BS 5839-8:2013

BSI Standards Publication

Fire detection and fire alarm systems for buildings –

Part 8: Code of practice for the design, installation, commissioning and maintenance of voice alarm systems

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 82, an inside back cover and a back cover.

Foreword

Publishing information

This Part of BS 5839 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 March 2013. It was prepared by Subcommittee FSH/12/5, *Fire alarm devices, voice alarm evacuation subsystems and emergency voice communications*, under the authority of Technical Committee FSH/12, *Fire detection and fire alarm systems*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 5839 supersedes BS 5839-8:2008, which is withdrawn.

Information about this document

This new edition introduces a number of technical changes. It does not constitute a full revision of the documents, which will be undertaken in due course. The principal changes introduced by this new edition are as follows.

a) A new subclause **14.2** has been added to give recommendations on the placement of loudspeakers.

b) New recommendations for audibility have been added to subclause **22.1**.

c) The text on cables and wiring (Clause **27**) has been updated.

d) The text on radio-linked systems (Clause **28**) has been modified to remove conflicts with BS EN 54-25:2008.

e) The commentary to Clause **40** has been modified to include more guidance on system testing and a new item b) has been added to subclause **40.1**.

f) Annex C has been modified to avoid the assumption of an amplifier efficiency of 50% (class AB).

g) The term "responsible person" has been removed and replaced with references to "premises management" to avoid confusion with the term defined in legislation.

Where appropriate, this standard refers to BS EN 54 product standards, particularly those that apply to components of voice alarm systems.

Use of this document

As a code of practice, this standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this standard is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

The word "should" is used to express recommendations of this standard. The word "may" is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the Clause. The word "can" is used to express possibility, e.g. a consequence of an action or an event.

Notes and commentaries are provided throughout the text of this standard. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Section 1: General

1 Scope

This standard gives recommendations for the design, installation, commissioning and maintenance of voice alarm systems which automatically broadcast speech or warning tones, in response to signals from their associated fire detection and fire alarm systems. It also covers systems that include a manual facility for the transmission of live voice messages as well as automatically generated messages for emergency purposes.

NOTE 1 The fire detection and fire alarm systems themselves are covered by BS 5839-1.

Systems that depend solely upon manual intervention are not covered by this standard. However, this standard can be used for guidance in the design, installation, commissioning and maintenance of such systems.

NOTE 2 This standard applies to extensions and alterations to existing systems, at least in respect of the design, installation, commissioning, maintenance, and the certification of the new work, albeit that the extended or altered system might not, overall, conform to this standard.

NOTE 3 BS 7827 provides further recommendations in respect of sports venues.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 4678-4, *Cable trunking – Part 4: Specification for cable trunking made from insulating material*

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

BS 6651:1999+A1:2005, *Code of practice for protection of structures against lightning*

BS 7629-1, *Electric cables – Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire – Part 1: Multicore and multipair cables*

BS 7671, *Requirements for electrical installations – IET Wiring Regulations*

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

BS 7846, *Electrical cables – 600/1 000 V armoured fire-resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire*

BS 8434-2, *Methods of test for assessment of the fire integrity of electric cables – Part 2: Test for unprotected small cables for use in emergency circuits – BS EN 50200 with a 930 °C flame and with water spray*

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

BS EN 54-3, *Fire detection and fire alarm systems – Part 3: Fire alarm devices – Sounders*

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

BS EN 54-16:2008, *Fire detection and fire alarm systems – Part 16: Voice alarm control and indicating equipment*

BS EN 54-23, *Fire detection and fire alarm systems – Fire alarm devices – Part 23: Visual alarm devices*

BS EN 54-24, *Fire detection and fire alarm systems – Part 24: Components of voice alarm systems – Loudspeakers*

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

BS EN 50086 (relevant parts), *Specification for conduit systems for cable management*

BS EN 50200:2006, *Method of test for resistance to fire of unprotected small cables for use in emergency circuits*

