

The Design, Installation, Commissioning and Maintenance of Fire Detection and Alarm Systems in Domestic Premises

A Guide to BS 5839-6:2019

Fourth edition

Colin S. Todd



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Dedications

This book is dedicated to my three children, Keith, Jayne and Fiona, for the support they have given me, personally, and in my career, throughout their lives; also to my grandchildren, William and George. And, with love, to Karen, with a special mention for the cats of Hutton Roof.

I wish to express my gratitude to Angus Stone, Will Lloyd and Andrew Speake for carrying out technical reviews of the contents of this book, Karen Haestier for her editorial review of the content and Joanna Harding for her work in typing much of the revised content.

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About the author

Colin Todd MBE, MSc, FBEng, MIRM, MSFPE, CPhys, FInstP, C Build E, FCABE, CEng, FIET, FIFireE graduated from Edinburgh University with an honours degree in Physics. He then undertook a 1-year master's degree in Fire Safety Engineering, developing a specific interest in quantitative assessment of risk, mathematical modelling and systems engineering.

In 1975, he joined the captive insurance company of Unilever Ltd. As a member of the risk management section, he carried out regular fire surveys of Unilever premises and was responsible for providing in-house advice on loss prevention matters. He later joined the technical department of the Fire Offices' Committee (FOC), which dealt with the preparation of codes and standards on fire protection and approvals of fire protection equipment. With the FOC he specialized in electrical matters, and was responsible for assessing the suitability of fire alarm equipment for FOC approval. During this time, he represented the FOC on national committees, including those of the British Standards Institution (BSI). (The FOC was later incorporated into the Loss Prevention Council and, subsequently, the Building Research Establishment.)

Colin Todd is a chartered engineer and a Fellow of the Institution of Engineering and Technology (formerly the Institution of Electrical Engineers), the Institute of Physics, the Association of Building Engineers and the Institution of Fire Engineers. He is a corporate member of the Institute of Risk Management and the Society of Fire Protection Engineers. He is also a standards associate of the British Standards Society.

In 2014, he was awarded a BSI Distinguished Service Certificate for valuable contributions to the development of British, European and International Standards. In 2017, he was judged by a panel of experts as number one in the top 10 influential people in fire safety. He was awarded an MBE for services to fire safety in the 2020 New Year Honours List.

As the final President of the UK Chapter of the Society of Fire Protection Engineers, he was instrumental in the merger between that organization and the Society of Fire Safety Engineers to form the Institute of Fire Safety, which subsequently became the Engineering Council Division of the Institution of Fire Engineers (IFE) (now the Registrants' Group of the Institution). He is a former member of the board of the Division and the Division's Membership Committee, which he chaired for many years. The Division was empowered to award engineering qualifications,

including that of Chartered Engineer, to suitably qualified fire safety engineers. He is also a former member of the IFE Board, where he held the responsibility for technical issues. He serves on a number of BSI committees, including those concerned with fire detection and fire alarm systems. He chairs the Fire Risk Assessment Council of the Fire Industry Association (FIA) and is a board member of the FIA.

Colin is also experienced in assessment of fire alarm contractors' competence in fire alarm work, acting on behalf of certification bodies. For around 15 years, he also acted as a technical expert for the United Kingdom Accreditation Service (UKAS), in the accreditation of certification bodies that certificate fire alarm contractors under the relevant industry certification schemes. Colin's consulting practice, C.S. Todd & Associates Ltd, is independently certificated by the National Security Inspectorate (NSI) for the design and verification of fire detection and alarm systems under the British Approvals for Fire Equipment (BAFE) SP203 scheme for fire alarm specialists. The practice was the first independent consulting practice to receive this certification.

Foreword

This book gives an insight into the thinking behind the British Standards Institution's (BSI) code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in dwellings (BS 5839-6). The need for the book does not arise from any deficiencies in the code; it arises from the fact that users of the code often wish to know why particular clauses have been put into the code.

Achieving a suitable design for occupancies such as houses in multiple occupation and sheltered housing requires a detailed understanding of fire protection principles. Even in relatively small dwellings, a number of engineering judgements have to be made. This book aids specifiers, designers and installers in making those judgements.

In 1994, the author of the book, Colin Todd, was contracted by BSI to write the first draft of BS 5839-6. Subsequently, in 2003, he was contracted to draft the first major revision of the code, which was published as the 2004 version. He is a member of the BSI technical committee responsible for the code, being the Institution of Fire Engineers' representative on the committee. Because of this, he was party to all the discussions that led to the 2013 edition and the new, revised 2019 version of BS 5839-6; indeed, he was very much involved in the drafting of much of the new text for the 2019 version. He is thus ably qualified to expand on and explain the content of the code. The interpretations given in this guide are, of course, Colin Todd's but, naturally, they benefit from Colin's close involvement in the development of the code.

J. Naar

Chair, BSI Technical Committee FSH/12/1, Fire Detection and Alarm Systems

1 Introduction

The aim of this book is to provide guidance on what, at the time of writing, is a recently revised version of BS 5839-6. The new (2019) version supersedes the earlier (2013) edition and incorporates significant changes, particularly in respect of the level of protection recommended for various types of domestic premises, and in respect of the premises within the scope of the code.

The code, which, as one part of the BS 5839 suite of codes and standards, bears the generic heading '*Fire detection and fire alarm systems for buildings*' is entitled '*Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises*'. As such, it is to this code that designers, suppliers, installers, regulatory authorities and consultants will turn in order to obtain guidance on good practice in respect of the provision of automatic fire detection in any type of dwelling, from a small flat to a stately home.

To many of us in the fire engineering profession, the design of fire precautions in most dwellings may lack the engineering challenge of the design of fire safety in more complex occupancies. However, it is easy to forget that the vast majority of fire deaths in the UK still occur in dwellings. Whether this is because of the attention to fire precautions that goes into the design of non-domestic buildings, leaving dwellings as something of a forgotten and final frontier for fire engineering, or whether it is simply the greater inherent risk associated with dwellings and their occupants, is a moot point; I suspect that it is a bit of both.

However, there is no uncertainty in the benefit of domestic fire detection to the safety of life from fire. Indeed, I believe that it would be no exaggeration to say that the domestic smoke detector is one of the greatest success stories in the last half century of fire protection, such has been the impact on loss of life. It is unfortunate that the media have never seemed to consider this success to be of major interest to the general public; perhaps success is less newsworthy than doom and gloom! Even in these days, when every item of expenditure seems to come under the most stringent scrutiny, I believe that expenditure to date on domestic smoke detection can be shown to be cost-effective in terms of lives saved, given typical figures quoted for the value of a human life.

So domestic fire detection is successful and here to stay, but does it really warrant a comprehensive engineering code of practice, particularly as many 'systems' in dwellings still comprise nothing more than battery-operated

smoke alarms installed by the occupier? The background to the production of BS 5839-6 will be examined more closely in the next chapter. Suffice it to say at this stage that not only is the code warranted but support for legislation, particularly building regulations, with a detailed and definitive code of practice is actually essential. Moreover, although we tend to think of a house (or dwelling) as a simple three- or four-bedroom house at most, I would suggest that Windsor Castle and Buckingham Palace are houses (possibly in multiple occupation)! Indeed, case law abounds as to what, in law, actually constitutes a house and a house in multiple occupation (HMO). Happily, in using the code of practice, it will rarely, if ever, be necessary to engage in such pedantry, albeit that it can be a source of substantial income for the legal profession.

Particular occupancies, such as sheltered housing, HMOs and large mansions, require a relatively detailed understanding of fire protection principles if the fire detection systems installed in them are to be suitably designed. However, even in relatively small dwellings, there are a number of engineering judgements to be made in respect of the form of protection that is to be provided. For example, will battery-operated smoke alarms be sufficiently reliable? Unfortunately, deaths have occurred in dwellings protected by such devices from which batteries have been removed because of an inability to pay for replacements, frequent false alarms and 'borrowing' the batteries for use in other household appliances or toys.

To what extent does this mean that 'tamper-proof' batteries should be used (whether in battery-only devices or mains/battery devices)? If we use mains-operated smoke alarms, should we connect them on their own circuit or is it acceptable to connect them on, say, an existing lighting circuit? How many smoke alarms or smoke detectors do we actually need in any case? Is it sufficient to install them just in the hallways and landings or might we need them in some rooms as well? There is a need to address such questions in some detail as domestic fire detection is now the norm rather than an unusual accessory, and these matters are fully considered in the code.

I believe that the code should, for most circumstances, prove to be simple and straightforward to use. Some may argue that the code, at first reading, seems rather complicated for something as simple as dwellings. However, this is a result of the very comprehensive nature of the code and the consequent need to provide guidance on both life safety and property protection in the very wide range of buildings that may constitute dwellings of one kind or another. It is also necessary for the code to acknowledge the numerous different forms of fire detection 'system' that are currently available, ranging from one or more battery-operated smoke alarms to comprehensive new technology systems of the type described in BS 5839-1.¹ As in the case of any British Standard, the code does not

¹ BS 5839-1, *Fire detection and fire alarm systems for buildings – Part 1: Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises.*

hypothesize on what might become available but merely reflects on what is offered in the marketplace today and the recognized good practices that are associated with the different types of equipment.

Given that it is then necessary to 'match' system type to application – for example limiting the use of the simpler systems to smaller and lower-risk properties – the code at first sight may seem something of a cultural shock, bearing in mind that other available guidance is restricted to a few basic design requirements in the guidance that supports building regulations and a guide to householders produced by the Government. However, I hope that when it comes to applying the code to any particular dwelling, using any particular type of fire detection installation, the code should provide simple and definitive advice.

