



The Design, Installation, Commissioning and Maintenance of Voice Alarm Systems

A Guide to BS 5839-8:2013

Douglas F. Mason and Colin S. Todd

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To my dear wife, Elizabeth.

Douglas F. Mason

To my three loving children, Keith, Jayne and Fiona (Little Boo), because of whom I am blessed. And to Karen for her everlasting love and support. And to the cats of Hutton Roof (past and present), for their loyal company as I write in the dead of night.

Colin S. Todd

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About the authors

Colin Todd graduated from Edinburgh University in 1974 with an honours degree in physics. He then became one of the first four students in the United Kingdom to undertake a postgraduate Masters degree in fire safety engineering, thereby shaping his future career in fire protection.

After fire protection experience in industry, the Fire Offices' Committee (which was later incorporated into the Loss Prevention Council) and a leading insurance broker, he founded the leading fire consultancy practice, C.S. Todd & Associates, in 1982. The practice, of which Colin is managing director, provides consultancy services in all aspects of fire safety and fire engineering, but has always been able to offer specialist advice on fire detection and fire alarm matters, an area in which Colin specialized during his time with the Fire Offices' Committee (FOC).

Colin served for two years as a member of the Board of the Institution of Fire Engineers (IFE), and was the director responsible for technical matters. He also served on the Board of the Engineering Council Division of the Institution, and, for many years chaired the Division's Membership Committee. He is, at the time of writing, Chairman of the Fire Risk Assessment Council of the Fire Industry Association.

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

For many years, Colin has served on national standards making committees, particularly those of BSI. He is a member of the BSI Technical Committee that was responsible for the production of BS 5839-8, and he served on the BSI working group that prepared the final draft of the 1998 version of the standard.

Douglas Mason graduated from Glasgow University with a degree in mathematics and physics. His career spanned industrial electronics, defence electronics and research before he entered the field of fire protection in 1983 as Engineering Manager of Planned Equipment Ltd, a fire detection system manufacturer and installer. He became technical director of the company, and designed a new generation of conventional (but microprocessor-based) fire alarm panels.

The company also majored in sound systems, and Douglas led the company into the voice alarm field. He was responsible for the introduction of a range of sophisticated, electronic voice alarm control equipment.

Recognizing the need for standardization, Douglas lobbied the British Fire Protection Systems Association (BFPSA) (now the Fire Industry Association) to develop a voice alarm standard. He subsequently chaired the BFPSA working group that generated the first UK standard for voice alarms in 1994. He then served as a member of the BSI working group that, in effect, converted the BFPSA Code into BS 5839-8.

He joined C.S. Todd & Associates in 1998 as a senior consultant specialising in fire detection and voice alarm consultancy work, and until 2008 designed many fire detection and fire alarm systems and voice alarm systems.

Also, since 1998, he has drafted a number of British Standards, including BS 5839-9, and most recently has served on the BSI working group that created the revised version of BS 5839-8.

Douglas is a chartered engineer and a corporate member of the Institution of Engineering and Technology. He retired from full-time employment with the practice in 2008, but continues to work as a part-time consultant in this field.

I. Introduction

This is the third edition of *The design and installation of voice alarm systems*. The book remains a guide to BS 5839-8,¹ the first code of practice in the UK for the design, installation and maintenance of voice alarm (VA) systems, but has been brought up to date to reflect the changes to that document. The Code is one part of the BS 5839 suite of codes, all of which now bear the generic title *Fire detection and fire alarm systems for buildings*.

Since the publication of the original version of BS 5839-8 in 1998, VA systems have become more prevalent, particularly in buildings in which substantial numbers of members of the public assemble, but also in medium and large multi-storey office buildings. Accordingly, there is an even greater need for the Code, and for it to be as appropriate and up to date as possible. This book refers to the latest (2013) version of the Code but covers all the extensions of the scope introduced in BS 5839-8:2008, as well as those now included in BS 5839-8:2013, such as allowance for an increasing need for fire-resistant data cable. New concepts, such as types of VA systems, have been introduced to help those specifying VA systems.

In the first edition of this Guide, the question ‘Why is there a need for a “guide to the guide”?’ was asked. The answer is probably still ‘interpretation’. As in its first published form, this book gives further guidance on issues that were previously contentious or surrounded by ambiguity. However, the Code has now been in force for 15 years and a number of changes have been found to be needed; few, if any, of these changes were made to the Code (in 2008, and now in 2013) because the Code, in its original form, was ‘wrong’. However, as well as the extension to the scope,

¹ BS 5839-8:2013 *Fire detection and fire alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of voice alarm systems*.

account has had to be taken of newly published standards and codes of practice, particularly BS EN 54-16,² which obviates the need for many of the previously included detailed recommendations relating to control and indicating equipment for VA systems and BS EN 54-25,³ which refers to radio-linked VA systems.

Codes of practice do not give detailed guidance on implementation, nor is it possible, in a code of practice, to explain in any detail the reason behind the various recommendations made. The main purpose of this Guide is, therefore, to increase understanding of the Code by, for example:

- explaining the reasons for the recommendations in the Code;
- outlining the consequences of failures to satisfy the recommendations;
- providing more detailed guidance on the manner in which the recommendations may be satisfied;

using numerous examples to aid interpretation. Also, the Guide is not as formal a document as the Code, permitting it to include background and other associated information. For example, the opportunity is taken to consider the use of VA systems for purposes other than emergency warning. The authors hope that this approach will make the Guide interesting to read, as, they hope, was the case with previous editions.

Although the Code has been used primarily for VA systems associated with fire detection systems in buildings, these systems have sometimes included facilities for broadcasting messages relevant to other emergency situations such as bomb or other security alerts. To take this into account, ‘fire microphones’ are now referred to as ‘emergency microphones’. It is important that the Code deals with emergencies other than fire emergencies, because BS EN 60849,⁴ another VA system standard dealing with such emergencies, has been withdrawn. It should, however, be noted that there are also other relevant codes or standards that may be specified in particular circumstances, for example BS 7827⁵ if the voice alarm is intended for use in a sports ground or stadium.

It is strange how long it has taken for voice messages to become established as credible alarms of fire – or, indeed, any other emergency. In the

² BS EN 54-16:2008 *Voice alarm control and indicating equipment*.

³ BS EN 54-25:2008 *Fire detection and fire alarm systems — Components using radio links*.

⁴ BS EN 60849:1998 (edition 2) *Sound systems for emergency purposes*.

⁵ BS 7827:1996 *Code of practice for designing, specifying, maintaining and operating emergency sound systems at sports venues*.

1. Introduction

17th century, a handbell was used to draw people's attention, but the warning was usually supplemented by a voice message, if only comprising the word 'Fire'! Even in those early days, the use of voice messages must have assisted in evacuation.

In recent times, however, bells or electronic sounders, without any voice messages, have been established as fire alarm warning signals. The very word 'alarm' conjures up loud bells or sirens and, to those of us in the fire safety profession, it seems obvious that these warnings should be taken seriously. We all know, however, that the sound of ringing bells is really useful only to those who have been trained to recognize them as warnings of fire and to respond appropriately.