BS EN 50289-4-16, *Communication cables – Specifications for test methods – Part 4-16: Environmental test methods – Circuit integrity under fire conditions*

BS EN 60079-14, *Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installations in hazardous areas (other than mines)*

BS EN 60268-16, *Sound system equipment – Part 16: Objective rating of speech intelligibility by speech transmission index*

BS EN 60702-1, IEC 60702-1, *Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V – Part 1: Cables*

BS EN 60702-2, IEC 60702-2, *Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V – Part 2: Terminations*

BS EN 61241-14, *Electrical apparatus for use in the presence of combustible dust – Part 14: Selection and installation*

BS EN 61241-17, *Electrical apparatus for use in the presence of combustible dust – Part 17: Inspection and maintenance of electrical installations in hazardous areas (other than mines)*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in BS 5839-1 and the following apply.

3.1 acoustically distinguishable area (a.d.a.)

subdivision of an emergency loudspeaker zone characterized by an individual reverberation time and ambient noise level

NOTE This may be an enclosed or otherwise physically defined space.

3.2 ambient noise

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

3.3 area of coverage

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

3.4 attention-drawing signal

tone which precedes either an alert or evacuate message when the system is automatic and put in emergency broadcast mode by the detection system

3.5 audibility
property of sound which allows it to be heard among other sounds

3.6 automatic mode
mode of operation of a voice alarm system which does not require manual intervention

3.7 clarity
property of a sound which allows its information-bearing components to be distinguished by the listener

NOTE 1 It is related to the freedom of the sound from distortion of all kinds.

NOTE 2 There are three kinds of distortion that can reduce the clarity of a speech signal in an electro-acoustic system:

a) amplitude distortion, due to non-linearity in electronic equipment and transducers;

b) frequency distortion, due to non-uniform frequency response of transducers and selective absorption of high frequencies in acoustic transmission;

c) time domain distortion, due to reflection and reverberation in the acoustic domain.

3.8 critical signal path
all components and interconnections between every fire alarm broadcast initiation point and the input terminals on, or within, each loudspeaker enclosure or other alarm warning device

3.9 emergency loudspeaker zone
part of the area of coverage to which emergency information can be given separately

3.10 emergency microphone
microphone dedicated for use by the fire and rescue service or other responsible persons as part of a voice alarm system

3.11 emergency mode
status of a system whereby emergency messages (either live or pre-recorded) are broadcast

NOTE 1 If the system is in manual mode, all emergency messages would be preceded by a pre-announcement tone. If the system is in automatic mode, all messages would have intervening tones between the messages.

NOTE 2 If the system is used for broadcasting sounds other than emergency messages and tones, the sources of such non-emergency broadcast are to be disabled for the whole period of the state of emergency.

3.12 equivalent continuous sound pressure level
$\mathbf{L_{eq,T}}$
twenty-fold decimal logarithm of the ratio of the root mean square (RMS) sound pressure level for a given time interval to the reference sound pressure, where the RMS sound pressure is determined with a standardized frequency weighting

NOTE 1 The A-weighted time-average sound pressure level is notated $L_{Aeq,T}$, where T is the time interval.

NOTE 2 BS EN 61672-1 gives further information regarding the requirements for sound pressure measurements.

3.13 intelligibility
measure of the proportion of the content of a speech message that can be correctly understood

*NOTE Satisfactory intelligibility requires adequate audibility (see Clause **21**) and adequate clarity (see Clause **22**).*

3.14 listener
person of normal hearing within the area of coverage and able to understand the speech message broadcast

3.15 loudspeaker circuit
transmission path to an assembly of loudspeakers supplied from the same control equipment and protected against over-current by the same protective device(s) or current limitation arrangements

3.16 manual mode
operator-controlled broadcast of live or pre-recorded sounds

3.17 maximum alarm load
load imposed on the power supply of a voice alarm system under emergency conditions

NOTE This will normally comprise the power required for simultaneous operation of all voice alarm loudspeakers, all VACIE, all emergency microphones and any external alarm devices, such as visual warning beacons, driven from the voice alarm system.