Even so, since BS 5839-6 effectively takes domestic fire detection a step forward and introduces new standards for the protection of dwellings by automatic fire detection, I hope that this guide will provide some insight into its recommendations and help to ensure that the philosophy behind the recommendations is implemented accurately in future installations.

However, as a code of practice, it is accepted that, in some circumstances, variations from the recommendations of the code may be appropriate; the code itself caters for such variations. As experience in the use of the code grows and any anomalies come to light, amendments may be necessary. If users of the code consider that an amendment to a code or standard may be necessary, or that some clarification may be required, it is always worthwhile writing to the BSI committee responsible for its production, in this case technical committee FSH/12/1. My experience of BSI committees is that all such comments, whether from a major installer, a small electrical contractor, a single independent consultant or whomever, are always given serious consideration, and it is from such comments that codes of practice sometimes develop and keep pace with custom and practice.

Obviously, this guide is not a substitute for the code itself but should be read in conjunction with the code. The guide should not be regarded as offering any final authoritative interpretation on any recommendations of the code, although I hope that the opinions expressed are an accurate reflection of the committee's intent when the code was published. If it is essential to obtain a definitive interpretation, such as in the event of a dispute, advice may be sought from BSI, which will refer the matter to the relevant committee. Ultimately, the final arbiter in such a dispute can, however, only be the courts. Hopefully, BS 5839-6 will prove sufficiently unambiguous that such disputes will be extremely rare.

As discussed in the next chapter, domestic fire detection has made a significant impact on fire deaths in dwellings, which account for around 80 per cent of all fire deaths. It is relatively cheap in relation to the enhancement in life safety it can provide. It can protect those in society who are most vulnerable to fire, namely the elderly and the very young. Personally, as a parent, I was always reluctant to permit my children

to stay overnight with friends unless the house had smoke alarms, particularly if I knew that members of the family were likely to smoke.

However, if the full potential of this important form of fire protection is to be realized, long-term reliability and continued use must be ensured by proper system design, appropriate installation practices and the avoidance of unnecessary false alarms. The new version of BS 5839-6 will go a long way towards achievement of this objective. As recently as 15 years ago, a family saved from fire by the early warning from a smoke alarm was newsworthy. Hopefully, by the time BS 5839-6 is ready for its next revision, the death of a family due to the absence of properly designed and installed fire detection will be sufficiently unusual to be equally newsworthy.

2 Domestic fire detection: a short history

In the UK, domestic fire detection is a relatively modern innovation. However, in the US, self-contained domestic fire detectors first became available in 1955 – 65 years ago! However, these devices were heat detectors and were relatively insensitive, even compared with the heat detectors that are available today. They were mechanically powered and used either compressed gas or a wound spring as a source of energy to operate an audible alarm that formed an integral part of the device.

The earliest relevant standard for domestic fire detection installations was probably the American National Fire Protection Association (NFPA) standard NFPA 74, *Household Fire Warning Equipment*, which was first published in 1967. The development of this standard followed withdrawal of an earlier document (NFPA 74M, *Manual on Home Fire Alarm Systems*), the first version of which appeared as a two-page document in 1950. Since the original publication of NFPA 74, the standard has been revised very significantly several times. In studying BS 5839-6, one can find evidence of only the most minor influence of the NFPA standard, since the British code is based more on current custom and practice in the UK and, to some extent, on the thinking embodied in BS 5839-1. However, this is not to say that the practices adopted in the UK and the US are necessarily inconsistent.

The original NFPA standard was based on practices adopted in industrial and commercial premises, whereby there was general coverage by detectors throughout protected premises. Therefore, the standard required that there be at least one heat detector in every room and a smoke detector outside the bedrooms. These detectors were of the conventional 'system' type, necessitating the provision of control and indicating equipment that could power and monitor the heat and smoke detectors. Because of the cost of such installations (estimated at \$1,500 for a small house at then current prices), they were few in number – it has been estimated that fewer than 1 per cent of homes in the US were protected in this manner.

Self-contained smoke alarms as we know them today were first produced in the US during the latter half of the 1960s. The earliest types produced were mains-powered optical detectors, but, towards the end of the decade, battery-powered ionization chamber smoke detectors were produced. During the 1960s, a number of tests led to the conclusion that

smoke detectors in circulation spaces could, in some fires at least, give an earlier warning than heat detectors in the room of origin, albeit that the tests tended to use open plan layouts.

In 1974, NFPA 74 accepted two important principles. First, it might not be necessary to install a detector within every room in a dwelling. Secondly, and consequent to the latter philosophy, different 'levels of protection' could be defined. While the highest level, Level 1, was consistent with the earlier requirements of NFPA 74, the lowest level, Level 4, required only a single smoke detector outside the bedrooms and a further smoke detector at the top of any basement staircase.

Support for the use of smoke detectors in circulation spaces comes from the conclusions of the 'Indiana Dunes' tests, which were carried out in three real houses, which were intended for demolition, during the 1970s. Following these tests, the 1978 version of NFPA 74 defined the minimum standard as smoke detection on every level of a house.

By the late 1970s, a number of states in the US required the installation of smoke detection in new dwellings under local building codes. There are, in fact, many thousands of state, city and county building codes in the US, but it is now the case that all state codes require the installation of smoke detection in dwellings (and indeed other 'sleeping risks'). In practice, whether under a state code or other local building code, all new dwellings in the US must be protected by smoke detection. Perhaps more interestingly, most such codes require this retrospectively in existing dwellings. However, enforcement of the retrospective requirement is very limited – there are no inspections, although, occasionally, a house owner is prosecuted if, for example, there is a serious fire and it is discovered that the house has no smoke detection.

In 1993, the requirements of NFPA 74 were incorporated in the new National Fire Alarm Code, NFPA 72, and it is this standard to which building codes now refer. In 2001, a US Fire Administration report recorded that it was determined in an NFPA study that 94 per cent of US housing was, even then, protected by at least one smoke alarm, although, sadly, it was estimated that 40 per cent of domestic fires occurred in the remaining 6 per cent of housing stock. (It remains the case that, as recently as 2019, 40 per cent of fire deaths in the US still occur in homes with no smoke alarms.) Given the long experience of domestic smoke alarms in the US, it is also interesting to consider the effect that smoke alarms have had on fire deaths. From 1980, a time when smoke alarm requirements were starting to become common, fire deaths have fallen from 6,500 to 3,655 in 2018.

Interestingly, this still represents one fire fatality in the US around every 144 minutes and is a significantly higher rate of fire deaths than are now experienced in the UK; the population of the US is around five times that of the UK, but the annual number of fire deaths in the US is around

11 to 12 times the number in the UK (though President Trump might offer a different narrative!).

It has been estimated that the effect of 100 per cent compliance with the NFPA standard throughout the US would result in a 50 per cent drop in fire deaths. NFPA estimates that the death rate per 1,000 fires is more than twice as high in homes that do not have any working smoke alarms. In the UK, the distinction between death rates in dwellings with, and without, working smoke alarms is even greater.

Noted in a later chapter is that, in the UK, BS 5839-6 attempts to move things forward from the simple battery-operated smoke alarm to smoke alarms and smoke detection systems of higher reliability. This mirrors progress in the US, where the NFPA standard accepts battery-powered detectors only for retrofitting in existing homes but requires mains-powered devices for new homes. Since the 1996 edition, the NFPA 72 National Fire Alarm Code has required mains-powered smoke alarms with a standby supply for new homes.

As in the UK, there is experience in the US that smoke alarms are not being adequately maintained. In this context, clearly, battery-operated devices present the greatest potential for failure. In 1995, the Consumer Product Safety Commission in the US released the results of its National Smoke Detection Project. It was found that, when initially tested, about one-third of detectors (mains and battery operated) did not function. When the power supplies were reconnected, approximately one half of the detectors then functioned correctly. The NFPA then estimated that households with non-working smoke alarms outnumbered those with no smoke alarms. Of particular interest was the fact that most of those that initially failed to function had been intentionally disconnected due to false alarms. This study had a clear message in terms of the effect of false alarms on user attitude towards smoke alarms, and the importance, in effect, to life safety of minimizing false alarms. The approach of BS 5839-6 to this problem is discussed in a later chapter.

In the UK, smoke alarms first became available in the 1970s. The first devices were generally of the battery-operated type and were imported from the US. The cost, which was sometimes as high as £45 per unit (around £500 at today's prices), was extremely expensive compared with today's prices of just a few pounds. It is difficult to think of any other common consumer products that have spiralled downwards in price to such a great extent, which is something of a tribute to the manufacturers' contribution to domestic fire safety.

Initially, there was no great enthusiasm for smoke alarms, and various obstacles to their widespread usage were sometimes expressed. These included the differences in construction of American and British dwellings, a perception that nation-wide use would not be cost-effective, concerns of users over false alarms and, of course, the relatively high cost to the

individual householder, the highest-risk category of whom would be unable to afford such a perceived non-essential.

By 1987, only 9 per cent of all houses in England and Wales were protected by even a single smoke alarm. However, active campaigns by individual fire brigades and, more particularly, vigorous central government-funded advertising began to take effect in the latter part of the 1980s. The year 1988, in particular, was a time of enormous growth in smoke alarm sales.

