The Design, Installation, Commissioning and Maintenance of Fire Detection and Fire Alarm Systems in Non-domestic Premises
A Guide to BS 5839-1:2013

Colin S. Todd

BS 5839-1:2013 is the new code of practice that makes recommendations for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in non-domestic premises.

Compliance with BS 5839-1 is very commonly required throughout the UK by building control bodies, fire and rescue authorities and other authorities who may enforce provisions for fire safety in certain occupancies.

This new book, fully revised and updated in its fourth edition, is the comprehensive guide to BS 5839-1:2013. Based on in-depth experience of developing this code of practice as well as its use in the field, this book provides full background explanation and discusses the practical application of its recommendations.

About the author

Colin S. Todd is a leading specialist in fire detection and fire alarm systems and has been a significant player in the development of this important code of practice. He sits on several national fire technical committees and has drafted numerous codes and standards on behalf of BSI and other leading bodies. His published works include A Comprehensive Guide to Fire Safety, A Guide to BS 5839-6, A Guide to BS 5839-8 (co-author) and PAS 79.
The Design, Installation, Commissioning and Maintenance of Fire Detection and Fire Alarm Systems in Non-domestic Premises

A Guide to BS 5839-1:2013
As in the previous edition, this book is dedicated to my children, Keith, Jayne and Fiona, all of whom make me proud every day. And to Karen for her undying love and support. (Plus a special mention for the cats of Hutton Roof.)

This current version 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 chairman of the committee for many years until the time of his death in 2010.

I would also wish to include in my dedications those fourteen 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 and, hence, to this current revision of this book. The fire safety profession, through improvements in standards, will strive to ensure that such a tragic event never occurs again.
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About the author

Colin Todd MSc, FIFireE, FBEng, MIRM, MSFPE, C.Phys, FInstP, C.Eng, FIET graduated from Edinburgh University with an honours degree in Physics. He then undertook a one 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 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.

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 previous member of
the Board of the Division and the Division’s Membership Committee, which for many years he chaired. The Division was empowered to award engineering qualifications, including chartered engineer, to suitably qualified fire safety engineers. He is also a previous member of the IFE Board, where he held the responsibility for technical issues. He serves on a number of British Standards Committees, including those concerned with fire detection and fire alarm systems. He also represents the Confederation of British Industry on an expert group of the Loss Prevention Certification Board that is responsible for the development of approval schemes for all aspects of automatic fire alarm equipment.

Colin is also experienced in assessment of fire alarm contractors’ competence in fire alarm work, acting on behalf of certification bodies. He also acts 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 two previous guides to BS 5839-1:2002 written by Colin Todd and published in 2003, 2006 and 2008. Since publication of these earlier guides, some amendments have been made to the code, while fire safety legislation in the United Kingdom has been subject to radical change.

The advice provided by BS 5839-1:2013, the British Standard 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 book serves to further that understanding. It is not a replacement for the code.

This guide not only explains the code, it also provides extensive information regarding issues that have 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 (FSH/12/1), responsible for the code, 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, including those leading to the latest (2013) edition 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
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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. 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.

J. Naar
Chairman, BSI Technical Committee FSH/12/1
1. Introduction

The aim of this book is to provide guidance on the current edition of BS 5839-1, which was published in March 2013. 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 United Kingdom.

Compliance with the code is very commonly required by building control bodies throughout the United Kingdom, fire and rescue authorities and other authorities who may enforce provisions for fire safety in certain occupancies (e.g. housing authorities in the case of houses in multiple occupation, or Health and Safety Executive for construction sites). Frequently, property insurers also require 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 less 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 ‘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 to 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 2010.

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
Introduction

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 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 (as amended). On this basis, it is reasonable to assert that the 2013 edition of the code constitutes an important member of the suite of codes and standards on which fire safety in the twenty-first century is based. The 2013 edition of the code was the culmination of three amendments to the 2002 version, necessitating this fourth edition of this guide. These factors, coupled with the rate at which fire detection technology advances, make it unlikely that the current code and this current edition of the guide will have the 14-year life of its predecessor.
4. Scope of BS 5839-1:2013

Although the generic title of BS 5839 has traditionally been ‘Fire detection and alarm systems for buildings’, this was 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 of the minor change of title and this very first sentence of the code.

First, contrary to the possible implication of the traditional generic title, the code does not just deal with systems that include automatic fire detection; manual fire alarm systems, in which an alarm of fire can only be raised 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 (previously known as system ‘type’ in BS 5839-1:1988); 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 changed generic title and the scope of BS 5839-1 in 2002 makes 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 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.
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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. 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, even though these are 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, HVAC 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. Indeed, in some

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5 BS 5839-6:2013, Fire detection and fire alarm systems for buildings — Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises.

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premises, the prime purpose of any automatic fire detection 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, does deal with this matter. Any special requirements 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.

In 2007, a new part (Part 4) of BS 7273 was published; this 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).

On the other hand, 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 only used 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, 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, a Eurocode publication can be used for advice on such systems.

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, but is a general code of practice dealing with fire protection of critical electronic equipment installations.

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

* DD CLC/TS 50398 Alarm systems – Combined and Integrated Systems/General Requirements*
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 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 alarm systems in hospitals are designed in accordance with HTM 05-03 Part B, 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, so that, for example, the code acknowledges that different minimum sound pressure levels apply to alarm signals and 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 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 code, such as CP 1019 or BS 5839-1:1980. 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 5839-1:2013 installation would probably be appropriate.

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8 HTM 05-03 Part B, Alarm and detection systems. Published by the Department of Health in England and Wales. (In Scotland, the relevant code of practice is SHTM 82 published by NHS Scotland.)
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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, 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.

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. Since they are, however, 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.)

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9 BS 8456:2005, Code of practice for design and installation of directional sounder evacuation systems.