identifying any variations from these recommendations (see **3.35**), should be issued to the user. If the system is installed by the user or the landlord, certification will not be necessary for the purpose of compliance with this standard.

NOTE Since Grade F systems are only suitable for installation in existing single family dwellings of no more than two storeys, a certificate of compliance with this standard will not normally be required by any enforcing authority, and is unlikely to be required by a fire insurer.

24 User instructions

24.1 Commentary

It is essential that the occupier of the dwelling (which might mean all occupiers in the case of a house in multiple occupation) understands the operation of the system, the action to take in the event of a fire alarm signal, the means for avoidance of false alarms, the procedures for testing the system and the need for routine maintenance of the system. It will normally be the responsibility of the installer of the fire detection and fire alarm system to provide this information, but, as smoke alarms might be installed by the householder, the equivalent information needs to be provided by the supplier of smoke alarms.

It is important that the information provided is sufficient to ensure that the user of the system can 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.

24.2 Recommendations

The following recommendations are applicable.

a) The supplier of the fire detection and fire alarm system should provide the occupier of the dwelling (or the owner in the case of a house in multiple occupation) with written information on the following matters. The same information should be provided to purchasers of smoke alarms.

i) Operation of the system;

ii) in the case of Grades D, E and F systems, the importance of interlinking all smoke alarms and heat alarms in the dwelling;

iii) action in the event of a fire alarm signal;

iv) avoidance of false alarms;

v) the typical lifetime of components that are likely to require replacement during the life of the system (e.g. electrochemical cells in carbon monoxide detectors);

vi) a warning that an apparent false alarm from a carbon monoxide detector might actually be caused by a potentially dangerous concentration of carbon monoxide (e.g. from a poorly ventilated fuel burning appliance);

vii) action in the event of a false alarm;

viii) routine testing of the system (including, where applicable, arrangements for testing any means for transmission of fire alarm signals to an alarm receiving centre);

ix) maintenance of the system (including intervals at which any batteries should be replaced);

x) the need to keep a clear space around all detectors and manual call points;

xi) special precautions relevant to any lithium batteries used in the system;

xii) checking the system on reoccupation of the dwelling after a vacation, etc.;

xiii) the need to avoid contamination of detectors by paint;

xiv) in the case of systems with facilities for automatic transmission of fire alarm signals to the fire and rescue service, special instructions regarding the need to avoid false alarms (see Annex D).

b) The operating instructions should be sufficient to enable a layperson to understand fully the use of all controls and the meaning of all visual and audible signals that the system is capable of giving.

c) Operating instructions should describe the circumstances under which silencing and disablement facilities should be used, but should stress the importance of maintaining the system in the normal state, in which fire can be detected and alarm signals given.

d) The recommended action in the event of fire should stress the importance of ensuring that all occupants leave the dwelling as quickly as possible and that the fire and rescue service is summoned immediately; it should be made clear that the fire and rescue service should be summoned regardless of the size of the fire and regardless of whether there is a facility for automatic transmission of fire alarm signals to the fire and rescue service.

e) Guidance should be given to the user concerning common causes of false alarms and their avoidance. The user should be advised to take precautions to prevent false alarms and damage to detectors by contamination during work that gives rise to dust, smoke, paint spray, etc. The means for resetting after false alarms should be made clear in the instructions.

f) Instructions for routine testing of the system should accord with the recommendations of Clause **25**.

g) Instructions for maintenance of the system should accord with the recommendations of Clause **26**.

25 Routine testing

25.1 Commentary

All Grades of system need to be tested periodically to ensure that there has not been any major failure. This does not require any specialist knowledge, and can normally be carried out, quite easily, by the occupier of the dwelling, who will, however, need simple instructions in how to do so.

25.2 Recommendations

The following recommendations are applicable.

a) Instructions to users should stress the importance of routine testing of the system (see Clause **24**).

b) Grade A systems should be tested every week in accordance with the recommendations of **44.2** of BS 5839-1:2002.

c) All systems, other than Grade A systems, should be tested at least every week by operating all fire alarm devices in the dwelling. In the case of smoke alarms and any heat alarms, the weekly test may be carried out by use of a test button on each of the smoke alarms and heat alarms installed in the dwelling.

NOTE In some Grade D and E systems, a manual test switch (which can take the form of a manual call point) can be added to the system to permit routine testing without the need to access test controls on the smoke or heat alarms themselves.

d) If the dwelling has been unoccupied for a period during which the normal and standby supply (if provided) could have failed, the occupier should check immediately on reoccupying the dwelling that the system has not suffered total power failure.

26 Maintenance

26.1 Commentary

It is essential that the system is subject to periodic inspection, so that unrevealed faults are identified, and, in the case of more complex systems, so that preventive measures can be taken to ensure the continued reliability of the system.

In dwellings in which a Grade A system is provided, 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 will normally be an outside fire alarm servicing organization. Competence of a fire alarm servicing organization can be assured by use of organizations that are third-party certificated, by a UKAS-certificated certification body, to carry out inspection and servicing of fire alarm systems (e.g. certificated under the British Approvals for Fire Equipment (BAFE) SP 203 scheme or the BRE Certification LPS 1014 scheme).

26.2 Recommendations

The following recommendations are applicable.

a) Grade A systems should be inspected and serviced at periods not exceeding six months in accordance with the recommendations of Clause **45** of BS 5839-1:2002. An inspection and servicing certificate of the type contained in **G.6** of BS 5839-1:2002 should be issued. In houses in multiple occupation, batteries in any radio-linked devices (such as manual call points, automatic detectors and fire alarm devices) should be changed by the servicing organization before the low battery warning condition recommended by **27.2**b)3) of BS 5839-1 is likely to be given.

b) Grade B and Grade C systems should be serviced every six months in accordance with the supplier's instructions.

c) Smoke alarms in Grade D, Grade E and Grade F systems should be cleaned periodically in accordance with the manufacturer's instructions.

d) Where experience shows that undue deposits of dust or dirt are likely to accumulate, so affecting the performance of the system before detectors are cleaned or changed at the intervals necessary for compliance with the recommendations of **26.2**a), **26.2**b), or **26.2**c), more frequent cleaning or changing of detectors should be carried out.