In 1988, the Home Departments published guidance for householders entitled *Smoke alarms in the home*. This booklet was also reproduced as an appendix to BS 5839-1:1988. As demand for smoke alarms grew, the prices fell dramatically; as prices fell, more householders, convinced by fire brigade/Home Office campaigns, felt able to justify the cost, and the upward spiral of demand, along with the downward spiral in cost, was inexorable. Ionization chamber detectors were the cheaper and so were in greater demand than optical detectors. The law of supply and demand caused the differential to increase to an extent that, for some time, the differential in price was around 3:1 in the case of battery-operated devices, although only about 30 per cent in the case of mains-operated smoke alarms. As discussed in a later chapter, the guidance contained in BS 5839-6 has tended to result in increased sales of optical detectors and thus a significant decrease in price differential, particularly for mains-operated and 'long-life' battery-operated alarms.

The first available guidance in the form of *Smoke alarms in the home* implied that one smoke alarm might be sufficient in a multi-storey house, although it was made clear that two or more would offer more reliable early warning and greater time to escape; the intention was clearly to ensure that some affordable protection was provided in as many dwellings as possible. The Government was, however, still reluctant to make the installation of smoke alarms compulsory in normal single-family dwellings.

In other, higher-risk dwellings, the situation was rather different. In this connection, a particularly 'live' issue, and one that remains a current issue today, is the problem of fire safety in houses in multiple occupation (HMOs). In 1985, a working party established by the then Institute of Environmental Health Officers (now the Chartered Institute of Environmental Health) determined that the risk of dying in a fire for those living in HMOs was between eight and 10 times the risk of dying in a single-family dwelling. However, in England and Wales, the relevant legislation, at the time, namely the Housing Act 1985, permitted local authorities to require only adequate means of escape; there were no powers to require fire detection and alarm systems (or emergency lighting, fire extinguishing appliances, etc.). The Act was, nevertheless, amended by the Local Government and Housing Act 1989 to enable the local authority to require other 'fire precautions', which was generally accepted to include automatic fire detection and alarm systems.

(Unfortunately, because of a transfer of responsibility for guidance on fire precautions in HMOs from the Home Office to the Department of the Environment (DoE), it was 1992 before suitable guidance on the standards that should be required was made available in the form of Department of the Environment Circular 12/92.) Subsequent research carried out on behalf of the Government, and published in 1997, suggested that the risk of dying from fire was actually highly variable across the many very different types of properties that constitute HMOs. Some findings of this research were taken into account in the drafting of the 2004 version of BS 5839-6.

So this special category of high-risk dwellings could be required to have automatic fire detection under powers granted by legislation. In 1990, further support for the use of smoke alarms and, in the case of certain dwellings, complete fire detection systems complying with BS 5839-1, came in the form of BS 5588-1,² which recommended that self-contained smoke alarms (requirements for the performance of which had been incorporated in BS 5446-1³ during the same year) or a BS 5839-1 system be installed in all dwellings. In 1993, BS 5588-1 was amended to recommend that, in the case of smoke alarms, these should be mains powered. For certain dwellings (sheltered housing, flats in a mixed user development that was protected by an automatic fire detection and alarm system and large private dwellings, such as country mansions), BS 5588-1 specifically recommended a fire detection and alarm system complying with BS 5839-1.

However, undoubtedly the greatest impetus to the future use of smoke detection in dwellings came in the form of proposals that all new dwellings should be required by legislation to be protected in this manner. In 1991, the then MP for York, Mr Conal Gregory, appalled by the deaths and injuries in dwellings, introduced a private member's bill, the Smoke Detectors Bill, requiring smoke detection in all dwellings. This bill received all-party support, but there was concern over any retrospective requirements that it might contain.

Ultimately, the Smoke Detectors Act 1991 received Royal Assent in July of that year, and required that smoke detectors be installed in all new dwellings in England and Wales. However, the Act was framed in such a way that it would be brought into effect only when the Home Secretary so determined by means of an order contained in a statutory instrument. The Government took the view that the matter should be dealt with by the then DoE through the Building Regulations, and therefore no such statutory instrument was ever issued; the Smoke Detectors Act therefore

² BS 5588-1, *Fire precautions in the design, construction and use of buildings — Part 1: Code of practice for residential buildings*. (Since superseded by BS 9991.)

³ BS 5446-1, *Components of automatic fire alarm systems for residential premises — Part 1: Specification for self-contained smoke alarms and point-type smoke detectors*. (Since superseded by BS EN 14604.)

remained in limbo and was never brought into effect. Ultimately, in 2006, it was repealed by the Regulatory Reform (Fire Safety) Order 2005.

Instead, the then DoE addressed the matter of smoke detection in dwellings as part of its revision of the Building Regulations and the guidance that supports them. The Building Regulations 1991, which came into force in England and Wales in June 1992, required that all dwellings be provided with adequate means of escape (Requirement B1 of Schedule 1 to the Regulations made this requirement in respect of all buildings to which the Regulations apply, except prisons). Approved Document B, which supports the Regulations by setting out the normal means of compliance with their requirements, then specified that dwellings should either be protected by an automatic fire detection and alarm system complying with the recommendations of BS 5839-1 for a Type L3 system or be provided with a suitable number of mains-operated smoke alarms that conformed to BS 5446-1.

Technically, therefore, at that time, there was not a specific requirement within the Building Regulations (or any other legislation) in England and Wales to provide smoke detectors in all new dwellings. It was simply the case that smoke detection was generally deemed necessary to satisfy Requirement B1. The requirement for smoke detection did not, however, sit comfortably as one of the provisions for adequate means of escape. Moreover, in theory, it would have been acceptable to demonstrate that adequate means of escape was provided by some other means. This somewhat inelegant means by which smoke detection was required in new dwellings in England and Wales ceased to exist after the year 2000. In that year, amendments to the Building Regulations 1991 (which later became the Building Regulations 2000 and are now the Building Regulations 2010) incorporated a new Regulation B1, which required that, in all premises within the scope of the Regulations (including dwellings), there must be not only adequate means of escape in case of fire but also appropriate provisions for the early warning of fire. The requirement for fire detection systems in dwellings (and some means of giving fire warning in all premises) thus became much more explicit.

An amended Approved Document B (2000 version) continued to provide the supporting guidance on the means of compliance with Regulation B1. The guidance did, however, somewhat undermine BS 5839-6; even though the guidance referred to BS 5839-6, as an alternative to compliance with the code, Approved Document B accepted compliance with 19 specific paragraphs in the Approved Document (other than in the case of large dwellings, for which a system complying with BS 5839-1 was advocated). Of course, these paragraphs could not possibly reflect all the technical recommendations of BS 5839-6, which had been developed primarily to support the Building Regulations.

In Scotland, the situation was much simpler. Smoke detection in new dwellings was first required when the Building Standards (Scotland) Regulations 1990 were amended by the Building Standards (Scotland)

Amendment Regulations 1993 to include a specific requirement that every dwelling be provided with adequate means of warning the occupants in the event of fire. (Subsequent amendments extended this to all residential accommodation and enclosed shopping centres, and then, later, to all premises within the scope of the Regulations.) The Technical Standards that then supported the Regulations set out 'deemed to satisfy' standards for the necessary fire detection. These requirements were broadly in line with the recommendations of BS 5839-6 for a Grade D Category LD3 system (other than in the case of large dwellings, for which a BS 5839-1 system was required), but all the recommendations of BS 5839-6 did not need to be satisfied. Instead, the Technical Standards simply set out about half an A4 page of technical requirements drawn from BS 5839-6.

In Northern Ireland, the situation began as something between that in England and Wales and that in Scotland. In 1993, the Building (Amendment) Regulations (Northern Ireland) 1993 amended the Building Regulations (Northern Ireland) 1990 to make specific and detailed requirements in respect of smoke detection in dwellings. These requirements were, again, similar to the advice contained in Approved Document B. Subsequently, in the Building Regulations (Northern Ireland) 1994 (now the Building Regulations (Northern Ireland) 2012), the requirement was cast in a more functional form, but was still more specific in relation to fire detection and alarms than the Regulations in England and Wales. The then requirement under the Regulations in Northern Ireland was that, for all buildings, in the event of fire, there must be adequate means of giving warning and, where appropriate, adequate means of automatic detection. The supporting guidance was set out in Technical Booklet E 1994 published by the Department of the Environment (Northern Ireland). The approach was very similar to that in Approved Document B, in that (other than in large dwellings) it was possible to follow just six paragraphs in the Technical Booklet, rather than adopting BS 5839-6 in its entirety. However, as in Scotland, mains-operated smoke alarms in new dwellings in Northern Ireland were required to have a standby supply, which was not then the case in England and Wales.

The three sets of building regulations gave rise to certain difficulties. For example, the reference to a Type L3 system in accordance with BS 5839-1, which occurred in all three supporting documents, implied that if, instead of smoke alarms, a BS 5839-1 system is installed, detectors should be installed in all rooms opening onto the circulation areas, which could mean virtually all rooms in the house. Clearly, this is not what was intended, since, in the case of smoke alarms, only the circulation areas needed to be protected to satisfy the requirements. The problem arose because L3 was the lowest life safety designation recognized in BS 5839-1:1988, but, in order to protect escape routes, that code advised that detectors should be installed in all rooms adjoining the escape routes; this standard of protection was intended for situations such as hotel corridors, rather than domestic buildings.