Those unfamiliar with a building may not recognize the warning from an audible alarm device as a fire warning. Moreover, there is a tendency for members of the public to disbelieve the warning, even if they do recognize it, on the assumption that it might be a test or a false alarm. (Unfortunately, statistically, this assumption is correct!) This means that there is often reluctance on the part of occupants to evacuate a building when the fire alarm system is operated, resulting in a 'pre-movement time', between the initial sounding of the alarm and the initiation of evacuation, that can greatly exceed the evacuation time itself.

Research has shown that the reluctance arises, in part, because of a desire for further information. This information can be provided by broadcasting an appropriately worded speech message, thereby resulting in a much more appropriate response; practical research and anecdotal information both confirm this.

There is now, however, some evidence that emergency voice messages, although in themselves giving clear information on action to be taken in the event of fire, can sometimes be ignored in a real fire condition, if occupants of a building have been exposed excessively to repetitive broadcasts of the actual emergency messages for test purposes (despite messages before and after the tests, advising listeners to take no emergency action). To counter this, emphasis is put, in the latest version of the Code, on minimizing this exposure to the actual emergency message during weekly test periods, by broadcasting the message out of normal working hours.

That aside, the replacement of bells or electronic sounders by voice messages dramatically reduces the occupants' pre-movement time and, therefore, the overall evacuation time. There are not yet enough statistics to determine whether lives have been saved by the use of voice messages, but there can be no doubt that, in many types of building, life safety is enhanced by the use of these systems. The voice alarm is here to stay and its use will grow.

BS 5839-1⁶ refers its readers to BS 5839-8 for systems ‘where audible alarms comprise speech messages generated by a VA system’, and the design of VA systems is therefore established as a separate discipline in its own right. Although the design principles can, and should, be based on the principles developed for fire alarm systems, there are many special considerations in the design of VA systems. They involve audio technology and acoustics, and the system must be able to broadcast emergency messages that can be easily understood. Thus, there is a major difference between a conventional alarm sounder system and a VA system. For example, an alarm sounder system requires only adequate audibility for optimum perception of the warning, whereas a VA system requires intelligibility, of which audibility is only one component.

As discussed in more detail in the next chapter, the absence, for a considerable time, of specific codes of practice or standards for VA systems resulted in many design shortcomings, bad practices and, ultimately, installations that did not even meet the basic principles of fire alarm design as embodied in, for example, BS 5839-1. Inadequately intelligible and not easily understood broadcasts were one of the common shortcomings. Without the discipline now applied by the recommendations of BS 5839-8, many VA systems would still exhibit problems such as:

- unsuitable and non-fire rated cabling for loudspeaker circuits;
- unsuitable loudspeakers;
- ineffective fault monitoring arrangements for loudspeaker circuits;
- totally unmonitored sections of the alarm path, including the crucial link between the fire detection system and the VA system.

These shortcomings arose not merely through ignorance of system requirements (although the sound systems industry was initially slow to appreciate the principles of fire alarm design), but in order to reduce costs and win orders – a very unsatisfactory state of affairs! Accordingly, the publication of BS 5839-8 was an important step in rationalizing, standardizing and providing a tool for the control of design standards. These important factors have now been enhanced by the publication of this revised version of the Code. Nevertheless, the authors of the

⁶ BS 5839-1:2013 *Fire detection and fire alarm systems for buildings — Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises.*

1. Introduction

Code have once again been conscious of the need to avoid ‘going over the top’ in making recommendations or placing onerous requirements upon system designers that would inevitably lead to excessively high costs and drive purchasers back to conventional alarm sounder systems. In the original version of the Code, particular care was taken to avoid recommendations for VA systems that went beyond the analogous recommendations for conventional alarm sounder systems. The revised Code further emphasizes this need by introducing the concept of VA system types, which assists in providing a ‘horses for courses’ approach to VA system design.

Attempts have also been made to ensure that the Code is flexible where appropriate. For example, with the advent of BS EN 54-16, which *inter alia* gives performance requirements for power amplifiers, it may now not be necessary to include automatically switched standby amplifiers because of the inherent reliability of power amplifiers conforming to that British Standard.

Even after the great care taken in the original version of the Code to consider the views of all parties, and to develop recommendations that were logical and justifiable, there has been still some misunderstanding on certain issues, such as the use of ‘dual’ loudspeaker circuits. Particular attention is therefore given to these issues in this Guide.

In BS 5839-8:2008, a significant number of alterations and additions to the content were made, because of changes in technology, custom and practice. The principal changes (taken from the text of the revised Code) were as follows:

- a) ‘Types’ of VA systems have been introduced to recognize and identify the different configurations of systems that can be used and their specific operational needs;
- b) the need is clearly identified for the building evacuation plan to be based on a risk assessment by a competent person;
- c) recommendations in the use of voice sounders have been included as a clause in the main part of the Code as opposed to an annex, thus recognizing their increased acceptability in simpler VA systems where manual control is not required;
- d) recommendations for VA control and indicating equipment and power supply equipment have been rewritten taking into account that the new harmonized European standards, BS EN 54-16 and BS EN 54-4, give the applicable product requirements;
- e) the information on standby battery calculation has been consolidated into one informative annex;

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- f) two different levels of fire resistance of cables are recognized, and recommendations given for application of each type;
- g) recommendations for networked systems, for example in respect of cable types, are included;
- h) the use of radio to link parts of the VA system is recognized and recommendations for the implementation of such radio links included;
- i) recommendations for the maintenance of systems, including the periods at which routine servicing should be carried out, have been revised;
- j) the single 'commissioning and installation' certificate has been replaced by a modular certification scheme separately covering: design, installation, commissioning, acceptance, verification, inspection and servicing, and modification;
- k) the code of practice has been simplified by the use of practice specification format, in which commentary on relevant principles is followed by short, succinct recommendations. This is intended to make the code of practice less ambiguous and simpler for the non-specialist to apply and compliance of installations more straightforward to audit;
- l) the term 'deviation' has been replaced with the term 'variation', to avoid any negative connotation associated with the term used to describe an aspect of system design that, for good reasons, does not conform to this standard.

Since then, at least the following alterations and additions have been made in BS 5839-8:2013:

- a) the text on radio-linked systems has been modified to remove conflicts with BS EN 54-25:2008;
- b) new recommendations for measurement of audibility of background noise have been added;
- c) the text on cables and wiring has been updated;
- d) Annex C has been modified to allow for alternative amplifier efficiencies;
- e) practical guidance is now included on placement of loudspeakers in simple acoustic environments;
- f) the term 'responsible person' has been removed and replaced with references to 'premises management' to avoid confusion with the term defined in legislation;
- g) changes have been made to recommended regular system test procedures.