Annex A (informative)
Fire risk assessment for dwellings

A.1 General

This annex discusses the factors that are generally relevant to consider in carrying out a fire risk assessment for a dwelling in order to determine the most appropriate design of fire detection and fire alarm system for any particular dwelling. It should, however, be noted that, if relevant factors, such as the characteristics of the occupants, change, there might be a need to reconsider the validity of the risk assessment and, hence, system design.

A.2 General approach

A.2.1 In assessing the fire risk, each room in the dwelling needs to be considered separately. It is appropriate for the assessment to be based on recognized fire statistics[2)].

A.2.2 In considering the probability of fire in a room, account needs to be taken both of statistical data on the relative likelihood of fire in a room of that type (e.g. living room, bedroom), and of all potential sources of ignition within the room. In considering the potential for injury or death to occupants, account needs to be taken both of statistical data on the relative likelihood of injury or death due to fires that start in a room of that type, and of all occupant characteristics, including lifestyle factors, that are relevant to the probability of their injury or death from fire.

A.3 Consideration of detection and warning objectives

A.3.1 In assessing the fire risk to which occupants of a dwelling are exposed, the following factors concerning detection and warning objectives are relevant.

a) The presence of smoke in escape routes is the greatest impediment to safe escape in the event of fire. It is essential that any fire that starts in a circulation area, or smoke that spreads into a circulation area, be detected as early as possible. To satisfy this objective, smoke detectors need to be installed in the circulation areas of all dwellings.

b) Just over half of all fatalities from fires in dwellings occur in the room where the fire originates. In this connection, it should be noted that, if the door of the room where the fire originates is closed, a smoke detector outside the room is unlikely to operate at an early enough stage to prevent loss of life in the room.

c) The combined number of fires originating in living rooms and dining rooms is similar to the number of fires originating in bedrooms. However, around 40 % of all fatal fires in dwellings start in living rooms or dining rooms, whereas approximately 30 % start in bedrooms. This suggests that, if detectors are installed within rooms in a dwelling, the living room and dining room might be the first priority, followed by the bedrooms. However, it might be appropriate to reverse these priorities if the fire risk in the living room or dining room is low but occupants smoke in bed, or if bedrooms contain potential sources of ignition such as electric blankets or other electrical appliances.

d) Occupants of dwellings are at greater risk when they are asleep. It is therefore essential that fire detection and fire alarm systems are capable of operating correctly when occupants are asleep and are capable of arousing occupants from normal sleep.

2) A suitable source of statistical information is *Fire Statistics United Kingdom* [2], published annually by the Office of the Deputy Prime Minister (ODPM). Further information can be found in the latest version of the *British Crime Survey* [3], which is also published by the ODPM.

A.4 Consideration of occupant characteristics

A.4.1 In assessing the fire risk to which occupants of a dwelling are exposed, the following factors concerning occupant characteristics are relevant.

a) Elderly people are at significantly greater risk from fire than other age groups. For those aged 80 years or more, the probability of dying from fire is several times that for those aged from 30 to 59 years. Those aged from 60 to 80 years are also at slightly increased risk. Children under 5 years are at greater risk than older children. Dwellings in which the principal occupant is elderly, or in which there is a number of elderly occupants or young children, should be protected to an appropriately high level.

b) Socially deprived occupants on a low income are more likely to suffer death or serious injury from fire than those in higher socio-economic groups. The British Crime Survey also indicates that properties located on council estates, lone parent households, households that suffer financial instability, and properties located in inner cities or areas of high physical disorder, have the greatest likelihood of experiencing a domestic fire. For those most at risk, replacement of batteries in smoke alarms may, of necessity, be a low priority. In these cases, a more reliable power supply for the fire detection and fire alarm system is essential.

c) The risk of death from fire in a house in multiple occupation is generally higher than in a single-family house. However, the term "house in multiple occupation" (HMO) includes a wide range of varying forms of dwelling, in which the risk from fire varies significantly[3)]. In some HMOs, such as households with long-term lodgers and houses shared by a limited number of persons, the risk from fire might not be very different from the risk in a similar property occupied by a single family. The risk appears to be greatest to those living in houses converted into bedsits, and to elderly people living in sheltered housing. In the event of fire, the risk to people in houses converted into flats is greater than the risk to those living in purpose-built flats, unless the same standard of structural fire protection applies in both cases. Generally, in all HMOs, the risk is greater if the property exceeds two storeys in height. Where the risk in an HMO is relatively high, it is essential that there is protection by a highly reliable fire detection and fire alarm system. It is also essential that a warning is given in the event of a fault that impairs the standard of protection.

d) People with impaired mobility require more time to escape. To allow for this, the system needs to ensure earlier warning in the event of fire; this might necessitate the provision of detectors in additional rooms.