A more specific inconsistent detail in these sets of Regulations was the form of electrical supply to smoke alarms. All required mains-powered devices but, whereas, as noted above, in Scotland and Northern Ireland a standby supply (battery or capacitor) was required, in England and Wales, 'mains-only' smoke alarms without any standby supply were acceptable. BS 5839-6 led the way somewhat by recommending the provision of a standby supply for smoke alarms in all new dwellings, and this recommendation was adopted in the subsequent revision of Approved Document B.

Now, in 2020, all three guidance documents that support building regulations in England, Wales, Scotland and Northern Ireland specify that smoke alarms in dwellings should be mains operated with a standby supply. The guidance documents continue to permit compliance of smoke alarm installations with just the key points of BS 5839-6, which are set out in each guidance document, as opposed to full compliance with BS 5839-6. In England and Wales, in dwellings of more than one storey, with any storey exceeding 200 m² in area, a Grade A Category LD3 system is specified by Approved Document B if the dwelling has two storeys, or a Grade A Category LD2 if there are three or more storeys (i.e. smoke alarms are precluded). It is notable that, only in the case of large dwellings, with one or more floors over 200 m² in area and three or more floors in total, are detectors specified in areas other than circulation areas. The Category LD2 system specified for such dwellings will have detectors in the kitchens and principal habitable rooms.

In Northern Ireland, the standard of fire detection specified for dwellings in Technical Booklet E, which supports the Building Regulations (Northern Ireland), is higher than is specified for England and Wales in Approved Document B. As well as smoke detectors in circulation spaces, Technical Booklet E specifies a heat alarm in each kitchen and a smoke alarm in the principal habitable rooms. This accords with the recommendations of BS 5839-6, whereas a lower standard is accepted in England and Wales. However, as in Approved Document B, Technical Booklet E permits compliance with specified technical details regarding installation matters, siting of detectors, etc., rather than full compliance with BS 5839-6.

For large houses (of more than 200 m² on any storey), Technical Booklet E specifies a Grade B Category LD2 system for these large dwellings of up to three storeys, or a Grade A Category LD2 system if there are more than three storeys. In fact, there is now no such thing as a Grade B system; in practice, such systems, which were, in effect, BS 5839-1 systems with very simplified CIE, were never produced, and they have been dropped from the 2019 version of BS 5839-6. No doubt, when Technical Booklet E is next revised, the reference to Grade B will be dropped, probably in favour of a Grade A system.

In Scotland, the guidance in the Technical Handbook that supports the Building (Scotland) Regulations is similar to that in Northern Ireland, in that, as recommended in BS 5839-6, the guidance specifies heat detectors

in kitchens and smoke detectors in the principal habitable room(s). Again, the use of a Grade D system of smoke alarms is limited to dwellings with no storey greater than 200 m² in area. However, in contrast with the guidance in England, Wales and Northern Ireland, there is no definite guidance on the systems that should be installed in larger dwellings. It is left to the designer as to what is appropriate for compliance with the Regulations in these circumstances.

Regardless of the variations in the guidance under building regulations across the UK, the recognition of the need for smoke detection in new dwellings under legislation enhanced the status of domestic smoke detection as an essential life safety measure. Since 1987, the percentage of homes in England and Wales protected by smoke alarms has risen from 9 per cent to over 90 per cent, although this is obviously more the result of public education and awareness than new house building per se.

The mains-operated smoke alarms specified in the Regulations became readily available in the latter half of the 1980s and, clearly, have made an important contribution to detector reliability. Many years ago, a Home Office study of battery-operated smoke alarms in 10,000 houses in the Tameside region of Greater Manchester showed that, 3 years after installation, 11 per cent of smoke alarms were ineffective. In 30 per cent of these cases, batteries were either missing or flat. It is now generally accepted that mains-operated devices with a standby supply dominate sales, particularly amongst local authorities, for whose housing stock BS 5839-6 recommends against battery-operated smoke alarms.

As a code of practice, BS 5839-6 in general simply reflects good standards of custom and practice in the marketplace today. However, in a number of respects it also 'pushes the boat out' in terms of a number of aspects of design, with the intent of moving domestic fire detection forward. For example, concepts first introduced in the 1995 version of the code include the use of mini-systems (as opposed to purely self-contained smoke alarms), integrated fire and intruder alarm systems, wireless (radio-based) systems and, in terms of system performance, better-designed installations that will be less susceptible to false alarms. There is now much greater emphasis on avoidance of false alarms in the current version of the code.

In the 2004 version of BS 5839-6, the much greater specification of standby power supplies for mains-operated smoke alarms is one example of the manner in which domestic fire detection moved further forward as a result of the revision of BS 5839-6. Perhaps more importantly, the 2004 version of the code recommended that, for all new dwellings, detectors should be installed not just in the circulation areas but in the kitchen and the 'principal habitable room' (i.e. normal living room). This further improves the standard of fire protection in new dwellings at almost negligible cost. Unfortunately, as noted earlier, while this recommendation has been adopted for some years in the guidance that supports building regulations in Scotland and Northern Ireland, it has still not, in 2020, been adopted in the guidance that supports the Building

Regulations 2010 in England and Wales, which still advocates only smoke detectors in the circulation areas of a normal-size dwelling.

In 2013, BS 5839-6 incorporated new guidance on fire alarm systems in sheltered housing. As part of this guidance, an enhanced standard of protection was advocated for each dwelling unit in sheltered housing, recognizing the vulnerability of residents in these dwellings. The recommended standard of protection in new sheltered housing flats has been further enhanced in the 2019 version of BS 5839-6, which now advocates a Category LD1 level of protection for these flats. Although, at the time of writing, these new recommendations are not yet incorporated in the guidance that supports building regulations, it is to be hoped that, as in other respects discussed above, that guidance will, in the future, be amended to reflect the recommendations of BS 5839-6.

The 2019 revision of BS 5839-6 incorporates a number of significant changes, as follows.

- The scope of the code has been extended to include supported housing. This is housing (other than sheltered housing) designed for vulnerable people with common characteristics (such as mental health issues) who are living as part of a community with support. The scope has also been extended to include certain self-catering holiday homes and certain premises with short-term paying guests.
- As discussed earlier in this chapter, Grade B systems have been dropped from the code. In addition, Grade E (mains-only smoke alarms without a battery back-up) systems have been dropped. These have not been available in the UK for some years, and their use would, in any case, never now be advocated.
- Grade D (mains/battery smoke alarms) and Grade F (battery-only smoke alarms) have been subdivided into Grade D1/Grade D2 and Grade F1/Grade F2. The designation '1' indicates that batteries are tamper proof and are not designed to be replaced by the user; in practice, most commonly, the batteries are lithium cells soldered onto a printed circuit board. The designation '2' indicates that the standby supply consists of a user-replaceable battery or batteries. This distinction permits, for example, tamper-proof batteries to be specified within the code for all rented accommodation, as it is known that those living in rented accommodation are, typically, at greater risk from fire than those living in owner-occupied dwellings.

The impetus for this distinction can be traced to a house fire in which two children died and it was subsequently discovered that the circuit serving the mains/battery smoke alarms had been isolated at the electrical distribution board of the house, and the batteries had been removed. This led to a note in the 2013 edition of the code advocating tamper-proof batteries in certain rented accommodation, but this has now been extended, in the 2019 version of the code, with a more positive recommendation that smoke alarms in all rented accommodation should incorporate tamper-proof batteries.

- Table 1, which contains the key recommendations within the code for the grade and category of system that should be installed in the various types of domestic premises within the scope of the code, has been completely revised to reflect the increased scope of the code and to recommend higher standards of protection; for example, reference has already been made to enhancement in the level of protection recommended for sheltered housing flats.
- A new recommendation has been included to address a known problem of blocking or delaying of fire alarm signals transmitted via social alarm systems in sheltered housing to an alarm receiving centre.

A further, apparently small, but important, addition to the 2019 version of BS 5839-6 was brought about by the tragic fire at Grenfell Tower in London in 2017. Following the fire, there were (possibly well-intentioned) actions to install communal fire alarm systems in purpose-built blocks of flats that were designed on the basis of a 'stay put' strategy, and for some fire alarm contractors to actively promote this concept. In a block of flats with a stay put strategy, if there is a fire in one flat, all occupants of other flats can, and should, safely remain within their own flats unless their flat is affected by fire or smoke, or they are instructed to evacuate by the fire and rescue service.

A communal fire alarm system undermines the stay put strategy and potentially exposes residents to risk by initiating their evacuation into common parts that may be affected by smoke (e.g. when the fire and rescue service opens the entrance door to the flat of fire origin). As a result of these misplaced actions, within the foreword to BS 5839-6 there is now a warning that communal fire alarm systems in these blocks of flats are normally undesirable and can even lead to risk to occupants.

In the UK, the pace of development in the use of domestic smoke detection has been rapid, with alkaline (PP3) battery-operated smoke alarms, which were quite 'newfangled gadgets' to most people 30 years ago, now beginning to look almost old-fashioned. There is no doubt that the next decade will see further significant developments in the technology and practices associated with domestic fire detection.

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3 Scope of BS 5839-6

The recommendations of BS 5839-6 basically apply to any form of fire detection installed in any premises that would, in common parlance (as opposed to a strict legal context), be described as a house or dwelling (with the possible exception of some houses that are converted into hostel-type accommodation) and in sheltered housing schemes. There will certainly be very few, if any, forms of conventional single-family (or 'single-household') accommodation that do not come within the scope of the code, whether or not such units are independent or part of larger premises. Moreover, unlike many British Standards, which are clearly not intended to be retrospective, this code gives guidance on the protection of existing, as well as new, dwellings. However, nowhere does the code suggest that existing fire detection and alarm systems in dwellings should be upgraded. It is more the case, therefore, that the retrospective nature of the code relates to new fire detection systems for existing dwellings.

