

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

A Guide to BS 5839-1:2017

Fifth edition

Colin S. Todd



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Dedications

As in the previous editions, this book is dedicated to my children, Keith, Jayne and Fiona, all of whom make me proud every day; also to my grandchildren, William and George. And to Karen for her undying love and support. (Plus a special mention for the cats of Hutton Roof.)

This book is also dedicated to the memory of a good friend and colleague of over 30 years, John Northey (1938–2010), a member of the technical committee responsible for all versions of BS 5839-1 (and its predecessor, CP 1019) since the 1970s and Chair of the committee for many years until the time of his death in 2010.

I also wish to include in my dedications those 14 souls who died in the tragic fire at Rosepark Care Home in January 2004, and all of their loved ones. Their deaths led to the amendment of BS 5839-1 in 2013, which continues with the current (2017) version. The fire safety profession, through improvements in standards, will strive to ensure that such a tragic event never occurs again.

I wish to express my gratitude to Angus Stone and Will Lloyd 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.

Contents

About the author	ix
Foreword	xi
1 Introduction	1
2 History of fire alarm installation codes	4
3 The format and layout of the code	29
4 Scope of BS 5839-1:2017	32
5 Contents of the code	38
6 Defining the terms	53
7 Selecting a suitable fire alarm system	60
8 The fire alarm contract and definition of responsibilities	67
9 The interface between the fire alarm system and other systems	71
10 The components of the system	75
11 Design of fire alarm circuits	77
12 Detection zones and alarm zones	92
13 Communication with the fire and rescue service	99
14 Audible, visual and tactile fire alarm signals	106
15 Staged fire alarms	119
16 Manual call points	124
17 Which type of detector?	128
18 Spacing and siting of automatic fire detectors	141

19 Control and indicating equipment	155
20 Networked systems	160
21 Power supplies	163
22 Cables and wiring	177
23 Radio-linked systems	186
24 Electrical earthing and electromagnetic compatibility	191
25 Limitation of false alarms and unwanted fire alarm signals	194
26 Installation work	221
27 Inspection and testing	227
28 Commissioning	229
29 Documentation	233
30 Certification	237
31 Acceptance by the user or purchaser	240
32 Verification	242
33 Routine testing	245
34 Servicing	248
35 Repair and non-routine attention	254
36 User responsibilities	259

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 follows on from previous guides to BS 5839-1 written by Colin Todd and published in 2003, 2006, 2008 and 2013. Since publication of these earlier guides, BS 5839-1 was revised in 2017, while fire safety legislation and enforcement in the UK are, at the time of writing, in a state of change as a result of the disastrous fire at Grenfell Tower in London in June 2017.

As in the case of all versions of BS 5839-1 since 2002, the advice provided by BS 5839-1:2017, the British Standard Institution's (BSI) code of practice for fire detection and fire alarm systems, is presented in the form of explanatory information followed by specific recommendations. The explanatory information helps readers to understand the rationale behind the recommendations. This guide serves to further that understanding. It is not a replacement for the code.

This guide not only explains the code but also provides extensive information regarding issues that need to be considered when designing, installing and commissioning a fire detection and fire alarm system. It could be considered as a course textbook for all those concerned with fire detection and fire alarm systems, including users, regulators and those who approve fire detection and fire alarm systems.

The guide benefits from the fact that Colin Todd was contracted by BSI to produce the draft for the 2002 version of BS 5839-1. In preparing that draft, Colin consulted various interested parties. It also benefits from the fact that Colin is a member of the BSI technical subcommittee responsible for the code, FSH/12/1, and of its parent committee, FSH/12. He was involved in the committee discussions that took place before the 2002 version of the code was published and in those before each of the amendments to the code were made and those leading to the latest (2017) version of the code.

Colin was particularly instrumental in proposing and drafting the amendments in 2013 that were made as a result of the findings of the Fatal Accident Inquiry into the tragic fire at Rosepark Care Home in Scotland in 2004, which resulted in the deaths of 14 elderly and infirm people. Colin was a Crown expert witness at the Inquiry, and recommendations he made to the Inquiry for amendments to BS 5839-1 were commended in the findings of the Inquiry for consideration by the Scottish Government. The BSI technical committee responsible for BS 5839-1 had no hesitation in considering and adopting Colin's recommendations in the hope that they would help to prevent such a tragedy in the future.

Colin has also been instrumental in the development of other British Standards, both through membership of BSI committees since 1976 and through consulting work in drafting standards, including the first versions of BS 5839-6, BS 5839-9 and BS 7273-4.

Following the Grenfell Tower fire, he was invited by the Scottish Government to join the Building Standards (Fire Safety) Review Panel, tasked with advising the Scottish Minister for Local Government, Housing and Planning on consequent changes to the Building (Scotland) Regulations and the supporting Technical Handbooks. In this role, Colin proposed the installation of evacuation alert systems in high-rise blocks of flats, a measure that came into force in Scotland from October 2019. Colin was also contracted by the Scottish Government to draft a new standard for evacuation alert systems to support their use for compliance with the Building (Scotland) Regulations. The Scottish Government tabled Colin's draft to BSI for the purpose of producing BS 8629:2019.

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 the current edition of BS 5839-1, which was published in 2017 and was subject to a minor corrigendum in February 2018. 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 design, installation, commissioning and maintenance of systems in non-domestic premises*'. As such, the code represents the universal 'Bible' for those involved in the design, installation, commissioning, maintenance and use of fire detection and fire alarm systems in the UK.

Compliance with the code is very commonly required by building control bodies throughout the UK, fire and rescue authorities and other authorities that may enforce provisions for fire safety in certain occupancies (e.g. housing authorities in the case of houses in multiple occupation, or the Health and Safety Executive for construction sites). Frequently, property insurers also require the provision of automatic fire detection systems complying with the recommendations of the code, or are prepared to take account of such systems in their underwriting considerations, provided the system complies with the code.

Consulting engineers also commonly demand compliance with the code, often as part of the electrical specification for a building. However, following the 2002 version of BS 5839-1, a simple reference to the code, along with siting of devices on associated drawings, does not, by itself, constitute 'design' of the system as that term is defined in the code. Whereas, under previous versions of the code, there could be some ambiguity as to whether some aspects of design were the responsibility of the specifier, the supplier of the equipment or the installer, the scope and duties of the 'designer' since the 2002 version of the code are much clearer, thereby, hopefully, resulting in fewer contract disputes if systems are found to fall short of compliance with the code. Experience shows, nevertheless, that there is still an educational process required before the identity and role of 'the designer' is fully understood by all relevant parties.

This guide is less detailed than the equivalent guide to the 1988 version of the code. The reason for this is that the code now contains substantial explanatory text that provides background information on the reason for the majority of the recommendations made within the code. Moreover, the 'unbundling' of the explanatory text and the recommendations within the code, effectively, makes the explanatory text, referred to in

the code as 'Commentary', a form of guide to the recommendations of the code. Although, inevitably, some of the contents of this guide will virtually repeat parts of the commentary within the code, the intention of this guide is not merely to pull together such explanatory text into a single document; instead, the guide is intended to provide readers with guidance on practical application of the recommendations in a variety of situations, taking into account the insight into the recommendations provided by the commentary. Thus, 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 it is hoped that the opinions expressed are an accurate reflection of the relevant BSI technical 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, the current edition of BS 5839-1 is sufficiently less ambiguous and clearer than previous versions that the need for such interpretations and the occurrence of disputes are not common. To further assist users in interpretation, BSI has published a series of interpretations given in response to queries put to the technical committee (rather like FAQs on internet websites). This information is given in PD 6531, the latest version of which was published in 2018.

In 2006, there were radical changes to fire safety legislation in Great Britain, with greater responsibility placed on those who employ people to work in, and/or have control over, buildings to ensure the adequacy of fire precautions in the buildings for which they are responsible. More specifically, suitable and sufficient fire risk assessments need to be carried out by all such dutyholders. Equivalent changes to legislation in Northern Ireland were implemented in 2010.

There is a compelling logic in this approach to fire safety, and it has already led to a much more flexible and pragmatic approach to the formulation of appropriate 'recipes' for fire safety in buildings. There is no doubt that this has led to enhanced recognition of automatic fire detection as one of the ingredients in the recipe. Whereas, traditionally, different components of fire protection were thought to be watertight compartments, each considered separately and independently of the others, the modern and more holistic approach to fire safety recognizes the influence that the presence of automatic fire detection can have on the level of safety afforded to occupants of a building, sometimes resulting in the possibility to relax requirements in respect of other fire precautions. This recognition has become more explicit since the publication of a new comprehensive guide to the design of fire precautions in buildings, in the form of BS 9999. For example, BS 9999 permits slightly longer distances of travel to fire exits, and a slight

reduction in the width of exits, if a suitably designed fire warning system is provided.

This modern approach to fire safety is clearly acknowledged and well recognized within BS 5839-1. On this basis, it is reasonable to assert that the 2017 version of the code constitutes an important member of the suite of codes and standards on which fire safety in the 21st century is based.

2 History of fire alarm installation codes

General

The earliest codes of practice for the installation of automatic fire detection and alarm systems were those produced by the then Fire Offices' Committee (FOC). The 'Committee' comprised representatives of most of the major fire insurers in the UK, and the 'rules' of the FOC were associated with fire insurance underwriting considerations.

The FOC was constituted to represent fire insurers' interests after insurers suffered numerous severe fire losses in the latter part of the 19th century, particularly in London wharfs and warehouses. Although the FOC became well known throughout the world as a fire protection approvals and code-producing body, its principal *raison d'être* was to set minimum rates or 'tariffs' for different classes of trade. Insurance premium discounts could be offered to clients who installed adequate fire protection measures, whereas premium penalties could be imposed for risks that had adverse features.

In order to ensure that the fire protection systems for which premium discounts could be offered were reliable and effective, it was necessary for the FOC to enter the business of approving equipment; the first heat detector (known then as an 'approved thermostat') was approved in the early 20th century. It was, however, also necessary to develop 'rules' for the installation of the fire protection equipment. Thus, the earliest automatic fire detection codes of practice in the UK were associated with protection of property, rather than safety of life.

