BRITISH STANDARD

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Part 8 : 1998

Fire detection and alarm systems for buildings

Part 8. Code of practice for the design, installation and servicing of voice alarm systems

ICS 13.220.20; 13.320

Committees responsible for this British Standard

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

AEA Technology
British Cable Makers Confederation
British Fire Protection Systems Association Ltd.
British Fire Services' Association
British Telecommunications plc
Chartered Institution of Building Services Engineers
Chief and Assistant Chief Fire Officers' Association
Consumer Policy Committee of BSI
Department of Health (NHS Estates)
Department of the Environment (Building Research Establishment)
Department of the Environment, Transport and the Regions
Department of the Environment (Property and Buildings Directorate)
Electrical Contractors' Association
Health and Safety Executive
Home Office
Institute of Fire Safety
Institute of Petroleum
Institution of Electrical Engineers
Institution of Fire Engineers
London Fire and Civil Defence Authority
Loss Prevention Council
Ministry of Defence
National Association of Fire Officers
National Caravan Council Limited
National Inspection Council for Electrical Installation Contracting
Professional Lighting and Sound Association
Trades Union Congress

The following body was also represented in the drafting of the standard through subcommittees and panels:

Engineering Industries Association

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Contents

Foreword

This Part of BS 5839 has been prepared by Technical Committee FSH/12. No existing standard is superseded but this Part of BS 5839 expands the recommendations given in **9.12** of BS 5839 : Part 1 : 1988. It should be read in conjunction with BS 5839 : Part 1, BS 6259 and BS 7443.

Conventional alarm sounders, such as bells or electronic sounders, are not always sufficiently informative to ensure a rapid and safe evacuation of buildings in the event of a fire. In many buildings there is a need to broadcast clear emergency voice messages, particularly where phased evacuation procedures are used. This has led to the increasing use of sound distribution systems in lieu of conventional alarm sounders. These systems are generally known as 'voice alarm' systems and are normally used in conjunction with manually operated or automatic fire detection and alarm systems.

Other standards relating to fire detection and alarm systems refer only briefly to public address as a means of giving alarms. Conversely, standards relating to sound systems do not always give specific information about fire alarm applications. This code of practice for voice alarm systems has, therefore, been prepared to:

a) give guidance to those who specify, design, install, commission, service and use voice alarm systems;

b) help clarify interpretation of other sound and fire alarm system standards in respect of voice alarm systems;

c) ensure that high standards of reliability, safety and security are achieved, together with acceptable standards of performance.

It has been assumed in the drafting of this standard that the execution of its provisions will be entrusted to appropriately qualified and experienced persons.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 34, an inside back cover and a back cover.

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Section 1. General

1 Scope

This code of practice provides recommendations for the planning, design, installation and servicing of voice alarm systems associated with fire detection and alarm systems in and around buildings. It does not cover the fire detection and alarm systems themselves, which are covered by BS 5839 : Part 1.

Voice alarm systems covered by this code of practice are those which automatically transmit messages in response to signals from their associated fire detection and alarm systems. Systems that necessitate manual intervention are outside the scope of this code of practice, although voice alarm systems normally include a facility for transmission of live voice messages as well as automatically generated messages.

Although this Part of BS 5839 does not cover the use of voice sounders in a fire detection and alarm system, recommendations for the use of these devices have been included in annex E.

This standard applies only to voice alarm systems for use in a temperate climate such as that of the United Kingdom.

This standard does not apply to sports stadia, which are covered by BS 7827.

2 References

2.1 Normative references

This Part of BS 5839 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on page 34. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this Part of BS 5839 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on page 34, but reference should be made to the latest editions.

3 Definitions

For the purposes of this Part of BS 5839 the definitions given in BS 5839 : Part 1 and BS 5839 : Part 4 apply, together with the following:

3.1 area of coverage

The area throughout which speech signals from the voice alarm system are sufficiently intelligible and warning signals from the system are sufficiently audible.

3.2 audibility

The property of a sound which allows it to be heard among other sounds.

NOTE. Audibility depends upon the relative loudness and frequency content of the sound in comparison with other sounds which are present at the same time.

3.3 access level

The accessibility of controls and visibility of indications, subclassified as follows:

a) access level 1: no restrictions;

b) access level 2: restricted to persons authorized to operate voice alarm equipment;

c) access level 3: restricted to persons authorized to re-configure site specific data or carry out servicing;

d) access level 4: restricted to persons authorized by the manufacturer to carry out repair or make hardware and/or software changes to voice alarm equipment beyond that which is authorized at access level 3.

3.4 clarity

The property of a sound which allows its information-bearing components to be identified by the listener.

3.5 critical signal paths

All components and interconnections between every fire alarm broadcast initiation point and the input terminals on, or within, each loudspeaker enclosure.

3.6 fire microphone

A microphone dedicated for use by the fire service or other responsible persons as part of a voice alarm system.

3.7 fire risk

A combination of the probability of fire occurring and the magnitude of the consequences of fire.

3.8 intelligibility

A measure of the proportion of the content of a speech message that can be correctly understood.

NOTE. Satisfactory intelligibility requires adequate audibility (see **3.2**) and adequate clarity (see **3.4**).

3.9 listener

A person of normal hearing who is able to understand the language broadcast.

3.10 loudspeaker zone

Any part of the area of coverage to which information can be given separately.

3.11 system monitoring

The automatic checking of the voice alarm system for integrity throughout its audio and/or associated control-data paths.

3.12 voice alarm system

A sound distribution system that provides means for automatically broadcasting speech messages and warning signals.

4 Exchange of information

4.1 General

The requirements for the voice alarm system, including those imposed by the configuration and usage of the premises, should be ascertained by consultation between the user of the system and all other interested parties. On the basis of these consultations, a system specification should be prepared showing the following:

a) definition of the functional requirements;

b) details of the installation proposed;

c) accommodation required for the equipment;

d) special provisions required for the equipment and its wiring;

e) interconnections with the fire detection and alarm system required to achieve the specified functions;

f) interconnections with any other systems.

It is desirable that one organization should be given overall responsibility for the performance of the total system formed by the integration of the fire detection and alarm system and the voice alarm system. The responsibilities of the main contractor and all sub-contractors should be clearly defined in all relevant documentation relating to the installation.

Prior to undertaking changes or extensions, consideration should be given to their effect on the performance of the existing system and agreement should be obtained from all interested parties.

4.2 Action in the event of an alarm of fire

The design of the voice alarm system and the way in which it interfaces with the fire detection and alarm system will depend on the actions required after a fire has been detected. It is thus essential that these actions are established and agreed after discussions amongst all relevant parties.

If the preferred mode of evacuation of the building is such that different actions may be required in different areas of the building, then the fire detection and alarm system and the voice alarm system should be so designed that the necessary commands, messages or signals can be distributed easily. The area in which the fire is first detected usually determines the initial distribution of alarm signals and messages. The relationship between the location of the fire and the distribution of warning signals and pre-recorded messages should be carefully defined and specified prior to the design of the system, since it may reflect strongly on the facilities required in the voice alarm system, the wiring arrangement and the nature of the interface between the voice alarm system and the fire detection and alarm system. For example, a building using a phased evacuation scheme could require an evacuation message in some areas, while in other areas an alert message only would be broadcast initially. The exact content of the alert or evacuation messages may also vary with the area of the building where they are broadcast. In such cases, it is essential that the interfaces between the fire detection and alarm system and the voice alarm system are capable of providing this differentiation. Care should be taken to ensure that messages are not misunderstood in any parts of the building where signals relating to more than one area may be audible, for example a stairwell or an atrium.

This code of practice is concerned with the design of the voice alarm system and its interface to the fire detection and alarm system; the requirement for the evacuation scheme should be determined in consultation with the relevant authorities (see also BS 5588 : Part 11).

If the voice alarm system is shared with alarm systems associated with hazards other than fire, then the various hazard alarms should be properly co-ordinated and distinct from each other. In these buildings the relative priorities should be carefully assessed and the voice alarm system designed so that a higher priority alarm cannot be prevented or obscured by a lower priority alarm. Although in general fire will have the highest priority, there are buildings in which other hazards have a higher priority. If the voice alarm system is also used to provide other audio services such as general paging and background music, the system should be designed so that those services cannot prevent or delay any fire alarms. If the voice alarm system is shared with another form of alarm system, reference should be made to BS 7807.

4.3 Consultation

The following parties should be involved in consultation where appropriate:

a) the user or the user's representative;

b) the designer of the voice alarm system;

c) the designer of the fire detection and alarm system;

d) the acoustics engineers or consultants;

e) the installer(s);

f) the local fire authority or other enforcing authorities;

g) the fire insurer;

h) the building contractors;

i) the architects.

Any deviations from the recommendations of this code of practice should be agreed by the interested parties.

4.4 Multi-occupancy buildings

If the building is under the control of more than one occupant, a fire in a part of the building under the control of one occupant may spread to, or otherwise affect, a part or parts under the control of others. It is, therefore, important that, where possible, all those who might be affected should be consulted prior to designing the voice alarm system, to ensure that emergency messages take into account the requirements of all the occupants of the building.

5 Planning schedule

A typical list of events to be taken into consideration in preparing a planning schedule is as follows, but not necessarily in the order stated:

a) survey of the site or detailed examination of site drawings, including acoustic assessment;

b) assessment of the usage of the site including:

1) periods of non-occupation;

2) areas with high noise levels requiring special consideration;

3) personnel, for example: hard of hearing, trained or untrained, non-English speaking;

4) proposed actions and procedures to be taken in the event of a fire;

c) liaison with all interested parties to ensure system compatibility, for example interface with fire detection and alarm system;

d) system specification and requirements for design and estimating purposes;

e) tendering and quotation;

f) consideration of proposals, prices and delivery times;

g) consideration of servicing requirements;

h) agreement on the proposal and actions to be taken in the event of a fire, including signal and message details;

i) agreement on the facilities to be provided at the control equipment, for example manual controls and indications, (see clause **17**);

j) detailed system design;

k) ordering;

l) agreement on final specification and any variations from the original specification;

m) production, pre-delivery acceptance test and delivery of equipment;

n) installation and testing of equipment and system, including audibility and intelligibility;

o) commissioning and certification of system;

p) system documentation and user training;

q) acceptance by the client and other interested parties;

r) handover of system;

s) service agreement.

On large sites, all the above considerations should normally be included as stages of a critical path chart.

Consideration should be given to the siting and accommodation of equipment (see clause **25**).

Consideration should also be given to other work being done on the site so that the installation can be carried out at convenient times without conflicting with other contractors.

Temporary physical protection may be required on some system components to prevent deterioration arising from dust, damp or physical damage.

The final connection, switching on and commissioning of the voice alarm system should be carried out at times agreed between interested parties. There may, however, be an interim period of partial operation, either because of partial occupation of the building or to provide protection against risks during construction. Such operation is a matter of agreement between the interested parties.

Section 2. Design considerations

6 General

6.1 Purpose

A voice alarm system is primarily intended to be used in conjunction with a fire detection and alarm system to control the safe evacuation of building occupants by providing:

a) clear, unambiguous spoken instructions for evacuation of the area of immediate risk;

b) voice messages and signals which contribute to the management of an emergency.

Voice alarm systems linked to fire detection and alarm systems may be used to give warning of other incidents, for example bomb alert, chemical spillage and extinguishing agent discharge (see **4.2**). The system may also be used for routine functions, such as broadcast of music, paging or general announcements providing that such facilities are always overridden in the event of an emergency (see clause **16**).

6.2 Messages

Once a fire has been detected, it is essential that persons be evacuated from the areas of immediate danger as quickly as possible to minimize risk to life.

This may present few problems where occupants are familiar with the site and have been trained in the evacuation procedures. In public locations, few will be totally familiar with the site and therefore will require precise verbal information on the actions required of them. Reference should be made to clause **14** for recommended types of messages.

6.3 Circuit design

Compatibility of voice alarm system components is essential if the effectiveness and intelligibility of broadcast messages is to be achieved.