The 'systems' covered by the code

Let us consider first, though, the forms of fire detection to which the code applies. Before we actually open the code to read it, the use of the term 'fire detection and fire alarm systems' in the title might, at first, mislead us; we might think that the code applies only to 'systems' in the sense that the term is used in BS 5839-1 (i.e. systems comprising control and indicating equipment, fire detectors and independent alarm sounders). In fact, nothing could be further from the truth, as is implied, if not expressly stated, in the foreword to the code, which explains that BS 5839-1 does not provide recommendations for fire detection and fire alarm systems in dwellings.

However, the very first clause of BS 5839-6 removes any ambiguity. Clause 1 ('Scope') advises that the 'systems' covered by the code range from a single self-contained smoke alarm (which could be battery operated) to complete systems of the type to which BS 5839-1 applies. Moreover, lest it be thought that the application of the word 'system' to a single battery-operated smoke alarm is something of a contradiction, it should be pointed out that the term 'fire detection and fire alarm system' is defined in Clause 3 ('Terms and definitions'). The definition for the purpose of BS 5839-6 is a:

‘system that comprises a means for automatically detecting one of the characteristic phenomena of fire and a means for providing a warning to occupants’.

A note to the definition makes it clear that this definition is intended to include ‘systems’ that comprise one or more smoke alarms, as well as, of course, the ‘systems’ to which the term is more commonly applied.

An important point to note from Clause 1 is that the recommendations of the code may be applied to the fire detection part of a combined fire/intruder alarm system or a fire/social alarm system. (Social alarm systems are alarm systems installed in the homes of elderly or disabled people to enable them to summon help in an emergency.) This is important to note because we may well see much greater use of such integrated systems, particularly those integrating fire and intruder detection, in the future.

This will, arguably, be a very good thing because it could potentially enable us to have slightly more sophisticated domestic fire detection systems, with a higher degree of monitoring and control, on the back of the intruder alarm system that occupiers will much more readily install. After all, the public perceive burglary as a much greater risk than fire, and, in the sense of the greater chance of occurrence, they are probably correct in this perception. Intruder alarm systems are no longer an accessory of the large houses of the rich – just count the bell boxes in any typical row of back to backs in any large town. Because of the mass market, the cost of control panels has dropped considerably.

Unfortunately, the public perception of fire risk was never such as to create a mass market for domestic fire alarm control panels. Such a panel was described in an annex to previous versions of BS 5839-6, and would have been the control panel for a Grade B system. However, as such panels were never produced, Grade B systems never really existed, and they have been dropped from the 2019 version of BS 5839-6. On the other hand, fire detection as a value-added facility in an intruder alarm system is likely to prove more attractive, with no need for separate control panels, and the possibility, should it be desirable, for remote transmission of fire alarm signals to an alarm company monitoring centre. Such integration is not entirely without certain technical obstacles, owing to the differences between this code and those dealing with intruder alarm systems. These will be considered in a later chapter, but they are not insurmountable; the basic philosophy should, however, be that the integrity of the fire detection and alarm arrangements should not, as a result of the integration, be reduced below the standards advocated by BS 5839-6.

The code does not specifically refer, in the scope, to integration of fire detection with other types of alarm system, but, presumably, this would be equally acceptable, subject to similar safeguards to protect the integrity of the fire detection arrangements. In the future, we are likely

to see systems in which, for example, any permutation from the following could be provided:

- fire detection;
- intruder detection;
- carbon monoxide gas detection (a growth area in the UK);
- social alarm provisions.

There are already moves to integrate fire detection with 'smart homes' technology, so possibly creating a form of Grade C system.

The properties covered by the code

Now turning to the types of premises that come within the scope of the code, Clause 1 indicates that these include, but presumably are not restricted to, the following:

- bungalows;
- multi-storey houses;
- individual flats;
- individual maisonettes;
- mobile homes;
- premises used as sheltered housing;
- houses in multiple occupation (HMOs) comprising several self-contained single-family dwelling units;
- supported housing for people with common characteristics (e.g. mental health issues) who are living in the community with support (whether or not the support is provided on a 24-hour basis);
- self-catering holiday homes with accommodation for up to 10 guests, with no accommodation below ground floor level or above first floor level, and with no floor greater than 200 m² (for larger premises, BS 5839-1 should be used);
- premises with short-term paying guests in the home of a resident operator (a 'bed and breakfast' establishment), subject to a limit of eight guests, with no accommodation below ground floor level or above first floor level, and with no floor greater than 200 m² (for larger premises, BS 5839-1 should be used);
- mansions;
- permanently moored boats used solely as residential premises.

The restriction on scope in relation to the number of guests, the location of the accommodation and the floor area in holiday homes and bed and breakfast establishments is based on a similar restriction in scope of specific guidance from the Scottish Government on fire safety measures in such premises, which was considered as a useful cut-off for use of BS 5839-6, as opposed to BS 5839-1.

BS 5839-6 is not applicable to hostels, caravans or boats (other than the permanently moored boats described above), nor is it applicable to any systems installed within the common parts of blocks of flats. As discussed in Chapter 2, communal fire alarm systems are not normally appropriate in the common parts of blocks of flats, but, if, for whatever reason, such systems are installed, they would fall within the scope of BS 5839-1, rather than BS 5839-6. Often, smoke detection is installed in blocks of flats purely to operate smoke control systems; that fire detection should not be considered as part of a fire warning system but as part of the smoke control system, in which case reference should be made to BS 7273-6.⁴

Individual flats, maisonettes and sheltered housing

In the case of flats and maisonettes used for general housing, as discussed above, the code makes it quite clear that its recommendations apply only to the individual dwelling units and not to any communal parts. This is because, in the case of blocks of flats and maisonettes, compliance with national building regulations has always necessitated that each dwelling unit is constructed as a fire-resisting enclosure. The implications of this are that, in the event of a fire in, say, a single flat within a block of flats, every other flat should usually be a place of relative safety, and complete evacuation of the block will not normally be necessary, even if, when the door of the flat with the fire is opened, some smoke enters the communal escape routes. The escape routes themselves should, of course, be sterile areas, devoid of any combustible materials. Thus, in the event of a fire, all residents, other than those in a dwelling in which fire starts, should be safe to remain within their own flat. This is normally described as a 'stay put' policy.

If there is a need for more residents to evacuate, this is then initiated by the fire and rescue service. BS 8629⁵ contains recommendations for evacuation alert systems that can be provided to assist the fire and rescue service in this respect; again, it is important that these are not considered to be fire alarm systems but as a tool provided purely to assist the fire and rescue service in alerting residents to an instruction to evacuate their flat (something of a 21st century replacement for firefighters knocking on doors).

Therefore, fire detection systems are not normally installed throughout the communal areas of flats and maisonettes. (The only occasional exceptions might be old blocks of flats with insufficient compartmentation to support a 'stay put' policy.) Indeed, a communal fire alarm system in a block of flats can actually result in a certain amount of danger to occupants by causing

⁴ BS 7273-6, *Code of practice for the operation of fire protection measures – Part 6: Fire detection and fire alarm systems – Interface with ancillary systems and equipment.*

⁵ BS 8629, *Code of practice for the design, installation, commissioning and maintenance of evacuation alert systems for use by fire and rescue services in buildings containing flats.*

unnecessary evacuation, perhaps, in the case of an actual fire, into a smoke-filled corridor or staircase. A further practical consideration is that, unless there is a 24-hour concierge or similar arrangement, there may be no responsible person to take charge of the system, to silence and reset alarms or to investigate alarm conditions.

In the case of sheltered housing, logic might dictate that a similar situation applies. In sheltered housing, each flat is designed as a fire-resisting 'box' in exactly the same way as a flat in a general needs block of flats. In very simple sheltered housing blocks with no communal facilities, architecturally, the building is more or less indistinguishable from a general needs block of flats, and then there is no need for a communal fire alarm system. However, more commonly nowadays, sheltered housing is often provided with various communal facilities, such as laundries and living rooms; the common parts may also be less sterile than those of a general needs block to provide a more homely environment by the provision of items such as tables or chairs. In addition, there is often an office for a warden or scheme manager.

Accordingly, it is commonly appropriate for a communal fire alarm system to be provided in modern sheltered housing. In addition, for reasons discussed later in this guide, in sheltered housing, it is recognized practice for fire alarm signals (both from the flats themselves and, where there is a communal system, from the common parts) to be transmitted automatically to an alarm receiving centre. In the 1995 and 2004 editions of BS 5839-6, any fire alarm system within the common parts of sheltered housing was outside the scope of the code. The system would have been covered by BS 5839-1. However, in the 2013 edition, there was a major change in the scope of BS 5839-6 (and a corresponding change in the scope of BS 5839-1). In the 2013 edition, the fire alarm systems in both the sheltered housing flats themselves and all common areas (to the extent that a system is necessary in the common parts) were brought within the scope of BS 5839-6, and any system within the common parts no longer lies within the scope of BS 5839-1 (though the Grade A system recommended in BS 5839-6 will be one to which the vast majority of the recommendations of BS 5839-1 applies). This change was made in 2013 as a result of recognition by the BSI technical committee responsible for the code of the change in the nature of sheltered housing over recent years and the lack of consistent guidance in other codes of practice and guidance documents.