Although simple, electrical, manual fire alarm systems became well recognized as essential for protection of occupants of buildings, it was to be many decades before automatic fire detection became recognized in the same light. Automatic detection tended to be regarded as insufficiently reliable, or unnecessary, for protection of life. As recently as the 1970s, guidance that supported the (now repealed) Fire Precautions Act 1971, in respect of certification of hotels and boarding houses under the Act, advised that a manual fire alarm system was sufficient and that automatic fire detection might only be necessary to compensate for shortcomings in structural fire protection measures, such as means of escape. Today, any hotel without comprehensive automatic fire detection would not meet the standards now applicable in England and Wales

under the Regulatory Reform (Fire Safety) Order 2005.* Shortcomings in fire detection should be identified by the fire risk assessment required by this legislation and should be acted upon by the relevant dutyholder (normally the employer).

1951 code: CP 327.404/402/501

The British Standards Institution (BSI) first produced a code of practice (CP 327.404/402/501) in 1951. This code of practice was based on the FOC rules and, indeed, reference to these rules and, more particularly, the FOC list of approved equipment was frequently made in situations in which the role of the automatic fire detection system did relate to life safety, rather than the property protection objective for which the rules and the approved list were published.

1972 code: CP 1019

The FOC continued to publish its rules, and both these rules and the BSI code appeared to stand the test of time, in that a new version of the BSI code did not appear until 1972, when it was published as CP 1019. Arguably, it was only then that the specialist nature of fire alarm systems was recognized within BSI, in that, whereas CP 327 comprised a series of codes of practice for telecommunications facilities, sound distribution, clock systems and fire alarms, CP 1019 was a code of practice dedicated to the installation and servicing of electrical fire alarm systems.

Systems designed and installed in accordance with CP 1019 very rarely exist today. These systems would fall significantly short of satisfying the recommendations of any subsequent version of BS 5839-1. For example, CP 1019 contained no quantitative recommendations regarding sound pressure levels of alarm signals; it was merely required that there be at least two sounders inside the building and, in the case of a system incorporating automatic fire detectors, an additional sounder outside the building. With regard to audibility, the recommendation was that the type, number and location of alarm sounders should be such that the alarm was distinct from the background noise in every part of the premises.

None of the wiring used in a CP 1019 system needed to be fire resisting, and the wiring to fire alarm sounders did not need to be monitored. For small manual systems, a single power supply was satisfactory, and it was only with the publication of the 2002 version of BS 5839-1 that this recommendation, which continued to appear within the earlier versions of BS 5839-1, was withdrawn. However, such systems would not meet

* and equivalent legislation in Scotland and Northern Ireland.

current legislation, as they contravene the requirements of the Health and Safety (Safety Signs and Signals) Regulations 1996 (see Chapter 21).

The fact that CP 1019 had a lifetime of only 8 years before it was completely revised and published as BS 5839-1, compared with the 21-year life of its predecessor, is a reflection of the speed with which developments were occurring in the field of fire detection and alarm systems (and electronics generally). Equally, a number of concepts that, today, we regard as 'modern' were addressed in CP 1019.

For example, the forerunner of the modern 'voice alarm system', which now warrants its own dedicated code of practice (BS 5839-8¹), warranted a subclause in CP 1019 that addressed the subject of 'audible alarms provided by public address equipment'. Similarly, two-stage alarms were addressed, albeit that this subject warranted only a single sentence. Moreover, some of the concepts, and even the detailed text, incorporated within BS 5839-1:2017 are identical to specific clauses of CP 1019; an example concerns the use of mains-powered sounders to reinforce the primary fire alarm sounders in areas with high ambient noise levels.

There was an implication in CP 1019 that manual fire alarm systems were provided to satisfy legislation and that automatic fire detectors were provided purely for property protection. This principle arose from the attitudes to automatic fire detection described above, and the fact that CP 1019 was based on the fire insurers' FOC rules. Thus, CP 1019 'allowed' manual call points to be incorporated within automatic fire detection systems, but, if automatic fire detection was installed, compliance with CP 1019 demanded that every portion of the building should be covered, other than small lavatories, which could rely on detection within any common lobby serving them; this reflected insurers' attitudes that manual call points did not contribute to property protection and that partial coverage by automatic fire detection was not recognized as a valid principle for fire insurance purposes.

BS 5839-1:1980

BS 5839-1 was first published in 1980 as a revision of CP 1019. For the first time, the 1980 code was produced by a fire standards committee within BSI, as opposed to a more general electrical engineering committee. Although, on the face of it, this first version of BS 5839-1 had the same 8-year life as its predecessor, in fact, the 1980 code was amended five times, in some cases quite fundamentally, between 1980 and 1984.

Unlike CP 1019, BS 5839-1 drew a significant distinction between systems intended for the protection of life and those for the protection of

¹ BS 5839-8, *Fire detection and fire alarm systems for buildings – Part 8: Code of practice for the design, installation, commissioning and maintenance of voice alarm systems*.

property. The role of automatic fire detection, particularly for protection of escape routes, was acknowledged. For property protection, the code still encouraged protection of all parts of the premises with automatic detectors. However, for the first time, it was acknowledged that a lower standard of protection, by installation of detectors in high-risk areas only, could still be worthwhile. However, a 'health warning' was included to draw attention to the fact that such an installation would be unlikely to satisfy the requirements of fire insurers.

Another major difference between BS 5839-1 and CP 1019 was that the use of telephones for initiating a fire alarm signal within a building was no longer recommended; such an arrangement, whereby the fire alarm signal was given by dialling a predetermined number on a telephone, was acceptable under CP 1019.

Also, other important changes from CP 1019 (either in the first published version of BS 5839-1 or as it was ultimately amended by 1984) included a distinction between cables that were permissible if operation during a fire was required and cables permissible where prolonged operation during a fire was not required. In the former case, which would apply to, for example, alarm sounder circuits, PVC insulated cables in steel conduit were no longer acceptable without additional fire protection (e.g. by chasing into walls or protection by fire-resisting construction). PVC insulated cables in rigid PVC conduits did not require such additional protection, as it was considered that greater thermal insulation would be provided to the cables.

Another new principle introduced within the first version of BS 5839-1 was a need to avoid total loss of the fire alarm signal throughout a building in the event that fire results in a short circuit of a sounder circuit at a single point in the building. The intent of this recommendation, which is discussed further in Chapter 11, was widely misunderstood, to the extent that, even today, this issue is probably the most misunderstood aspect of fire alarm design practice.

For the first time, quantitative guidance was given on sound pressure levels within BS 5839-1. It was no longer adequate to offer the fire safety officer a tour of the building and hope that the fire alarm signal would be sufficiently audible to them. The recommendation for a minimum sound pressure level of 65 dB(A), or 5 dB(A) above background noise, and 75 dB(A) at the bedhead in 'sleeping risks', was introduced. The figure of 75 dB(A) was based on American research on the sound pressure levels required to rouse people from sleep.

A very important development in the world of fire protection was also reflected for the first time in BS 5839-1:1980, namely the self-contained domestic smoke alarm. An amendment to the original 1980 code gave important advice on the use of domestic smoke alarms that is still valid today. Indeed, recommendations for the installation of at least two smoke alarms in a two-storey house, and for the interconnection of smoke

alarms, exceeded the first 'official' recommendations produced by the Home Office around 8 years later. It is interesting to note that it was then not until 1992 that the original guidance was 'rediscovered', or at least recirculated, in the guidance that supported the Building Regulations 1991 in England and Wales, by which time, sadly, deaths had occurred in two-storey dwellings 'protected' by the single smoke alarm that Home Office guidance suggested would be acceptable on the basis that it was better than nothing.

In 1982, during the early life of BS 5839-1:1980, the first addressable systems, in which each detector was separately identifiable at the control and indicating equipment (CIE), appeared on the UK market. Since these had not been anticipated when the 1980 code was written, it did not adequately cater for such systems. These 'new generation' systems gave rise to new perplexities in terms of compliance with the letter, or at least the spirit, of the code. Particular issues included zonal indication; some people claimed that, since a text display of the identity and location of each detector could be given at the CIE, conventional zone indicators were unnecessary.

Another issue was tolerance to fault conditions, particularly short circuits. The large number of devices that could now be connected on a single circuit created the potential for areas larger than that of the conventional zone to lose protection in the event of a single fault. This led to the introduction of short circuit isolators, but perplexity regarding the number and location of isolators remained.

This situation was merely a reflection of the fact that codes of practice do not lead technology but merely endeavour to articulate good custom and practice in the use of existing technology. There is, therefore, always a 'phase angle' between technology and the codes of practice that describe recognized good practice in its use.

BS 5839-1:1988

When the code was revised in 1988, account was taken of addressable systems, but all recommendations of the code could be applied to both conventional and addressable systems. Indeed, generally, the view was taken that the introduction of addressable systems, while providing many benefits, should not significantly increase the vulnerability of the system to faults. Hence, for example, the 1988 code recommended that, in the event of a single fault condition, the area throughout which protection was disabled should not exceed the maximum permitted for a single zone. This is, of course, inherently true in the case of a conventional system, in which a circuit and a zone are synonymous, but necessitated the provision of short circuit isolators at zone boundaries (but not necessarily every zone boundary in the case of small zones) in the case of addressable systems.

The slower speed of microprocessors in those days could mean something of a delay between manual call point or detector operation and the operation of fire alarm sounders, particularly in systems in which, to minimize false alarms, devices were polled several times to confirm their alarm status before a fire alarm signal was given. While a short delay between operation of a fire detector and the sounding of the alarm was not significant (and, indeed, was already permitted by the standards of the day), concern was expressed regarding possible delays between operation of a manual call point and the sounding of the fire alarm. The concern did not relate to the overall evacuation time but to the confusion that could result if someone operated a manual call point and the system appeared not to operate.

If, for example, a light switch were operated but the lights did not come on for 10 seconds, long before that period had expired it would be considered that the light was inoperative. Given that, in an emergency, time appears to pass more slowly, on perception that a manual call point was inoperative, a person might follow some inappropriate course of action. Particular concern was expressed regarding certain occupancies, such as hospitals. Whereas, in other occupancies, it would be reasonable to assume that, having operated a manual call point, a person would evacuate the building, in hospitals, staff are trained to raise the alarm and then begin movement of patients. If the fire alarm system were considered to be inoperative, a nurse might well move further from the patients who need assistance in order to raise the alarm by other means.