1. Introduction

VA systems must be properly designed if they are to operate continuously and reliably. However, the philosophy behind the recommendations of BS 5839-8 does not involve the creation of systems that cannot fail. (Indeed, not only is 100 per cent reliability impossible, but it would be unaffordable even if it did exist.) The Code does stress the need for measures that will minimize failures and downtime, but also stresses the need for comprehensive monitoring of all critical system elements. This need for comprehensive fault monitoring is one of the main features that distinguish a VA system from a traditional public address system.

As in the case of any code of practice, BS 5839-8 provides recommendations, rather than requirements. In practice, of course, the Code forms the basis for purchase specifications and requirements by enforcing authorities. Nevertheless, variations from the recommendations may be acceptable in particular circumstances. Such variations should be subject to agreement between all interested parties, including the purchaser, any relevant enforcing authority and, possibly, the fire insurer.

VA systems are particularly appropriate for medium- and large-sized buildings that house significant numbers of members of the public. The ability of these systems to broadcast specific messages for particular areas of the building and real time speech make them very suitable for buildings in which phased evacuation is used. However, the principle of using voice messages to give fire warning is appropriate for virtually any size of building, and, as the cost of systems decreases and there is greater integration of VA systems and fire detection systems, the size of buildings for which VA systems are used will continue to decrease. The enhanced guidance contained in the revised version of BS 5839-8 should assist this growth in VA systems, while ensuring that the systems installed meet the needs of fire safety.

Even though the revised Code addresses the few ambiguities and imperfections found in the original version, further such issues may arise, as experience in the use of the Code continues to grow. Users should note that BSI technical committees always welcome feedback. The technical committee responsible for BS 5839-8 would, no doubt, be prepared to consider further comments from users and would, obviously, continue to be in a position to respond to enquiries in the event of serious problems of interpretation.

2. Voice alarm systems and standards – a short history

Before the discovery of electricity, the spoken word was the first form of local warning by someone who had seen something recognizable as an emergency or warning whether it be smoke, fire, remote signals transmitted via semaphore, bonfires, etc. However, communication of the message across even a limited area involved dispatching a messenger, even over very short distances.

The ancient Greeks had found that, in order to transmit a really clear voice message across an assembled group of people simultaneously, there were benefits if the auditorium were a rounded hollow in the side of a hill and the speaker was located at a ‘focal point’. This was, effectively, early acoustic design and no doubt of a very approximate nature. Nevertheless, it demonstrated an understanding that consistent intelligibility throughout a listening area is essential if the message is to be understood by everyone.

Voice alarms, as we know them today, have become possible because of:

- the discovery of electricity;
- inventions such as microphones, amplifiers and loudspeakers;
- the development of communications techniques.

Early public address systems were used first for indoor and outdoor meetings, etc., but their use grew for paging and background music.

During the Second World War, there was plenty of opportunity for installation and regular use of emergency sound systems. For example, they were used to scramble air force crew and give specific orders. However, large loud sirens were widely used for air raid warning, so as to warn large numbers of people quickly and simultaneously. Air raid sirens are, of course, an example of the exceptional case where the

meaning of the alarm signal was known to everybody, with very little training!

By the 1950s, every respectable large office block had 'the Tannoy', as public address systems were often known. 'Music while you work' in factories brought a large increase in the use of sound systems in industry. Because public address systems were installed and available, consideration began to be given to their use in the event of fire and other emergencies. Thus, it is the case that, in the UK, public address systems have been used for giving fire warnings for several decades. In some cases, the public address system was the primary means of giving fire warnings (as well as serving as a conventional public address system), although, in other cases, public address systems were used only to provide supplementary information when fire alarm sounders operated. The level of integration of a fire detection system with a public address system tended to be either non-existent or very crude.

The term 'voice alarm system' or 'voice evacuation system' was sometimes used by certain organizations to describe these systems. However, in engineering terms, these early systems were simply relatively standard public address systems that happened to be used for fire warning.

These early systems often relied upon either taped messages or real time speech, often by operators who were ill-suited to the task! Moreover, the systems themselves fell far short of the level of integrity expected of a fire alarm system, even a fire alarm system that met the less stringent standards of the time in question. Circuits were neither monitored nor wired in fire-resisting cable, while standby power supplies were either non-existent or, often, of a relatively short duration. Until the 1960s, valve amplifiers were used, making the systems prone to failure, while elementary design of microphones and, particularly, loudspeakers, resulted in inefficiency of systems, necessitating large loudspeakers that did not produce a particularly high output.

The intelligibility of the systems was often quite poor. Indeed, in some cases, the paucity of loudspeakers was such that the messages were completely unintelligible within, for example, cellular office accommodation. Sometimes, the system was intended to do no more than attract attention with an alarm tone, so causing people to vacate their offices and proceed to a location, such as the corridor, where the broadcast information might be intelligible.

Thus, for the vast majority of applications, bells and electronic sounders were the norm. These devices are, after all, loud and attention-drawing. Bells and sounders are still in popular use today and are perfectly adequate as fire alarms for many applications, provided listeners are

2. Voice alarm systems and standards - a short history

trained to recognize them and understand the action they must take on hearing them.

In the UK, recognition of what became known as ‘use of public address equipment in lieu of conventional sounders’, and the need for special consideration of particular aspects of engineering design, can be traced back at least as far as 1972, when British Standard Code of Practice CP 1019 was published, to provide recommendations on fire alarm system design. This code contained eight recommendations for public address systems that were to be used for giving fire warnings. Most of these recommendations remain relevant, and indeed are an inherent part of good design today, although some are still overlooked from time to time by designers! The recommendations were carried over into BS 5839-1:1980 and BS 5839-1:1988, but expanded by a later amendment to the latter code. Since then, versions of BS 5839-1, published after the first version of BS 5839-8, have been able to refer to the latter code of practice for recommendations in respect of VA systems.

In the USA, the first National Fire Protection Association (NFPA) ‘Voice/Alarm Signalling Service Sub-Committee’ was formed in 1975 and immediately began work on the development of NFPA Standard 72F.⁶ As in the case of BS 5839-8, the intention was to standardize design practices.

The approach in both of the early UK and American codes was simply to ensure that the principles of fire alarm design were adopted in the design of VA systems. There was little or no attention to acoustic issues, or to aspects of design for which there was not a strictly analogous aspect in fire alarm system design.

Major growth in the use of VA systems in the UK probably emanated from two sources, both of which are discussed in more detail in the next chapter. The first source was the increased use of phased evacuation principles for tall buildings, the construction of which went through a boom, particularly in London, during the 1980s. Secondly, a considerable amount of important and quite elegant research into human behaviour in fire revealed that response of people to alarm signals could be greatly improved by provision of additional information via voice messages. It is interesting to note that, in the first case, the intention is to ensure that those who need not evacuate are reassured and remain in their own areas of the building, while the intention in the second case is to promote rapid evacuation!

⁶ NFPA 72F *Standard for the Installation, Maintenance and Use of Emergency Voice/Alarm Communication Systems*.