Chapter 10 includes a discussion of sheltered housing and explains the background to this change of scope in BS 5839-6, as well as the philosophy behind the associated recommendations incorporated in the code.

Houses in multiple occupation

In the case of HMOs, a different situation pertains. These properties are usually large single-family houses that have been converted for multiple

occupation. (If the property were purpose-built for multiple occupation in the form of numerous single-family dwelling units, it would, of course, more likely be regarded as a block of flats and not an HMO.) The integrity of fire-resisting barriers may not, in practice, be such that each unit of accommodation can be treated as a place of safety. Therefore, the house must be treated as single protected premises. Accordingly, where the code applies to an HMO, the entire premises, and their fire detection requirements, are addressed by the code.

However, not all HMOs come within the scope of the code. It is often convenient to divide HMOs into two distinct categories, namely those comprising a number of self-contained dwellings and those of the hostel type. It was found convenient to recognize this distinction in BS 5839-6, not least because the range of premises that can be regarded as an HMO are quite wide, and the limits are not well defined. (A good lawyer can happily while away many an hour proving or disproving that a property is an HMO!) Premises that are clearly HMOs, or are normally treated (rightly or wrongly) by some authorities as HMOs, include some houses subdivided into flats, youth hostels, hostels for homeless people, homes for women who have suffered domestic violence, houses shared by students and student hostels within a university campus.

Clearly, some of the examples given above are not similar in nature to properties that we generally think of as a house; some may actually be purpose-built for their present use and may never even have started life as a large single-family home. For those at one end of the range, the hostel-like properties, BS 5839-1 appears to give adequate advice on fire detection and alarm systems. Indeed, there may be only a fine dividing line between some of these premises and conventional hotels, for which BS 5839-1 is ideal. Since there is no easy line to draw between one property of the hostel type and another, BS 5839-6 excludes all HMOs of the hostel type from its scope.

However, HMOs comprising properties in which people live in self-contained single-family flats or maisonettes are within the scope of the code. Many of these properties have some readily identifiable factors that are common to flats (e.g. the need to provide warning to occupants in the event of a fire in their own accommodation, the relatively long-term occupation by occupiers of dwelling units, the potential absence of interrelationships between occupants of different independent living units, the absence of supervision, the absence of anyone to take charge in the event of a fire warning, etc.), while retaining some factors that would also have been relevant to the original house prior to its subdivision (e.g. the need to provide warning before fire affects the communal escape routes). The likely absence of supervision and of a responsible person to monitor the alarm system and take charge in the event of an alarm signal alone gives rise to special considerations in the design of fire detection and alarm systems. In the case of properties of this type, BS 5839-1 may not, therefore, always provide sufficient guidance.

It is appreciated that circumstances will arise in which it is not entirely clear as to whether a house should be regarded as a hostel or as a number of self-contained dwellings. This can sometimes arise in the case of certain student accommodation. However, in most cases, simple common sense will dictate which description is more appropriate and, therefore, whether the appropriate code of practice is Part 1 or Part 6 of BS 5839. In any case, the same dilemma can arise in the broader application of fire legislation to such premises, and so difficulties of interpretation are not, therefore, unique to fire detection and alarm considerations.

In providing technical guidance, however, BS 5839-6 tends to regard houses shared by not more than six residents, living together as a single household, as equivalent to a single-family dwelling house, in that the recommendations of the code for single-family dwellings also apply to these dwellings. A classic example of such a dwelling is one shared by students. However, even where care is provided to some of the six residents, the code treats the premises as a dwelling (as opposed to, say, a residential care home, for which, clearly, the recommendations of BS 5839-1 would generally be more appropriate). The same approach is adopted to single-family dwellings with long-term lodgers, as research has tended to indicate that the risk to the occupants from fire is not significantly different from that in any typical single-family dwelling house.

The above interpretation of the scope of the code is also reflected in Clause 3, in which 'dwelling' is defined, for the purpose of interpreting BS 5839-6, as a:

'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; or
- d) as a shared house'.

Supported housing

Supported housing is a form of so-called specialized housing (see Chapter 10), comprising housing in the community for vulnerable people with common characteristics, such as mental health problems, blindness, etc. Earlier versions of BS 5839-6 included within their scope NHS housing in the community for people with mental illness or learning difficulties. NHS Estates previously produced specific guidance on fire safety in these properties in the form of HTM 88, and it was for properties within the scope of HTM 88 that BS 5839-6 gave guidance in previous versions of the code. However, HTM 88 is now withdrawn; supported housing is now much

broader in its scope of residents and is operated by social housing providers or local authorities, the latter of which commission the support service.

In recognition of the potential risk to residents in supported housing, the 2019 version of BS 5839-6 explicitly includes supported housing within its scope (though it might be argued that modern supported housing is a particular form of HMO and so always fell within the scope of BS 5839-6). As discussed in Chapter 10 of this guide, to address the risk, BS 5839-6 recommends the provision of comprehensive fire detection within supported housing.

Mobile homes and other forms of dwelling

For the purpose of BS 5839-6, 'mobile home' is defined as a:

'transportable unit of living accommodation that does not meet the requirements for construction and use of road vehicles'.

This somewhat convoluted description is based on definitions within other British Standards relevant to such accommodation.

However, as previously noted, the code excludes caravans from its scope.

Scope of protection: life and property

Most of the recommendations of the code are concerned principally with the protection of life. However, the code does also address property protection. This was possibly a little controversial when the first (1995) version of the code was released for public comment. At that time, BSI requested particular comment on whether it should include recommendations for property protection. The general consensus was that it should do so. Consideration was given to pulling all such recommendations together into one section, but, in practice, this is probably not necessary, as recommendations specific only to property protection are not extensive. Moreover, for protection of large properties, the code advocates that the fire detection and alarm installations should conform to the relevant recommendations of BS 5839-1.

Use of BS 5839-6 systems in workplaces

When the code was first published in 1995, there was no intention that its recommendations should be applied to places of work (other than, perhaps, in the case of someone working from their home). However, without any real reference to the BSI technical committee responsible for

the code, others produced guidance on fire protection of small workplaces that made reference to the use of BS 5839-6 systems.

Philosophically, there must, of course, be some very small workplaces in which one or two interlinked smoke alarms might be satisfactory – perhaps as a means of warning to the occupants of a small, cellular office that there is a fire in an outer office through which they must pass to escape. If the premises are so small that no electrical fire alarm system is necessary (because word of mouth would, otherwise, be a suitable means of warning in the event of fire), it might be unreasonable to expect a complete fire alarm system to be installed for the above purpose. (Even then, arguably to satisfy the Health and Safety (Safety Signs and Signals) Regulations 1996, which, effectively, require that fire alarm systems in workplaces have a standby power supply, the smoke alarm(s) would need to be mains operated with a standby battery.)

The problem with formal recognition of BS 5839-6 systems for use in workplaces is that it becomes something of a ‘thin end of the wedge’. There is serious potential for employers to then install smoke alarms or other forms of BS 5839-6 systems as a cheap, substandard alternative in premises that unequivocally require a proper fire alarm system complying with BS 5839-1. (The author has even encountered the use of domestic smoke alarms in part of a large warehouse!) To avoid this situation, BS 5839-6 excludes from its scope any premises used for purposes other than as a dwelling, such as small shops, factories or similar premises used solely as a place of work. Given this exclusion with BS 5839-6, it would seem inappropriate for any other guidance document to advocate the use of BS 5839-6 systems in workplaces, or for specifications for fire detection systems in workplaces to call for compliance with BS 5839-6. It is thus the responsibility of any party proposing the use of smoke alarms, for example, to justify their use; it is likely that such applications will be very limited.

For whom is the code intended?

When reading BS 5839-6, it is worth remembering that its recommendations, which deal with many quite complex and engineering-related matters, are not intended for the householder. Clause 1 makes clear that they are intended for architects and other building professionals, enforcing authorities, installers and others responsible for implementing fire precautions in domestic premises. However, those writing guidance for householders in the form of, say, instructions provided with smoke alarms should take account of the code’s recommendations (particularly Clause 24, which deals with user instructions) in their guidance. There will still, of course, be a need for documents such as the Government’s *Smoke alarms in the home* that give simple guidance to householders. It may be necessary, nevertheless, for such documents to be updated to take account of the code’s recommendations.

4 Format and contents of the code

Since the 2004 version, BS 5839-6 has been set out in 'practice specification' format. In this format, each clause begins with a 'commentary', followed by the actual recommendations themselves. To distinguish between the commentary and the recommendations, the commentary is written in italics, while the recommendations are written in normal standard roman text.

The purpose of the commentary is to provide background information on the principles associated with the topic that is the subject matter of the clause in question. It is written in something of a narrative style and contains no specific or positive recommendations. Thus, for example, to avoid confusion, the word 'should' is not used in the commentary, as this verb is reserved for the recommendations; rather, the wording used contains phrases such as 'it needs to be ensured', 'it is appropriate', etc.

For the contractor who wishes simply to comply with the recommendations of the code and is not concerned with the whys and wherefores of the underlying philosophy, there should be absolutely no need to read any of the commentary. Similarly, if anybody such as an enforcing authority, third-party certification body or representative of the user or purchaser is carrying out an audit of compliance with the code, the audit should be against only the recommendations of the code and not the commentary. In this sense, compliance with the commentary does not arise.

The commentary is, however, useful for those who want a greater insight into the recommendations. Such insight might actually be necessary in situations in which strict compliance with the recommendations is difficult but there is a desire still to meet the spirit of the recommendations. Thus, in considering whether a 'variation' from the recommendations of the code is acceptable, reference may need to be made to the commentary.