After much debate of this subject, the technical committee responsible for the code decided that, while not wishing to penalize new technology, there was a need to limit the delay between operation of a manual call point and the sounding of alarm devices in, at least, the zone of origin (which would then be audible to anyone operating the manual call point). In order to minimize the effect of this recommendation on systems already in the marketplace at the time, a maximum delay of 8 seconds was recommended in the 1988 code; this figure was based on the maximum time delay that was known to occur with systems already on the market. However, the code gave notice that this period would be reduced to 3 seconds from 1 January 1990.

This 3-second period remained somewhat controversial throughout the 1990s, at least within the European standards forum. Some European countries saw no good reason for imposing such a short period for the maximum permissible delay. The result was that, when the European product standard for CIE, BS EN 54-2, was published in the UK in 1998, a maximum time delay of 10 seconds was permitted (a retrograde step, in the opinion of the author, and one that is still incorporated within the current version of BS EN 54-2).

This presented a dilemma when the code was further revised in 2002. Should the code concede that a 10-second delay was permissible, particularly because a fundamental principle of European standardization

is that barriers to trade between European countries were not permitted by national codes (unless strictly necessary on the grounds of safety)? Alternatively, should the maximum delay of 3 seconds be so sacrosanct as to create a situation in which products complying with the European standard adopted in the UK, and, therefore, possibly even third-party certificated in accordance with the standard, could not be used in installations complying with BS 5839-1?

Ultimately, it was agreed that the maximum period of 3 seconds should remain within BS 5839-1:2002 but in conjunction with a 'health warning' that BS EN 54-2 permits a delay of 10 seconds. As a compromise, the code advised that a delay of between 3 seconds and 10 seconds might be acceptable, but only with the agreement of the relevant enforcing authority and the recording of the delay as a variation in the completion certificate. This advice remains within the 2017 version.

By 1988, there was much greater use of automatic fire detection for protection of life, particularly in premises in which people sleep. The original principle for certification of hotels under the Fire Precautions Act, that a manual fire alarm system was sufficient, had evolved into a requirement that, in the event of a fire within, say, a hotel bedroom, automatic fire detection should give a sufficiently early warning for those beyond the room of fire origin to make their escape before smoke from the fire made escape routes impassable. In practice, this 'escape route protection' translated into the installation of smoke detectors within escape routes, such as corridors and staircases.

Around the mid-1980s, however, the Home Office began to question whether the objective described above was adequately achieved by the installation of smoke detectors in escape routes only. This led to very elegant research work by the then Fire Research Station involving full-scale fire tests in a rig that simulated a hotel corridor with bedrooms opening into it.

The research showed that, under certain conditions (but only certain conditions), it was possible that, when a fire occurred in a bedroom, smoke could smoke log the corridor, precluding escape by those beyond the room of fire origin, before detection by smoke detectors in the corridor, spaced at the normally specified intervals for these detectors. This research was taken into account in the 1988 code, which introduced the concept of the Type L3 ('escape route protection') system. In this system, detectors are installed within not only the escape routes but also all rooms opening onto escape routes.

The purpose of the L3 system was to provide a specification for automatic fire detection in circumstances in which the detection was required to protect sleeping occupants under legislation, particularly the (now repealed) Fire Precautions Act (i.e. in hotels and boarding houses). It was appreciated that the L3 system would represent a considerably increased

cost, compared with the provision of detection purely in escape routes. However, as the research showed that, in the specific conditions of the research set-up, up to 9 minutes' extra time for escape could be achieved, simply by installing heat detectors within the bedrooms, the additional cost associated with this greatly increased level of protection was considered justifiable.

As much of the smoke that created the problem within the corridor arose from pyrolysis of the timber of the bedroom door, rather than from the hot buoyant products of the fire, the objective, in the L3 system, was to give a warning before the door itself was under severe attack by fire. The BSI technical committee considered that this could be easily achieved by the use of either a heat detector or a smoke detector, as even a heat detector would provide a generous time for escape before the timber at the head of a timber door was undergoing pyrolysis. Moreover, for the purposes of this objective, the exact location of the detector was not critical.

Accordingly, the 1988 code introduced the principle that, for 'escape route protection' with the objective defined above, the detectors in rooms opening onto escape routes could be either heat detectors or smoke detectors, and that the detector need not be ceiling mounted but could be mounted, for example, on the wall close to the door. The latter installation practice was permitted for ease of installation, thereby minimizing the cost impact of the enhanced, and more expensive, protection recommended.

Unfortunately, when the 1988 code was published, many fire authorities throughout the UK totally misunderstood the concept of the L3 system. Many fire officers assumed that the new requirements for fire detectors within rooms opening onto escape routes (which became a requirement for certification of hotels and boarding houses under the Fire Precautions Act) were intended to protect the sleeping occupant in the room of fire origin. In effect, they thought that the objective of the automatic fire detection in sleeping risks had changed. In fact, the 'goalposts had not moved' in any way; the intention of legislation and the L3 system described in BS 5839-1 was still only to protect those beyond the room of fire origin.

Based on this misconception, many fire authorities rejected the idea of heat detectors within bedrooms. Fire officers began to impose requirements for smoke detectors in all hotel bedrooms in the case of new applications for certification under the Fire Precautions Act (and, sometimes, even when material alterations were carried out to existing hotels). It was not until 1991 that definitive guidance on this issue was produced by the Home Office / Scottish Office in the form of what was commonly known as the 'Purple Guide', which provided guidance to fire and rescue authorities on the fire precautions that should be required as a prerequisite of certification of hotels and boarding houses under the Fire Precautions Act.

The 'Purple Guide' advised that the detectors installed in hotel bedrooms should be heat detectors in the case of hotel bedrooms that are to be occupied by one or two persons; this was to avoid the much higher incidence of false alarms associated with smoke detectors. The guidance did, however, advise that it was reasonable to expect smoke detectors in accommodation provided specifically for disabled persons or elderly people, who may need assistance in case of fire, in dormitory accommodation for a large number of people, or in other circumstances in which there might be a high probability of ignition. Unfortunately, by the time this guidance was produced, many fire authorities were entrenched in their policy of requiring smoke detectors in hotel bedrooms. A number of fire and rescue authorities even suggested that the Home Office was in error in its interpretation of BS 5839-1.

Some of the confusion arose from the fact that the 'Purple Guide' also recommended that the automatic fire detection and alarm system be a Type L2 system. The new L2 system, first defined in the 1988 code, was, by definition, equivalent to an L3 system with the addition of fire detection in areas in which the normal occupants are especially vulnerable to fire starting in their vicinity and areas with a high probability of ignition, such that fire could spread to affect the building's occupants. The guidance on the L2 system also stated that, in the case of sleeping accommodation, any smoke detectors in the room should be sited in accordance with normal recommendations, rather than be, for example, wall mounted. It was argued by some fire and rescue authorities that the L2 designation, in conjunction with the above advice, supported their requirements for smoke detectors in bedrooms. In fact, the code also advised that a reference to a Type L2 system was virtually meaningless unless the party specifying L2 clarified the areas to be protected by detectors, over and above the areas that would require protection in a Type L3 system. In effect, the Home Office had followed this advice perfectly by specifying that smoke detection should be installed in certain rooms, such as those used by disabled people. In effect, the detectors in these rooms were 'L2' detectors, while the heat detectors installed in other bedrooms were part of the basic L3 system. Ultimately, the issue of interpretation of the code was referred to the BSI technical committee, which confirmed that there was no anomaly between the guidance contained in the 'Purple Guide' and the recommendations of BS 5839-1; the Home Office had fully understood the concept behind Type L3 and Type L2 systems (which is hardly surprising, since it had funded the research that led to the need for the L3 concept).

Nevertheless, this issue remained, if anything, even more controversial under the new fire safety legislation that came into effect in Great Britain in 2006. In England and Wales, sector-specific guidance on the Regulatory Reform (Fire Safety) Order 2005 was produced by the then Department for Communities and Local Government (DCLG) (now the Ministry of Housing, Communities & Local Government (MHCLG)). One specific guide deals with sleeping accommodation. Unfortunately, that guidance is far from definitive in terms of the types of detector that should be installed

in the bedrooms of hotels, boarding houses, hostels and similar premises, abdicating responsibility for such a decision to the findings of the fire risk assessment. The 'suggested' standard of protection for such premises is Category L2.

However, BS 5839-1 advises that any specification of Category L2 needs to include details of those areas of the building that are to be protected; the DCLG guide is silent on this matter. The reference to Category L2 simply means that the system should satisfy the recommendations for a Category L3 system, with the additional objective of affording early warning of fire in specified areas of high fire hazard level and/or high fire risk.

Category L3 can be satisfied with heat, smoke, carbon monoxide or multi-sensor fire detectors in rooms opening onto escape routes. Without further information, the DCLG guidance is, therefore, too vague for consistent interpretation.

Some enforcing authorities in England and Wales took the view that legislation now demands protection of an individual(s) within the bedroom of fire origin, using the powers of enforcement to require the originally acceptable heat detectors to be changed to smoke detectors. Others endeavour to persuade upgrading of this nature but see no reason to enforce such a change, unless as compensation for some other shortcoming. Yet others see no shortcoming in the existing provision of heat detectors in accordance with original practice.

In Scotland, Scottish Government guidance on the equivalent Scottish legislation (the Fire (Scotland) Act 2005 in conjunction with the Fire Safety (Scotland) Regulations 2006) recommends that, for small premises, reference should be made to the recommendations of BS 5839-6 for a Category LD2 system (as defined in BS 5839-6), but that, in larger premises, a Category L2 is 'likely to be appropriate', without further detailed advice on how this should be interpreted. Equally, in the experience of the author, the Scottish Fire and Rescue Service tends to adopt a pragmatic approach to the matter in the case of existing premises.