Compatibility should be ensured between the system components, for example microphones, amplifiers, loudspeakers and interconnecting cables, all of which can have a marked effect on system performance. All interconnecting cables should be in accordance with the recommendations of clause **19**. Particular care should be taken to ensure compatibility with cable parameters, such as capacitance, and signal characteristics.

Interconnecting cables should be monitored as recommended in clause **7**.

6.4 System interface

The link between the fire detection and alarm system and the voice alarm system is of vital importance to maintain the integrity of overall operation. It may be desirable on larger systems, where distributed control equipment is used, to provide a link at each control equipment location rather than to rely on a central location. Each link should be monitored as recommended in clause **7**. The voice alarm system should be capable of continuing to broadcast alarm messages which have been initiated by the fire detection and alarm system even in the event of a subsequent fault in the interconnecting link between the two systems; i.e. the voice alarm system should ‘latch’ on receipt of a signal from the fire detection and alarm system until de-latched by a separate command from the fire detection and alarm system. Interruption by higher priority broadcasts should still be possible.

In complex buildings where activation of the Evacuate or Alert signal can be manually initiated at remote voice alarm equipment, consideration should be given to the need for such actions to be indicated at any central fire detection and alarm control and indicating equipment.

The interlinking cable between the fire detection and alarm system and the voice alarm system should be protected against fire and mechanical damage (see **19.3**) and should, where practicable, pass through areas of low fire risk.

The interface between the fire detection and alarm system and the voice alarm system should be such that any delay in the automatic transmission of the relevant pre-recorded message (see clause **13**) is minimized. The delay between operation of a manual call point and the start of the voice alarm broadcast should not exceed 3 s. Where the automatic transmission of a pre-recorded message is in response to a signal from an automatic fire detector, the broadcast should begin not more than 10 s after the time at which detector response is specified in the appropriate Part of BS 5445 or BS 5839.

NOTE. The fire detection and alarm system may incorporate a delay between the operation of a manual call point or automatic detector and transmission of a signal to the voice alarm system. Consultation between the manufacturer or supplier of the fire detection and alarm system and the manufacturer or the supplier of the voice alarm system may be necessary to ensure that the overall delay does not exceed the above intervals.

The division of control exercised by the fire detection and alarm system and the voice alarm system should be such that automatic functions by one system do not prevent the correct functioning of the other system.

6.5 Circuits containing fire detectors

If communication between the fire detection and alarm system and the voice alarm system is achieved via the fire detection circuit, then the removal of any detector(s) should not inhibit the operation of the voice alarm system.

A single fault on a fire detection circuit should not affect communication with the voice alarm system.

6.6 Loudspeaker circuits

6.6.1 *General*

The integrity of a voice alarm system should be at least equivalent to that recommended by BS 5839 : Part 1 for sounder circuits. That standard recommends that the wiring of sounder circuits should be so arranged that, in the event of a short-circuit developing in any part of the wiring during a fire, a minimum of one alarm sounder should continue to sound. Therefore, in the event of a single open-circuit or short-circuit fault on a loudspeaker circuit of a voice alarm system, the emergency broadcast should be intelligible at one point, at least, in the building, preferably at a supervised location, such as a reception area, security control room or main entrance foyer. This minimum provision would not ensure that the reduced emergency broadcast is audible and intelligible throughout the building. If it is considered that some audibility or intelligibility should be maintained over a greater area of the building, additional loudspeaker circuits should be provided (see **6.6.3**).

6.6.2 *Loudspeaker circuits failure*

Failure of loudspeaker circuits can be caused by physical damage to cables, faults in equipment or damage to cables by fire. In the case of systems designed in accordance with this Part of BS 5839, loudspeaker circuits should be protected against accidental or fire damage (see **19.3**). An open-circuit or short-circuit fault on one loudspeaker circuit should not affect the operation of any other circuit or loudspeaker zone. A short-circuit fault on a loudspeaker circuit should not cause damage to the associated amplifier. In addition, any failure of a loudspeaker circuit should result in a fault warning at the fire detection and alarm control and indicating equipment within 100 s of its occurrence.

6.6.3 *Additional loudspeaker circuits*

In buildings designed to accommodate the general public in large numbers, typically within a single space, the threat to life in the event of a fire may be such that the provision of additional loudspeaker circuit(s) within a loudspeaker zone is justified. Examples include:

a) transport terminal concourses;

b) mall areas of covered shopping complexes;

c) public areas of:

1) cinemas, theatres and other places of entertainment;

2) large department stores;

3) leisure centres.

Additional loudspeaker circuits should be provided in any uncompartmented public spaces of such buildings if the space is either:

i) greater than 4000 m^2 in area; or

ii) designed to accommodate more than 500 members of the public.

Even if additional loudspeaker circuits are provided in large public spaces in order to satisfy the above recommendations, it is not generally necessary to provide them in small cellular spaces and non-public areas of such buildings.

In areas where additional loudspeaker circuits are installed, the intention in the event of failure of one circuit should be to maintain a level of audibility and intelligibility, albeit at a reduced level. In order to achieve this, the loudspeaker circuits should be evenly distributed and interleaved such that adjacent loudspeakers are on different circuits.

The additional loudspeaker circuits should not be enclosed in a common cable sheath. For example, two circuits should not be served by a common four core cable, as this would not adequately protect against loss of both circuits due to fire or mechanical damage.

6.7 Visual alarm signals

Where high background noise is present or where occupants are likely to be hard of hearing or wearing ear protection, the broadcast messages should be supplemented with visual alarm signals. Visual alarm signals should always be used where background noise levels exceed 90 dBA.

The visual alarm devices should normally be as described in **9.7** of BS 5839 : Part 1 : 1988. Other types of visual alarm devices may be used as appropriate to site conditions.

Wiring to visual alarm devices should satisfy the recommendations of BS 5839 : Part 1.

6.8 Program controlled systems

Where the configuration or any other function of the voice alarm system is determined by a device the operation of which is reliant on a stored program, the following provisions apply.

a) Access to facilities provided for alteration should be restricted to access level 3 for site specific data and access level 4 for the program and all other data (see **17.3.3**).

b) Any function relying on a stored program should not use rotating disks or other media using moving parts or any other form of easily corruptible memory.

c) The operation of processors should be continuously monitored (see **7.4**).

d) In the event of failure of any processor, provision should be made for a minimum level of fall-back operation appropriate to the application, at least allowing manual access to all loudspeaker zones using the fire microphone.

e) Following re-initialisation, repair of any fault or restoration of any total power supply failure, the system should be capable, within 30 s, of giving a general Evacuate broadcast and, within a further 10 min, of attaining a normal operating condition.

6.9 Interfaces with other sound systems

If there are other independent systems on the site, for example a sound distribution system, audio-visual presentation or sound reinforcement system, switching outputs should normally be provided for automatically muting these systems. In certain circumstances, for example a major sound reinforcement system in a public performance venue, it may be more appropriate to provide an audio line level message feed and/or a signalling voltage to the independent system.

Consideration is needed as to when the mute function should operate, i.e. on Alert or Evacuate status. Cancellation of the mute should be possible only at the control equipment of the fire detection and alarm system.

6.10 Combined use with fire alarm sounders

There may be circumstances in which both voice alarm loudspeakers and fire alarm sounders are used in the same building, such as:

a) use of voice alarm in public areas of a large building complex with fire alarm sounders in, for example, plant areas to which the public has no access;

b) use of fire alarm sounders as a primary means of warning with a voice alarm system to provide supplementary information.

In such cases, the following recommendations apply.

1) The operation of fire alarm sounders should not cause the intelligibility of the voice broadcast to be below the recommendations given in clause **15**.

2) Attention-drawing signals used to introduce voice messages should be the same as those produced by the fire alarm sounders for a similar stage of alarm and should be in accordance with **9.4** of BS 5839 : Part 1 : 1988.

3) The procedures for operating such systems should be such as to avoid confusion in an emergency.

4) If it is necessary to silence fire alarm sounders in order to broadcast the voice messages, re-starting of the fire alarm sounders should be automatic so that no period of silence exceeds 10 s.

7 Fault monitoring

7.1 Interface with the fire detection and alarm system

A short-circuit or disconnection of the communicating link between the fire detection and alarm system and the voice alarm system should be indicated at the fire detection and alarm system control and indicating equipment.

As a minimum, the voice alarm system should be capable of transmitting to the fire detection and alarm system one common 'Voice alarm system fault' for any fault condition which may occur within the voice alarm system.

7.2 Monitoring of the voice alarm system

The voice alarm system control equipment should be capable of indicating any of the following conditions:

a) short-circuit or disconnection of any normal power supply associated with the giving of any alarm of fire, or other total loss of power from such a normal power supply;

b) short-circuit or disconnection of any standby power supply associated with the giving of an alarm of fire. Where the standby power supply comprises a number of batteries connected in parallel, the indication should be given in the event of disconnection of any one battery or short-circuit of a single cell within a battery;

NOTE 1. Unmonitored facilities may be provided for giving an audible and visible warning in the event of simultaneous failure or disconnection of both mains and standby power supplies.

c) short-circuit or disconnection of any battery charging equipment associated with the giving of an alarm of fire;

d) rupture of any fuses or operation of automatic circuit breaker, isolator or protective devices that may prevent an emergency broadcast;

e) failure of a fire microphone including the capsule voice coil, pre-amplifier and essential wiring to the rest of the equipment;

f) failure of critical signal paths;

NOTE 2. Switching devices, whether solid-state or electromechanical, in a critical signal path need not be tested or exercised automatically as part of the critical path monitoring. However, the signal path between these switching devices and other components in the critical signal path should be monitored up to the switching devices themselves. For example, if there is a relay in the critical signal path, failure of the connection to the relay contacts should result in a fault warning. It is accepted that mechanical failure of the relay, such that it would not operate on demand, will be identified only during the course of routine testing or servicing (see clause **32**).

g) amplifiers and/or modules missing within a critical signal path;

h) failure of emergency message generators including all emergency pre-recorded message stores;

i) open-circuit, short-circuit or earth faults on any loudspeaker circuit, including any spur circuit;

j) failure of a processor to correctly execute its software program;

k) failure of any power amplifier, including any standby amplifier;

l) failure of the interconnecting data and/or voice communication links between components of a distributed system;

m) cessation of any scanning or interrogating process within the control equipment;

n) detection of any error in memory checking procedures recommended in **6.8**;

o) failure of an ambient noise sensing and compensation controller (see clause **11**).

The fault indication should be given within 100 s of the occurrence of the fault regardless of whether the voice alarm system is being used for a non-emergency purpose, such as transmission of background music.

The indication of faults that exist prior to initiation of an emergency broadcast may be suppressed during the emergency broadcast, except where these pre-existing faults might adversely affect any emergency broadcast.

Open-circuit or short-circuit faults on loudspeaker circuits that occur after initiation of an emergency broadcast should be indicated in accordance with the recommendations of **7.3** during the emergency broadcast, unless this is prevented by the broadcast of the emergency message in the same zone as the fault. Other faults that occur after initiation of the emergency broadcast may be suppressed during the emergency broadcast.

If the indication of any fault condition is suppressed during an emergency broadcast, the indication should be given in accordance with the recommendations of **7.3** within 100 s of the silencing of the emergency broadcast.

7.3 Fault warning

7.3.1 *Fault warning responses*

In the event of any of the fault conditions listed in **7.2** occurring, a fault warning should be given, at the control equipment, by at least the following:

a) an audible warning from a sounder, preferably within the control equipment. The sound level should not be less than 50 dBA at 1 m from the control equipment enclosure, when measured with an instrument conforming to BS EN 60651, type 2 with slow response;

NOTE. BS 5839 : Part 1 recommends that the sound level produced by the sounder should be not less than the ambient sound level. A sound level of 50 dBA might not be adequate for control equipment installed in noisy environment; in such situations an (additional) external sounder might be required.

b) a visible indication by means of a separate light emitting indicator (the general fault indicator);

c) separate light emitting indicators and/or an alphanumeric display, giving at least, the following:

1) a visible indication, common to all power supplies, of the faults described in **7.2**a, **7.2**b and **7.2**c.