The coming together of fire detection systems and sound systems in a widespread manner has, therefore, taken place primarily within more recent years. However, during the initial years of the growth in the use of VA systems, it rapidly became clear that there was inadequate guidance on design issues. Part of the problem has been that, even in the 1990s, the provision of VA systems tended to be achieved by taking an off-the-shelf fire detection and fire alarm system and connecting it, often by relatively crude means, to a public address system of enhanced design, to form a single system that often fell short of the spirit, and sometimes even the letter, of even the simple guidance traditionally contained in fire alarm design codes.

The link between the fire detection system and the VA system was, for many years, a particularly 'grey' area. Clearly, this is an essential part of the alarm path that must be robust and fully monitored. However, it was quite common for the supplier of the fire detection system to give very little attention to this matter, as the VA system was treated as an auxiliary system, connection to which justified, sometimes, nothing more than an unmonitored piece of telephone cable. Basically, the organization providing the fire detection system considered that this was an input to the VA system and nothing to do with a fire alarm supplier, while the supplier of the VA system treated it as an output from the fire alarm system and nothing to do with the voice alarm supplier!

Loudspeaker circuit monitoring also presented particular problems and was not always properly considered or implemented. In the inevitable competitive commercial world, purchasers often selected the lowest cost system, which, unsurprisingly, did not always have comprehensive fault monitoring of the type generally required for fire warning systems.

Equally, after certain fire disasters, an increase in attention to fire safety standards sometimes led to some consultants' requirements being considered as over-specification. In some aspects of design, the requirements specified went beyond those that would traditionally apply to a fire warning system.

There was, therefore, an urgent need for suitable standardization. Many hoped that, when BS 7443⁷ was published in 1991, it would resolve some of the contentious issues. This British Standard was actually the British version of an IEC standard, IEC 849:1989.⁸

Unfortunately, the standard, which had been produced without any real reference to those involved in fire alarm standards, provided little

⁷ BS 7443:1991 *Specification for sound systems for emergency purposes*.

⁸ IEC 849:1989 *Sound systems for emergency purposes*.

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practical assistance. It did, however, introduce the concept of speech intelligibility, and made a definitive recommendation in respect of the manner in which intelligibility should be measured and the result that should be achieved.

On the negative side, the standard introduced widespread confusion as to whether conformance necessitated two independent (and usually 'interleaved') loudspeaker circuits on all floors of a building, a practice that was not required at the time to satisfy the recommendations of BS 5839-1 for sounder circuits (although this is now recommended for a limited number of situations in the current version of BS 5839-1).

However, VA standards moved forward with a quantum leap when, in 1994, the British Fire Protection Systems Association (BFPSA) published its *Code of practice for the design, installation and servicing of voice alarm systems associated with fire detection systems*. In contrast with BS 7443, this code of practice contained a significant amount of 'meat'. Moreover, it adopted many of the principles contained in BS 5839-1, so ensuring at least a degree of consistency of design principles between fire alarm systems using conventional sounders and those incorporating VA systems.

The BFPSA (now known as the FIA) code lacked, however, some of the rigour of a British Standard, and remained somewhat ambiguous in respect of a number of matters. In the meantime, voice alarms with design deficiencies were being installed into complex buildings, in which the safety of large numbers of people would depend on adequate fire warning. Such was the concern over this issue by the Loss Prevention Certification Board (LPCB) that the LPCB issued a Technical Bulletin, reminding interested parties, particularly fire alarm contractors certificated by the LPCB, of commonly experienced pitfalls and a number of design features required for conformance to BS 5839-1.

BSI simply adopted the BFPSA code, verbatim and in its entirety, as the first draft of BS 5839-8, which was then offered for public comment. The public comments were not extensive in number, but were very significant in respect of the technical matters and fundamental design principles that they addressed. Accordingly, the BSI Technical Committee responsible for the new code formed a small working group, which, over a prolonged period of time that was commensurate with the significance of the public comment, undertook major redrafting of the document. The working group added new material on issues that commentators indicated should be addressed, in some cases completely rethinking the philosophy that underlay a number of design principles, and providing a more definitive code of practice, against which quite rigorous and unambiguous verification could be undertaken. About eight years after

publication of the Code, the same BSI Technical Committee re-formed a working group to revise the Code, following a considerable number of comments received. Once again, drafting required a prolonged period of work, but all the issues referred to in the Introduction of this Guide were addressed in detail, resulting in an updated Code that is easier to digest than its predecessor.

Although it is still the case that the revised BS 5839-8 is only a code of practice, it will continue to form the basis of contracts and enforcing authority requirements. The authors of the revised version have therefore striven to ensure that the Code is as definitive and as unambiguous as possible, without stifling innovation.

When drafting the original version of BS 5839-8, in the absence of appropriate product standards, it was decided to include recommendations for equipment, such as control and indicating equipment, despite the fact that the Code was a systems-related document. With the publication, for example, of BS EN 54-16 for voice alarm control and indicating equipment and BS EN 54-4⁹ for power supply equipment, it has been possible for the revised Code to concentrate more upon the systems aspects of voice alarm.

In our opinion, an excellent job was done in updating BS 5839-8. It is now set out in 'practice specification' format, with separate commentary and recommendations, making it easier to read than in its previous version. The Code should be an even more valuable document in the promotion of greater use of VA systems as a result of increased user and specifier confidence, as well as clearer, standardized objectives for the product designer.

⁹ BS EN 54-4:1998 *Fire detection and fire alarm systems. Power supply equipment.*

3. The role of voice alarm systems in fire warning

In principle, a VA system can be used as the means of broadcasting fire alarm signals in any building, regardless of size, occupancy or function (provided, of course, the nature of the building is not such that reasonable intelligibility would be impossible to achieve – the issue of alarm intelligibility is discussed in Chapter 19). It is unlikely that, engineering and economic issues aside, there would ever be a significant fire safety or managerial basis for rejecting a VA system in favour of a system that used conventional alarm sounders.

In practice, there is little, if any, advantage in using a VA system in buildings of limited size, with occupants who are familiar with the building and trained in evacuation procedures. Voice alarms are still not being used in such buildings to any great extent, simply because of the greater cost normally associated with the VA system. However, there is a continuation of the trend towards the use of VA systems in more straightforward buildings than has traditionally been the case, provided any cost penalty associated with a VA system can be kept to a minimum. Even in straightforward buildings, a VA system can be designed to provide additional information (such as the location of the fire) if this information is of value to occupants.

Equally, there are buildings for which the use of a VA system may be regarded as essential or, at the very least, recognized good practice. Such cases arise when there is a recognized need for:

- optimum control of large numbers of the public;
- sophisticated evacuation procedures;
- an enhanced motivation to evacuate.

Three common examples of buildings in which one (or more) of these factors is relevant are buildings in which:

- phased evacuation procedures are used;
- the public assemble within a single large compartment;
- pre-movement time must be minimized.

The concept of phased evacuation has been used for many years in buildings in which it is unnecessary, and even undesirable, to evacuate the entire building when fire is first detected. In a large industrial site with an extensive range of buildings, even though the buildings may be interconnected, there may be no need to evacuate areas remote from the fire. A VA system can provide information as to the location of the fire, so that, for example, a fire team may be assembled, other key staff may be aware of the situation and occupants may be advised to keep out of the affected area.