3.18 noise measurement ($L_{A10,T}$)
noise level exceeded for 10% of the measurement period with "A" frequency weighting calculated by statistical analysis over a representative period, T

3.19 non-emergency mode
status of a system whereby non-emergency sounds are broadcast

NOTE Typically the non-emergency broadcast would be background music, paging or operational messages.

3.20 PA zone
subdivision of an emergency loudspeaker zone also used for non-emergency broadcasts

NOTE In this context, a PA zone might be used for any kind of non-emergency broadcast, such as music.

3.21 pre-announcement tone
short tone or series of tones broadcast before each live message

3.22 premises management
persons having day-to-day control of the premises, the fire and voice alarm systems and implementation of the fire procedures

NOTE In large premises, a single person with specialist knowledge is often delegated the responsibility for the fire detection and fire alarm system and associated matters. In small premises, a person with specialist knowledge is unlikely to be present, but responsibility for the fire detection and fire alarm system can still be delegated to a specific "delegated person".

3.23 reverberation time
RT
time in seconds required for the average sound-energy at a given frequency to decay by 60 dB after the sound source has been stopped

3.24 transmission path
physical connection between sound system components (external to the cabinet of the component) used for the transmission of information

NOTE This could include audio and/or power.

3.25 voice alarm control and indicating equipment
VACIE
component or components of a voice alarm system through which other components may be supplied with power

NOTE 1 VACIE is used:

- *to receive signals from the fire detection and fire alarm control and indicating equipment (CIE);*
- *to manage priority and signal routing from emergency microphone(s) and message generator(s);*
- *to transmit messages to loudspeaker circuits;*
- *and to provide:*
  - *if required, manual controls for the selection of loudspeaker circuits;*
  - *if required, indicators for identifying which loudspeaker circuit is selected;*
  - *message generators and power amplifiers;*
  - *if required, emergency microphone(s) for broadcasting live emergency messages.*

NOTE 2 VACIE is also used to monitor the correct functioning of the system and give audible and visible warning of any faults, e.g. short circuit, open circuit, or a fault in the power supply or power amplifiers.

3.26 voice alarm system
VAS
sound distribution system that broadcasts speech messages and/or warning signals in an emergency

4 Need for a VAS

*COMMENTARY ON **4***
The need for a VAS in any specific building will normally be determined by the authority responsible for enforcing applicable fire safety codes and/or by a fire risk assessment carried out by the owner, landlord, occupier or employer, as appropriate.

In general, it is appropriate to install some form of VAS in all buildings which are subject to a predetermined evacuation plan. In buildings where occupants are adequately trained to respond effectively to a fire alarm and where trained fire wardens are available to marshal the evacuation, traditional alarm devices, such as bells or electronic sounders, arranged to produce a single alarm signal or a two-stage alarm signal, may be deemed sufficient. Even in the latter case, the use of a VAS would still be appropriate to enhance the management of an evacuation.

Where there is uncertainty regarding the need for a VAS, or the type of system that should be used (see Clause **5**), reference should be made by the potential purchaser or user to one or more of the following:

a) BS 9999, BS 7827 and Building Regulations Approved Document B Volume 2, *Buildings other than dwelling houses*, as amended [1];

b) guidance documents that support fire safety codes;

c) any authority responsible for enforcing fire safety codes applicable to the premises.

5 Types of systems

*COMMENTARY ON **5***
VASs are installed in buildings to aid the safe evacuation of occupants in the event of a fire. As such, VASs can be an essential part of the objective of fire detection and fire alarm systems to protect life (BS 5839-1:2013, Category L).

Because of the great variety of applications for systems covered by this standard, systems have been divided in a number of different types, reflecting the degree of manual control required. This standard does not recommend which type of system is to be installed in any given premises. The various system types can be regarded as an aid *to purchasers, users, specifiers, enforcing authorities, insurers or system designers when selecting a suitable system for a given building.*

It is important that the degree of manual control is appropriate to the risk and to the availability of trained personnel to operate the system.