2) a visible indication, common to all signal paths, of the rupture of any fuse or operation of protective device, as described in **7.2**d, which is capable of affecting a critical signal path and which is not otherwise indicated as a fault of a monitored function;

3) a visible indication, common to all fire microphones, of the faults described in **7.2**e;

4) a visible indication, common to all emergency message generators, of the faults described in **7.2**h;

5) an individual visible indication, for each loudspeaker circuit, of the faults described in **7.2**i;

6) a visible indication, common to all the interconnecting links, of the faults described in **7.2**l;

7) an individual visible indication for each faulty power amplifier (see **7.2**k);

8) a visible indication common to all the faults described in **7.2**f, **7.2**g, **7.2**j, **7.2**m, **7.2**n and **7.2**o.

7.3.2 *Fault warning sounder*

The audible warning recommended in **7.3.1**a should be distinctive and of a different character from any fire alarm signals. This warning should sound for a minimum of 0.5 s at least every 5 s.

7.3.3 *Silencing of the fault warning sounder*

If provision is made for manually silencing the fault warning sounder, the fault warning sounder should resound in the event of the detection of a further fault from a different source.

NOTE. It is not considered necessary to resound the sounder for different faults from the same source. It is also recognized that some of the faults listed in **7.2**, for example failure of a processor, may prevent the detection of other faults.

7.3.4 *Resetting from the fault warning condition*

Resetting from the fault warning condition should either be automatic when all faults are removed (non-latching fault warnings), or should be by a manual control (latching fault warnings). If the fault warning condition can be cancelled by resetting when the fault(s) still exists, then the fault warning condition should be restored within 100 s.

NOTE. It is permissible for the fault warnings to latch for some types of fault and not for others.

7.4 Monitoring of software controlled equipment

The correct operation of the system software by any processor should be monitored by internal self-checking procedures and by an appropriate monitoring circuit, for example a watch-dog circuit, in accordance with the following recommendations.

a) The monitoring circuit and its associated indication and signalling circuits should not be prevented from determining and signalling a fault condition by the failure of any monitored processor or associated clock circuits.

b) The monitoring circuit should monitor the operation of routines associated with the functions of the main program elements, i.e. it should not be solely associated with 'waiting' or other 'housekeeping' routines.

c) In the event of a failure by a microprocessor to execute its software correctly the monitoring circuit should, in addition to initiating an audible and visual fault warning, perform as follows:

1) re-initialise the processor and attempt to restart the program at a suitable point within 10 s of the occurrence of the failure. The re-initialisation procedure should verify that the contents of memory, both program and data, are not corrupted;

2) either:

i) record that a failure has occurred using a system capable of recording a minimum of 99 failures and resettable only by an operation restricted to authorized servicing personnel; or

ii) automatically reset the equipment and give both a visual and audible warning that an automatic reset has occurred.

8 Power amplifiers

Consideration should be given to the effect of a failure of any power amplifier on the performance of the system. The voice alarm system should continue to operate in accordance with the recommendations given in this standard in respect of audibility and intelligibility in the event of the failure of a single power amplifier.

This may be achieved, for example, by either of the following arrangements:

a) the failed amplifier is automatically disconnected from the circuit and sufficient power from paralleled amplifiers remains to meet the load requirement for the affected loudspeaker circuit(s);

b) the failed amplifier is automatically replaced by a standby amplifier of at least the same power rating.

Other arrangements than those described above may be possible. Where the voice alarm system is continuously supervised by trained staff, who would be in a position to implement manual substitution of a failed amplifier with a standby amplifier within 5 min of the failure, automatic switching to achieve the performance recommended above may not be necessary, subject to the agreement of the interested parties (see **4.3**). All standby amplifiers including those intended for manual substitution should be kept in a powered up state and be continuously monitored.

9 Loudspeaker zones

The system should be capable of being subdivided into loudspeaker emergency broadcast zones if required by the specified evacuation procedure. Loudspeaker zones are not necessarily the same as other zones such as fire detection zones. For non-voice alarm use a loudspeaker emergency broadcast zone may be subdivided or zones may be combined.

Loudspeaker emergency broadcast zones should be selected so that an effective evacuation of the building can be carried out without confusion or misinterpretation of information. Loudspeaker zone boundaries should, where possible, coincide with walls, permanent partitions or doors within the building to aid acoustic separation between zones. This is particularly necessary if two adjacent zones can broadcast two different messages simultaneously. Where zone boundaries meet without a physical partition and different messages could be broadcast simultaneously, the intelligibility of a message broadcast in one zone should not be reduced below the recommendations in clause **15** by the broadcasting of messages in other zones. Particular care should be taken to ensure appropriate acoustic separation between accommodation and staircase enclosures.

There should be no conflict between the zone boundaries of the fire detection and alarm system and the loudspeaker emergency broadcast zone boundaries. It is possible that a number of fire detection and alarm system zones may be contained within a single loudspeaker emergency broadcast zone but no fire detection and alarm system zone should contain more than one loudspeaker emergency broadcast zone.

10 Types of loudspeaker

10.1 General

The selection of the type, number, location and orientation of loudspeakers is a critical part of voice alarm system design and requires information such as:

a) acoustic environment;

b) ambient noise level;

c) climatic environment;

d) area coverage requirement;

e) mounting arrangements, for example ceiling tiles, wall, pole, etc.;

f) architectural design and relevance of the appearance of the loudspeaker;

g) type of broadcast, i.e. if used for purposes other than voice alarm, such as background music;

h) interrelationship between loudspeaker zones and fire compartments;

i) the requirements for potentially explosive atmospheres;

j) the directional characteristics, sensitivity and frequency response of the chosen loudspeaker.

10.2 Recommended types of loudspeaker

The following types of loudspeaker are recommended:

a) *horn:* for use in external and industrial environments or environments with high noise levels or in acoustically difficult conditions;

b) *flush mounted*: for use in offices, department stores and supermarkets;

c) *wall mounted:* for use in offices, small workshops, stores and general small areas in buildings;

d) *bi-directional:* for use in corridors and long narrow areas;

e) *column having a wide horizontal and narrow vertical coverage angle:* for use in halls and concourse areas;

f) *projector:* mounted in a tube fixed by means of an adjustable bracket thus enabling the propagation of sound in a preferred direction;

g) *explosion-protected* (for example flameproof horn): suitable for use in potentially explosive atmospheres.

Annex A gives examples of the typical performance characteristics of the types of loudspeakers recommended in this list.

10.3 Protection of loudspeakers

In the event of fire, it is accepted that an individual loudspeaker can fail if directly exposed to heat. However, it is important that such a failure does not result in failure of the circuit to which the loudspeaker is connected, for example due to a short-circuit of the conductors. At present, there is no standard for fire-resisting loudspeakers, although a European Standard for alarm sounders is in preparation and the relevant section may be applicable. In the meantime, it should be ensured that loudspeaker design is such that failure of the associated circuit is unlikely to occur if the loudspeaker is exposed to fire before evacuation of the building is complete. Suitable design measures include:

a) use of terminal blocks with a melting point of not less than 650 °C, for example constructed from ceramic materials;

b) use of terminal blocks of a lower melting point but protected with thermal insulation;

c) design of terminal blocks such that, on melting, an open-circuit or a short-circuit does not occur.

In addition, the design and layout of internal wiring should be such as to avoid, as far as practicable, the potential for fire to cause a short-circuit that would result in failure of the loudspeaker circuit, as opposed to the individual loudspeaker concerned.

In order to prevent inadvertent contact and damage by falling objects, every flush-mounted ceiling loudspeaker should be fitted with a rear enclosure. This should be constructed from non-combustible material with a melting point of at least 800 °C, for example steel, in order to provide additional protection for the cable termination.

Where loudspeakers are mounted in fire-resisting barriers, particularly fire-resisting ceilings, the fire resistance of the barriers should be maintained. Specialist advice on this matter may be necessary.

11 Ambient noise sensing and compensation controller

A voice alarm system may be provided with an ambient noise sensing and compensation controller (ANS), which senses background noise and automatically adjusts voice alarm broadcast levels as background noise levels vary. The purpose of this facility is to ensure that the sound level of the voice alarm broadcast exceeds background noise by the recommended amount (see **15.2**c).

Although such a facility can be used with advantage in spaces that can be subject to significant variation in background noise levels, for example airport and railway concourses, its use is not normally essential. However, where an ANS is provided, its design should be such as to avoid the risk of broadcast levels being too low due to a failure of the ANS. The ANS should fail safe so that, in the event of a failure, broadcast reverts to a pre-determined level. Such failures include, but are not necessarily restricted to:

a) failure of any noise-sensing transducer;

b) short-circuit or disconnection of any noise sensing microphone circuit;

c) failure of the associated control circuit.

Care should be taken in the design of such a facility to ensure that the voice alarm broadcast level is not unduly affected by a localized, abnormal noise, for example from a screaming child.

12 Fire microphones

12.1 General

Fire microphones may be provided as a means of overriding pre-recorded emergency broadcast messages. This facility may not be necessary in simple buildings in which recorded emergency broadcast messages are sufficient to ensure effective communications, unless the consultation between the parties listed in **4.3** indicates otherwise. Fire microphones should, however, be provided in complex buildings, including those where phased evacuation is used, as a means of ongoing control of evacuation by the building management or the fire service.

12.2 Types of fire microphone

12.2.1 As the microphone is common to all areas of broadcast, which may vary in acoustic characteristics, it is important that the microphone is of a suitable grade to achieve the required intelligibility of sound reproduction throughout the installation.

In general, the microphones described in **12.2.2**a should be used, particularly for control rooms and other normally quiet areas. Where ambient noise levels are high, or where conditions would make the use of such types impracticable, either the microphone described in **12.2.2**b or a noise-cancelling version of the microphone described in **12.2.2**a should be used.

12.2.2 The recommended types of microphone are as follows:

a) unidirectional, mounted on a flexible or fixed arm with in-built windshield to prevent 'popping' noise whilst speaking. The recommended minimum ± 3 dB frequency response for this type of microphone is 200 Hz to 10 kHz;

b) hand-held close-talking noise-cancelling, with an integral press to talk switch. The recommended minimum ± 5 dB frequency range for this type of microphone is 250 Hz to 5 kHz.

12.3 Siting and mounting of fire microphones

The location of any fire microphone(s) should be agreed with the fire service. Normally, where one or more fire microphones are provided, one fire microphone should be located at the indicating equipment intended for use by the fire service on arrival.

Care should be taken in locating the microphones to avoid sound coloration or feedback from system loudspeakers, pick-up and amplification of background noise and reverberant acoustic conditions at microphones, all of which can reduce the quality of the signal. Consideration should be given to the use of shock/vibration isolating mountings to reduce unwanted noise or vibration pick up.

12.4 Accessibility

The fire microphone should either:

a) be dedicated purely to the broadcast of emergency messages, in which case means should be provided to prevent its use for non-emergency functions, for example by enclosure in a glass fronted box; or

b) be used for emergency and non-emergency functions, in which case means should be provided to prevent non-emergency broadcast from overriding a pre-recorded emergency broadcast (see **16.2**).

13 Message generators

Since a voice alarm system depends on the ability to broadcast recorded emergency messages, the reliability and integrity of the associated message generators is as important as that of other elements of the system. Such message generators should be designed to use solid-state electronics exclusively, for message storage and control.

Apart from relays, for example associated with status or fault indication, there should be no moving parts; tape players or disk drives, for example, should not be used. The recording should be stored in non-volatile memory and the recorded message(s) should be protected from unauthorized changes.

The broadcast voice should sound natural; this can readily be achieved with a high quality recording. A synthesized voice should not be used unless the resultant broadcast sound is indistinguishable from that of a human voice.