However, perhaps the most common phased evacuation application in which the use of a VA system is particularly important involves tall office buildings. In these buildings, subject to certain safeguards that need not be discussed here, the number and/or widths of staircases may be reduced if a phased evacuation system, rather than any form of single stage evacuation, is adopted. The philosophy is that the staircase capacities need not be designed to cater for the simultaneous evacuation of all occupants. Instead, occupants are evacuated in a controlled and phased manner, usually two floors at a time, normally starting with the floor of fire origin and the floor immediately above. Since the occupants of two floors only are likely to be using the staircases at any one time, the permitted reduction in staircase capacity can be significant, providing greater usable and lettable floor space. Phased evacuation is mainly used in the case of office buildings, particularly those over around 30 m in height, although it is, occasionally, used in other occupancies.

In the case of a tall office building with a phased evacuation arrangement, there must be an unambiguous method of giving instructions to evacuate and, of course, giving instructions not to evacuate. This can be achieved with bells or electronic sounders (e.g. by the use of an intermittent signal for the 'alert' condition and a continuous signal for the 'evacuate' instruction).

The use of a VA system, however, adds a further dimension to the management of the evacuation. Firstly, voice messages are much less ambiguous than intermittent or continuous tones. (Although to those of us conversant with two-stage alarm arrangements, the intermittent or continuous ringing of bells, and the meanings associated therewith, appear relatively straightforward to understand, the confusion that can exist in the minds of occupants who have been inadequately trained is astonishing!) Moreover, the VA system can, and should, provide

3. The role of voice alarm systems in fire warning

reassurance to occupants on floors not yet to be evacuated that they are safe and need not attempt to evacuate, notwithstanding that, looking from their windows, they may see a host of fire appliances and, possibly, even evidence of a fire! It is important that occupants are reassured in this way since, if they were to decide to attempt, in effect, to evacuate from all areas of the building simultaneously, there would be serious overcrowding on the staircases.

Such is the recognition of the role of VA systems in phased evacuation that, for example, the London District Surveyors Association (LDSA) guidance document on phased evacuation¹⁰ specifically recommends the use of VA systems, although there is the potential to relax this in the case of office buildings of six storeys or fewer. Similarly, BS 9999¹¹ makes reference to VA systems and their benefits in supporting means of escape.

The reason for the use of VA systems becoming standard practice in large public assembly buildings is somewhat different. In this case, the majority of occupants will be unfamiliar with the fire alarm signals and the evacuation procedures.

Use of a VA system ensures that an unambiguous warning is given to all occupants. The VA system is also used to provide additional information regarding the procedures to be followed. In this respect, there can be vastly more flexibility than in the case of a system using conventional alarm sounders; pre-recorded messages can be overridden by real time messages broadcast from a control room, where information on the fire is available, or by the fire and rescue service when they take charge. This can permit direction of occupants regarding escape routes that should be used (or not used), etc.

Response to fire alarm warnings and motivation to evacuate have been the subject of considerable research on the subject of human behaviour in fire, particularly during the 1980s. The results of much of this research were widely disseminated, even reaching the general public by means of some of the popular science programmes on television.

The research indicated quite unambiguously, as everyone in the world of fire safety knew only too well, that people tend to react inappropriately to conventional fire warning signals. They might even be unsure as to whether the warning signal was intended to indicate fire or some other emergency. However, even if they were to recognize the sound as that of

¹⁰ LDSA Fire Safety Guide No. 3. 1990 *Phased Evacuation from Office Buildings*.

¹¹ BS 9999:2008 *Code of practice for fire safety in the design, management and use of buildings*.

a fire warning, there would be a tendency to disbelieve the warning signal, on the assumption that it might be a test or false alarm. As a result of this uncertainty, there is often a reluctance on the part of building occupants to evacuate when the fire alarm system is operated, resulting in a 'response time' that can greatly exceed the evacuation time, so constituting the major element of the time interval between outbreak of fire and total evacuation of a building.

Research also showed that part of that delay resulted from a desire for further information, which could be satisfied only by conferring with others, or even telephoning others, to obtain appropriate information that was perceived to be reliable in nature. There is, however, a remarkable contrast in behaviour when the fire warning comprises an appropriately worded speech message, giving clear and unambiguous information along with appropriate instructions. In this case, the response is much more immediate, so resulting in a significant reduction in the time between outbreak of fire and occupants' arrival at a place of safety outside the building.

In the fire engineering design of buildings, involving a holistic approach to fire safety design, account may be taken of the shorter evacuation time that will pertain if a VA system is used instead of conventional alarm sounders. In fire engineering design, the time between ignition and evacuation may be divided into a number of components, one of which is 'pre-movement time', defined as the time between the giving of an alarm signal to occupants of the building and the point at which occupants begin to evacuate. Pre-movement time is, itself, divided into two components, namely, 'recognition time' and 'response time'. Recognition time is the period for which the alarm signal is evident but occupants are not yet responding to it. During this period, occupants continue with their normal activities. Response time is the period after occupants recognize that they are being given an instruction to evacuate, but before they begin to move directly to an exit.

In the fire engineering approach, a reduction in response time may be assumed if a VA system is used. (However, care should be taken to ensure that, in situations with rapid fire development, the assumed benefit of a VA system is not overstated; ultimately, there must come a point in fire growth when evacuation will begin, regardless of whether an audible alarm has even been given.) Equally, with increasing use of VA systems, there are suggestions that this benefit may not now be as great. This may be the result of exposure of the public to false alarms from automatic fire detection systems in which warning is given by a VA system. Even so, BS 9999, for example, permits travel distances to exits to be increased by 15 per cent and door widths to be reduced by 15 per cent if there is

3. The role of voice alarm systems in fire warning

automatic fire detection (primarily smoke detection) *and* a VA system, provided these show a clear benefit.

It is clear, therefore, that a VA system employing speech messages is not simply a new-fangled form of fire alarm signal. The specific use of a VA system, rather than conventional sounders, may form an integral part of the fire safety strategy for the building. In performing this role, it may, therefore, not simply act as an alternative form of fire warning, but a necessary form of fire warning, given the nature of the strategy proposed.

4. Scope of BS 5839-8

The Code has been written to guide all interested parties involved in any stage of a VA installation project, both technically and in terms of project management. Coverage extends therefore from microphones to loudspeakers via amplifiers, but also from initial planning to system maintenance via design and handover.

The recommendations of BS 5839-8 basically apply to any VA system that is automatically triggered by, and therefore effectively forms an integral part of, a fire alarm system. Normally, VA systems are used in buildings in which there is a significant amount of automatic fire detection, but the recommendations of the Code would apply even if the fire alarm system were purely a manual (break glass call point) system. In this respect, the Code interfaces perfectly with BS 5839-1, advising on the connections between the fire detection and fire alarm system and the VA system, as well as on the information that must be fed back from the VA system to the fire detection and fire alarm system. (The previous sentence presupposes that the two systems are entirely separate; this need not, of course, be the case, and the availability of fully integrated fire detection/voice alarm systems has grown, as predicted, since the first edition of this book was published.)