Of course, BS 5839-1 simply sets out a menu of systems from which specifiers, regulators and enforcing authorities can select the system of their choice. The code does not provide recommendations on the nature of the protection that should be provided in any specific occupancy, although, since the 2002 version, an informative annex in the code has commented that, in the bedroom areas of hotels and hostels, the design requirements are usually based on the recommendations for a Category L3 system. No amendment to this information has been considered necessary by the introduction of new fire safety legislation in 2006 or the new version of the code in 2017.

In general, the recommendations in the code on protection of escape routes remain consistent with those in the 1988 code. However, endeavours have been made to further explain and clarify the concept

of escape route protection. In addition, a minor relaxation from the recommendation to install detectors in rooms opening onto escape routes is given in the case of short corridors that are separated from other sections of the escape routes by fire-resisting construction.

However, the recommendations of BS 5839-1 in respect of the use of heat detectors were still questioned, and even challenged, by some fire and rescue authorities. It was even suggested that BS 5839-1 was in conflict with national fire safety legislation. The matter was brought to a head when a hotel chain challenged an enforcement notice, issued by a fire and rescue authority under the Regulatory Reform (Fire Safety) Order 2005, requiring that, in one of its hotels, heat detectors in bedrooms be changed to smoke detectors. The matter was referred to the Secretary of State for a Determination, which the legislation in question permits in the case of certain technical disputes between the 'Responsible Person' under the legislation and an enforcing authority. Determinations are binding on the enforcing authority.

The case put to the Secretary of State by the enforcing authority was that, by failing to protect adequately the occupants of a bedroom in which a fire starts, the use of heat detectors in hotel bedrooms contravened the Regulatory Reform (Fire Safety) Order. The hotel chain argued that the original intent of the detectors in hotel bedrooms was not related to protection of the occupants of the bedroom (other than in the case of bedrooms for disabled persons, in which, in the hotel in question, smoke detectors were provided). The alleged change of requirement brought about by the reform of fire safety legislation was challenged. The hotel chain cited compliance of the existing system, with heat detectors in bedrooms, with BS 5839-1, and referred to the very low risk to occupants of hotel bedrooms, based on statistics regarding the low number of fires in bedrooms, the other fire protection measures and the negligible number of fire fatalities in bedrooms (regardless of the type of detector installed). Reliance was also placed on the fire risk assessment that had been carried out. The concern of the hotel chain was not simply cost but the increased level of false alarms that were likely to occur.

The advice given to the Secretary of State by the Chief Fire and Rescue Adviser was that the fire risk assessment had been carried out appropriately, and the Chief Fire and Rescue Adviser noted compliance with BS 5839-1. In contrast, he considered that the fire and rescue authority had based its assessment on general arguments about risk without demonstrating why this particular hotel presented a higher risk than those anticipated in BS 5839-1. Accordingly, the advice concluded that the use of heat detectors in this hotel was an appropriate technical solution for compliance with legislation. Consequently, the Secretary of State determined that the existing heat detectors enabled compliance with the legislation and that there was no need to change these to smoke detectors.

Determinations are case specific, but this very important Determination vindicated the recommendations set out in the British Standard. The

full Determination can be viewed on the web (www.gov.uk/guidance/determinations-under-the-fire-safety-order#determination-about-adequacy-of-fire-detection-in-a-hotel). It was considered by the then Chief Fire Officers' Association that, as a result of this Determination, further clarification or explanation of the relevant recommendations in BS 5839-1 was required. Accordingly, further explanation of the thinking behind the recommendations was included in PD 6531:2010 and remains in the 2018 version.

Returning to other, less controversial, new aspects introduced into the code in 1988, the code, for the first time, provided recommendations on radio-linked systems in which, at that time, fire detectors and manual call points could be linked to CIE by radio, rather than wiring. At the time in question, it appeared to the BSI technical committee that only one commercially available system was used in significant numbers. Accordingly, on the basis that 'if it isn't broken, don't fix it', the recommendations for radio-linked systems in the 1988 code were based on the design of that particular system. Thus, for example, the recommendation in the 1988 code that sounder circuits in radio-linked systems should be 'hard wired', rather than 'wireless', simply arose from the fact that, as the one major commercially available system did not use radio-linked sounders, there was no need to consider these or make recommendations for them.

In the 1988 code, all advice on domestic smoke alarms was removed. Instead, as an appendix to the code, the Home Departments' *Smoke alarms in the home*² booklet was reproduced. It is this booklet that suggested that one smoke alarm might be sufficient – guidance that was, happily, subsequently reversed again, in the case of houses of two or more storeys, as discussed earlier in this chapter.

By 1988, the increase in the use of automatic fire detection had led to a commensurate increase in the number of false alarms. Accordingly, the 1988 code gave more detailed recommendations on the avoidance of false alarms. An entire clause of the code was devoted to this subject.

BS 5839-1:2002 (and the 2013 edition)

By 2002, the 1988 code was rapidly becoming out of touch with the latest technology and with custom and practice. In addition, the lack of clarity of some recommendations, to the extent that what was, or was not, a positive recommendation could be difficult to determine, coupled with the somewhat theoretical discussions in some clauses, were creating problems.

² This booklet was produced by the Home Office / Scottish Home and Health Department / Northern Ireland Office in 1988.

Installations were difficult to audit under certification schemes for designers and contractors, such as the BRE Certification LPS 1014 scheme and the British Approvals for Fire Equipment (BAFE) modular schemes, the latter of which were launched in 2002. The 1988 code could also be quite difficult for small contractors to implement, in view of some of the difficulties described above. It was therefore found that, in installation audits by certification bodies, many conscientious contractors, striving hard to comply with the recommendations of the code, fell short of compliance, sometimes as a result of recommendations that were tucked away within somewhat academic discussion of matters, such as stratification of smoke.

In addition, by 2002, the role of automatic fire detection in fire engineering solutions was well recognized and, in a less sophisticated manner, as a need identified in the fire risk assessments that were, by then, required under legislation. However, the 1988 code and its five system 'types' were insufficiently flexible to cater for the 'tailor-made' use of fire detection associated with these modern concepts.

However, perhaps the greatest shortcoming of the 1988 code was that it did not adequately reflect the manner in which fire alarm contracts operate. The 1988 code was written around a mythical organization or character, known as 'the installer'. Certification of the completed installation rested, according to the code, with the commissioning engineer of the installer.

In practice, many fire alarm systems are designed by consulting engineers, rather than by the installer, particularly in the case of large new building projects. The installer is often an electrical contractor, whose sole role is to install the system in accordance with the requirements of the designer. Under these circumstances, the commissioning engineer may be employed by the manufacturer or supplier of the fire alarm equipment, who is contracted purely to supply and commission the equipment.

In the situation described above, it is entirely unreasonable to expect the commissioning engineer to certificate that the design and installation of the system comply in full with all recommendations of the code of practice. Moreover, it may be beyond the ability of the commissioning engineer to carry out this task, since they are not a design engineer. This had led to widespread complaints that BS 5839-1 certificates were meaningless. While this is quite a valid complaint, it is understandable as to how this situation had arisen.

The 2002 code was drafted by consultants, acting under contract to BSI. The consultants were tasked with drafting a code that would take account of advances in technology, but that was simpler than the 1988 code. Part of this simplification was to comprise removal of unnecessary explanatory text, so that the code was 'user-friendly', albeit that the consultants were instructed to identify any explanations that remained necessary. There was also a requirement to take account of the many

new European standards for fire alarm products that had been published subsequent to 1988. Account was also to be taken of interpretations given by the BSI technical committee on various clauses of the 1988 code, all of which had been published in the form of the 1997 version of PD 6531. In addition, recognition of the need for risk assessment and the importance of performance-based requirements was necessary.

The brief to the consultants from BSI also required additional, or more comprehensive, guidance on a number of matters, particularly false alarms but also including servicing and maintenance. Most difficult and controversial of all, the consultants were to take up a well-known 'poisoned chalice' by reviewing the guidance given on cables.

A debate had raged for many years on the subject of the fire-resisting cables used in fire alarm systems. As a result of this, a BSI working group had determined that two different 'grades' of fire-resisting cable were necessary. The consultants were tasked with making proposals as to the circumstances in which each grade would be appropriate; specifically, there was a need for proposals as to the circumstances in which only the 'enhanced' grade of fire-resisting cables should be recommended.

In order to address these requirements, the new code was, for the first time, written in 'practice specification' format. The format of the current code is discussed in the next chapter of this guide.

The 2002 code also addressed at least four technologies that first became available, or, at least, became much more common, since the publication of the 1988 code. These include carbon monoxide fire detectors, video smoke detection and multi-sensor detection. In addition, a new clause within the code dealt with fire warning systems for deaf people. This clause was an important step forward in making buildings safer for use by deaf people.

An important intention for the 2002 code was that it should much better reflect the manner in which fire alarm contracts operate. Accordingly, the code gave recognition to the various parties involved in the contract, namely the designer or specifier, the installer, the commissioning engineers, the maintenance organization and the user. Separate recommendations were, for the first time, given for each of these parties.

The term system 'type' was replaced by the term system 'category'. (The term 'type' is somewhat imprecise, as a reference to system type could relate to whether the system is conventional or addressable, smoke detection or heat detection, etc.) In addition, two new system 'categories' were introduced, namely the L4 system and the L5 system. These are discussed in a later chapter of this guide.

In the revision of the code, no existing recommendation was considered as sacrosanct. All existing recommendations were carefully reviewed and, if considered appropriate, modified. Thus, the 2002 code contained

a number of quite detailed technical changes, including a change (generally, an increase, but, under some circumstances, a minor decrease) in the maximum distance anyone should have to travel to reach the nearest break glass call point.

Flexibility was also given in the sound pressure levels produced by the system, with a small reduction in the minimum sound pressure level in the case of stairways, small rooms and 'specific points of limited extent'. Recommendations for standby battery capacity were simplified, resulting in a reduction in the minimum capacity recommended in some cases. (During the preparation of the 2013 edition of BS 5839-1, this subject was revisited as a result of comments received by the committee, but the original 2002 recommendation remains unchanged.) The maximum period between service visits was also increased, subject to determination that it was appropriate to do so on the basis of a risk assessment.