NOTE. The required intelligibility of broadcast is unlikely to be achieved unless the −3 dB points of the audio output from the generator are below 200 Hz and above 5.5 kHz.

Each generator should be monitored continuously to ensure the availability of audio output (see **7.2**). It is recommended that, during non-emergency operation, in addition to any appropriate internal software checks, where appropriate (see **7.4**), at least one message per generator is run and monitored.

14 Messages

14.1 General characteristics

14.1.1 *Attention-drawing signal*

Every message should be preceded by an attention-drawing signal. This should be a non-speech signal in accordance with **9.4.1** to **9.4.5** of BS 5839 : Part 1 : 1988. The attention-drawing signals used for Alert and Evacuate alarms may be identical. Where this is not the case, the signals should be in accordance with **9.9** of BS 5839 : Part 1 : 1988.

14.1.2 *Message quality*

The message should be clear, concise, intelligible and delivered in a calm and commanding manner. Care should be taken with intonation as this can have a significant effect on the way people respond to messages; for example a sense of urgency or a calming influence can be conveyed by intonation. Consideration should also be given to repetition as this will often enhance message perception.

In certain acoustic environments, for example where there are high noise levels and/or long reverberation times at low frequencies, a female voice may be more intelligible than a male voice.

Where overspill of a message into an adjacent zone is unavoidable, it may be easier to discriminate between simultaneous messages if each is delivered in a different voice, for example, male in one area and female in the other.

The speed of delivery of the message should take into account the acoustic characteristics of the building; the speech broadcast requires a slow delivery in reverberant areas.

14.1.3 *Language*

In particular circumstances, for example where the occupants of a building include a significant number of persons whose first language is not English, it may be appropriate to repeat messages in different language(s). For emergency messages, the formats outlined in **14.4** should be used except that successive recorded voice messages may be in different languages; each successive sequence of the messages should include versions in all the required languages but with a weighting of repeats in favour of the local language.

14.2 Live voice messages

Live voice messages should be broadcast only by operators trained in the proper use of microphones. Except where a fire officer or trained person in authority needs to make special announcements in an emergency situation, the operator should broadcast agreed standard messages, reading from a script.

14.3 Pre-recorded messages

The recordings should be made, where possible, by persons trained in the proper use of the microphone. Particular care should be taken to determine compatibility of language and dialect with the final recipients of the pre-recorded messages.

The recordings should be made in a recording studio or a room with a controlled acoustic environment having an ambient noise level no greater than 30 dBA and a reverberation time no greater than 0.5 s from 150 Hz to 10 kHz.

14.4 Emergency broadcasts

14.4.1 *Evacuate broadcast*

In time sequence, from start to finish, the format of the broadcast should be as described in table 1.

Table 1. Evacuate broadcast sequence
Attention-drawing signal — lasting 4 s to 10 s followed by: **Brief silence** — lasting 1 s to 2 s followed by: **Evacuate message** followed by: **Silence** — lasting 2 s to 5 s
NOTE. The periods of silence may need to be longer than indicated in certain circumstances, for example in spaces with long reverberation times, but should not be such that the time between the start of each repeated message exceeds 30 s.

This sequence should, if pre-recorded, be repeated continuously until manually silenced.

An example of an Evacuate message is as follows:

"Attention, please. Attention, please.
Fire has been reported in the building.
Please leave the building immediately, by the nearest exit.
Do not use a lift".

There should normally be one common Evacuate message in a building but, in special circumstances, for example where means of escape vary considerably throughout the building, a variety of messages may be desirable.

14.4.2 ***Alert broadcast***

In time sequence, from start to finish, the format of the broadcast should be as described in table 2.

Table 2. Alert broadcast sequence
Attention drawing signal — lasting 4 s to 10 s followed by: **Brief silence** — lasting 1 s to 2 s followed by: **Alert message** followed by: **Silence** — lasting 10 s to 20 s
NOTE. The periods of silence may need to be longer than indicated in certain circumstances, for example in spaces with long reverberation times, but should not be such that the time between the start of each repeated message exceeds 45 s.

This sequence should, if pre-recorded, be repeated continuously until manually silenced or until superseded, manually or automatically, by an Evacuate broadcast or by a '2nd sequence' Alert broadcast (see below).

In certain circumstances, for example in multi-storey buildings, it may be desirable to have two stages of Alert broadcast, often referred to as '1st sequence' and '2nd sequence' messages.

An example of an Alert message, where sequenced Alert messages are not required, is as follows:

"May I have your attention, please.
May I have your attention, please.
Fire has been reported in the building.
Please listen for further instructions."

An example of a '1st sequence' Alert message is as follows:

"May I have your attention, please.
May I have your attention, please.
Fire has been reported in the building.
This report is being investigated.
Please remain at your workplace whilst the fire alert exists."

An example of a '2nd sequence' Alert message is as follows:

"May I have your attention, please.
May I have your attention, please.
You are reminded to remain at your workplace whilst the fire alert exists."

14.4.3 ***Coded Alert broadcast***

Unlike the Alert broadcast, which is intended to be understood and acted upon by all the building occupants, a Coded Alert broadcast (which may be appropriate in premises occupied by the general public) is an apparently routine staff-related message which is actually interpreted by certain members of the staff as a warning of a possible fire condition.

The format of such messages will depend largely upon particular circumstances but will probably be of the form:

"Attention please! Will Mr Frost ring 123";

or:

"Attention please! Will Mr Snow go to the ground floor concourse".

The use of Coded Alert broadcasts without evacuation of any area of the building in the event of a fire condition is deprecated for many premises. Such broadcasts should be provided only after consultation with the interested parties (see **4.3**).

14.5 Test messages

14.5.1 ***General***

Test messages should be provided to allow voice alarm systems to be tested without unnecessarily disturbing or alarming the occupants of the building.

NOTE. The use of Test messages is not sufficient for the recommended weekly testing of the whole of the fire detection and alarm and voice alarm systems (see clause **32**).

14.5.2 ***Audio system test messages***

These may be used to check the operation of the audio system during routine maintenance (see **32.2**) and do not include the broadcast of fire warnings. An example of such a message is as follows:

"This is a test of the public address system."

14.5.3 ***Announcements to precede and follow fire alarm tests***

These may be provided to allow the fire alarm system to be tested without unnecessarily disturbing or alarming the occupants of the building. An example of an announcement to precede a fire alarm test is as follows:

"May I have your attention, please.
May I have your attention, please.
The fire alarm system is about to be tested.
Please take no further action."

An example of an announcement to follow the fire alarm test is as follows:

"May I have your attention, please.
May I have your attention, please.
The fire alarm test is now complete.
If you had any difficulty in clearly hearing any part of the message, please advise the main reception.
Thank you for your co-operation."

NOTE. There should be the minimum of delay between the broadcast of the first message and the actual fire alarm test.

15 Audibility and intelligibility of messages

15.1 General

The basic aim of a voice alarm system is the effective communication of fire warning signals and messages. In order to achieve this, it is essential that the system provides satisfactory speech intelligibility.

In acoustically-simple buildings, i.e. those with controlled acoustics and low occupational noise levels, such as open plan office areas, systems can often be satisfactorily designed from experience, using simple rules of thumb for loudspeaker configurations, without recourse to formal prediction techniques. Many buildings have, however, more difficult acoustic environments due to a combination of the room acoustic conditions and/or high ambient or occupational noise levels. Examples of such buildings are shopping centres, swimming pools, railway stations, industrial buildings, bottling plants and power stations.

15.2 Parameters affecting intelligibility

Intelligibility can be affected by the following factors.

a) *Low 'early-to-late' sound ratio*. The sound which travels directly between the loudspeaker and the listener, together with sound which arrives at the listener from reflections within 35 ms of the direct sound, the 'early' sound, aids intelligibility. Reflections arriving more than 95 ms after the direct sound, the 'late' sound, (i.e. echoes) reduce intelligibility. The use of sound absorption material, for example perforated roof decking, acoustic ceilings, carpets and upholstered seating, optimizes the 'early-to-late' ratio.

NOTE 1. Early-to-late' is often described as 'direct-to-reverberant'.

b) *Signal level*. In order for the signal to be intelligible, it has to be sufficiently audible (see **15.4.1**).

c) *Signal to background noise ratio*. Low signal to background noise ratio reduces intelligibility.

NOTE 2. To achieve a satisfactory level of intelligibility, the speech signal to background noise ratio should normally be at least 10 dB.

d) *Solid elements*. Intelligibility is normally significantly reduced by the presence of a solid element, for example a door or partition, between the loudspeaker and the listener. The intelligibility reduction will depend upon the construction and the signal to noise ratio on the listener side.

15.3 Optimizing intelligibility

In order to optimize intelligibility of signals and messages the following steps should be taken.

a) The system specification should, where practicable, state typical background noise levels throughout the building. Annex B gives typical expected noise levels for a range of building types.

b) If appropriate, advice should be sought from a qualified electro-acoustic designer. The assistance of a specialist should be considered for a building or areas with any of the following:

1) likely reverberation times exceeding 1.5 s at speech frequencies of 500 Hz to 2 kHz;

2) background ambient or occupational noise levels exceeding 75 dBA;

3) probable loudspeaker to listener distances exceeding 10 m.

c) The 'early-to-late' sound ratio and the signal to background noise ratio should be optimized by ensuring that:

1) directional loudspeakers are used which 'beam' sound onto the listeners, avoiding 'spill' onto distant surfaces such as rear walls which can cause discrete high level late reflections, perceived as echoes, and unwanted reverberation which reduces the 'early-to-late' ratio;

2) the loudspeaker to listener distance is minimized.

NOTE. In order to maintain the desired minimum level of intelligibility in areas which may be subject to significant variation in background noise, ambient noise sensing and compensation control can be used (see clause **11**).

15.4 Assessment of audibility and intelligibility

15.4.1 *Audibility*

A minimum sound level for the attention-drawing signal of either 65 dBA, or 6 dB above any other noise likely to persist for a period longer than 30 s, whichever is the greater, should be produced in all accessible parts of the building except as recommended in **9.3** of BS 5839 : Part 1 : 1988. If the fire routine for the premises requires the audible alarm to arouse sleeping persons then the minimum sound level should be 75 dBA at the bed head with all doors shut. This will not guarantee that every person is be awakened but can reasonably be expected to wake a sleeping person in most circumstances.

15.4.2 *Intelligibility*

There are various methods whereby an objective measurement of intelligibility may be made. If applied rigorously, some of these are time-consuming and expensive. For the purpose of this standard, the intelligibility should be quoted using the speech transmission index (STI). An STI of 0.5 is considered to be a reasonable minimum value for a voice alarm system, although, in some very reverberant spaces (for example swimming pools) and areas with high background noise, this may be difficult to achieve. In such areas, an acceptable level of intelligibility should be agreed by the interested parties (see **4.3**). However, it is not envisaged that intelligibility need always be measured as part of routine commissioning or handover tests. In many cases, a subjective assessment of intelligibility may be sufficient and acceptable to the interested parties. Measurements may, nevertheless, be necessary in case of dispute (see **28.5.3**). In this case, it is recommended that reference is made to BS EN 60268-16 for the appropriate method of measurement. The method to be used should be agreed by the interested parties (see **4.3**).

16 Priorities

16.1 General

Different messages in a voice alarm system should be prioritized so that a message of a higher priority overrides a message of a lower priority. Even the lowest priority emergency message of the voice alarm system should override any other form of broadcast such as paging, music, or general announcements.

Whilst systems should always be capable of operation in a fully automatic mode (because of integration with their associated fire detection and alarm system(s)), a facility may be required for manual intervention to control:

a) the type of pre-recorded message being broadcast;

b) the distribution of messages to different zones;

c) real time instructions or information to occupants via the fire microphone(s) (see **12.1**).