VA systems other than those of Type V1 (see Chapter 7) incorporate a facility for live speech broadcast. VA systems within the scope of the Code must, however, always have a facility for automatic transmission of pre-recorded messages. A system that requires manual intervention by an operator in order to transmit either pre-recorded or live messages would not come within the scope of the Code, nor would such a system generally be regarded as acceptable for fire warning purposes. Thus, the simplest VA system to which the Code would apply would be one in which, for example, there was only a single message (and thus a single stage alarm arrangement) that was automatically triggered by an associated fire detection and fire alarm system (whether incorporating

automatic fire detectors or not). Systems used in large complexes will, of course, be much more sophisticated, typically involving tens of loud-speaker zones, several emergency microphones, multiple evacuate/alert and test messages, several different types of loudspeaker and often various manual controls to start and stop messages.

The Code applies equally to centralized systems, in which all power amplifiers are installed at a single location, and distributed systems, where power amplifiers, etc., are located in groups at strategic points around a building. The choice between the two types of system is basically a matter of economics and engineering 'taste', but exactly the same recommendations apply to both types of systems. Some recommendations of the Code may appear quite onerous for small systems but the view taken was that system format was an engineering issue to which absolutely consistent recommendations should apply.

Fire telephones are specifically excluded since they make up an entirely separate form of communication system, now referred to as an emergency voice communication system. A VA system is intended to inform the occupants of a building collectively of the existence of a fire. Fire telephones, on the other hand, are provided for operational use by the fire and rescue service during the fire, and for use by fire wardens in an emergency or, much more commonly, disabled persons requiring assistance with evacuation. A code of practice covering such systems, BS 5839-9,¹² was published in 2003.

Voice alarms used for fire warning, and conforming to BS 5839-8, may be used for warning of other types of emergency, such as bomb warnings, etc. The potential use of VA systems for this purpose is fully acknowledged in BS 5839-8, which provides relevant recommendations in respect of, for example, prioritization. This continues to represent a distinct difference from recognized practice in the USA, where use of a VA system for purposes other than fire warning would need special approval. The acceptance of VA systems for multiple emergency situations and for non-emergency broadcasts, such as paging, background music, etc., is extremely important, as it often makes the VA system economically viable in situations in which a public address system is required for other purposes. This is considered further in Chapter 14. If one were designing a VA system for purposes other than fire warning, although this would not lie within the scope of the Code, its

¹² BS 5839-9:2003 *Fire detection and fire alarm systems for buildings — Code of practice for the design, installation, commissioning and maintenance of emergency voice communication systems.*

4. Scope of BS 5839-8

recommendations would nevertheless be appropriate if there were a need for high reliability and integrity of the warning system.

Originally, BS 5839-8 did not apply to VA systems used in sports stadia because of the existence of the code of practice, BS 7827, which provides recommendations for the installation, maintenance and operation of permanently installed sound systems used for emergency purposes at sports venues. However, most of the recommendations of the Code apply to such systems and this was recognized in an Amendment to the Code, introduced in 2005. The revised version of BS 5839-8 now includes more information relevant to sports venues, but, in the Scope, still refers the reader also to BS 7827.

The first version of the Code, although an installation code of practice, contained a number of recommendations for the design of hardware. This arose because of the absence of product standards for components of VA systems. With the advent of BS EN 54-16, a product standard for control and indicating equipment for VA systems (including microphones), it has been possible to remove much of that information. Recommendations for appropriate loudspeakers, however, have had to be retained in the revised Code because the new standard BS EN 54-24¹³ for VA system loudspeakers does not (at the time of this edition going to press) include requirements for fire-related mechanical and electrical integrity of loudspeakers and their connections.

The Code continues to apply only to VA systems that are used in a temperate climate such as that of the UK.

In the original Code, recommendations for the use of voice sounders (stand-alone devices connected to fire alarm systems, containing the components necessary to generate and broadcast their own digitally recorded messages) were included in an annex. In recognition of their increasing use, voice sounders are now dealt with in a separate clause of the revised Code.

¹³ BS EN 54-24:2008 *Fire detection and fire alarm systems. Components of voice alarm systems. Loudspeakers.*

5. Contents of the Code

The presentation of the revised Code has been totally altered to follow a practice specification format. This makes for concise recommendations, with separate commentaries (in italics). Those checking what recommendations apply to a particular feature of a VA system should therefore be able to do so quickly, whilst those who wish to check on the reasoning behind them can do so in the commentary. The original Code was quite intentionally drafted to follow and parallel the format of BS 5839-1:1988 and the revised version retains that approach, but now emulating BS 5839-1:2013. The title of each of the six sections of the Code corresponds to a title in Part 1. These titles are:

- General.
- Design considerations.
- Installation.
- Commissioning and handover.
- Maintenance.
- User responsibilities.

Four annexes provide further information on a number of issues.

These six sections are subdivided into a total of 44 clauses, which are briefly reviewed, along with the four annexes, below, highlighting important aspects that will be discussed in subsequent chapters of this Guide.

Section I – General

1. Scope

The scope of the Code has been discussed in the previous chapter. The important point is that the VA systems covered by the Code are those

which automatically transmit messages in response to signals from associated fire detection and fire alarm systems; systems that necessitate manual intervention are outside the scope of the Code.

2 Normative references

In accordance with current BSI practice (different from that applying at the time of publication of the original version of the Code), only 'Normative' references appear in Section 2. 'Normative' references are basically other standards and codes (or European Directives), providing requirements or recommendations that should be followed. Most, but not all, of these are, in this case, BSI publications.

If, in the Code, a normative reference includes a date, the edition of that date, only, applies (together with any amendments to the reference that have been made prior to the publication of BS 5839-8). If the reference is undated in the Code, the latest edition of the document applies, together with any amendments.

Many normative references in the Code are dated, since they are references to sections or clauses of a standard published on a particular date. However, in the case of normative references that are undated, over a period of time the recommendations of BS 5839-8 could change subtly, because of changes to the recommendations or requirements contained in normative references. It is, therefore, important that users of the Code ensure that they refer to the latest version of undated normative references.

3 Terms and definitions

Clause 3 now defines 26 terms used in BS 5839-8 *as they are to be understood for the purpose of interpreting the Code*. These include a definition of 'voice alarm system' itself.

Some of the terms defined may be unfamiliar to those in the fire industry, as opposed to the sound systems industry. One important term is 'intelligibility', a particularly important parameter in VA system performance. Intelligibility is discussed in Chapter 19 of this Guide. The terms 'emergency loudspeaker zone' and 'PA zone' are also defined here; it is important to distinguish these from fire detection zones.