A.5 Consideration of lifestyle factors

A.5.1 In assessing the fire risk to which occupants of a dwelling are exposed, the following factors concerning occupants' lifestyles are relevant.

a) The use of candles in dwellings has increased in recent years, resulting in more fires ignited by candles (e.g. from 760 fires in 1991 to around 2 000 fires in 2001). Non-fatal casualties from such fires have risen commensurately (from 230 in 1991 to 920 in 2001). The frequent use of candles in a particular room might be justification for a fire detector in that room, particularly if lit candles could be left unattended near combustible materials.

b) Incapacity as result of alcohol consumption or use of drugs are known risk factors for occupants of dwellings. Such incapacity can result in occupants failing to be roused from sleep by the sound of a smoke alarm or the effects of fire, until escape from fire is impossible. Once roused from sleep, those under the influence of alcohol or drugs can suffer from impaired decision-making, possible confusion and disorientation, and impaired motor functions. These factors can seriously delay or preclude escape from fire. Alcohol consumption is also sometimes a factor in ignition of fire (e.g. when an occupant falls into a deep sleep immediately after food has been left on a cooker, or while holding a lit cigarette). If alcohol or substance abuse by occupants is known to occur on a regular basis, a high standard of fire detection is warranted, possibly comprising a heat detector in the kitchen, a heat or smoke detector in the lounge, and, possibly, smoke detectors in certain bedrooms.

c) The need for use of certain medical equipment can also increase the risk to occupants from fire. Examples are medical beds, which are not subject to restrictions in bedding flammability and can be a source of electrical fires, and the use of oxygen cylinders, which can release oxygen that then results in more rapid fire development, and can explode if involved in fire. Again, these considerations might justify enhanced fire detection.

3) From *Fire Risk in Houses in Multiple Occupation: Research Report* [4].

A.6 Consideration of ignition sources

A.6.1 In assessing the fire risk to which occupants of a dwelling are exposed, the following factors concerning ignition sources are relevant.

a) In the United Kingdom, over 40 % of fires in dwellings attended by fire and rescue services involve cooking appliances. The 2001/2002 British Crime Survey, published by the Office of the Deputy Prime Minister, estimates that over half of all dwelling fires were caused by accidents while cooking. Approximately 15 % of all fire deaths result from fires that originate in kitchens. However, in existing single-family dwellings, it might not be necessary to install detectors in kitchens for the protection of life, provided that a smoke detector is sited in any adjacent circulation space. Nevertheless, it is considered that the small additional cost of installing heat detectors in kitchens in new dwellings is justifiable.

b) Electrical appliances and wiring are the second most common source of ignition of accidental fires in dwellings, accounting for approximately 10 % of all fires in dwellings, but result in only approximately 6 % of deaths. Fires involving electric blankets and bed warmers result in around 40 % of the fatalities that occur in fires ignited by electrical appliances (other than electrical cooking or heating appliances). Use of electric blankets, particularly by high-risk groups such as the elderly, increases the justification for providing smoke detectors in bedrooms.

c) Smokers' materials and matches are the third most common source of ignition of accidental fires in dwellings. However, fires started by smokers' materials and matches are the most common cause of fatalities, resulting in around 40 % of fatalities in accidental fires. In many cases, the item ignited is bedding or furniture. If occupants are known to smoke, there is greater justification for installing fire detectors in living rooms and dining rooms, particularly as older furniture might not be resistant to ignition by a smouldering cigarette or a match. If the occupants smoke in bed, consideration might be given to the installation of smoke detectors in bedrooms.

d) Space heating appliances are a further common cause of fatalities from fire in dwellings. Such fires account for around 12 % of fatalities in accidental fires. These fires often result when combustible materials are placed too close to the source of heat. If portable heaters or solid-fuel fires are used during the night, there might be justification for installing smoke detectors in the relevant rooms, particularly if these are bedrooms.

e) Arson is a growing problem; the number of maliciously ignited fires in dwellings trebled in the 20 years from 1981 to 2001. Malicious ignition is the second most common source of ignition of all fires in dwellings, although the proportion of deaths that result remains around 10 %. Malicious ignition is a more significant source of ignition of fire in multiple-occupancy dwellings than in single-family dwellings. If malicious fire-raising is a significant possibility, the level of protection needs to be high. If malicious ignition by a third-party is considered to be a significant threat (e.g. by passing burning material through a letterbox), the system needs to be capable of providing early warning of a fire inside the dwelling that starts in the vicinity of any entrance door.

A.7 Additional considerations for property protection

A.7.1 The matters described in **A.3**, **A.4**, **A.5** and **A.6** relate to the risk to life from fire. All systems complying with this part of BS 5839 should be designed to protect occupants in the event of fire. Only in exceptional circumstances (e.g. in a house of historic importance in which no one sleeps) is it likely that the objective of the system would be solely the protection of property. However, the objective of the system might sometimes be the protection of property as well as of life. A fire detection and fire alarm system for the protection of property needs to be able to detect fire automatically and result in the summoning of the fire and rescue service at an early enough stage in fire development to ensure that, when the fire and rescue service arrives, the fire is relatively restricted in extent.

A.7.2 If the attendance time of the fire and rescue service is incompatible with the probable rate of fire spread, and water supplies for fire-fighting are limited, the provision of additional fire protection measures to limit fire development prior to the arrival of the fire and rescue service needs to be considered in the case of properties of particular importance (e.g. a historic country mansion).

A.7.3 Additional considerations need to be taken into account in assessing the risk to property from fire, and these have implications for the design of systems intended to protect property as well as life.

A.7.4 Since a fire that starts anywhere in the house will result in damage, detectors need to be provided in some or all rooms of the dwelling. It is unlikely to be sufficient to provide detectors only in circulation areas. The primary considerations are the probability of fire in each room and the probability that fire will be discovered before significant spread occurs. Accordingly, there might be a need for fire detectors in kitchens, living and dining rooms, for example, as well as in boiler rooms and other infrequently visited areas (e.g. cellars and roof spaces) where there are likely sources of ignition. Table A.1 can be used as a basis for prioritizing the areas in which additional detectors should be installed.