The issue of fire resistance of cables was addressed by a new recommendation that all cables used within the fire alarm system, including those carrying the mains supply, should be fire resisting, while specific situations in which only cables of enhanced fire resistance should be used are identified.

Perhaps one of the most important changes in the 2002 code was the much greater significance attached to avoidance of false alarms. Substantial hopes were pinned on the code to make a major impact on the number of false alarms that are generated by automatic fire detection and alarm systems. Prior to publication of the 2002 version of BS 5839-1, over 250,000 false alarms were generated by fire alarm systems each year, and this is no longer regarded as acceptable by central government, fire and rescue authorities and users of fire detection and alarm systems. This has led, in England, to non-response policies to signals generated by fire alarm systems (at least in certain types of premises and/or at certain times of day), unless the presence of a fire can be confirmed by someone. In England, powers have also been given to the fire and rescue service to charge for attendance at certain categories of false alarm (e.g. misinstalled systems). However, unfortunately, the code has not been successful in bringing about a major reduction in false alarms.

The 2002 code introduced a 'cradle-to-grave' responsibility for limitation of false alarms on all parties. The major responsibility for avoidance of false alarms is imposed on the designer. However, the installer has a minor role to play. The commissioning engineer has an important role to play in checking that the installed system is likely to be satisfactory in its immunity to false alarms. The user is expected to manage the building and the system properly in order to minimize false alarms. When the system is serviced, under the code, it is the responsibility of the servicing organization to monitor the false alarm record and to provide suitable advice where appropriate. New benchmark figures for anticipated and acceptable rates of false alarms were, for the first time, incorporated within the 2002 code.

Whereas, in the 1988 code, false alarms warranted a single clause within one section of the code, since 2002, one entire section of the seven sections into which the code is divided is devoted purely to the matter of limitation of false alarms. The code stresses the importance for the designer and the commissioning engineer to consider fully the recommendations contained in this section of the code. A major change in philosophy towards automatic transmission of fire alarm signals to the fire and rescue service was to be found in the 2002 version of the code. Previous versions of the code had provided information on methods for transmitting fire alarm signals from protected premises to the fire and rescue service, although the very detailed information contained in the 1980 code was not included within the 1988 code.

However, no previous version of the code has positively recommended whether, in fact, there is any need to transmit signals automatically to the fire and rescue service or an alarm receiving centre (ARC). The 2002 code took a completely different approach. It was recognized that, if the objective of the system is property protection, unless the premises are continuously manned on a 24-hour basis, the objective will not be achieved unless there is automatic transmission of signals to the fire and rescue service (normally via an ARC). Thus, the code recommended that all Category P systems have a facility for automatic transmission of signals to the fire and rescue service, unless the premises are continuously manned. Failure to provide such a facility in a Category P system is, therefore, a variation from the recommendations of the code, which would need to be agreed with the interested parties and recorded as a variation in the relevant certificate (see Chapter 8).

In general, the safety of occupants of buildings should not depend on intervention by the fire and rescue service (other than in special cases, such as blocks of flats, residential care homes and hospitals). Thus, in general, BS 5839-1 does not regard facilities for automatic transmission of fire alarm signals to the fire and rescue service as absolutely essential in a Category L system. Similar comments apply, of course, to a Category M system, since the system cannot generate an alarm signal unless someone is there to operate a break glass call point; this person can then ensure that the fire and rescue service is summoned.

However, the 2002 code recommended that, if the early summoning of the fire and rescue service is considered critical to the safety of occupants, facilities should be provided for automatic transmission of alarm signals to an ARC, unless there are reliable arrangements for summoning of the fire and rescue service by persons in the building; this might apply, for example, in a hospital that has no 24-hour manned switchboard from where an emergency call can be made.

The 2013 edition of the code also made the specific recommendation that automatic transmission facilities be provided in residential care homes. That amendment also noted that, in Scotland, the Building (Scotland) Regulations (which apply to new building work) require

automatic transmission in the case of hospitals, residential care homes and shopping centres.

In addition, in certain non-domestic premises in multiple occupation, such as an office building with numerous tenants, a small business park or some retail parks, automatic transmission of fire signals might be necessary to a Category L system. Accordingly, the 2002 version of BS 5839-1 introduced the recommendation that, if such premises are served by a single fire alarm system, this system should have the facility for automatic transmission of signals to the fire and rescue service, unless there are reliable arrangements for summoning the fire and rescue service when the system operates. The problem does not arise in the case of manual fire alarm systems, for the reasons already stated. However, if there is automatic fire detection, the operation of a fire detector in the occupied premises of one occupier might well affect the safety of other occupiers, none of whom might regard it as their responsibility to summon the fire and rescue service when the fire alarm system operates as a result of a fire alarm signal that does not emanate from their own premises. Thus, in these circumstances, there may be a need for transmission of fire alarm signals to the fire and rescue service via automatic means.

There is no doubt that the 2002 code of practice was revolutionary in many respects, as it incorporated numerous new ideas that were intended to result in more reliable and trouble-free installations that more closely comply with both the intent and the letter of the code than had previously been the case.

However, the extensive nature of the changes incorporated within the 2002 code were such that, since 2002, new ambiguities and perplexities came to light. As a result of these, the code was first amended in December 2004. Although most of the amendments were minor, or even editorial, the number of amendments was such that, rather than issuing an amendment slip, the code was reprinted to incorporate the amendments. A further amendment was made in April 2008 as a result of, in 2007, the 5-yearly review that all British Standards undergo. Again, although, in principle, the changes made were primarily editorial, some of these amendments contain important amplification or clarification of advice, albeit no major changes to specific recommendations. The April 2008 amendment also updated references to fire safety legislation.

No matter how hard committees try to make British Standards clear and unambiguous, specific projects or circumstances often bring to light problems in interpretation. BSI receives a small, but almost continuous, flow of queries on interpretation of BS 5839-1. So that all users of the code can benefit from the interpretations given by the committee responsible for BS 5839-1, all significant queries and interpretations are published in PD 6531, new versions of which were published in 2010 and 2018; reference has already been made to the explanation in PD 6531

regarding the acceptance, in BS 5839-1, of the use of heat detectors in hotel bedrooms. For designers and others with a need for intimate understanding of BS 5839-1, PD 6531 is almost essential reading.

The publication of the 2013 edition of BS 5839-1 arose from the findings of a tragic fire at the Rosepark Care Home in Lanarkshire in January 2004. Fourteen elderly and infirm people died in the fire, even though the building was modern, purpose-built and not particularly large. In 2011, the findings of a Fatal Accident Inquiry were published. The Sheriff Principal, before whom the Inquiry was heard, found that, as well as systemic failures of the owners to manage fire safety, there were failings in numerous fire precautions and in the fire risk assessment for the Home. Various recommendations in respect of fire alarm systems in residential care homes were commended by the Sheriff Principal for consideration. Without exception, all these recommendations have now been incorporated into BS 5839-1.

Specifically, as a result, from the 2013 edition, BS 5839-1 now makes the following recommendations or comments.

- 1) Where occupants of a building will need assistance from staff to evacuate the building (e.g. in residential care homes and hospitals), the fire alarm system should be addressable if there are facilities for more than 10 people to sleep.
- 2) Experience shows that the responsibility for the provision of a zone plan is often ill-defined, leading to the absence of a suitable zone plan when an installation is handed over. It is important that this responsibility is defined at an early stage of the planning of an installation.
- 3) In residential care homes, facilities should be provided for automatic transmission of alarm signals to an ARC.
- 4) In residential care homes, where early extinguishing action by the fire and rescue service is critical to life safety, it is not appropriate to delay the summoning of the fire and rescue service when the fire alarm system operates.
- 5) In residential care homes, a staff alarm should not incorporate any delay in summoning the fire and rescue service when the fire alarm system operates, but there may be a delay in the general alarm signal, provided all staff are made aware of the fire alarm signal.
- 6) In at least one multiple fatality fire it has been determined that some or all of the deaths could have been avoided if a diagrammatic representation of the premises (commonly described as a zone plan) had been provided in close proximity to the CIE. Accordingly, it is important to ensure that a suitable zone plan is provided adjacent to all CIE (including repeat CIE), unless the CIE incorporates a suitable display (e.g. an illuminated mimic diagram). The objective is to ensure that those responding to a fire alarm signal (including staff on the premises and firefighters) are given unambiguous information as to the location of a fire. (A definition of 'zone plan' is also now included.)

- 7) Arrangements for filtering of automatic summoning of the fire and rescue service by an ARC should not be applied to signals from fire alarm systems in residential care homes.
- 8) Before accepting a fire alarm system, the purchaser or their representative should ensure that a suitable diagrammatic representation of the premises is provided close to all CIE.
- 9) When a servicing organization takes over servicing arrangements for an existing fire alarm system, major areas of non-compliance with BS 5839-1, which should be documented and identified to the user, include the absence of a zone plan or other suitable diagrammatic representation of the premises.
- 10) The user of the fire alarm system should ensure that, where necessary, a suitable zone plan is displayed and kept up to date.
- 11) Within the system acceptance certificate is a requirement for the person who accepts the system to verify (by ticking a box) that a suitable zone plan or other suitable diagrammatic representation of the premises) is provided on or adjacent to all CIE.

It will be noted that these 11 amendments all relate to two objectives, namely the rapid and unambiguous identification of the location of a fire and the rapid summoning of the fire and rescue service, with particular reference, in both cases, to residential care homes. This is because one major aspect of the Rosepark fire was confusion by staff as to the location of the fire (its fire alarm system was non-addressable and had no zone plan but only a zone list) and a 9-minute delay between the sounding of the fire alarm system and the summoning of the fire and rescue service. The Fatal Accident Inquiry concluded that rapid and unambiguous identification of the location of the fire might have prevented some or all of the 14 deaths, while early attendance of the fire and rescue service might have prevented four of the deaths.

Since the 2013 edition of BS 5839-1 was instigated purely as a result of the findings of the Rosepark Fatal Accident Inquiry, it was not intended to undertake a complete revision of the code in 2013. However, the opportunity was taken to make amendments on other matters. The most significant of these related to high sensitivity aspirating fire detection systems. Research has shown that these systems can offer similar benefits to beam-type smoke detection systems in buildings with very high ceilings. However, this had never been acknowledged in BS 5839-1, which limited the ceiling height at which the systems could be used to a much lower height than beam-type smoke detectors. The 2013 edition, effectively, created equivalence between the two forms of smoke detection.