Type V1: Automatic evacuation

The objective of the Type V1 system is to offer automatic operation of the VAS against a pre-programmed set of evacuation rules. The system may also have facilities for the manual selection and initiation of non-fire emergency messages, provided that these are automatically overridden by messages initiated from the fire detection and fire alarm system.

Type V2: Live emergency messages

In addition to the automatic facilities provided by the Type V1 system, the Type V2 system provides the facility to broadcast live emergency messages by means of an all-call emergency microphone situated at a strategic control point.

The objective of the Type V2 system is to allow supplementary live announcements to be made.

NOTE V2 systems may incorporate supplementary all-call emergency microphones at fire and rescue service access points.

Type V3: Zonal live emergency messages

Type V3 provides, in addition to the functions of the Type V2 system, the facility to broadcast live emergency messages in predetermined emergency zones or groups of zones.

The objective of the Type V3 system is to permit evacuation control in specific areas of the building where a predetermined evacuation plan might not cover all eventualities.

Type V4: Manual controls

In addition to automatic operation and live emergency messaging provided by the Type V3 system, the Type V4 system has the facility to select and direct stored emergency messages to individual zones. V4 systems also have the ability to disable or enable emergency broadcast messages and display their status.

The objective of the Type V4 system is to allow well trained and disciplined staff to follow a pre-planned evacuation strategy when the automatic mode needs to be overridden.

Type V5: Engineered systems

Type V5 applies where the application falls outside the scope of Type V1–V4, or wherever a prescriptive solution is either unsatisfactory or where the designers believe that an alternative approach is more suitable. It covers tailored solutions based on the assessment of special or mutable risks.

5.1 Any requirements imposed by enforcing authorities for a VAS should clearly state the type of system required.

5.2 The purchaser of the system should inform the designer of the system as to the type of system that is required (e.g. in purchase or tender specification).

5.3 If the designer has not been informed as to the type of system required, the designer should make clear to the purchaser which type of system that is proposed, prior to an order for the system being placed.

5.4 In each of the situations described in **5.1**, **5.2** and **5.3**, the description of the system should be further amplified by adequate information on the areas of the building that are to be covered by the specific VAS type.

5.5 The system design certificate (see **D.1**) should clearly state the type of system and provide a brief description of the areas of the building that are covered.

6 Exchange of information and responsibilities

*COMMENTARY ON **6***

The purpose of a VAS is to support the fire safety strategy for the building in providing an effective means of alerting and evacuating its occupants. It is, in particular, important that the VAS is based on an agreed building evacuation plan and procedures.

It is advisable that there be relevant consultation between the user or purchaser and the system designer. In a small, simple building, the extent to which such consultation is necessary might be minimal; the user or purchaser might have little knowledge of fire safety principles, and system design can involve little more than determination of the appropriate locations of loudspeakers and microphones. In complex premises, there will be a need for extensive consultation between the user or purchaser, the enforcing authority, the system designer and, possibly, specialist consultants.

The design may be undertaken by the supplier, the installer, representatives of the user or purchaser (including consultants), or by any combination of these parties. It is desirable that, at the contract stage, a single organization takes responsibility for the design of the system, a single organization takes responsibility for the installation work, including compliance with the design, and a single organization takes responsibility for commissioning of the system. One organization may undertake the responsibility for two or all three stages. The responsibility for each of these three stages needs to be clearly defined and documented.

6.1 The system requirements, in particular those relating to the building evacuation procedures, should be ascertained as accurately as possible by consultation between the user or purchaser and other interested parties, such as the enforcing authority and the emergency services.

6.2 If a building contains alarm systems associated with hazards other than fire, the various hazard alarms should be properly coordinated and given distinct messages. In such buildings, the VAS should be arranged so that the higher priority alarm cannot be prevented or masked by one of a lower priority.