A.7.4 There is evidence that the presence of fire detectors can result in a reduction in the amount of damage in the event of fire, provided that prompt action is taken when fire is detected. Even in dwellings protected by smoke alarms, property has on occasions been saved because neighbours heard the alarms when the dwelling was unoccupied. However, a good level of property protection can usually be achieved only if there is a means for automatic transmission of fire signals to the fire and rescue service when the dwelling is unoccupied (see Clause **20**).

Table A.1 — Relative frequency of fire in rooms within dwellings[a]

Room	Proportion of all domestic fires %
Kitchen	54
Bedroom, bedsitting room	12
Living room, dining room	12
Access area	6
Refuse area	3
Store room	2
Bathroom, cloakroom, WC	2
Roof space	1
Laundry	1
Airing cupboard, drying cupboard	1
Miscellaneous and unknown	7

[a] Based on information provided by the Office of the Deputy Prime Minister.

Annex B (informative)
Choice of appropriate Grade of fire detection and fire alarm system

B.1 General approach

This standard recognizes six different Grades of fire detection and fire alarm system, which differ widely in cost, complexity, reliability and level of self-monitoring. The guidance in this annex is intended to assist in selection of appropriate Grade, based on the specifier's assessment of the risk to occupants of the dwelling from fire.

B.2 Grade F (Battery-operated smoke alarms and heat alarms)

B.2.1 The simplest form of fire detection and fire alarm system is a single battery-operated smoke alarm. The protection afforded by these devices is obtained at very low cost and they are relatively simple to install in existing dwellings.

B.2.2 Battery-operated smoke alarms conforming to BS 5446-1:2000, and heat alarms conforming to BS 5446-2, give an audible fault warning before an increase in the internal resistance, or a decrease in the terminal voltage, of the battery prevents correct operation. Provided that the battery is always replaced when necessary, battery-operated smoke alarms and heat alarms can provide a degree of protection at minimal cost. However, the audible fault warning can be disabled by removal of the battery, and failure to then replace the battery results in loss of protection. The socio-economic groups most at risk from fire are those least likely to be able to ensure that a healthy battery is always present. Batteries are also sometimes removed to prevent false alarms or, in the case of batteries used in some smoke alarms and heat alarms, for use in other appliances. In some "tamper proof" models, access to batteries does, however, require use of a special tool, to reduce the risk of casual battery removal. The ability of battery-operated smoke alarms and heat alarms to detect a fire some years after initial installation is, nevertheless, not considered to be high. Reliability can, however, be improved by use of long-life (e.g. lithium) batteries.

B.3 Grade E (Mains-powered smoke alarms and heat alarms)

B.3.1 Mains-powered smoke alarms and heat alarms are potentially more reliable than battery-operated devices because they require less attention by the user. The cost of the fire detection and fire alarm system is, however, higher, owing to the need to install a mains power supply to the smoke alarms and heat alarms, and to the higher cost of the smoke alarms and heat alarms themselves.

B.3.2 Mains-powered smoke alarms and heat alarms suffer from the disadvantage that there is no protection when the electrical supply to the circuit supplying the detectors is interrupted. This interruption can occur for any of the following reasons.

a) The electricity supply to the dwelling might be interrupted due to a fault in the public electricity supply. In this case, the fault is unlikely to exist for more than a few hours and, in most areas of the United Kingdom, faults of this type occur infrequently. The proportion of time for which mains-operated detectors are disabled by supply faults is likely to be almost negligible.

b) The electricity supply to the dwelling might be disconnected deliberately by the public electricity supplier in order to carry out essential maintenance or other work. This would normally occur only after occupiers have been notified. Disablement for this reason is infrequent, usually of relatively short duration and normally occurs during the day, when the fire risk to occupants is lower.

c) The electricity supply to the dwelling might be disconnected deliberately by the public electricity supplier for contractual reasons (e.g. failure by the occupier to pay for supplies). Disablement of this type is largely, but not solely, associated with social deprivation.

d) The electricity supply within the dwelling might be disconnected at a coin- or card-operated meter because of the inability of the occupier to pay for further supplies. This is usually associated with social deprivation.

e) The circuit supplying the smoke alarm(s) might be interrupted due to a fault or to the unwanted tripping of a protective device (e.g. a circuit breaker or residual current device), or by deliberate action on the part of the occupier (e.g. due to a previous false alarm).

B.3.3 In order to ensure reliability and provide a suitable means for deliberate disconnection in the event of a fault that results in a prolonged false alarm of fire, smoke alarms and heat alarms operated only from a mains supply ought to be supplied from a dedicated circuit at the dwelling's main distribution board (see **15.6**).

B.3.4 A further disadvantage of smoke alarms and heat alarms operated solely from a mains supply is that, if a fault occurs on the circuit supplying the detectors, a warning is not always given, other than visually at the detectors. The detector(s) could, therefore, unknown to the occupants, remain disconnected for a considerable time. Although this could be overcome by connecting the smoke alarms and heat alarms to a circuit supplying, for example, regularly used lighting, the benefits would be outweighed in many cases by the risk of failure of a lighting circuit due to fire damage, before fire has been detected and adequate warning has been given to occupants.

B.3.5 In many existing typical single-family dwellings in which occupants are not considered to be at high risk from fire, the reliability of mains-operated smoke alarms and heat alarms might be sufficient to provide an adequate degree of protection. However, consideration would need to be given to the relative frequency of mains supply failures or disconnections and the likelihood that, during such periods, occupants will use methods of lighting, heating and cooking that would increase the fire risk.