Turning to the recommendations themselves, these are relatively short and, for ease of reference, each and every recommendation is numbered. This assists those who wish to create checklists for compliance with the code and to refer to a specific recommendation when highlighting any area of non-compliance.

Unlike BS 5839-1, which is subdivided into seven sections that 'overlay' the conventional subdivision into clauses, BS 5839-6 is simply divided into

27 clauses, with nine supporting annexes. Some clauses cover matters that warrant an entire section of BS 5839-1, reflecting the simpler nature of the systems generally installed in dwellings. A contrast may also be drawn with BS 5839-1, in that different sections in that code are intended for different parties, such as the designer, the installer, etc. However, it is likely that the entire readership for whom BS 5839-6 is intended should probably read virtually all clauses that apply to the category and grade of system, and to the property with which they are concerned. This is because, for many BS 5839-6 systems, the designer, installer and commissioning organization will be the same party.

In the following paragraphs, each clause and annex is reviewed, and important aspects that will be discussed in later chapters of this guide are highlighted.

1 Scope

The scope of the code was discussed at length in the previous chapter. As noted in that chapter, Clause 1 describes the types of property for which recommendations are provided and the types of fire detection system covered. This clause also outlines the types of property that are outside the scope of the code. The intended readership of the code is defined, as is the scope of protection for which recommendations are given, namely property protection as well as life safety.

2 Normative references

The various other publications to which BS 5839-6 refers can be subdivided into two groups, namely 'normative' references and 'bibliography'. The latter is discussed at the end of this chapter. 'Normative' references are basically other standards and codes that provide requirements or recommendations that should be followed. Failure to comply with a normative reference is equivalent to failure to comply with BS 5839-6, since normative references, in effect, form part of the code. All of these are, in this case, BSI publications.

The normative references incorporated within the code are set out in Clause 2. If the normative reference includes a date, only the edition of that date applies. If the reference is undated in the code, the latest edition of the document applies, together with any amendments.

Since most normative references in the code are undated, this means that, over a period of time, the recommendations of BS 5839-6 could change subtly because of changes to the recommendations or requirements contained in those normative references. It is, therefore, important that users of the code ensure that they refer to the latest version of undated normative references.

3 Terms and definitions

Clause 3 defines the meanings of 67 terms used in BS 5839-6, *as they are to be understood for the purpose of interpreting the code*. Perhaps the most important is the definition of ‘dwelling’, since this helps define the scope of the code; this has already been discussed in the previous chapter.

In many cases, the definitions used are those contained in British Standards or other codes, so ensuring consistency. Where this is not the case, and the definition given is unique to BS 5839-6, significant differences between the BS 5839-6 definition and that in other codes are highlighted.

This occurs, for example, in the case of the definition of ‘monitored wiring’. For the purpose of BS 5839-6, monitored wiring is generally wiring in which an open circuit results in a fault warning, whereas a short circuit results in *either* a fault warning or a fire warning. This contrasts with the definition given in BS 5839-1, which is such that, in monitored wiring, a fault warning (and not a fire warning) results from both open and short circuit faults; monitoring, as defined in BS 5839-1, is, in fact, recommended for some systems in BS 5839-6. (If this appears to be confusing, all should become clear in later parts of the code and this guide!)

Most of the definitions merely formalize the common understanding of the terms in question, and they will be familiar to most users of the code. However, a small number of definitions determine in some subtle but important manner the way in which the code is to be understood. One example, the definition of ‘monitored wiring’, has already been discussed.

Perhaps the most significantly subtle of the other definitions is the definition of ‘fire risk’. There is a tendency for the terms ‘risk’ and ‘hazard’ to be used, quite incorrectly, in fire protection as though they are synonymous. The ubiquitous ‘fire risk assessment’ that modern fire safety legislation requires also often highlights the fact that different people mean different things when they talk about ‘fire risk’ – hardly helpful if we are to communicate successfully with each other on matters pertaining to avoidance, or assessment, of fire risk. BS 5839-6 makes it clear that, for the purpose of this document, fire risk is to be understood as a combination of the probability of fire occurring (which, by itself, is often incorrectly referred to as ‘fire risk’) and the magnitude of the consequences of fire. This tends to be consistent with the understanding of the term ‘risk’ used by those in the health and safety field, where the terms ‘hazard’ and ‘risk’ are used less interchangeably.

Thus, for example, by the definition in BS 5839-6, the fire risk would be low if there were very little chance of an outbreak of fire, even though the probability and extent of harm to occupants in the event of fire might not be low. On the other hand, even if the probability and extent of potential harm were quite low, say because of good means of escape, the

fire risk would, by definition, be high if one of the occupants were known to be prone to wilful fire raising.

An important definition, first given in the 2004 version of BS 5839-6, is that given for the term 'principal habitable room'. The importance of the term is that, for example, in new dwellings, the code recommends the installation of a detector in this room. In practice, in most dwellings, the room will be the room that is easily recognizable as the 'living room'.

Other important definitions, first introduced in the 2004 version of the code, include those applicable to the four categories of false alarm identified in the code. (The term 'false alarm' itself is also defined.) The term 'mixed system', first introduced in the 1995 version of the code, was also formally defined for the first time in the 2004 version.

4 Fire risk assessment

This clause of the code effectively sets out the philosophy that underpins a substantial part of the code. The clause is supported by an annex, which describes a 'first principles' approach to determining the appropriate form of fire detection and alarm system and the appropriate level of protection. This thereby not only offers justification for the recommendations made in later clauses dealing with these matters but also provides an approach that can be used if the reader wants to tailor make protection for a particular dwelling instead of adopting later recommendations for 'typical' dwellings. Both protection of life and protection of property are addressed, with particular emphasis, of course, on the former.

Such is the importance of this clause that a later chapter of this guide is dedicated to its subject matter. However, at this stage, it should be noted that the clause advises that the level of fire risk in dwellings covered by the code is unlikely to be sufficiently low to obviate the need for some form of fire detection and alarm system. Equally, the clause acknowledges the need for generic prescription of design parameters for specific forms of dwelling, for use when factors such as occupant characteristics are unknown. This will very often be the case, particularly in the case of application of the code to new dwellings in order to satisfy building regulations.

5 System components

Effectively, this short clause simply lists the relevant product standards with which components of the system should conform. In most cases, the relevant product standards are the British version of European Standards, published as the relevant part of BS EN 54, but, for example, they also

include, of course, the product standards for domestic smoke and heat alarms (BS EN 14604⁶ and BS 5446-2,⁷ respectively).

6 Monitoring of circuits

This clause does not apply to smoke alarms, only to fire alarm systems that incorporate control equipment. The clause provides recommendations for the monitoring of power supplies and circuits external to any control equipment.

7 Grades of system

This clause formally defines six 'grades' of system. System grade is related to engineering considerations and system format, as opposed to the level of protection afforded by the system, which is addressed in the next clause. The grades of system are discussed in the next chapter of this guide.

8 Categories of system

Clause 8 provides a method for specifying different levels of protection by reference to five 'categories' of system defined in this clause (in the same way that eight categories of system are defined by BS 5839-1). Three system categories are intended for protection of life, while a further two are intended for protection of property. Again, this is very similar to, but simpler than, the system subdivisions contained in BS 5839-1.

9 Choice of system

Having described a basis for risk assessment and its implications for system design, and having set out a menu of system grades and categories, the code logically goes on to provide definitive advice on the grades and categories of system that are appropriate for different types and sizes of dwelling. This enables the reader to by-pass the fire risk assessment clause, particularly if the occupant characteristics, which should be taken into account in a risk assessment, are unknown. (For those familiar with emergency lighting and BS 5266-1, there is some analogy between this

⁶ BS EN 14604, *Smoke alarm devices*.

⁷ BS 5446-2, *Fire detection and fire alarm devices for dwellings — Part 2: Specification for heat alarms*.

clause and the clause in that code that provides recommendations on the application of emergency escape and safety lighting for typical premises.)

This clause is one of the most important in the entire code, since it contains, within a single, quite complex table, the generic 'standard' solution for fire detection in any particular type of dwelling. This table, Table 1, was subject to major revision in the 2019 version of the code, reflecting the extended scope of the 2019 version, as well as the more stringent recommendations for certain types of premises.

10 Types of fire detector and their selection

This clause reviews the 'armoury' of detector types available to the designer and specifier. Methods of operation of the detectors are described, and there is guidance on the applications for which each type of detector is suitable. The latter guidance is related not only to fire type but also to system category (as defined in Clause 8).

11 Location and siting of fire detectors

Clause 11 provides further guidance on the location and siting of fire detectors. To a large extent, this will be related to system category, since system category will basically define the number of detectors that need to be provided and their location. However, detailed recommendations on detector siting and spacing are also given.

12 Limitation of false alarms

This is a very lengthy clause, particularly in comparison with the short clause contained in the 1995 version of the code. This reflects the much greater importance that is now attached to the avoidance of false alarms. Pragmatic guidance on avoidance of false alarms is provided. Emphasis is placed on selection of the correct type of detector and facilities for user control. The automatic transmission of fire signals to the fire and rescue service is discouraged unless significant attention is given to avoidance of false alarms.

13 Audible fire alarm devices and audibility

This clause describes a number of considerations in respect of sounder type and frequency. The most important recommendations of the clause, however, are those dealing with audibility. Definitive advice is given on the sound levels that should be achieved at the bedrooms of the dwelling.