NOTE Although, in general, fire is given the highest priority, there are buildings in which other hazards might have higher priorities than fire.

6.3 The user or purchaser of the system (or an appointed representative of these parties, such as a consultant) should ensure that, to the extent appropriate, consultations take place at, or prior to, the system design stage with the authority responsible for enforcing fire safety legislation (e.g. the building control authority, fire authority, Health and Safety Executive).

6.4 The designer of the system should ensure that, to the extent appropriate, consultations take place at the design stage between all relevant interested parties within the following list:

a) the user or purchaser;

b) consultants (including architects, mechanical and electrical consultants, acoustic consultants and fire engineering consultants).

6.5 The installer of the system should ensure that, to the extent appropriate, consultations take place between all relevant interested parties in the following list:

a) the designer;

b) the user or purchaser;

c) the supplier of the system;

d) consultants (including architects, mechanical and electrical consultants, acoustic consultants and fire engineering consultants).

6.6 Before an order is placed for the system, the responsibility for each of the following stages should be clearly defined and documented:

a) system design;

b) installation;

c) commissioning;

d) acceptance;

e) verification.

6.7 One organization should take overall responsibility for the performance of the total system formed by the integration of the VAS and the fire detection and fire alarm system.

7 Variations from the recommendations of this standard

*COMMENTARY ON **7***
The recommendations given in this standard are based on recognized good practice and are suitable for the majority of normal applications.

There will, however, be applications in which the recommendations might be unsuitable and would lead to systems that would be unnecessarily expensive, incorporating measures that could not be regarded as cost-effective, or that could be difficult to install.

In these circumstances, variations from the recommendations might be necessary, even though, in general, the user, purchaser or enforcing authority requires strict compliance with the standard.

This does not, however, imply that the designer or installer is free to ignore the recommendations of this standard under circumstances in which a user, purchaser, enforcing authority or insurer seeks compliance with it.

While it is necessary for certain limitations or performance levels recommended in this standard to be expressed numerically, the values quoted are often approximate and based on well-established and proven custom and practice, or the judgement of experts. While they are generally applicable, rigid adherence to them might not be appropriate in every case, nor is it the case that minor variations need necessarily have any significant effect.

Examples of values include, but are not restricted to, the following:

a) maximum size of open areas in public buildings above which duplication of loudspeaker circuits is recommended;

b) minimum sound pressure levels;

c) minimum intelligibility;

d) minimum duration of standby power supplies;

e) performance parameters for standard and enhanced fire resisting cables, and restrictions on the use of the former type of cable.

For example, in an office building, it might be judged that sound pressure levels of 57 dBA could be accepted in a number of cellular offices, since to achieve the 60 dBA recommended in this standard would necessitate a large increase in the number of loudspeakers (and hence in cost).

7.1 Any variations from this standard incorporated within a specification or design proposal should be clearly identified, so that they are obvious to any party from whom approval of the specification or design proposal may be sought, such as the user, purchaser or enforcing authority.

7.2 Any variations from this standard identified or proposed during installation or commissioning, but not clearly identified in the documented design, should be documented (other than in the case of "snags" for which rectification is proposed) for subsequent approval.

7.3 All variations, whether of the type described in a) or b), should be agreed amongst interested parties (see Clause **6**) and, if necessary, the risk assessement reviewed (see Clause **8**).

NOTE This recommendation is not intended to imply that it is the responsibility of the installer or commissioning engineer to verify or certificate compliance of the system design with this standard. However, if variations are identified by an installer or commissioning engineer, particularly variations related to circumstances that might not have been known to the designer (e.g. structural features of the building that affect intelligibility), they need to be documented for referral to the designer, user or purchaser for agreement or action.