B.4 Grade D (Mains-powered smoke alarms with standby supplies)

B.4.1 The reliability of systems comprising mains-powered smoke alarms and heat alarms can be improved by the use of devices that incorporate, within each device, a standby supply (e.g. a primary or secondary battery or a capacitor), which powers the smoke alarm or heat alarm when the mains supply is unavailable. The installation of mains-powered smoke alarms and heat alarms with standby supplies needs to be considered if the reliability of the mains supply is not high, or if the fire risk is likely to increase during periods of failure or disconnection of the mains supply to the dwelling.

B.4.2 Although the cost of these smoke alarms and heat alarms might be higher, this additional cost is, nevertheless, justified in the case of fire detection and fire alarm systems in new dwellings. It is also justified in the case of systems installed in existing dwellings occupied by persons who might not be able to replace batteries soon after the audible fault warning of a battery-operated smoke alarm or heat alarm sounds (e.g. elderly or socially deprived occupants).

B.4.3 Because of its capability to operate in the event of mains failure, a fire detection and fire alarm system comprising mains-powered smoke alarms and heat alarms that incorporate a standby supply may be connected to a lighting circuit (see **15.5**). This has the advantage that the circuit is unlikely to be disconnected for a prolonged period of time. However, consideration needs to be given to the difficulty of disabling a smoke alarm that is permanently in the alarm state owing to a fault, without isolating lighting.

B.5 Grade C (Fire detectors supplied with power from a common power supply unit, with central control equipment)

B.5.1 More effective control and monitoring of a fire detection and fire alarm system can be provided by connecting all fire detectors to a common power supply, comprising the normal mains, rectified and regulated as appropriate, with a standby supply, such as a secondary battery. Examples of such systems include:

a) one or more smoke alarms and heat alarms operating at extra-low voltage and connected to a control unit at an appropriate location in the dwelling;

b) intruder alarm systems or social alarm systems that incorporate control and indicating equipment to which one or more fire detectors are connected; the detectors can be smoke alarms or fire detectors with independent sounders.

B.5.2 This type of system normally incorporates a secondary battery of a type unsuitable for use in normal domestic appliances and removable only with the use of a tool. The battery is, therefore, unlikely to be removed for other purposes.

B.6 Grades A and B (Systems of a type described in BS 5839-1)

B.6.1 A higher standard of control, monitoring and system availability can be achieved by installing a system of the type recommended in BS 5839-1. Such systems comprise dedicated fire alarm control and indicating equipment, fire detectors and fire alarm sounders. Where wiring is used to connect the fire detectors and fire alarm sounders to the control and indicating equipment, the wiring is monitored so that a fault indication is given at the control and indicating equipment in the event of specified faults in the wiring. The cost and complexity of these systems is significantly greater than that of the systems described in **B.2**, **B.3**, **B.4** and **B.5**.

B.6.2 Systems of the type recommended in BS 5839-1 might, nevertheless, be appropriate where the risk is high and a commensurately high level of reliability is required. However, adequate protection of a dwelling might be possible without following all the recommendations of BS 5839-1.

Annex C (normative)
Control and indicating equipment for Grade B systems

C.1 General

This annex gives the functional requirements for control and indicating equipment for Grade B systems.

NOTE It is presumed that most control panels for Grade B systems will not have facilities for zone indication, or will have facilities for indication of no more than two zones. However, nothing in **C.2** to **C.17** is intended to preclude the use of multi-zone equipment or addressable systems, for which these recommendations are equally applicable.

C.2 Indications of fire

C.2.1 The operation of one or more fire detectors or manual call points should result in the following:

a) power being supplied to alarm sounder circuit(s);

b) the illumination of a red visible indicator clearly labelled with the word "FIRE";

c) the operation of a sounder within the control and indicating equipment. This sounder may be the same as the fault sounder;

d) the operation of any other functions provided, e.g. the changeover of volt-free relay contacts.

C.2.2 None of the responses specified in items a) to d) of **C.2.1** should be prevented by the simultaneous operation of two detectors, or by the operation, at a rate not exceeding one detector every two seconds, of any further detectors up to the maximum number of detectors that can be connected to the control and indicating equipment (as specified by the manufacturer).

C.3 Response time

Any delay in the responses listed in **C.2** should be limited as follows.

a) Response to a detector should occur not more than 10 s after the point at which the detector is required to operate by the appropriate part of BS EN 54.

b) The delay in the response to the operation of a manual call point should not exceed three seconds.

C.4 Silencing

A clearly labelled switch should be provided to silence the responses described in **C.2.1**a) and **C.2.1**c). The alarm should not be automatically silenced or cancelled. Operation of the silencing switch should not cancel the responses described in **C.2.1**b) and **C.2.1**d). The operation of silencing the alarms should cause the indicating equipment to give a visual and audible indication until the switch is restored to the normal position or, if the silencing facility is a biased switch, until the fire detection and fire alarm system is reset. The visual indication may be the same as that for a fault warning, provided that labelling makes this evident. The audible warning should sound for a minimum of 0.5 s at least once every 10 min.

C.5 Manual restarting of the alarm after silencing

After the fire alarm signal has been silenced, it should be possible to restart the sounders, either by restoring the silencing switch to its normal position or, if the silencing facility is a biased switch, by resetting the system while detectors or manual call points remain in the alarm condition.

C.6 Priorities

An alarm of fire should not be inhibited or delayed by any other indication that the equipment may be giving, e.g. a fault warning.

C.7 Resetting

The visible indication described in **C.2.1**b), and the operation of any ancillary function as described in **C.2.1**d), should persist until the system is manually reset by use of a reset switch at the control equipment.