The 2013 edition also included various editorial changes. The most important of these was the elimination of the term 'responsible person', meaning the person(s) in the premises responsible for day-to-day control of the fire alarm system and associated matters. The term was dropped in favour of the term 'premises management', as the term 'responsible person' has a legally defined, but different, meaning within the Regulatory Reform (Fire Safety) Order.

In the course of preparing the 2013 edition, various recommendations for radio-linked systems were removed. This is because the recommendations related to radio-linked products, which are now the subject of BS EN 54-25.³ However, in respect of power supplies, BS 5839-1 makes additional recommendations, over and above the requirements of BS EN 54-25. This is discussed in Chapter 23 of this guide.

A further subtle, but important, amendment was made to commentary within the section on maintenance. This amendment was made specifically as the result of a case involving prosecution of a fire alarm contractor under the Regulatory Reform (Fire Safety) Order. In the case in question, part of the prosecution's allegations (albeit not the principal allegation) was that, since the fire alarm contractor had, during a one-off maintenance visit, pointed out to the user that there was no zone plan and that audibility was poor in part of the premises, the contractor was not simply carrying out routine maintenance but was advising on upgrading of the system. It was then alleged that the contractor was, therefore, in breach of the Regulatory Reform (Fire Safety) Order by failing to point out other areas of non-compliance with BS 5839-1.

In the event, the prosecution dropped all charges against the contractor after the contractor commissioned an independent expert witness report. The contractor's defence costs were paid from public funds, but he had been put to considerable anguish, lost time and reputational risk. Routine maintenance of a fire alarm system does not include a review of design. However, it is important that contractors are encouraged to point out shortcomings in system design that they happen to notice. It is, therefore, counterproductive for there to be any implication that, by pointing out, say, only one shortcoming in a system with three shortcomings, liability falls on the contractor for those they failed to identify. Accordingly, a new paragraph of commentary in the 2013 edition made it clear that routine maintenance does not involve a review of design, and that any defects in design pointed out by a maintenance contractor cannot be taken as an implication that all such defects have been, or need be, identified.

BS 5839-1:2017

It is, perhaps, something of a tribute to the 2002 version of BS 5839-1 (which represented a major revision of the code) that, even after 11 years, the 2013 edition really comprised simply the 2002 version with a small number of amendments; as discussed earlier in this chapter, these were primarily made in response to the fire at Rosepark Care Home. Similarly, the current, 2017 version of the code resulted from merely the normal periodic review to which all British Standards are subject, rather than from any respect in which the recommendations of the 2013 edition were outdated.

³ BS EN 54-25, *Fire detection and fire alarm systems – Part 25: Components using radio links*.

Although the foreword to the 2017 version lists 20 principal changes introduced in the 2017 edition, scrutiny of those reveals that many of these changes are more of an editorial nature than relating to fundamental technical principles. Thus, for example, four of the changes relate to publication, revision or changes to other British Standards since 2013, while three changes relate only to definitions or terminology. None of these changes affects practice in the design, installation, commissioning or maintenance of systems.

The most visually obvious change in systems conforming to the 2017 edition of BS 5839-1 arises from a new recommendation that all manual call points are fitted with a protective cover to reduce the potential for false alarms. This does **not** change the 'Type A' manual call point recommended in the code to a Type B manual call point (as these terms are defined in BS EN 54-11).

While the Type A manual call point is known as 'single action' and the Type B as 'double action', the actions in question relate to those involved in operating (rather than accessing the operating mechanism of) the call point, including the breaking or displacing of the frangible element (the 'glass'). In a Type A call point, it is the single action of breaking or displacing the frangible element that causes the fire alarm system to operate. In a Type B manual call point (rarely found in the UK, but commonly found elsewhere in Europe), a further action is required after breaking or displacing the frangible element.

The fitting of the protective cover, therefore, simply makes the conventional UK call point a Type A call point with a cover, rather than a Type B call point. Accordingly, the new recommendation that all manual call points should be fitted with a protective cover does not conflict with the recommendation that manual call points should meet the requirements of BS EN 54-11 for a Type A manual call point.

This new recommendation was included in the 2017 version of the code as a result of groundbreaking research on the causes of false alarms. This research, which I championed, was funded by the Fire Industry Association (FIA) in conjunction with other partners, including the BRE Trust, British Approvals for Fire Equipment (BAFE) and my own consulting practice, C.S. Todd & Associates Ltd. The research, which was carried out by BRE, involved placing a fire alarm specialist in the city of Glasgow to attend, with the assistance and cooperation of the Scottish Fire and Rescue Service, all false alarms in the Greater Glasgow area, with a view to determining the cause in virtually real time; all previous research on false alarms had involved only desktop reviews of false alarm statistics.

The research concluded that a significant number of false alarms resulted from physical impact to the sides of a manual call point, accidental operation or malicious operation. It was concluded that accidental and malicious operation could be reduced by installing protective covers that

require the dual action of lifting the protective cover and activating the call point mechanism.

Previous 'desktop' research by BRE had reached the same conclusion, as had the experience of Buckinghamshire and Milton Keynes Fire Authority, the latter of which reported reduction in false alarms as a result of the fitting of these protective covers. In the BRE 'live' research project, it was estimated that the fitting of protective covers had the potential to reduce the total number of false alarms from fire alarm systems by around 13 per cent.

Obviously, if a person is sufficiently ill-intentioned, they can still cause a false alarm by operation of the manual call point. However, many malicious activations of manual call points occur quite 'casually', in that the person is not particularly ill-intentioned but (e.g. in student accommodation) simply succumbs to the temptation to press the readily accessible frangible element of a manual call point as they walk along a corridor. Very often, they would not go to the trouble of stopping, lifting the protective cover and then operating the manual call point.

New recommendations within a British Standard are, of course, not retrospective, so the fitting of protective covers will not generally be adopted in existing installations by fire and rescue service crews unless experience of malicious false alarms makes this appropriate. However, at the time of writing, the Scottish Fire and Rescue Service is considering the possibility of the retrospective fitting of protective covers in certain existing installations, with external funding for the purchase of the covers.

A further, potentially noticeable amended recommendation relates to the facilities for local isolation of the mains supply in close proximity to CIE. Prior to 2002, while it was normal practice to provide this facility, it was not a specific recommendation of BS 5839-1 that local isolation (e.g. for maintenance) should be provided. When this recommendation was incorporated within the 2002 version of the code, it was considered that, as the facility was considered necessary for the safety of maintenance technicians, as an isolation facility, double pole isolation was necessary (to avoid risk arising from reverse polarity of the supply). This precluded the previous custom and practice of using a fuse (i.e. a single pole device) as a means of isolation.

In the 2017 revision, the technical committee responsible for BS 5839-1 took a different view. It was considered that, under the Electricity at Work Regulations 1989, safe isolation requires verification that isolation has been successful (i.e. it should not be assumed, in a safe system of working, that an isolator, whether single pole or double pole, is an infallible device). Accordingly, the 2017 version of the code no longer specifically recommends the use of a double pole isolator; either single pole or double pole will comply with the recommendations of the code.

As noted earlier in this chapter, the great hopes held in 2002 that the 2002 version of the code would make a material impact on false alarms

has never really materialized. However, further recommendations on false alarm reduction have been incorporated within the 2017 version of the code. In particular, in the 2002 version, 'staff alarm' arrangements, whereby, on operation of a single smoke detector, there is an investigation by staff prior to summoning the fire and rescue service and evacuating the building, were regarded very much as a last resort in the reduction of false alarms. Since then, custom and practice in this respect has changed quite significantly.

Accordingly, the 2017 version of the code regards staff alarms as more of a norm, and a new flow chart, showing typical staff alarm arrangements, has been incorporated. While staff alarms are given greater acceptance in the 2017 code, suitable, and increased, safeguards are recommended. For example, it remains the recommendation of the code that, in residential care premises, a staff alarm should not incorporate any delay in summoning of the fire and rescue service when the fire alarm system operates (resonating with the recommendations of the Fatal Accident Inquiry into the fire at Rosepark Care Home, which was discussed earlier in this chapter).

In addition, it is recommended that staff alarms should not normally be incorporated within signals from manual call points, heat detectors or sprinkler systems. Nevertheless, in the case of manual call points, it is acknowledged that, in the case of a large place of public entertainment, a staff alarm might be given so that staff can be prepared to assist in an orderly evacuation.

Also, whereas in the previous version of the code, 'coincidence operation' of detectors was acknowledged as of potential benefit as a safeguard in a staff alarm arrangement, coincidence detection is now a specific recommendation of the code in the case of a staff alarm arrangement. A further warning is given in relation to staff alarms in a building in which smoke detection has been incorporated as a means of warning occupants of an inner room in the event of a fire in the access room; there should be no delay in warning occupants of the inner room.

Within the 2017 code, distinction is now made between false alarms in general and false alarms that, more specifically, result in summoning of the fire and rescue service. In keeping with terminology within the fire and rescue service, these latter false alarms are now described as 'unwanted fire alarm signals' (UFAS), a term that is now defined in the code. In order to address UFAS specifically, further new recommendations have been incorporated within the new 2017 code. For example, where, in a new system, there is a connection to an ARC, it is now recommended that this connection is disabled during the 'soak period' recommended in the code.

In addition, a new concept, which takes into account the potential presence of a remotely monitored intruder alarm system, as well as a remotely monitored fire alarm system, is discussed (though not specifically recommended). In this arrangement, which is a form of 'time-related'

system, if the ARC that monitors the intruder alarm system is aware that the intruder alarm system is unset (so there should be persons on the premises), alarm filtering can be applied whereby the ARC contacts the premises prior to summoning the fire and rescue service on receipt of a fire alarm signal.

With further regard to ARC monitoring, it is commonplace for transmission equipment to be shared by both the fire alarm system and any intruder system. However, in effect, this is facilitated by an interface between the fire alarm system and the intruder alarm system transmitter, which, inevitably, has tended to result in some departures from the recommendations of BS 5839-1. Under previous recommendations of the code, it was necessary to treat these departures as 'variations', necessitating agreement by the interested parties and recording of the variations on the system design certificate.