16.2 Classification of priorities

To aid in system design it is useful to classify the level of priority allocated to a particular event so that it may be rated according to a factor of urgency. Whilst the following primary levels are recommended, there may be advantages in adding further sub-groups depending upon the site's operational structure:

a) fire microphones. A fire microphone, if provided, should have the highest level of priority for access to the voice alarm system;

b) pre-recorded emergency messages:

  1) Evacuate — potentially life threatening situation needing immediate evacuation;

  2) Alert — dangerous situation nearby requiring warning of potential evacuation;

c) non-emergency — operational message, for example test.

The above classification can then be used, in descending order of priority, to ensure that appropriate alarm signals and messages are provided.

17 Control equipment

17.1 General

The control equipment of the voice alarm system should normally comprise facilities for the following (see figure 1):

a) reception, control and relaying of signals from the fire detection and alarm system or fire microphones;

b) indication and warning associated with signals described in a) and with system statuses;

c) generation, amplification and distribution of messages to loudspeakers.

The control equipment may be contained in more than one enclosure installed in locations distributed within the building. For example, an operator console with visual indications, manual controls and, possibly, a microphone may be located in the control room whilst the electronic rack containing the control logic, monitoring circuits, message generator and amplifiers may be in a separate area of low fire risk. Where the control equipment is so distributed, means should be provided for monitoring all interconnections included in the critical paths, as recommended in clause **7**.

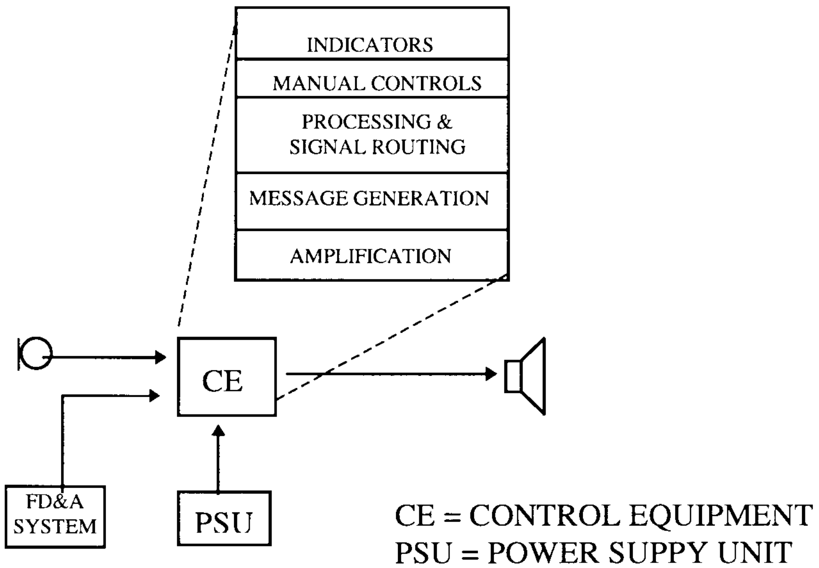

Figure 1. Functions of a voice alarm system

The minimum facilities provided by the control equipment (see clause **5**i) should be determined after consultation with interested parties (see **4.3**).

17.2 Indications and controls

17.2.1 *Recommended controls*

17.2.1.1 In the simplest voice alarm system, no manual controls need be provided. Silencing and evacuation controls, which silence or initiate a voice alarm message, will already have been provided at the fire detection and alarm system control equipment.

17.2.1.2 The following manual controls should be provided in the circumstances described:

a) microphone 'press to talk' switch (or 'all call' switch in a small system):	– wherever a fire microphone is provided;
b) loudspeaker zone select/de-select switches to enable manual initiation of broadcast of Test, Alert, Evacuate and live speech messages to individual loudspeaker zones:	– all buildings with phased evacuation and certain buildings with two-stage alarm;
c) activate/de-activate Alert message in selected zones:	– all buildings with phased evacuation and certain buildings with two-stage alarm;
d) activate/de-activate Evacuate message in selected zones:	– all buildings with phased evacuation and certain buildings with two-stage alarm;
e) silence fault sounder switch:	– where this sounder is located so close to any fire microphone that intelligibility of emergency broadcasts would be reduced.

NOTE 1. Controls for loudspeaker zone selection, item b), and message activation item c) and item d) may be combined.

NOTE 2. When the activate Evacuate message switch, item d), is operated those zones in which the Evacuate signal is not given should automatically receive the Alert signal.

NOTE 3. In a building with phased evacuation in which staircase capacity has not been designed for simultaneous evacuation, a single control that would initiate an evacuation signal throughout the building should not be provided.

17.2.2 *Recommended indications*

17.2.2.1 Facilities should always be provided to indicate the following conditions:

a) system energized (regardless of whether the system is energized from the normal supply or the standby supply);

b) faults (see **7.3.1**).

NOTE. The indicator of energization should normally be illuminated and extinguish only in the event of total power failure.

The indicator described in item a) should comprise a discrete light emitting indicator with a life of at least 15 years. The indicators described in item b) should be in accordance with **7.3.1.**

17.2.2.2 The following indicating facilities should be provided under the circumstances described:

a) Alert message activated:	– all buildings with phased evacuation and all buildings where the control in **17.2.1.2**c is provided;
b) Evacuate message activated:	– all buildings with phased evacuation and all buildings where the control in **17.2.1.2**d is provided;
c) Test message activated:	– where a facility is provided for initiating the broadcast of a test message;
d) zone selected:	where the controls described in **17.2.1.2**b are provided.

17.2.2.3 Other indications and controls may be provided, subject to access being provided or limited as indicated in **17.3**. Such indications and controls may include, but are not restricted to the following:

a) activate Test message switch;

b) activate other non-fire related message switch;

c) fire microphone 'talk now' indicator;

d) loudspeaker zone 'busy' indicator, at fire microphones.

NOTE. The provision of the controls and indicators described in this sub-clause is not necessary to satisfy the recommendations of this code of practice.

17.2.3 ***Silencing***

Provision for the silencing of any messages initiated by the fire detection and alarm system should only be at the control equipment of the fire detection and alarm system.

NOTE. For example, a remote silencing facility for the fire detection and alarm system may be located in close proximity to the voice alarm controls.

17.3 Construction

17.3.1 ***Enclosures***

The control equipment should be housed in one or more enclosures providing a degree of protection of at least IP3X, as specified in BS EN 60529 : 1992. This degree of protection should be maintained at all times with access restricted to access levels 1 and 2.

NOTE. In some applications the control equipment may need to have protection against water spray or splashing. In such cases higher IP classifications should be used.

17.3.2 ***Manual controls***

All manual controls should be robust, positive in operation, and so designed and positioned as to restrict the likelihood of accidental operation. All manual controls should be clearly labelled to indicate their functions. Manual controls should provide a sensory feedback (tactile, visual or audible) upon operation.

17.3.3 ***Accessibility of manual controls and visual indications***

17.3.3.1 *General*

Access levels for manual controls and visual indications should be as given in table 3.

17.3.3.2 *Access level 1*

Manual controls for which accessibility at access level 1 is recommended should have no restriction on access. Indicators for which visibility at access level 1 is recommended should be visible from the front of the control equipment enclosure with all doors closed.

17.3.3.3 *Access level 2*

Manual controls for which accessibility at access level 2 is recommended or indicators for which visibility at access level 2 is recommended should have access restricted by means of a special procedure, for example, use of a key or code-operated switch or lock.

17.3.3.4 *Access level 3*

Manual controls for which accessibility at access level 3 is recommended or indicators for which visibility at access level 3 is recommended should have access restricted by means of a special procedure, for example, use of a key or code-operated switch or lock, differing from that for access level 2.

NOTE. Keys or codes providing access at level 3 may also provide access at level 2.

17.3.3.5 *Access level 4*

Access to the voice alarm equipment hardware and software should be restricted to access level 4 by means of a special procedure, for example, use of a key operated lock or special tools, differing from those for access levels 2 and 3.

Table 3. Access levels for controls and indications

Control or indication	Clause reference	Accessibility[1)] at access level			
		1	2	3	4
a) Manual controls (if provided)					
1) Microphone ‘Press to talk’[2)]	**17.2.1.2**a	N	R	R	R
2) Loudspeaker zone select/de-select	**17.2.1.2**b	N	R	R	R
3) Activate/de-activate Alert message	**17.2.1.2**c	N	R	R	R
4) Activate/de-activate Evacuate message	**17.2.1.2**d	N	R	R	R
5) Silence fault sounder	**17.2.1.2**e	N	R	R	R
6) Activate Test message	**17.2.2.3**a	N	R	R	R
7) Activate other non-fire related messages:	**17.2.2.3**b	N	R	R	R
i) higher priority than fire		N	R	R	R
ii) lower priority than fire		O	R	R	R
b) Recommended indications					
1) System energized	**17.2.2.1**a	R	R	R	R
2) General fault	**7.3.1**b	R	R	R	R
3) Other faults	**7.3.1**c	O	R	R	R
c) Other indications (if provided)					
1) Zone selected	**17.2.2.2**d	R	R	R	R
2) Alert message activated	**17.2.2.2**a	R	R	R	R
3) Evacuate message activated	**17.2.2.2**b	R	R	R	R
4) Test message activated	**17.2.2.2**c	R	R	R	R
5) Fire microphone ‘Talk now’	**17.2.2.3**c	R	R	R	R
6) Fire microphone loudspeaker zone ‘busy’[3)]	**17.2.2.3**d	R	R	R	R

1) Key: R = Recommended, O = Optional, N = Not recommended.
2) Access to this control should be restricted as recommended in **17.3.3.3**, but should not use a code.
3) With lower priority broadcast or higher/equal priority broadcast from another fire microphone.
NOTE. Although the provision of a manual control or indication may be optional, if provided, it should be in accordance with the relevant recommendations for accessibility.

17.3.4 *Visual indications*

17.3.4.1 *Colour*

The colours of light emitting visual indicators should be as follows:

a) red for indication of emergency message broadcast;

b) yellow for indication of fault;

c) green for indication of energization and selection of loudspeaker zone.

Indication of other functions within the voice alarm system should not be red or green.

17.3.4.2 *Flashing rates*

Indications should be given either by steady lights or by flashing lights. Where flashing lights are used, ‘on’ and ‘off’ periods should each be not less than 0.25 s. The rates of flashing should be as follows:

a) not less than 1.0 Hz for indication of broadcast of fire messages;

b) not less than 0.2 Hz for indication of faults.

17.3.4.3 *Labelling*

The function of each visual indicator should be clearly identified on the control panel.

17.3.4.4 *Indicator circuits*

The arrangement of the indicator circuits and the design of the equipment should not prevent the proper and separate operation of other indicators or of any internal sounder or any emergency broadcast.

17.3.4.5 *Visibility of light emitting indicators*

Light emitting visual indicators should be clearly visible under the following conditions without requiring any operator actions:

a) from any distance up to 3 m;

b) at any angle up to 22.5° from the normal to the panel;

c) in an ambient light intensity up to 500 lux.

17.3.4.6 *Legibility of alphanumeric displays*

Alphanumeric displays should be clearly legible under the following conditions without requiring any operator actions:

a) from any distance up to 0.8 m;

b) at any angle from the normal to the panel, up to:

1) 2.5° in the horizontal plane,

2) 5° in the vertical plane;

c) in an ambient light intensity from 5 lux to 500 lux.

17.3.5 ***Service life***

The control equipment should be so designed as to function reliably in the intervals between servicing recommended by the manufacturer. Equipment should be designed to have a service life of at least 15 years.

Components of good commercial quality should be used throughout the equipment. They should be selected for the intended purpose and should be expected to operate within their specification for the range of environmental conditions specified (see clause **20**). Thermionic devices should not be used. If other components with a mean time to failure of less than 15 years are used, their replacement intervals should be specified by the manufacturer. Data-containing devices should be protected against alteration caused by environmental conditions, for example ultraviolet radiation, and should be labelled with the version of the data contained.