C.8 Fault warnings

C.8.1 Fault warnings should be given in at least the following ways.

a) An audible warning should be given from a sounder situated within the control and indicating equipment. The sound level should be not less than 50 dB(A) at a distance of one metre from the control equipment. The audible warning may be identical to that used to indicate a fire condition. If the audible indication of fault is intermittent, it should sound for at least 0.5 s every 5 s. A facility should be provided to silence the audible fault warning. This facility may be the same as that used to silence fire alarm signals, provided that it comprises a biased switch or other arrangement fulfilling the same function and that labelling makes this clear.

b) An amber visible indicator should be illuminated on the indicating equipment.

C.8.2 Fault indications may be suppressed during an alarm condition, but in this case any faults remaining after the alarm condition has been cancelled and the system has been reset should cause the fault indication to be restored.

C.8.3 The fault warnings described in a) and b) of **C.8.1** should be given within the times specified in the event of any one of the following occurrences:

1) short circuit or disconnection of the connection to the normal power supply, or other total loss of power from such a normal power supply (within 30 min);

2) short circuit or disconnection of the standby power supply (within 15 min);

3) short circuit or disconnection of any battery charging equipment (within 30 min);

4) short circuit or disconnection of the leads to detectors, call points or alarm sounders external to the control equipment unless, in the case of a short circuit, this results in an alarm of fire (within 100 s);

5) cessation of any scanning or interrogating process within the control equipment (within 100 s);

6) rupture of any fuse or operation of any protective device [other than would result in 1) to 5)], such as to result in a fire alarm not being given as indicated in **C.2**.

C.9 Disablement

C.9.1 Facilities may be provided for isolating detectors or for disabling the fire alarm sounders (including the control sounder). A facility for isolating detectors may be combined with the reset control; a facility to disable fire alarm sounders may be combined with the silencing control.

C.9.2 The operation of any facility for disabling fire alarm sounders should be indicated visually. The visible indicator should be amber and may be the same as that used to provide a fault warning. It should be impossible to cancel the visual indication until the sounders are restored to the normal condition.

C.9.3 The operation of any facility that isolates detectors should be indicated visually and audibly. Both the visual and audible indication may be those used to provide a fault warning. The audible warning may be silenced, in which case the control for silencing may be that used to silence a fault warning.

C.10 Software-controlled equipment

Software-controlled equipment should conform to Clause **13** of BS EN 54-2:1997.

C.11 Indication of power supply

A green visible indicator should be illuminated when the normal power supply is operating. This indication should be extinguished if the normal supply fails.

C.12 Visual indicators

C.12.1 The operation or failure of one indicator should not prevent the proper and separate operation of any other indicator. The operation of any sounder, alarm circuit or other related function [see **C.2.1**d)] should not be prevented by any visual indicator defect and should not depend on the operation of any indicator.

C.12.2 Red and green indicators should not be used to indicate conditions other than fire or healthy status of the normal power supply respectively. The function of each visible indicator should be clearly identified on the control panel.

C.13 Manual controls

All manual controls should be clearly labelled to indicate their function and should be so arranged as to reduce the risk of inadvertent operation.

C.14 Electrical safety

The control and indicating equipment should comply with the following clauses of BS 3955:1986:

a) Clause **8** with the exception of **8.6**;

NOTE Marking of covers is not necessary where these covers protect elv battery terminals and need to be removed during maintenance to top up the battery.

b) Clauses **9**, **10** and **20**.

C.15 Transition between power supplies

Transitions between the main and standby supplies (and vice versa), or the reduction of mains voltage to a level outside its normal range, should not cause any change in any indications, warnings or outputs being given by the control and indicating equipment, other than those relating to the power supplies.

C.16 Recovery from total power failure

The system should be automatically restored to its normal working condition (although fault warnings may need to be reset manually) within 10 min of the restoration of the normal power supply following the failure of both the normal supply and the standby supply.

C.17 Power supply equipment

C.17.1 Any environmental changes that change battery charging parameters should be accommodated in the battery charging equipment e.g. temperature compensated battery changing for VRSLA.

C.17.2 The standby supply should be protected from discharge below the final battery voltage.

C.17.3 The power supply equipment should be capable of supplying the full alarm load at the nominal mains voltage +10 % –15 % whilst still charging the battery.

C.18 Marking

C.18.1 If control and indicating equipment for Grade B systems that meets all the recommendations of **C.2** to **C.17** is marked with a reference to this part of BS 5839, it should be marked "BS 5839-6:2004: Annex C".

C.18.2 Equipment that does not meet all the recommendations of **C.2** to **C.17** should not be marked with any reference to BS 5839-6.

Annex D (informative)
Model guidance to occupiers and landlords regarding avoidance of false alarms in systems with facilities for automatic transmission of fire signals to the fire and rescue service

Guidance to occupiers and landlords in properties with remote monitoring of fire alarm systems

IMPORTANT: You must read this guidance before your fire alarm system is monitored at a remote location.

The company responsible for the fire alarm system at your property has proposed that the system will be/continues to be [*delete as applicable*] monitored at a remote location (either an "alarm receiving centre" or the control room of your local fire and rescue service). **It is important that you read the guidance in this note carefully, before this service is provided**.

Remote monitoring of the system means that, when your fire alarm system sounds the alarm, the system automatically causes the fire and rescue service to be called (usually by staff at an alarm receiving centre). This service is often valuable if the people who live in your property have a disability and so might not be able to call the fire and rescue service themselves or get out of the property safely. It might also be required by your fire insurers if you live in a very expensive house, such as a mansion or country house.

In other properties, the monitoring service might not be of much benefit to you, as people in your property can usually call the fire and rescue service themselves, provided they do so from a place of safety, such as a telephone on the ground floor, near the front or back doors, or at a neighbour's house. Unless you live in an isolated location, if your house catches fire when you are not there, often neighbours will call the fire and rescue service.