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

This is an important clause, first incorporated in the 2004 version of BS 5839-6, which reflects the greater importance that is, happily, now attached, more generally, to fire safety of disabled people. The clause provides very useful guidance on the arrangements that should be made to warn deaf people and people who are hard of hearing in the event of fire. In general, the use of 'smoke alarm kits' conforming to BS 5446-3⁸ is recommended, unless a more sophisticated fire detection and alarm system is installed, in which case reference is made to the relevant recommendations of BS 5839-1.

15 Power supplies

Clause 15 provides detailed guidance on the power supplies (normal and, where relevant, standby) that should be used with each of the six grades of system. Clause 9 recommends that, for many applications, systems should have a standby power supply, and the appropriate specification for a standby supply is given in Clause 15.

16 Wiring

Recommendations are given for the type of wiring that should be used for each of the six grades of system. As well as electrical characteristics, protection against fire and mechanical damage is considered to the extent appropriate. The code accepts, however, that 'wireless' systems may be used, and these are considered in a later clause (see below).

17 Control and indicating equipment

This clause does not apply, of course, to systems comprising only smoke alarms, unless these are connected to some form of central power supply / control unit. However, since more complex ('grades' of) system are considered in the code, Clause 17 provides recommendations for the siting of any associated control equipment and for the facilities that should be provided by such equipment.

⁸ BS 5446-3, *Fire detection and fire alarm devices for dwellings — Part 3: Specification for smoke alarm kits for deaf and hard of hearing people.*

18 Manual call points

Discussion of manual call points is also relevant only to systems in very large properties. Guidance on the properties in which manual call points should be installed is given in this clause. Where these are to be provided, the clause gives recommendations on matters such as method of operation and siting.

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

This is yet another clause that is relevant only to very large properties, in which a system of the type considered in BS 5839-1 (or a similar system) is appropriate. Nevertheless, the very broad scope of the code makes this clause necessary for these large properties, in which detection zone indication will be valuable. However, in the case of a house in multiple occupation, other means of determining the source of an alarm condition are recognized and discussed.

20 Remote transmission of alarm signals

The circumstances under which this facility might be relevant are discussed, along with a number of technical issues relevant to transmission of alarms to (ultimately) the fire and rescue service. The clause tends to discourage the provision of such a facility unless there is a need for it and/or there are stringent precautions to avoid the unnecessary summoning of the fire and rescue service.

21 Radio-linked systems

This clause deals with the special considerations applicable to systems that use radio links between components, principally control equipment and detectors or sounders. Recommendations for power supplies are given, along with advice on factors relevant to the application of such systems.

22 Electromagnetic compatibility

Detailed guidance on this subject would be out of place in this code. In the case of systems of the type to which BS 5839-1 applies, the code refers to the more detailed recommendations contained in that code.

23 Installation, commissioning and certification

Basic good installation practices are described in this clause. In addition, there are recommendations in respect of final commissioning and certification, using the model certificates contained in the annexes to the code.

24 User instructions

This clause defines the information that the supplier should provide to the occupier or owner of the property. The recommended information is quite comprehensive and should prove of value in ensuring that systems are operated and maintained correctly. The clause is, therefore, quite important, and, in effect, defines the minimum information that should even, for example, be provided by manufacturers of smoke alarms.

25 Routine testing

This clause follows on, to some extent, from the previous clause, in that, although the user will not have a copy of BS 5839-6, the guidance in this clause should be incorporated in the instructions described in the previous clause.

26 Maintenance

This short clause briefly advises on the form of servicing that should be adopted and the periods between each servicing routine.

27 Logbook

This clause discusses the information that should be provided in a system logbook. However, the provision of a logbook is specifically recommended only for Grade A systems and any system in sheltered or supported housing.

Annex A Fire risk assessment for dwellings

This is an informative annex that is intended to assist in determination of the appropriate grade and category of system, according to the nature of the fire risk in a particular dwelling. Guidance is given on the implications of a number of factors for system design, if a designer were endeavouring to 'tailor make' a system for a specific dwelling. The factors comprise

the actual objective of the system, the characteristics of the occupants, lifestyle factors and ignition sources. Additional factors are given in the case of systems that are also intended to protect the property, as opposed to purely the occupants.

As the annex is informative, it is not necessary to refer to it in order to comply with BS 5839-6. However, it is a useful basis for the pragmatic assessment of fire risk in any dwelling.

Annex B Control and indicating equipment for Grade C systems

This is a normative annex, which (unusually for a code of practice) sets out recommended design parameters for control and indicating equipment for Grade C systems. In effect, it is a mini product standard for this equipment. As the annex is normative, for compliance with BS 5839-6, it is necessary for control and indicating equipment to conform to the recommendations of this annex.

Annex C Choice of appropriate grade of fire detection and fire alarm system

This, again, is an informative annex. It basically sets out the pros and cons of the six grades of system defined in Clause 7 of the code. In conjunction with Annex A, it can, therefore, assist the specifier in deciding on the appropriate grade of system in certain circumstances.

Annex D Model certificates for Grade A systems

This annex contains model certificates for design, installation, commissioning, acceptance and modification of Grade A systems. These are based on the equivalent certificates in Annex G of BS 5839-1:2017. As the annex is informative, other formats of certificate could be used, but they would be expected to contain equivalent information to that specified in the model certificate.

Annex E Model certificate for Grade C, Grade D and Grade F systems

This annex contains a single model certificate for the design, installation and commissioning of Grade C, Grade D and Grade F systems. The single

certificate recognizes that, for these systems, the three processes of design, installation and commissioning will probably be carried out by a single party. Again, as the annex is only informative, other formats of certificate could be used, but they would be expected to contain equivalent information to that specified in the model certificate. If different parties are responsible for each of the three processes, the certificate can be amended to indicate the actual process for which the signatory is responsible.

Annex F Model guidance to occupiers and landlords

This annex provides guidance to occupiers and landlords that should be read before installation of a domestic fire detection and alarm system from which a signal is transmitted automatically to the fire and rescue service. It is a specific recommendation of Clause 20 of the code that, before any facility for automatic transmission of a fire signal to the fire and rescue service becomes operative, the occupier or landlord (as appropriate) should be provided with written guidance regarding issues pertaining to false alarms. Clause 20 also recommends that this guidance is sent to the occupier or landlord at least every 12 months.

Annex G Method for calculating standby battery capacity for Grade A systems

This annex is adapted from Annex D of BS 5839-1:2017. The annex, which is normative, provides a formula that relates the capacity of valve-regulated lead acid batteries to the required standby duration. The normative nature of this annex should ensure that all those designing or specifying battery capacity do so on a common basis.

Annex H Model inspection and servicing certificate for all systems

This annex provides a simple, one-page certificate for servicing of any grade of system; this would even include a routine check by a contractor of, say, mains-powered smoke alarms. Again, as the annex is only informative, other formats of certificate could be used, but they would be expected to contain equivalent information to that specified in the model certificate.

Annex I Servicing procedure by a competent person

This annex sets out the work that should be carried out when a system is serviced. The procedures apply only to Grade C, D and F systems when the risk and/or circumstances require a competent person (i.e. not the user) to assess the fire alarm equipment and its operation.

Bibliography

A number of documents to which the code makes reference, but which are not necessary for compliance with the code, are set out in a bibliography at the end of the code. These include other British Standards, legislation, government guidance, etc.

5 Recognized forms of fire detection: grades of system

If we were to review all the fire detection products that are, or may be, used for the protection of dwellings, we would end up with a surprisingly wide range of permutations of system. The code recognizes all of these forms of fire detection. After all, a British Standard code of practice is meant to do just that – set out good practice in respect of the equipment that is on offer in the marketplace. Indeed, to a limited extent, the code even attempts to anticipate some variations that might be offered in the future, so hopefully avoiding unnecessary obstacles to developments in technology.

It was noted in an earlier chapter that the scope of the code encompasses fire detection and alarm ‘systems’ ranging from a single battery-operated smoke alarm to a sophisticated analogue/addressable automatic fire detection and alarm system. However, this does not imply that all of these various forms of fire detection are suitable for all applications. In order to specify the appropriate form of fire detection for any application, the code defines six different ‘grades’ of system, designated Grade A (the most sophisticated) to Grade F (the simplest).

The six grades are defined as follows.

Grade A: A fire detection and fire alarm system, which incorporates control and indicating equipment (CIE) conforming to BS EN 54-2⁹ and power supply equipment conforming to BS EN 54-4,¹⁰ and which is designed and installed in accordance with all the recommendations of Sections 1 to 4 inclusive of BS 5839-1:2017, except those in the following clauses, for which the corresponding clauses of BS 5839-6 should be substituted.

Clause/subclause of BS 5839-1:2017	Corresponding clause/subclause of BS 5839-6
16 (Audible alarm signals)	13 (Audible fire alarm devices and audibility)
18 (Fire alarm warnings for people who are Deaf and hard of hearing)	14 (Fire alarm warnings for people who are Deaf and people who are hard of hearing)
20 (Manual call points)	18 (Manual call points)
25.4e) (Capacity of standby batteries)	15.2c) (Capacity of standby batteries)
27 (Radio-linked systems)	21 (Radio-linked systems)

⁹ BS EN 54-2, *Fire detection and fire alarm systems — Part 2: Control and indicating equipment*.

¹⁰ BS EN 54-4, *Fire detection and fire alarm systems — Part 4: Power supply equipment*.