In the 2017 code, it is now acknowledged that it is common practice for the transmission of fire alarm signals to an ARC to be routed by the alarm routing equipment of an intruder alarm system. It is now advised in the code that, notwithstanding that the mains power supplies, cable types and cable routing for the alarm routing equipment might not necessarily conform to the recommendations of the code, this practice is regarded as acceptable and need not be regarded as a variation from the recommendations of the code. However, standby battery capacity and any cable between the fire alarm CIE and the alarm routing equipment still need to conform to the code.

In terms of signalling, something of an 'honourable mention of dual path signalling', which is commonly used in transmission of intruder alarm signals, is discussed as a means of enhancing the reliability of transmission of fire signals to an ARC.

In the 2017 code, enhanced guidance is given on applications for different types of fire detector with different principles of operation. In addition, there is new guidance on the advantages of multi-sensor detectors, particularly in relation to potential reduction in false alarms. It is also acknowledged that multi-sensor detectors can be used as an alternative to smoke detectors in escape routes, provided they meet the sensitivity requirements of the European standard for smoke detectors, BS EN 54-7.

In the 2017 code, some small changes have been made to the recommendations on detector siting. These represent very minor changes that apply only in particular situations, such as honeycomb ceilings, high spaces and vertical or flue-like structures.

Some changes have also been incorporated into the recommendations for inspection and servicing of systems. Again, these are quite minor and, in a number of cases, simply constitute clarification of original recommendations. For example, it has been clarified that the correct operation of fire alarm sounders need only be checked annually, and

not on every service visit. It has also been clarified that this annual check relates only to correct operation and not to a measurement of sound pressure level.

A new recommendation, while quite minor in the context of the code, relates to the circumstances of a fatal fire. In that fire, in the premises of a mental health trust, there was an alleged delay in staff proceeding to the room of fire origin because the fire alarm repeater unit on the floor in question required manual action (with which staff were not adequately familiar) to identify the address of the fire detector in the room.

While this did not represent a failure to conform to any recommendations of BS 5839-1, or the requirements of BS EN 54-2, an informative note is included within the 2017 version of BS 5839-1 to the effect that, in complex premises with repeat indicating equipment, it is expected that the form of display at CIE, including repeat CIE, will indicate the location of the first detector to operate, without manual intervention.

Though not a major change, a little-known recommendation in Subclause 12.2.2 of the previous version of the code, BS 5839-1:2013 (which is concerned with system integrity), has been dropped from the 2017 version of the code. The recommendation in question was that any fault forming a cross-connection between a detector circuit and sounder circuit should not affect any circuits other than the two circuits involved. This recommendation, which was first introduced in the 2002 version of the code, followed a fire in the course of which the fire detection and alarm system lost all power (both normal and standby).

It transpired that the cause of the problem was something of a quirk in the design of the CIE. The design of the control equipment was such that a short circuit on a detector circuit was current limited, while a short circuit on a sounder circuit would rupture a fuse in the sounder circuit. However, a cross-connection between the positive of a detector circuit and the negative of a sounder circuit (which occurred within a junction box during the fire) was not current limited, so it caused the normal power supply to fail and then the fuse in the standby battery supply to rupture, as both power supplies were, in effect, attempting to drive current into a short circuit without current limitation.

This cannot be regarded as anything other than something of a latent weakness in the design of the control equipment, but such a weakness does not result in any non-conformity with the standard for CIE, BS EN 54-2. Accordingly, a recommendation to preclude such a weakness was included in BS 5839-1:2002. It was dropped from the 2017 version of the code because it is a recommendation for the design of a product (the control equipment), which is not within the scope of the code; in addition, inconsistent with the intention of the code, it was not a recommendation that could be audited (other than by study of the control panel design by someone such as an electronics engineer). It should, perhaps, now be considered for inclusion in BS EN 54-2.

3 The format and layout of the code

The format

BS 5839-1 is set out in 'practice specification' format. In this format, each clause begins with a 'commentary', followed by the 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 'always needs to be subject to consideration', 'it needs to be ensured', 'it is appropriate', etc.

For the designer or 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, the concept of 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 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. (The concept of 'variations' is discussed in Clause 7 of the code and in Chapter 8 of this guide.)

Turning to the recommendations themselves, these are relatively short and, for ease of reference, each 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.

Layout of the code

The code is divided into seven main sections, followed by a number of annexes. The seven sections bear the following titles:

- Section 1: General;
- Section 2: Design considerations;
- Section 3: Limitation of false alarms and unwanted fire alarm signals;
- Section 4: Installation;
- Section 5: Commissioning and handover;
- Section 6: Maintenance;
- Section 7: User's responsibilities.

Section 1 (General) should be read by all users of the code, as the information in this section is aimed at all interested parties, namely the designer, installer, commissioning engineer, maintenance engineer and purchaser or user. In effect, Section 1 sets the scene for the fire alarm contract.

In both length and importance, Section 2 of the code ('Design considerations') is by far the most significant. It is aimed at a party described as 'the designer', and there is no doubt that the designer's duties under the code are quite onerous. Whereas, in years gone by, a party might claim to be the designer simply by referring to the system type (now system 'category'), specification of certain (usually electrical engineering) parameters, such as cable type, and by siting devices on drawings, as we shall see throughout the chapters of this guide, this alone would not satisfy the duties described for 'the designer' defined in BS 5839-1. Indeed, by definition, the designer described in the current code is responsible for ensuring that system design complies with all the very many detailed recommendations of Section 2 of the code. (It is reasonable to assume that the designer would also have responsibility for ensuring compliance with legislative requirements, as well as any contractual requirements imposed on the designer by the designer's client.)

Section 3 ('Limitation of false alarms and unwanted fire alarm signals') is dedicated solely to the subject of limiting the number of false alarms that the system is likely to generate throughout its lifetime, or, at least, the number of false alarms that result in summoning of the fire and rescue service ('unwanted fire alarm signals' (UFAS)). It is no accident that this section immediately follows the section on design, as the view taken in the drafting of BS 5839-1 is that the principal duty for avoidance or limitation of false alarms rests, initially at least, with the system designer. However, both Section 2 and subsequent sections of the code all make reference to Section 3, necessitating that this section should, at least to some extent, be read by all the interested parties who need to read Section 1.

Section 4 ('Installation') is very short. Indeed, in terms of number of pages, it represents only 3 per cent of the code. This reflects the fact that all that

the code expects of the installer is that they comply with the requirements specified by the designer and follows good installation practices of the type described in BS 7671⁴ (IET Wiring Regulations). (It is, of course, valuable if an installer has a certain understanding of fire alarm system design; designers will often have worked purely from drawings, so it is useful if an installer can identify structural features of the building, such as deep beams, of which the designer might not have been aware, so that any issues that arise from these features can be referred back to the designer for instruction.)

Section 5 ('Commissioning and handover') is concerned with the processes that occur after completion of installation work. Thus, this section deals with commissioning, acceptance by the user or purchaser and the (optional) process of verification. Verification is discussed further in Chapter 32.

Section 6 ('Maintenance') provides recommendations for maintenance of the system. In the context of the code, maintenance includes routine testing of the system, periodic servicing of the system and various forms of 'non-routine' attention (including repair, investigation and action on false alarms, action after a fire and action after a long period of non-occupation of the building).

Section 7 ('User's responsibilities') is aimed specifically at the user to whom the system is, ultimately, handed over. It provides guidance for all those who are charged with looking after the fire alarm system and, therefore, who are responsible for arranging testing, servicing or service contracts, action when false alarms occur, etc.

The contents of each of these sections is discussed on a clause-by-clause basis in Chapter 5, which also provides information on the seven annexes. At this stage, it should be noted that some of these annexes are indicated in the code as normative, which means that compliance with the code involves compliance with these annexes; they, therefore, add to, or amplify, the recommendations contained within the body of the code.

Other annexes are indicated as informative, in which case 'compliance' with these annexes does not arise. In effect, these annexes constitute guidance that is supplementary to the recommendations of the code and that, therefore, may, or may not, be relevant to any particular installation.

⁴ BS 7671, *Requirements for Electrical Installations. IET Wiring Regulations*.

4 Scope of BS 5839-1:2017

Although the generic title of BS 5839 was originally 'Fire detection and alarm systems for buildings', this was first changed to 'Fire detection and fire alarm systems for buildings' in the 2002 version of BS 5839-1. Moreover, the scope of BS 5839-1 is stated to be the planning, design, installation, commissioning and maintenance of fire detection and fire alarm systems in and around buildings, other than domestic premises. There are two important implications in the title and this very first sentence of the code.

First, contrary to the possible implication of the original title, the code does not deal just with systems that include automatic fire detection; manual fire alarm systems, in which an alarm of fire can be raised only by operation of a break glass call point, are fully recognized under the code. As we have seen in Chapter 2, this has, of course, always been the case, and the fact is well known to anyone with a reasonable knowledge of the code. However, the traditional title of the code had been known to cause confusion, particularly when reference is made to it without a reference to system category; a requirement for a system complying with BS 5839-1 has, on occasions, been considered to mean a system incorporating automatic fire detection. However, the current generic title and the scope of BS 5839-1 make it clear that the systems to which the code applies range from those comprising only one or two manual call points and sounders to complex networked systems that do indeed incorporate a large number of automatic fire detectors, etc.

The second implication of the information provided in the first sentence of the code is that, again contrary to the generic title of BS 5839, the code can be applied to systems 'around buildings' (i.e. in the open air). Such systems include, for example, those protecting open air storage of flammable liquids.

Systems installed in domestic premises (including sheltered housing blocks) are outside the scope of BS 5839-1 because they are the subject of an entirely separate code of practice, namely BS 5839-6.⁵ However, while the latter code is appropriate for systems protecting houses in multiple occupation that take the form of a number of self-contained units, BS 5839-1 would be the appropriate code for, for example, hostels,

⁵ BS 5839-6, *Fire detection and fire alarm systems for buildings — Part 6: Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises*.

even though these might be regarded as houses in multiple occupation under the Housing Acts in England and Wales. Moreover, for very large dwellings and all houses in multiple occupation other than those akin to the size of a normal single-family dwelling house, BS 5839-6 advocates a system that is, in effect, one complying with almost all the recommendations of BS 5839-1.