If your fire alarm system is monitored, it is very important that you do everything possible to avoid the fire and rescue service being called to your property as a result of a false alarm.

Nearly 30 % of fire calls that fire and rescue services receive each year are caused by false alarms from fire alarm systems. This is very costly for the taxpayer, and, in rural areas, often causes part-time firefighters to be called out from their homes or places of work. Most false alarms come from workplaces, such as offices, shops, factories, hotels, hospitals, colleges, etc., and not from private houses. This is because most houses do not have fire alarm systems that are monitored at alarm receiving centres or fire and rescue service control rooms.

However, a problem is that each smoke detector in a house is usually more likely to cause a false alarm than a smoke detector in a workplace. There are good reasons for this. In the small confines of a house, fumes from the kitchen, people smoking, steam, dust, aerosol sprays and some do-it-yourself or maintenance work (e.g. causing dust or involving use of blowlamps) can set off smoke detectors (but normally not heat detectors).

The fire and rescue service understands these problems. If they are called to a false alarm at your house, they will not be annoyed, nor will you be charged any fee for their call out. However, for your safety, they will always assume that any call to your property results from a genuine fire and react accordingly. In travelling to your property as fast as possible, the firefighters put themselves and other road users at additional risk. More importantly, while attending a false alarm at your property, the fire engines are not available to deal with other real fires in the area, and this puts other people at risk.

There are many things you can do to avoid false alarms and unnecessary calls to the fire and rescue service. These are set out below. Make sure you understand these measures if you wish your fire alarm system to be monitored at a remote location. If you need advice, contact the installer of your fire alarm system or your local fire and rescue service.

1) Unless you need the fire and rescue service to attend with the minimum of delay because you are disabled or because your fire insurer requires this, a short (usually no more than two minutes) delay should be allowed for you to check whether there is a fire before the call is passed automatically to the fire and rescue service. (People in the property should not, however, delay calling the fire and rescue service if they even suspect that there is a fire.)

Normally, the delay is applied by the alarm receiving centre, who will try to telephone you to check whether the signal they have received from your system is a false alarm. If you do not answer the telephone within two minutes, the alarm receiving centre will assume that there is a fire and call the fire and rescue service. If you are certain that it is a false alarm, you should answer the telephone as quickly as possible, so that the alarm receiving centre do not call the fire and rescue service. On the other hand, if there is a fire, you should not delay leaving the house to answer the telephone. You should get out right away and telephone the fire and rescue service yourself just in case the automatic transmission system has not worked properly.

In some sophisticated fire alarm systems, the delay is not applied at the alarm receiving centre. Instead, you will have a short period (normally no more than two minutes) to check whether there is a fire. If there is no fire, you can stop the signal being sent to the alarm receiving centre by using a control on your fire alarm control panel. If you do not stop the signal, the fire and rescue service will be called without further delay as soon as it is sent. If you have this type of system, you should make sure that you understand how to use the “abort” control.

If you have any doubts about the way your system operates, whether you have, or should have, a delay period, or any other uncertainty, you should contact your fire alarm installer or maintenance company as soon as possible.

2) So that faults in your system do not cause false alarms, you must have it serviced at least every six months. You should check that you have a current contract for servicing and for call-out of an engineer if your system is faulty.

3) There might be a switch on your fire alarm panel that allows you to disable the automatic transmission facility at certain times (e.g. if you find that cooking is likely to cause false alarms). If there is not such a switch, there might be a facility to disable the fire detectors. However, you should then ensure that the system is restored to normal operation as soon as the risk of false alarms no longer exists.

4) When cooking, you should make sure that fumes from the kitchen do not reach a nearby smoke detector (e.g. by shutting the kitchen door). You should also make sure that steam (e.g. from a bathroom) does not reach any smoke detector.

5) There are two types of smoke detector, called ionization smoke detectors and optical smoke detectors. Optical smoke detectors are less likely to cause false alarms during cooking. You should make sure that the smoke detectors near the kitchen (which means smoke detectors installed in both the hallway and upstairs landing of a typical two-storey house) are optical type. If you are not sure, you should ask your fire alarm system installer or maintenance company to confirm this.

6) If people are smoking in a room with a smoke detector, make sure that the room is ventilated, so that the smoke does not reach the smoke detector. (This does not matter if the room has a heat detector.)

7) Some aerosol sprays can set off smoke detectors. You should not spray any aerosol close to a smoke detector.

8) If a lot of dust is being generated (e.g. by builders), you should protect smoke detectors from the dust (e.g. by covering them with a plastic bag). You should, however, remove this as soon as the work that is causing the dust is finished. If someone is using a blowlamp (e.g. to burn off paint) near a smoke detector, you should disable the automatic transmission facility or the smoke detectors (but restore the system to normal operation as soon as the work is finished).

9) Carbon monoxide detectors can be set off by vehicle exhaust fumes, and might give false alarms if installed in a poorly ventilated kitchen.

REMEMBER

- Always make sure that someone in the house calls the fire and rescue service when there is a fire. Do not rely purely on the automatic transmission facility.
- Make sure everyone in the house knows how to prevent false alarms.
- Make sure your system is serviced properly.
- If there is anything about the system, or how to avoid false alarms, that you do not understand, ask your fire alarm installer or maintenance organization, or contact the community fire safety department of your local fire and rescue service.