17.4 Siting

17.4.1 ***Accessibility to site operators and the fire brigade***

Whilst the rest of the voice alarm control equipment may be located elsewhere in a building, the following controls and indicators should be located adjacent to the main access to the building and should either be combined with, or close to, the master fire detection and alarm control and indicating equipment:

a) recommended indications b)1) and b)2) given in table 3;

b) fire microphone (if provided);

c) manual controls a)1) to a)5 given in table 3 (if provided);

d) other indications c)1) to c)3), c)5) and c)6) given in table 3 (if provided).

Alternatively, these controls and indicators may, subject to the agreement of the fire brigade, be located in a security control room, or similar continuously manned control centre, to which there is ready access for the fire brigade and which could be used by them for command and control during the course of a fire.

17.4.2 ***Protection from fire or other hazards***

It is expected that control of the voice alarm system will be required for an extended period to allow for warning and safe evacuation of all occupants. The choice of location for the control equipment should, therefore, bear this fact in mind, ensuring that the fire rating of the relevant fire compartments and general protection from other site hazards is sufficiently high for the purpose.

17.4.3 ***Background sound levels***

Background sound levels in the vicinity of the control equipment should be limited, preferably to 40 dBA, so that they do not jeopardize the use of the fire microphone(s) or prevent audible warnings from being heard. If the sound level is higher than 40 dBA, a close-talking microphone should be used (see **12.2**).

17.4.4 ***Ambient light level***

The ambient light level in the vicinity of the control equipment should be such that any visual indications can be clearly seen and any instructions for use be easily read. Where necessary, additional lighting should be provided.

18 Power supplies

18.1 General

The power supply for the voice alarm system should be in accordance with BS 5839 : Part 4 and follow the recommendations for life safety systems in clause **16** of BS 5839 : Part 1 : 1988. The operation of voice alarm systems is more complex than that of alarm sounders and the advice given in BS 5839 : Part 1 should be supplemented by the recommendations in **18.2** to **18.4** inclusive of this standard.

18.2 Evacuation period

Complex or high-rise buildings may have extended evacuation times. The standby power supply should be capable of operating the system in Evacuate mode for a minimum period of 30 min. Where the total evacuation time for the building exceeds 20 min, this standby period of 30 min should be extended appropriately taking into account a sufficient safety margin.

18.3 Maximum load

The maximum load is imposed on power supplies during continuous broadcast to all zones. The normal and standby supplies should each be capable of supplying the maximum load irrespective of the condition of the other supply. The standby supply should not be used to support non-essential system operation, for example background music, and such use should be automatically discontinued on the changeover to standby power.

18.4 Standby battery type

Valve regulated lead acid batteries (VRLA), often referred to as sealed lead acid batteries (LA), are the commonest types in use for voice alarm systems. Nickel cadmium batteries may be used but it should be noted that their performance can be affected by a ‘memory effect’ which reduces the available capacity.

The calculations in **18.5** refer to the use of VRLA batteries. If nickel cadmium batteries are to be used, advice should be sought from the manufacturer, for each application.

18.5 Standby battery calculations

Where batteries are used as the standby supply, capacities calculated on the basis of operation of the system at maximum power for the whole evacuation period could result in excessive battery requirements. The following formula is therefore recommended for calculating the minimum total capacity of VRLA batteries:

$$C_{min} = 1.25\{(D_1 \times T_1 \times I_1) + (D_2 \times T_2 \times I_2)\}$$

where:

C_{min} is the minimum capacity of the battery at 20 °C when new (in ampere hours, (Ah));

T_1 is the battery standby period (in hours);

I_1 is the battery standby (quiescent) load current (in amperes), excluding load current in the alarm condition.

I_1 is measured or calculated as the sum of the quiescent currents of all the components of the voice alarm system, based upon operation at the nominal voltage (V), including contributions such as the current taken by the fault monitoring circuits;

T_2 is the alarm condition period (in hours) (normally ½ h but may need to be longer; see **16.5** of BS 5839 : Part 1 :1988). A minimum period of ½ h should always be used, even where a shorter period is requested;

I_2 is the total battery load current with all loudspeaker zones in full alarm condition (in amperes). See annex C for an approximate method of calculation of I_2 and for a worked example of a calculation to determine the required capacity of a VRLA battery;

D_1 is a de-rating factor derived from the manufacturer’s data, based upon the standby quiescent current I_1 and the discharge time T_1. This factor is the de-rating from the 20 h rate, and:

a) for T_1 = 24 h (i.e. greater than 20 h), D_1 = 1, since the 20 h rate is directly applicable;

b) for T_1 = 6 h (see **16.5.1.4** of BS 5839 : Part 1 : 1988), D_1 is the de-rating factor, read from the battery manufacturer’s data, which takes into account that the discharge time is 6 h, and not greater than 20 h;

D_2 is a de-rating factor derived from the manufacturer’s data, based upon full alarm load current I_2 and the discharge time T_2. This factor is the de-rating from the 20 h rate and takes into account that the discharge time is ½ h (normally), and not greater than 20 h;

The multiplying factor, 1.25, is included to allow for some ambient temperature variation and battery ageing.

NOTE 1. High ambient temperatures reduce battery service life dramatically; at extreme temperatures the battery may be destroyed. The service life quoted by the manufacturer is based upon battery operation within the range 20 °C to 25 °C. It is therefore recommended that the battery is located in an environment the temperature of which exceeds that range only occasionally. If this is not possible, it will be necessary to replace the battery more frequently. For example, a VRLA battery operating in a continuous ambient temperature of 35 °C has an expected life of only 60 % of its specified life at 20 °C.

NOTE 2. De-rating factors D_1 and D_2 are not always available from manufacturer's data. A safe approximation to ($D_2 \times T_2 \times I_2$) may often alternatively be obtained from a manufacturer's 20 h rate battery capacity selection chart, which gives a graph showing required discharge current versus required discharge time. Within the graph is a series of curves, each corresponding to a particular 20 h rate Ah battery size. After calculating I_2 (see annex E), and knowing T_2 (normally ½ h), the 20 h rate Ah value can be read from the graph. This figure may be taken to represent ($D_2 \times T_2 \times I_2$) in the expression for C_{min}. It may be a little higher in Ah value than ($D_2 \times T_2 \times I_2$) calculated using an available value for D_2.

18.6 Changeover

Any change between normal and standby supplies and vice versa should cause no interruption to the operation of the system, loss of information or change of operational status, apart from any indications associated with power supply operation.

The performance of the system should not be degraded by a changeover to the standby supply. In particular, sound pressure levels and intelligibility should still meet the specified performance.

19 Cables, wiring and other interconnections

19.1 General

The satisfactory operation of the voice alarm system depends very much on the integrity of the interconnections between its components. Because the primary function of a voice alarm system associated with a fire detection and alarm system is to broadcast messages after a fire has been detected, most of these interconnections will be required to function correctly for significant periods during a fire.

19.2 Transmission requirements of signals, and environmental conditions

Consideration should be given to the transmission requirements of the signals sent and the environment within which the signals are passed, as this may have a significant effect on the type of interconnections to be used. Possible problems are:

a) electrical noise disturbing the audio signal or corrupting the data transmitted;

b) incorrect choice of cable for the speed of the data transmission or impedance matching requirements of the equipment connected at both ends;

c) excessive voltage drop in the loudspeaker wiring limiting audio power transmission;

d) a high level of vibration, temperature or humidity, any of which may cause degradation of cable properties and eventual failure of the interconnection;

e) hazardous areas and their specific safety requirements.

With regard to item c), the maximum voltage drop in any loudspeaker circuit should not exceed 10 %.

NOTE. A 10 % voltage drop in a loudspeaker circuit approximates to a 1 dB loss of sound pressure level.

19.3 Protection of cables

All cables necessary to fulfil the primary function of the voice alarm system should be in accordance with the recommendations given in the following subclauses of BS 5839 : Part 1 : 1988:

a) **17.5** Protection of cables from electrical or mechanical damage;

b) **17.7** Conductor sizes;

c) **17.8** Conduit, ducting and trunking;

d) **17.9** Joints;

e) **17.10** Segregation of wiring;

f) **17.12** Overhead lines;

g) **17.13** Damp, corrosive or underground locations;

h) **17.14** Ambient temperatures.

Care should also be taken to ensure that protection from fire is adequately maintained when terminating the cables within junction boxes and loudspeakers.

19.4 Recommended cable types

The following types of cable are recommended for all equipment interconnections, other than those described in **19.5**:

a) mineral-insulated copper-sheathed cable conforming to BS 6207 : Part 1, with or without an overall polymeric covering, using terminations conforming to BS 6207 : Part 2;

b) cables conforming to BS 7629.

19.5 Connection to standby battery supply

Under conditions of mains supply failure, the current drawn from the standby battery during a broadcast is normally high. Typically, for a 24 V battery, this current will average between 30 A and 150 A. It is therefore very important that the cable conductor sizes are large enough to minimize temperature rise and voltage drop.

The standby battery should be located as close as practicable to the d.c. power input terminal of the voice alarm system. Whatever the length of this cable, its voltage drop at the maximum operating average current should not exceed 5 % of the d.c. supply voltage, i.e. 1.2 V for a 24 V battery. As an example, in an ambient temperature of 30 °C, each core of a copper cable pair of length 2 m would need to have a cross-sectional area of at least 25 mm^2 for a 100 A supply current. (This data is taken from BS 7671 : 1992.) If, however, the cable length were 15 m, a 70 mm^2 conductor size would be needed for the same supply current.

Where, as is normally the case, the standby battery supply is located close to or within the voice alarm system control equipment enclosure and in the same area of low fire risk (see **17.4.2**), the cables connecting to the voice alarm control equipment need not be fire-resisting since neither the control equipment nor the batteries will withstand very high local temperatures. However, should the standby battery supply cable exceed 10 m in length or extend into, or through, a different room from the control equipment, the circuit should be protected from fire in accordance with the recommendations given in **17.4.2** of BS 5839 : Part 1 : 1988.

20 Environmental conditions

The equipment used in the voice alarm system should be capable of performing all its functions in the environmental conditions expected in buildings. In particular, when subjected to the tests described in clauses **8**, **9**, **10**, **11** and **12** of BS 5839 : Part 4 : 1988, it should satisfy the criteria for conformity specified in those clauses. Where the methods of test described in those clauses refer to operation or disconnection of trigger devices, this should be deemed to mean operation or disconnection of the input to the voice alarm system from the fire detection and alarm system.

21 Variations in power supply

The equipment used in the voice alarm system should be capable of performing all its functions when exposed to expected variations in power supply. In particular, when subjected to the tests described in clause **16** of BS 5839 : Part 4 : 1988, it should satisfy the criteria for conformity specified in that clause.

22 Radio and electrical interference

The equipment used in the voice alarm system should be protected against electrostatic and electromagnetic interference and mains-borne electrical transients. In particular, when subjected to the tests described in clauses **13**, **14** and **15** of BS 5839 : Part 4 : 1988, it should satisfy the criteria for conformity specified in those clauses.

Even though the EMC performance of the components of the voice alarm system have been assessed, care should be taken when installing the system to ensure that the essential requirements are still met. In particular, recommendations given by manufacturers and/or suppliers relating to EMC protection of their equipment, for example type and routing of cables, shielding and earthing, should be followed.

Particular care should be taken in the design of the voice alarm system to avoid interference from other equipment, including radio transmitters such as portable telephones and hand-held two-way radios, and external sources such as lightning or power transients. Such interference can otherwise affect the normal operation of the voice alarm system.

NOTE. Attention is drawn to the 'essential requirements' for emission and susceptibility to radio and electrical interference given in the European Council Directives 89/336/EEC [1] and 92/31/EEC [2].

Section 3. Workmanship, installation and commissioning

23 Work off site

The recommendations for verification and packing of equipment given in **21.1** and **21.2** of BS 5839 : Part 1 : 1988 should be followed.

24 Work on site

The work on site should consist of the following:

a) siting and accommodation of control equipment, power supplies, microphones, amplifiers and loudspeakers;

b) installation of cables, including the provision of cable-ways;

c) installation of equipment;

d) inspection, initial testing, commissioning and certification.