5. Contents of the Code

4 Need for a voice alarm system

This short clause is there as a guide to those trying to establish whether a VA system is actually required for a particular premises. It basically refers the reader to appropriate guidance documents, standards and enforcing authorities.

5 Types of systems

VA systems can have varying degrees of manual control of broadcast of emergency messages, whether live or recorded. The revised version of the Code therefore groups VA systems into types, each of which defines a particular combination of automatic and manual control. More information about types of system, and their selection is given in Chapter 7.

6 Exchange of information and responsibilities

In the commentary, the Code makes it clear that the purpose of the VA system is to support the building's fire safety strategy (an obvious point, made in the previous version of the Code, but emphasized more in the revised version). To achieve that objective, particularly in complex premises, there needs to be liaison between the system designer, the user or purchaser, the enforcing authority and, possibly, specialist consultants.

The recommendations clarify the responsibilities for liaison of the user or purchaser, the designer and the installer to ensure that the VA system is appropriate in all respects. They include a recommendation to ensure that one organization is responsible for the overall fire detection and fire alarm system/voice alarm system package. The importance of this cannot be overemphasized, since many of the shortcomings that exist in installed systems have arisen from an approach in which a fire alarm company has been responsible for the design of the fire detection system while a sound systems company has been responsible for the design of the VA system. The result, in such cases, has sometimes been a package that, in various respects, has failed to provide the integrity and reliability required for a fire warning system.

Clause 6 also discusses issues such as the need to determine whether the VA system is to be used for other purposes.

7 Variations from the recommendations of this standard

This clause includes recommendations for the recording of variations at design, installation and commissioning stages. It has been introduced here to keep the order of sections similar to those in BS 5839-1.

Section 2 – Design considerations

8 Relationship between system type and evacuation plan

The purpose of this clause is to give some guidance on the types of VA systems that would be appropriate for different buildings, with differing evacuation strategies. Since the Code does not set out to define the exact system needed for any specific building, most of the clause consists of commentary. Recommendations include the need for a risk assessment to determine the appropriate type.

9 Interface with the fire detection and fire alarm system

This clause formed part of a ‘General’ clause in the original version of the Code. However, it is an essential and critical part of a VA system and has now rightly been written as a separate clause. Recommendations for the link included in the ‘old’ Code are retained but there is a new recommendation for greater protection against complete failure of the link.

10 Systems in explosive gas or dust atmospheres

Originally introduced under Amendment No. 1 as a subclause of ‘General’ in Section 2 of the original Code, this individual clause now follows the pattern in BS 5839-1.

11 System components

This new clause lists the standards to which components of a VA system should conform. None of these standards were published at the time of publication of the previous edition of this Code. Their existence has now enabled many of the product-related recommendations in the original version of the Code to be replaced by simple references to them.

5. Contents of the Code

12 Monitoring, integrity and reliability of circuits external to the voice alarm control and indicating equipment (VACIE)

The recommendations in this clause are now divided into two subclauses, ‘Fault monitoring’ and ‘System integrity’, for clarification. All aspects of fault monitoring are addressed, including the monitoring of the critical link between the fire detection and fire alarm system and the VA system. Advice is also given on the location at which fault indications should be given.

The clause gives very detailed advice on the nature of the failures within the system that should be indicated, as well as describing the form of indication that should be provided.

The ‘System integrity’ section covers such aspects as the need or otherwise for duplication of loudspeaker circuits.

13 Loudspeaker zones

This clause effectively introduces the concept of ‘emergency loudspeaker zones’. Particular attention is given to the need for acoustic separation between different loudspeaker zones and the relationship between boundaries of emergency loudspeaker and fire detection zones.

14 Loudspeakers

Factors to consider in selection of the type, number, location and orientation of loudspeakers are contained within the commentary. Also, in this version of the Code, more recommendations are made regarding, for example, loudspeaker mounting arrangements. With regard to types of loudspeaker, the annex included in the previous version of the Code has not been retained because it was not considered to be of much benefit to those who would normally design VA systems.

Consideration is given to the protection of loudspeakers against fire. In this respect, the Code offers advice beyond that offered in respect of conventional alarm sounders in BS 5839-1, and additional to the requirements of BS EN 54-24.

15 Voice sounders

In recognition of their increased usage, voice sounders are now covered by this main clause in the new version of the Code. Guidance, including

some caveats, is given on the appropriateness of voice sounders for certain applications, and recommendations are made for attention-drawing signals, voice recording, etc.

16 Power amplifiers

This clause is particularly important for the system designer since it defines the extent of resilience that should be provided to cater for the failure of a power amplifier. Reference is now made to the need for a risk assessment to determine whether standby amplification is required. This is because the Code now recommends that power amplifiers used in VA systems should conform to the requirements of BS EN 54-16, possibly precluding the need for standby amplifiers.

17 Ambient noise sensing and compensation controller (ANS)

This clause describes the facility that can be provided to adjust VA broadcast levels as background noise levels vary. Potential applications for the facility are described, along with safeguards to ensure that the provision of this facility cannot detract from system performance in the event of unforeseen circumstances.

18 Emergency microphones

The Code now recommends that emergency microphones (referred to as 'fire microphones' in the original version) should conform to the requirements of BS EN 54-16 (in which emergency microphones are deemed to be part of the voice alarm control and indicating equipment (VACIE)). However, an increased number of recommendations are included in the new Code, particularly relating to microphone location and environment.

19 Emergency message generators

This short clause contains very important recommendations, which have major implications for equipment design. Fault monitoring of message generators is now covered in BS EN 54-16.

5. Contents of the Code

20 Emergency messages

Clause 20 makes recommendations for the format of the messages that should be used, whether pre-recorded or live. Specific formats, timings and examples of wording are offered for evacuate, alert and coded alert broadcasts, as well as test messages.

21 Audibility of non-speech broadcast

This new clause reflects the extension of the scope of the Code to include non-speech emergency ‘broadcasts’. The recommendations also apply to the attention-drawing tones that precede emergency voice messages. Recommendations are similar to those set out for attention-drawing tones in the previous version of the Code. However, various explanatory notes, derived largely from BS 5839-1, are included.

22 Intelligibility of speech messages

Since audibility of non-speech broadcasts is dealt with separately in the new version of the Code, this section now relates purely to voice messages. The concept of ‘intelligibility’, which is, of course, unique to warning systems that broadcast speech messages, is introduced. Recommendations related to clarity and audibility, as components of intelligibility, are given. Guidance is also given on factors that can assist in the measurement and optimization of intelligibility. The Code recognizes that, where acoustic surroundings are difficult, objective measurement of intelligibility is likely to be needed.

This clause is, therefore, the foundation for VA system performance; many other clauses within the Code are concerned with engineering issues, with a view to optimizing integrity and reliability, but, from the point of view of the user, it is the recommendations within this clause that will ensure that the system performs well as a warning system.

23 Priorities

This is a short clause that makes recommendations in respect of the priorities that should be attached to different event messages.