It is not within the scope of BS 5839-1 to recommend whether, in the case of any particular building, a fire alarm system is necessary or, even if it is necessary, the category of system that should be installed. This is a matter for legislation, enforcing authorities, other interested parties (such as fire insurers and building occupiers or owners) and other codes of practice dealing more generally with the subject of fire safety.

However, purely for information, an informative annex does provide information on the categories of system that are typically installed in various types of premises. For example, in the case of common places of work, such as offices, shops, factories, warehouses and restaurants, the code notes that a Category M (i.e. manual) fire alarm system normally satisfies the requirements of legislation but is, however, often combined with a Category P (automatic fire detection) system to satisfy the requirements of insurers, as company policy for protection of assets, or to protect against business interruption.

Often, fire detection and fire alarm systems are interfaced with other fire protection systems and equipment. Such other systems and equipment include automatic fire extinguishing systems, smoke control systems and, for example, magnetic door holders that, on operation of the fire alarm system, allow fire-resisting doors to self-close automatically. Often, there is also an interface between the fire alarm system and other building services so that, for example, heating, ventilation and air conditioning systems shut down, stop recirculation of air or shunt extracted air to atmosphere rather than recirculate it. It is also very common for lifts to ground automatically on operation of the fire alarm system. Also, the use of electronic locking of doors on escape routes is increasingly common, necessitating an interface with the fire alarm system. Indeed, in some premises, the prime purpose of any automatic fire detection system present in the building is to operate other fire protection facilities, such as a smoke control system, rather than to give a warning of fire per se, which can sometimes be achieved adequately with a manual fire alarm system.

Fire detection and fire alarm systems that are capable of providing signals to initiate the operation of other systems and facilities come within the scope of BS 5839-1. However, the code does not apply to the other systems and equipment, nor does it apply to the circuits used to interface between the fire detection and fire alarm system and other systems. However, a completely separate suite of codes of practice, published as various parts of BS 7273,⁶ does deal with this matter. Any special requirements

⁶ BS 7273, *Code of practice for the operation of fire protection measures*.

associated with the operation of other systems (e.g. the siting of smoke detectors used to trigger the automatic closing of fire doors and shutters) are, therefore, outside the scope of BS 5839-1.

The most commonly applicable part of BS 7273 is Part 4, which deals with the interface between fire detection and fire alarm systems and door release mechanisms. As such, it deals with the interface between fire alarm systems and:

- devices that cause held-open fire doors to close (e.g. magnetic hold-open devices and acoustically or radio-linked hold-open devices);
- devices that release electronically locked doors (e.g. solenoid locks or magnetic locks);
- powered sliding doors on means of escape (which are normally required to remain permanently open in the event of fire).

The most recent part of BS 7273 is Part 6, which was published in 2019. Part 6, which completes the entire BS 7273 suite of standards, is concerned with the interface between fire alarm systems and 'ancillary systems and equipment'. In effect, the intent of Part 6 is to 'mop up' the interface with all systems and equipment that are not addressed by the other five parts. Accordingly, Part 6 addresses the interface between a fire alarm system and:

- smoke control systems;
- lifts and other lifting appliances;
- gas valves;
- fire-resisting shutters and active fire curtain barrier assemblies;
- electricity supplies;
- ventilation systems;
- lighting, intelligent signage and wayfinding;
- paging systems.

Some fire extinguishing systems have what the code describes as a 'secondary alarm function'. The most obvious of these is an automatic sprinkler system; although the purpose of the system is to control or extinguish a fire, each head may be regarded as a point-type heat detector. It is common practice, therefore, to capitalize on the fire detection function of the system to initiate a fire alarm signal in the building. If the building's fire alarm system has a facility for transmission of alarm signals to an alarm receiving centre (ARC), a fire alarm signal is also transmitted to the ARC. This is normally achieved by connecting a pressure switch in the pipework serving the sprinkler system's hydraulic water gong as a trigger device on a detection zone of the fire alarm system. Less commonly, a flow switch may be used as the trigger device, but, arguably, a flow switch is less reliable and flow switches are normally used only to provide supplementary indication if there is a need, in the case of a large sprinkler installation, to provide an indication of the area or floor in which sprinkler heads are operating.

The scope of BS 5839-1 extends to the use of signals of the type described above as one initiating element of the fire alarm system. Thus, it would be expected that the relevant clauses of the code would apply to the fire resistance and monitoring of the wiring to the pressure or flow switch.

In many complex buildings, such as shopping complexes, airport terminals and large public assembly buildings, a voice alarm system is used to give warnings of fire. Indeed, the use of a voice alarm system may be specifically recommended by guidance that supports building regulations or may be required to support a phased evacuation arrangement. The voice alarm system itself would be outside the scope of BS 5839-1, as an entirely independent code of practice, BS 5839-8,⁷ applies to voice alarm systems. The recommendations of that code of practice would, however, address the interface between the fire detection and fire alarm system and the voice alarm system, as well as dealing with other measures to ensure adequate integration of the two systems (e.g. display of voice alarm fault warnings at the fire alarm control equipment).

Systems in which the fire alarm system is integrated with systems other than voice alarms are not within the scope of BS 5839-1. This does not imply that such systems are not acceptable but merely that suitable recommendations are not contained within BS 5839-1. However, BS 5839-1 refers to a Eurocode publication for advice on such systems. Subsequent to the publication of the 2017 code, this publication has been withdrawn and is superseded by BS EN 50398-1.⁸

In some special applications or occupancies, the recommendations of BS 5839-1 may need to be modified, even though, generally, the fire alarm system in the premises in question would be intended to comply with the code. The code, itself, gives two particular examples of such a situation.

The first relates to fire detection and fire alarm systems in electronic data processing installations and similar critical electronic equipment rooms. The code points out that BS 6266 provides recommendations for the fire detection and fire alarm systems in such cases, over and above the recommendations of BS 5839-1. BS 6266 is not, primarily, a fire detection and fire alarm system code of practice; it is a general code of practice dealing with fire protection of critical electronic equipment installations.

Prior to 2002, the scope of BS 6266 related purely to systems in electronic data processing installations (i.e. computer rooms). However, traditionally, the greatly increased density of automatic fire detectors used in such installations had also been used for protection of critical electronic installations that did not involve data processing (e.g. electronic

⁷ BS 5839-8, *Fire detection and fire alarm systems for buildings – Part 8: Code of practice for the design, installation, commissioning and maintenance of voice alarm systems*.

⁸ BS EN 50398-1, *Alarm systems - Combined and integrated alarm systems - Part 1: General requirements*.

communications facilities, electronic production control facilities, etc.); in these cases, the density of detector spacing recommended in BS 6266 had been used. In recognition of this, the scope of the 2002 revision of BS 6266 extended to all critical electronic equipment installations, rather than the narrower scope of previous versions of that code.

Automatic fire detection and fire alarm systems in hospitals are designed in accordance with HTM 05-03 Part B,⁹ rather than BS 5839-1. This is recognized in BS 5839-1, which, therefore, points the reader towards HTM 05-03 Part B in the case of fire detection and fire alarm systems in hospitals. Nevertheless, the current version of BS 5839-1 does consider the special requirements of hospitals. For example, the code acknowledges that different minimum sound pressure levels apply to alarm signals, and it refers the reader to HTM 05-03 Part B for advice on these.

In addition to these explicit examples of situations in which BS 5839-1 defers to other codes of practice, in some situations a part of BS 7273 may override the recommendations of BS 5839-1. For example, in some situations, BS 7273-4 recommends closer spacing of smoke detectors in corridors than is recommended by BS 5839-1, if the detectors are used to trigger release of fire doors.

It is made clear in the code that its recommendations apply to at least any new work involved in extending or altering existing systems. There can, in practice, sometimes be an element of difficulty in determining how to deal with alterations to, or, more particularly, extensions to, an existing installation designed in accordance with a previous version of the code. At one extreme, it would not be reasonable to expect a complete new fire alarm installation to be installed, simply because a few detectors are added to a very old installation. At the other extreme, it would, arguably, be equally unreasonable to double the size of a CP 1019 installation if existing premises doubled in size; under these circumstances, a complete new BS 5839-1:2017 installation would probably be appropriate.

In practice, many extensions to existing installations fall between these two extremes, and there is, probably, no right or wrong answer as to the point at which a decision should be made to install a complete new system. The dilemma associated with alterations and extensions to existing systems is recognized in the code, which acknowledges that the extended or altered system might not, overall, comply with the recommendations of the code. However, contrary to a sometimes-encountered misconception, there is nothing to prevent a contractor from, say, extending a circuit that is wired in a non-fire-resisting cable, provided the new cable is fire resisting and that there is no engineering obstacle to jointing the two types of cable.

⁹ *Health Technical Memorandum 05-03: Operational provisions, Part B, Fire detection and alarm systems.* Department of Health. 2006. London: The Stationery Office. (In Scotland, the relevant code of practice is SHTM 82, *Scottish Health Technical Memorandum 82, Fire alarm and detection systems.* NHS National Services Scotland. 2013. London: The Stationery Office.)

The code points out that certain other systems or facilities are outside its scope. These include mechanically operated sounders (e.g. rotary gongs), which may be suitable for some very small premises, the public emergency call system (i.e. the 999 or 112 system) and audible or visual way-guidance systems. Audible way-guidance takes the form of 'sound beacons', which, by various methods, can attract those evacuating a building to the fire exits. However, while the code acknowledges the existence of such systems, since they are only complementary to the automatic fire detection and alarm system, they are regarded by the code as outside the scope of its recommendations. (These systems are, however, the subject of a separate code of practice, namely BS 8456.¹⁰ However, since they are not a form of fire warning but a means for way-guidance to indicate escape routes, this code of practice is the responsibility of an emergency lighting committee in BSI.)

¹⁰ BS 8456, *Code of practice for design and installation of directional sounder evacuation systems*.