25 Siting and accommodation

25.1 General

Care should be taken in planning the accommodation for the equipment to ensure that the structure can accept the necessary loading and that heavy or bulky equipment can readily and safely be transported to and from its installed position.

Consideration should be given to the possible need for cooling of any heat-dissipating equipment.

Access to equipment in service should be provided to allow it to be kept in a clean condition and be easily maintained.

Documentation should be provided within or adjacent to the control equipment as follows:

a) operating instructions for the correct action in the event of an emergency or fault indication;

b) system log book, which may be the same as the fire detection and alarm system log book.

25.2 Protection against lightning

All metallic parts of the system, including conduit, trunking, ducting, cabling and enclosures, should be well separated from any metalwork forming part of a lightning protective system. Further guidance is given in **25.3** of BS 6651 : 1992.

The recommendations for siting of equipment and routing of cables in hazardous areas given in **23.3** of BS 5839 : Part 1 : 1988 should be followed.

26 Installation of cables and wires

26.1 General

The recommendations given in the following subclauses of BS 5839 : Part 1 : 1988 should be followed:

a) **24.1** for cable ducts, channels and trunking;

b) **24.2** for cable holes;

c) **24.3** for precautions against the spread of fire;

d) **24.5** for earth continuity.

26.2 Cable and wiring

The installation of cable and wiring should be undertaken in accordance with BS 7671 : 1992. The recommendations given in **24.4.2**, **24.4.3** and **24.4.4** of BS 5839 : Part 1 : 1988 should also be followed.

27 Installation of equipment

The recommendations given in **25.1**, **25.2** and **25.3** of BS 5839 : Part 1 : 1988 should be followed. If equipment requires external ventilation or cooling, this should be operating prior to starting commissioning of the system.

28 Inspection, initial testing, commissioning and certification of systems

28.1 Record drawings and operating instructions

On completion of the installation, instructions on its use, routine attention and test procedures should be supplied to the person responsible for the use of the premises. The installer should draw the attention of the user to those clauses of this standard that may reflect on the use of the system, and in particular, those clauses dealing with user responsibilities.

Drawings should be provided to the user showing, for maintenance and record purposes, the positions of the various items of equipment, junction boxes, etc. and the sizes and routes of all cables and wires. Particular attention should be given to the locations of items needing regular attention or replacement. Wiring diagrams for junction boxes containing more than one circuit should be included. The records should be permanent and suitable for convenient reference. They should be prepared in accordance with BS 1635 and should be updated to include any modifications or additions to the system. If the purchasing specification so requires, circuit diagrams of the system and its components should be supplied in sufficient detail for the operation of the system to be understood by technical staff.

28.2 Inspection of installation

The complete installation should be inspected to ensure that the work has been carried out in a satisfactory manner, that the methods, materials and components used are in accordance with this standard, and that the record drawings and operating instructions (see **28.1**) have been supplied.

28.3 Testing insulation of cables and wires

The recommendations given in **26.3** of BS 5839 : Part 1 : 1988 should be followed. Particular note should be taken of the need to disconnect equipment which may be damaged when testing cables and wiring at 500 V d.c.

28.4 Earthing test

The recommendations given in **26.4** of BS 5839 : Part 1 : 1988 should be followed.

28.5 Commissioning tests

28.5.1 *General*

The system should be tested to ensure that it operates satisfactorily and that, in particular:

a) the recommended sound levels are met throughout the area of coverage (see **28.5.2**);

b) satisfactory intelligibility is achieved throughout the area of coverage (see **28.5.3**);

c) the correct signal is given in each loudspeaker zone in response to both automatic initiation and manual controls;

d) the interface with the fire detection system and any signals to ancillary equipment, such as beacons, are operating satisfactorily.

NOTE. The parameters in a) and b) should be checked for each emergency sound source.

28.5.2 *Audibility*

To ensure that the recommendations given in **15.4.1** are satisfied, the sound pressure level of at least the attention-drawing signal (see **14.1.1**) should be measured. The sound pressure level of the speech message should be at least as high as that of the attention-drawing signal. The precise measurement of the sound pressure level of speech is, however, difficult and requires complex equipment. It is recommended that a reading is made using a sound level meter set to 'A' weighting and 'slow response'. This will produce an approximation provided that the speech is not slow in delivery and has virtually no gaps. In measuring the sound pressure level of speech, there will be variations in the reading, even when the meter is set to 'slow response'; a visual estimate of the 'average' reading should be made.

28.5.3 *Intelligibility*

The extent and method of testing and levels of intelligibility to be achieved should be stated in the system specification (see **4.1**). If necessary, in the event of a dispute, objective intelligibility tests should be carried out (see **15.4**).

Intelligibility should be assessed under the worst expected noise levels; in particular, smoke extract fans, staircase pressurisation fans and other noise sources which would be operating during a fire should be running. If this cannot be achieved, the noise levels should be simulated for the test.

Subjective tests should be based on intelligibility, not merely audibility, and should be conducted by persons with normal hearing (see BS 5330 : 1976). Messages or text, preferably unknown to the listeners, should be read into a system microphone, where fitted. Repeated pre-recorded messages are of a lesser value for judgements, as the message is learnt by the listeners. Voice alarm systems should be assessed using speech, not warning signals.

28.6 Certification

The installer should supply to the user a certificate stating that the installation is in accordance with the recommendations given in this standard or, if deviations have been agreed (see **4.3**), a statement of these deviations should be given by the installer.

Certification of the voice alarm system installation and commissioning may be provided either on a document specific for the voice alarm system (see annex D) or preferably incorporated with certification for the fire detection and alarm system using common documentation based on the formats shown in annex D of this standard and appendix B of BS 5839 : Part 1 : 1988.

28.7 Handover

Where appropriate, the recommendations given in **26.7** of BS 5839 : Part 1 : 1988 should be followed.

29 Extensions and alterations to existing systems

The recommendations given in clause **27** of BS 5839 : Part 1 : 1988 should be followed when carrying out extension or modification work on existing systems.

Section 4. User responsibilities

30 General

The recommendations given in clause **28** of BS 5839 : Part 1 : 1988 regarding the general responsibilities of the user of the system should be followed.

31 Training

As real fire conditions are infrequent, the responsible person should ensure that the personnel involved in the operation of the system are trained on a regular basis. The training programme should be designed to meet the requirements of the individual disciplines but at least the following items should be considered:

a) the function and use of all system controls;

b) the purpose of all system indicators;

c) the position, type and function of every system component;

d) the location and use of the operating manual and where appropriate the maintenance manual;

e) the location of the event log book;

f) the location and use of the 'as fitted' drawings;

g) the purpose and control of any interlinked ancillary equipment functions;

h) the appropriate microphone technique.

32 Servicing

32.1 General

The recommendations given in section **4** of BS 5839 : Part 1 : 1988 should be followed. It is particularly important that maintenance is considered at the system design stage of the project. The maintenance contractor should be fully conversant with the characteristics of the system.

32.2 Routine maintenance

The recommendations for routine maintenance of the installed system given in **29.2** of BS 5839 : Part 1 : 1988 should be followed. In addition, the responsible person should ensure that:

a) on a weekly basis, all microphones are checked for correct operation;

b) over any period of not more than 13 weeks all loudspeaker zones are checked for correct operation, including a subjective assessment of message intelligibility.

NOTE. See **14.5** for recommendations on test messages.

32.3 Special servicing

The recommendations given in **29.3.2** of BS 5839 : Part 1 : 1988 regarding action by the user after any fire (whether detected automatically or not), where appropriate to the voice alarm system, should be followed. In addition, the responsible person should ensure that each loudspeaker and fire microphone is tested.

The recommendations given in **29.3.4** of BS 5839 : Part 1 : 1988 regarding action by the user following a fault should also be followed.

Annexes

Annex A (informative)

Types of loudspeaker

Table A.1 provides data for use in the selection of loudspeakers. It shows average parameters obtained from suitable products. The sensitivity is an important factor as it determines the total power required from the amplifiers. An increase in loudspeaker sensitivity of 3 dB reduces the total power requirement, including that from standby power supplies, by 50 %.

Table A.1 Types of loudspeaker

Generic loudspeaker type	± 5 dB Frequency response (see note 4)	Sensitivity level at 1 kHz (see note 1)	Continuous rated power	−6 dB dispersion angles (total) (see note 3)			
				2 kHz		4 kHz	
	Hz	dBA	W	Horizontal	Vertical	Horizontal	Vertical
Horn re-entrant 250 mm diameter (see note 2)	450 to 5000	105 to 109	10 to 30	50°	50°	35°	35°
Horn re-entrant 140 mm diameter (see note 2)	450 to 5000	102 to 106	10	75°	75°	45°	45°
Flush mounting ceiling cone 200 mm diameter	150 to 10 000	90	6	90°	90°	60°	60°
Flush mounting ceiling cone 100 mm diameter	200 to 12 000	87	6	100° to 120°	100° to 120°	80° to 90°	80° to 90°
Wall mounting cone 150 mm × 100 mm	150 to 10 000	90	6	100°	100°	70°	70°
Bi-directional cone × 2 150 mm × 100 mm	200 to 10 000	90	10	45°	100°	30°	60°
Bi-directional pressure driver horn loaded (see note 2)	400 to 6000	101	15	45°	45°	30°	30°
Column 1 m	150 to 12 000	96	30	120°	30° to 40°	90°	20° to 30°
Projector cone 100 mm	250 to 12 000	90	10	90°	90°	60°	60°
Flameproof horn (see note 2)	400 to 4000	99	15	90°	90°	50°	50°

NOTE 1. The sensitivity shown is referenced at 1 m/1 W in free field.
NOTE 2. The cut off frequency of a horn loudspeaker is mainly determined by the rate of expansion of the horn. The sensitivity is determined, in most cases, by the horn length and flare (mouth) area.
NOTE 3. In most loudspeaker assemblies using cone drivers, the dispersion angles vary with frequency and size of the drivers.
NOTE 4. It is assumed that the loudspeakers used are relatively free from distortion and have a smooth frequency response between the limits indicated.

Annex B (informative)

Typical noise levels in buildings

Table B.1 gives typical expected background noise levels for a range of building types. It should be borne in mind, however, that background noise levels can vary significantly from building to building of the same occupancy; likewise, occupancy can vary in any given building. Sound level readings for the table were taken, as far as possible, at the busiest periods and short-term bursts of very high level or very low level noise were ignored. For each type of building a typical range of background noise sound pressure levels is given.

On the whole, measurements for the table were made in large buildings the size of which was felt to be most appropriate for voice alarm systems. In some buildings, the range of background noise levels is very wide and the type of occupancy has been subdivided into, for example, quiet and noisy categories.

The table is intended only as a guide but where it is used to assess voice alarm system requirements, the higher of the two dBA figures in the appropriate range should always be used. Wherever possible, 'real' measurements should be made in the building where the voice alarm system is to be installed.