Annex E (informative)
Model certificates for Grade A systems

E.1 Design certificate

Certificate of design for the fire alarm system at:

Address: ……

……

I/We being the person(s) responsible (as indicated by my/our signatures below) for the design of the 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 Clauses **1** to **22** of BS 5839-6:2004 and the recommendations of Section 2 of BS 5839-1:2002 (as modified by the recommendations of BS 5839-6:2004) for the Grade A system 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 BS 5839-6:2004, Clause **8**):

……

Variations from the recommendations of BS 5839-6 (including any variations from Section 2 of BS 5839-1:2002, other than those specifically recommended by BS 5839-6:2004):

……

……

……

……

……

Extent of system covered by this certificate: ……

……

Brief description of areas protected (not applicable for Category LD1 or PD1 systems):

……

……

……

……

……

Detector coverage is designed to satisfy the recommendations of BS 5839-1:2002 for a Category L1 or L2 system.

N/A ☐ L1 ☐ L2 ☐

Measures incorporated to limit false alarms. Account has been taken of the guidance contained in Section 3 of BS 5839-1:2002 and, more specifically (tick as appropriate):

☐ 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: .....

.....

☐ Automatic transmission of fire alarm signals to the fire and rescue service is delayed by ……mins by a delay in transmission of fire alarm signals to the alarm receiving centre/a delay, pending verification, before the alarm receiving centre summon the fire and rescue service (delete as appropriate).

☐ 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 Sections 4 and 5 of BS 5839-1:2002 respectively.

Soak test

☐ In accordance with the recommendations of **35.2.6** of BS 5839-1:2002, 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 BS 5839-1:2002.

Verification

Verification that the system complies with BS 5839-1:2002 should be carried out, on completion, in accordance with Clause **43** of BS 5839-1:2002:

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 BS 5839-1:2002.

This certificate may be required by an authority responsible for enforcement of fire safety legislation, such as the building control authority or housing authority. The recipient of this certificate might rely on the certificate as evidence of compliance with legislation. Liability could arise on the part of any organization or person that issues a certificate without due care in ensuring its validity.

E.2 Installation certificate

Certificate of installation for the fire alarm system at:

Address: ……..

……..

I/We being the person(s) responsible (as indicated by my/our signatures below) for the installation of the fire alarm system, particulars of which are set out below, CERTIFY that the said installation work for which I/we have been responsible complies to the best of my/our knowledge and belief with the specification described below and with the recommendations of Section 4 of BS 5839-1:2002, 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 BS 5839-1 (see BS 5839-1:2002, Clause **7**):

……

……

……

Wiring has been tested in accordance with the recommendations of Clause **38** of BS 5839-1:2002. 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.

Supplied to the person responsible for commissioning the system ☐ Supplied by others ☐

This certificate may be required by an authority responsible for enforcement of fire safety legislation, such as the building control authority or housing authority. The recipient of this certificate might rely on the certificate as evidence of compliance with legislation. Liability could arise on the part of any organization or person that issues a certificate without due care in ensuring its validity.

E.3 Commissioning certificate

Certificate of commissioning for the fire alarm system at:

Address: ……

……

I/we being the person(s) responsible (as indicated by my/our signatures below) for the commissioning of the fire alarm system, particulars of which are set out below, CERTIFY that the said work for which I/we have been responsible complies to the best of my/our knowledge and belief with the recommendations of Clause **39** of BS 5839-1:2002, 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 systems described below.

Extent of system covered by this certificate: ……

……

……

……

Variations from the recommendations of Clause **39** of BS 5839-1:2002 (see BS 5839-1:2002, Clause **7**):

……

……

……

☐ 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 **39.2**c) of BS 5839-1:2002.

☐ 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 BS 5839-1:2002, I/we have not identified any obvious potential for an unacceptable rate of false alarms.

☐ The documentation described in Clause **40** of BS 5839-1:2002 has been provided to the user.

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 becomes operational, it should be soak tested in accordance with the recommendations of **35.2.6** of BS 5839-1:2002 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.)

This certificate may be required by an authority responsible for enforcement of fire safety legislation, such as the building control authority or housing authority. The recipient of this certificate might rely on the certificate as evidence of compliance with legislation. Liability could arise on the part of any organization or person that issues a certificate without due care in ensuring its validity.

E.4 Acceptance certificate

Certificate of acceptance for the fire alarm system at:

Address:

……

……

I/We being the competent person(s) responsible (as indicated by my/our signatures below) for the acceptance of the 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 system 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. (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 log book.

☐ 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:

……

……

……

……

……

……

Annex F (informative)
Model certificate for Grades B, C, D, E and F systems

Certificate of design, installation and commissioning* of the fire detection and fire alarm system at:

Address: ……

……

……

……

It is certified that the fire detection and fire alarm system at the above address complies with the recommendations of BS 5839-6 for design, installation and commissioning of a Category ……, Grade ……. system, other than in the respect of the following variations:*

……

……

……

……

Brief description of areas protected (only applicable to Category LD2 and PD2 systems).

……

……

……

……

The entire system has been tested for satisfactory operation in accordance with the recommendations of **23.3**p) of BS 5839-6:2004*.

……

Instructions in accordance with the recommendations of Clause **24** of BS 5839-6:2004 have been supplied to:*

Signed …….. Date:……

For and on behalf of ……..

*** Where design, installation and commissioning are not all the responsibility of a single organization or person, the relevant words should be deleted. The signatory of the certificate should sign only as confirmation that the work for which they have been responsible complies with the relevant recommendations of BS 5839-6:2004. A separate certificate(s) should then be issued for other work.**

This certificate may be required by an authority responsible for enforcement of fire safety legislation, such as the building control authority or housing authority. The recipient of this certificate might rely on the certificate as evidence of compliance with legislation. Liability could arise on the part of any organization or person that issues a certificate without due care in ensuring its validity.

blank

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[1] Health Technical Memorandum HTM 88: Fire Precautions in Housing Providing NHS-Supported Living in the Community. NHS Estates. 2001. London: The Stationery Office.

[2] Fire Statistics United Kingdom. Office of the Deputy Prime Minister. London: HMSO.

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