24 Voice alarm control and indicating equipment (VACIE)

With the advent of BS EN 54-16, it has been possible to remove much of the detail that was in the Control equipment clause of the previous version of the Code. However, there is a need to address the ‘options with requirements’ in that standard; recommendations for their use in VA systems in the UK are therefore included in the new version of the Code.

This clause includes a number of recommendations for siting of VACIE.

25 Networked systems

Following the introduction of a similar clause in BS 5839-1:2002 and retained in BS 5839-1:2013, the increasing prevalence of networked systems in large buildings is recognized in this new clause. Recommendations for network cable and system response times are included.

26 Power supplies

Here again, the clause is analogous to the corresponding clause of BS 5839-1. It is therefore now divided into three parts, covering mains supply, VA system power supply units and standby power supplies. In addition to the referred need for the power supplies to conform to the recommendations of BS EN 54-4, there are numerous systems-related recommendations.

Calculation of standby battery capacity is more complex in the case of a VA system than for a fire detection and fire alarm system. Accordingly, Clause 26 supplements the advice contained in BS 5839-1, particularly in respect of standby battery calculations. An entire informative annex is dedicated to the calculation of standby battery capacities.

27 Cables, wiring and other interconnections

Again, this clause relies substantially on the recommendations of Clause 26 of BS 5839-1. The text now reflects this section of BS 5839-1 including, for example, recommendations for the use of standard and enhanced fire resisting cable. Newly modified recommendations relating to conductor diameters, etc. allow the use of Cat 5 fire-resisting data cables in modern networked systems.

5. Contents of the Code

28 Radio-linked systems

This is a clause that was not included in the previous version of the Code. It recognizes that components such as microphones and loudspeakers may be radio-linked to VACIE and that sections of VACIE may be inter-linked by radio signals. Recommendations are given *inter alia* for power supplies, associated cables, communication, fault monitoring and radio surveys. Modifications to recommendations now avoid conflicts with BS EN 54-25.

29 Climatic and environmental conditions

This short clause deals with such matters as siting, safe mounting and robustness of VA equipment.

30 Radio and electrical interference

Now much expanded in the current version of the Code, this clause contains similar information to that in Clause 28 (Electromagnetic compatibility) of BS 5839-1. Recommendations are given for cable screening and earthing.

31 Electrical safety

Again derived from BS 5839-1, the short list of recommendations is clear-cut and simple. There is a detailed commentary, supported by two diagrams, that provides guidance on protective and functional earths.

Section 3 – Installation

32 Responsibility of installer

The recommendations in this clause comprise a list of practical points regarding actual installation of components and wiring. The particular drawing and documentation needs are also highlighted. (Clauses 32, 33 and 34 of this version of the Code mirror Clauses 36, 37 and 39, respectively, of BS 5839-1.)

33 Installation practices and workmanship

Installation techniques are covered here, with the accent on cabling.

34 Inspection and testing of wiring

Recommendations of this clause are almost entirely given over to testing of wiring and the need for test records.

Section 4 – Commissioning and handover

35 Commissioning

Within the recommendations of this clause, there is a long and useful list of commissioning, inspection and tests that should be carried out on a typical VA system.

36 Documentation

The recommendations of this clause include the provision of certificates, operation and maintenance manual, and as-fitted drawings.

37 Certification

This short clause gives guidance on the types of certificate that would be applicable to particular works.

38 Acceptance

The recommendations of this clause spell out, as guidance to the user or purchaser, the criteria for acceptance of a VA system.

39 Verification

Guidance is given here as to when verification of a system is necessary or desirable and how such a process should be carried out.

Section 5 – Maintenance

40 Routine testing

Recommendations of this clause include minimum routine tests needed to check operation of the various types of system, appropriate test broadcasts and test records.

41 Inspection and servicing

Following the format of the equivalent clause in BS 5839-1, this clause contains a comprehensive list of recommendations for routine maintenance. There are three lists of checks needed to be made at intervals of: three months, six months and one year, respectively.

42 Non-routine attention

This is a long and detailed clause that sets out recommendations for servicing/maintenance actions to be taken:

- after a change of maintenance organization;
- in the event of repair of faults or damage;
- in the event of modification work;
- after a fire; or
- after a long period of disconnection.

Section 6 – User responsibilities

43 Premises management

There is a need for the appointment of a responsible person to oversee all aspects of a VA system. The recommendations form a list of the duties of such a person. (In the previous edition of BS 5839-8, this person was described as the ‘responsible person’. However, this person, is not the ‘Responsible person’ on whom duties are imposed under the Regulatory Reform (Fire Safety) Order. That Responsible Person is usually a body corporate, whereas, in the case of BS 5839-8, the person would generally may be a premises manager, building services engineer or similar.) To avoid confusion of terminology, the term ‘Responsible person’ is no

longer used in the Code, reference being made instead, where required, to ‘premises management’.

44 Logbook

This clause identifies the need for a logbook to be available and includes details of the records to be kept in it.

Annexes

Annex A (Informative) – Typical ambient noise levels and their effect on system design

This annex contains useful information on how ambient noise should be measured and includes two tables. The first table gives an example of design data for a sound system in a hotel. The second table lists typical ambient noise levels in various environments, from very quiet to very loud.

Annex B (Informative) – Voice alarm control and indicating equipment

A useful description of the functioning and make-up of a VA system starts this annex. There is also a list of relevant ‘options with requirements’ appearing in BS EN 54-16. These are all cross-referenced to the relevant subclauses of that standard.

Annex C (Informative) – Standby battery calculations

In the previous version of the Code, the information in this annex was split into two sections: one in the main body of the Code and the other as an annex. Now, all the information is contained in one place. However, as before, detailed guidance is given, with a worked example, on calculation of the battery load current. The calculation is much more complicated than in the case of a fire alarm system using conventional sounders, because a typical emergency message is actually a composite of periods of silence, attention drawing signals and voice. Calculation formulae now include a variable for amplifier efficiency, to allow for, for example, Class D power amplifiers.

5. Contents of the Code

Annex D (Informative) – Model certificates

This annex includes suggested formats for certificates covering separate design, installation, commissioning, acceptance, verification, inspection and servicing, and modification.

6. Defining the terms

Because a VA system is an audio system, the Code contains audio terms that may be unfamiliar to some in the fire industry. A number of definitions therefore appear in Clause 3 of Section 1. Although most of the definitions are of audio terms, others are included to prevent ambiguity.

The following list gives the definitions set out in the Code, but with explanatory comments in each case, where considered necessary.

acoustically distinguishable area (a.d.a)	subdivision of an emergency loudspeaker zone characterized by an individual reverberation time and ambient noise level
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NOTE This may be an enclosed or otherwise physically defined space.

This is a useful term when considering types of loudspeaker to be used in a system.

ambient noise	ambient sound pressure, expressed in dB, normally present in an a.d.a., measured using the equivalent sound pressure level, $L_{Aeq,T}$ or $L_{A10,T}$, depending on the nature of the noise.
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This is a new definition, added for clarification.

area of coverage	area, inside and/or outside a building, where the voice alarm system meets the recommendations of this standard
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