Table B.1 Typical occupational noise levels (L_p)

Area			L_p dBA
Airport terminals:	check in, arrivals and departures concourses		59 to 72
	gate rooms and pier walkways		54 to 64
	customs:	— baggage reclaim	63 to 71
		— channels	59 to 70
		— departure lounge	49 to 64
Arenas, auditoria:	Concert halls, cinemas, theatres, etc.		60 to 75 see note 1
Banks, building societies:	public areas		50 to 64
Bus stations:	quiet		58 to 68
	noisy		63 to 73
Cafeterias:	quiet		55 to 65
	noisy		68 to 78
Classrooms:	quiet		56 to 68
	noisy		64 to 72
Conference/meeting rooms:			40 to 45
Corridors:	uncarpeted:	— quiet	45 to 55
		— noisy	66 to 76
	carpeted		28 to 32
Courtrooms:			40 to 50
Dealing rooms:	computerized		60 to 70
	'traditional'		80 to 90
Exhibition halls:			63 to 73
Factories:	control rooms		70 to 75
	light assemblies		80 to 85
	heavy engineering		95 to 105
Hospitals:			see note 2
Hotel bedrooms:	TV off		28 to 35
	TV on		60 to 70

Table B.1 Typical occupational noise levels (L_p) (*continued*)

Area			L_p dBA
Kitchens (commercial):			65 to 75
Leisure centres:	squash courts		65 to 80
	ice-rinks (public sessions)		69 to 80
	swimming/diving pools		72 to 79
	fun pools		81 to 87
	bowling		78 to 85
Libraries:	book/reading areas:	— quiet	35 to 45
		— noisy (e.g. heavily air-conditioned)	50 to 60
	reception:		50 to 60
Museums, galleries:	quiet		48 to 60
	noisy		60 to 73
Offices:	cellular		40 to 50
	open plan		50 to 70
	noisy		70 to 85
Plant rooms:	boiler:	— quiet	66 to 72
		— noisy	76 to 86
	air handling		84 to 87
	compressor		89 to 93
Railway stations (surface):	waiting rooms		54 to 65
	concourses		60 to 66
	platforms:	— electric trains	60 to 72
		— diesel trains	75 to 85
Restaurants:			72 to 75
Shops, stores:	quiet		50 to 60
	noisy		65 to 75
Shopping malls:			70 to 75
Sports halls:	quiet		60 to 72
	noisy		72 to 82
	loud ball games		78 to 93
Warehouses:	quiet		47 to 63
	noisy		63 to 80

NOTE 1. In these occupancies, management procedures will normally be that performances cease prior to an emergency broadcast being made; the background noise level will then be significantly lower than that occurring during the performance. It is the latter noise level, as given here, that should be used for designing the system.

NOTE 2. Special considerations apply in the case of hospitals because, for example, in many areas the emergency broadcast is intended primarily for staff rather than patients. Detailed guidelines on sound levels that should be produced by the fire detection and alarm system are given in HTM 82 [3].

Annex C (informative)
Calculation of battery load current (I_2)

C.1 Equation for calculating I_2

The exact calculation of I_2 (see **18.5**) is complicated because a typical emergency message is a composite of periods of silence, attention-drawing signals and voice. The periods of silence, however, should be considered as extensions to the 'voice' element; this is a safeguard to allow, for example, for the use of a fire microphone to override the emergency message. A method of calculating I_2 approximately is given below.

First, it is necessary to know:

a) the nominal battery voltage, V (in volts);

b) the total duration of one message cycle, including the subsequent period of silence until the start of the next cycle, M (in seconds);

c) the total duration of the attention-drawing signal(s) within the message cycle, X (in seconds);

d) the total duration of the speech section of the message, together with all periods of silence, including the subsequent period of silence until the start of the next message cycle, Y (in seconds);

e) the sum of the required maximum output powers to all loudspeakers, based upon a sinusoidal input, L (in watts).

NOTE 1. The total loudspeaker power required from an amplifier is often significantly less than the rated power output of the amplifier.

NOTE 2. When the system specification calls for spare capacity, i.e. a reserve of power, to meet possible future requirements for increased loudspeaker coverage, this should be taken into account at the design stage, resulting in an increased value for L.

To derive from the output power requirement the associated input power from the battery, an allowance has to be made for amplifier efficiency. Whilst the relationship between output and input power is not simple, an overall efficiency of 50 % can be used; i.e. the maximum input power for a sinusoidal signal is $2L$ watts. This figure can be used directly for calculating the power associated with the attention-drawing signal (which is assumed to be sinusoidal).

For speech, however, the average power is considerably less than for the 'sinusoidal' attention-drawing signal.

A very approximate reduction factor of 2 may be used to estimate its input power requirement (a small amount of compression of the speech signal is allowed for within this factor); i.e. the maximum input power for speech signals is L watts. I_2 can then be calculated from the following formula:

$$I_2 = \frac{2L(X/M) + L(Y/M)}{V}$$

$$I_2 = \frac{L(2X + Y)}{MV}$$

The calculated value of I_2 can now be used to determine the de-rating factor D_2 from the battery manufacturer's information.

C.2 Example

Calculation of the standby battery capacity required, in ampere hours, for a VLRA battery to satisfy the following requirements (reference being made to **17.5**):

V	= 24 V	(standby battery voltage)
T_1	= 24 h	(standby period)
T_2	= ½ h	(period on full alarm load)
I_1	= 2 A	(total quiescent current, including any monitoring current)
L	= 1000 W	(output power required for all loudspeakers)
M	= 32 s	(total duration of one message cycle, including periods of silence)
X	= 8 s	(total duration of the attention drawing-signal within one message cycle)
Y	$= M - X$ $= (32 - 8)$ = 24 s	(the total duration of the speech section of the message, together with all periods of silence, including the subsequent period of silence until the start of the next message cycle)

$$I_2 = \frac{L(2X + Y)}{MV} = \frac{1000 \times (2 \times 8 + 24)}{32 \times 24} = \frac{1000 \times (16 + 24)}{768} = \frac{1000 \times 40}{768} = 52.08 \text{ A}$$

= 52.1 A (approximately)

The minimum battery capacity, C_{min}, required can now be calculated as follows (see **18.5**):

D_1 = 1

D_2 = 1.9 (from the manufacturer's data relating to a 52.1 A discharge rate for ½ h, say — but see also note 2 to **18.5**)

$$C_{min} = 1.25\{(D_1 \times T_1 \times I_1) + (D_2 \times T_2 \times I_2)\}$$
$$= 1.25\{(1 \times 24 \times 2) + (1.9 \times 0.5 \times 52.1)\}$$
$$= 1.25\{48 + 49.5\}$$
$$= 1.25 \times 97.5$$
$$= 121.875 \text{ Ah}$$

A combination of the manufacturer's standard batteries should be used to give a total capacity at the 20 h rate (C_{20}) of at least 122 Ah.

Annex D (normative)
Model certificate of installation and commissioning of a voice alarm system

Certificate of installation, commissioning and acceptance of a voice alarm system at:

User name:.. Contract No.:.................................

Site address:...

Installed areas:..

....

....

Work performed: ....

....

....

In accordance with **28.6** of BS 5839 : Part 8 : 1998, the installation has been inspected and been found to be in accordance with the recommendations of this code except for the following:

....

....

....

....

....

In accordance with **28.6** of BS 5839 : Part 8 : 1998:

a) subclause **28.3**, the insulation of cables and wires has been tested,
b) subclause **28.4**, the earthing has been tested, and
c) subclause **28.5**, the entire system has been tested for satisfactory operation.

Commissioning engineer's signature:... Date:..

Supplier representative's signature:.. Date:..

The system is accepted in good working order and, in accordance with BS 5839 : Part 8, record drawings, operating instructions and a system log book have been supplied and received. Attention has been drawn to the recommendations concerning user's responsibilities, particularly those concerned with routine attention and test procedures.

Signed for and on behalf of the user:.. Date:..

Name: .... Position:..

Annex E (normative)
Recommendations for the use of voice sounders

E.1 General

Voice sounders are stand-alone devices which contain the components necessary to generate and broadcast digitally recorded messages. They do not rely on the transmission of audio signals from a central source. Usually, only a d.c. voltage is needed to operate the devices as they work in the same way as standard fire alarm sounders. Some voice sounders, however, have message select facilities for multiple message systems. These require communication with the control equipment of the fire detection and alarm system in the form of extra conductors in the cable and/or data signals.

E.2 Applications

Some installations where voice control of evacuation is required may not be of sufficient size or complexity to justify a voice alarm system. In such installations, voice sounders may be used to achieve some of the benefits of voice control of evacuation (see **6.1**). Care should be taken, however, to ensure that the voice sounder system is suitable for the site and evacuation procedures. In particular:

a) the inability of voice sounders to reproduce live speech from a fire microphone should be appreciated;

b) when more than one voice sounder is broadcasting a message, broadcasts from different voice sounders typically drift out of phase with one another because each has its own independent clock. This can lead to loss of intelligibility.

Where a simple evacuation procedure is adopted, the system will be straightforward. If phased evacuation or multiple messages are required, consideration should be given to the installation of a voice alarm system.

If a more versatile voice sounder system is required and the use of multiple message devices is considered, the planning schedule in clause **5** should be taken into account to ensure that all concerned parties agree to the system specification and evacuation procedures. Care should also be taken when planning the layout of devices to ensure that acoustic barriers and zone separation are adequate. Reference should be made to clause **9** on loudspeaker zones.

E.3 Coverage

The design of the layout of voice sounders should ensure adequate coverage and intelligibility. Sound pressure levels and intelligibility should be in accordance with the recommendations laid out in clause **15**. It should be noted that intelligibility cannot be measured unless the voice sounder is capable of broadcasting a suitable test signal.

NOTE. The subject of intelligibility of these devices is still under study.

Because of the wide range of frequencies in a spoken message and varying attenuation of these frequencies, it is unlikely that adequate coverage can be obtained with the same number of voice sounders as of fire alarm sounders. This is particularly important when trying to upgrade a system to use voice sounders.

E.4 Monitoring

Most voice sounders are connected to standard fire detection and alarm control equipment which uses end of line resistors for monitoring the integrity of the alarm circuits. In selecting a voice sounder for a system, a check for monitoring compatibility should be made to ensure that the circuit is monitored for both open-circuit and short-circuit fault conditions without affecting the operation of the voice sounder.

Consideration should also be given as to how the system will be tested, so that a test message can be made available if required.

E.5 Messages

Reference should be made to clause **14** for details of message formats and recommendations regarding language.

List of references (see clause 2)

Normative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 1635 : 1990	*Recommendations for graphic symbols and abbreviations for fire protection drawings*
BS 5330 : 1976	*Method of test for estimating the risk of hearing handicap due to noise exposure*
BS 5588 :	*Fire precautions in the design, construction and use of buildings*
BS 5588 : Part 11 : 1997	*Code of practice for shops, offices, industrial, storage and other similar buildings*
BS 5839 :	*Fire detection and alarm systems for buildings*
BS 5839 : Part 1 : 1988	*Code of practice for system design, installation and servicing*
BS 5839 : Part 4 : 1988	*Specification for control and indicating equipment*
BS 6207 :	*Mineral-insulated cables with a rated voltage not exceeding 750 V*
BS 6207 : Part 1 : 1995	*Cables*
BS 6207 : Part 2 : 1995	*Terminations*
BS 6259 : 1997	*Code of practice for the design, planning, installation, testing and maintenance of sound systems*
BS 7443 : 1991	*Specification for sound systems for emergency purposes*
BS 7629 :	*Specification for 300/500 V fire resistant electric cables having low emission of smoke and corrosive gases when affected by fire*
BS 7629 : Part 1 : 1997	*Multicore cables*
BS 7629 : Part 2 : 1997	*Multipair cables*
BS 7671 : 1992	*Requirements for electrical installations. IEE Wiring Regulations. Sixteenth edition*
BS 7807 : 1995	*Code of practice for design, installation and servicing of integrated systems incorporating fire detection and alarm systems and/or other security systems for buildings other than dwellings*
BS EN 60268	*Sound system equipment*
BS EN 60268-16[1]	*The objective rating of speech intelligibility by speech transmission index*
BS EN 60529 : 1992	*Classification of degrees of protection provided by enclosures (IP code)*
BS EN 60651 : 1994	*Specification for sound level meters*

[1] In preparation.

Informative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 6651 : 1992 *Code of practice for protection of structures against lightning*
BS 7827 : 1996 *Code of practice for designing, specifying, maintaining and operating emergency sound systems at sports venues*

Other references

[1] THE COUNCIL OF THE EUROPEAN COMMUNITIES. Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility. Official Journal of the European Communities, No, L 139, 23. 5. 89.

[2] THE COUNCIL OF THE EUROPEAN COMMUNITIES. Council Directive 92/31/EEC of 28 April 1992 amending Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. Official Journal of the European Communities, No, L 126, 12. 5. 92.

[3] DEPARTMENT OF HEALTH. Fire Code Alarm and Detection Systems. Health Technical Memorandum 82. The Stationery Office.

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