7.4 All variations should be listed in the relevant system certificate (see Clause **37**).

Section 2: Design considerations

8 Relationship between system type and evacuation plan

COMMENTARY ON ***8***

a) Risk assessment

It is important that the design of the VAS is based on the results of a risk assessment such that potential failure to achieve satisfactory results is reduced to reasonable and acceptable levels. In order to obtain practical results, a pragmatic rather than prescriptive approach is recommended. Risk assessment need not be onerous, particularly for small premises.

For larger and more complex buildings a risk assessment needs to focus upon the risks of the specific and varied uses of the building and sub-sections of the building. An example would be an exhibition and conference centre which hosts many and varied activities at different times, each with different levels of occupancy and staffing.

One of the results of such a risk assessment will be an evacuation plan for the building or part of the building. This will govern the degree of manual control required and, thus, the type of the VAS.

The type will be linked to one or more of the following factors:

a) the need for manual intervention;

b) the provision of continuing operator and staff training;

c) the regularity of evacuation drill;

d) the layout and complexity of the building;

e) the density of occupation;

f) the type of occupants, e.g. staff, members of the public, able or disabled, etc.;

g) the need for phased and/or partial evacuation;

h) the likelihood of any hazards, e.g. fire, bomb, nuclear and chemical spillage, civil commotion, etc.

Sound systems used as VASs may be extended in their design and scope to include non-voice alarm functions such as background music, sound re-enforcement or non-emergency paging. As a result, the number of PA zones may be considerably larger than the number of VA zones. However, the voice alarm function needs to take priority without compromise.

b) Selection of type

Type V1 system

A V1 system is used when the VAS is intended to provide automatic staged or immediate evacuation. A V1 system does not provide an emergency microphone but may provide some manual controls for non-fire emergency messages and other facilities such as silencing the fault sounder. The system is reset by silencing the sounder output at the fire detection control panel.

A V1 system may have any number of emergency loudspeaker zones according to the evacuation strategy requirement. It will normally only have an "evacuate" message; however, an "alert" message may be provided if the evacuation strategy calls for it.

Examples of buildings where a V1 system would be used are buildings used as small and medium sized places of assembly, including public houses, shop units, factories, schools, hotels, office blocks, cinemas, bus stations and nightclubs.

NOTE See fire safety risk assessment guidance from the Department of Communities and Local Government[1]*.*

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[1] Available for free download at www.communities.gov.uk

Shops that have V1 systems and are incorporated into shopping centres are often connected to the landlord's system so that messages and live announcements from that system can be heard.

A V1 system may be appropriate where automatic messaging will meet the requirements of the evacuation strategy, without the need for live spoken messages. This might be the case where the provision of live spoken messages is not viable because there is no certainty that staff will be present who are appropriately trained to give the live messages, or management cannot be sure that the correct live message(s) would be given.

Type V2 system

A V2 system is used when, although the voice alarm function is triggered automatically by the fire detection and fire alarm system, the building has an all-call emergency microphone that can be used to make announcements throughout the building. Further all-call emergency microphones may be provided at fire and rescue service access points. A V2 system would not have other manual controls except where there is a facility to silence the fault sounder. The system is reset by silencing the sounder output at the fire detection control panel.

Examples of buildings where a V2 system would be used include:

a) a leisure centre with two emergency loudspeaker zones, "Wet-side" and "Dry-side" where the detection of a fire automatically triggers different simultaneous alert messages in each zone. After a time delay or if the fire is confirmed, the "evacuate" message is broadcast in both zones. A responsible person is able to make announcements in both zones simultaneously using an all-call emergency microphone;

b) an office building with six or more floors and one tenant, where the detection of a fire results in phased evacuation by triggering an evacuate message to the floor of origin and an alert message to all other floors. After a preset delay, the evacuate message "steps" out to the two adjacent floors until the whole building is receiving the evacuate message. An all-call emergency microphone is provided for use by a responsible person to make live emergency broadcast;

c) a multi-screen cinema with several auditoriums, a lobby and staff areas, where the detection of fire automatically triggers an evacuate message to the emergency loudspeaker zone where the fire has been detected and a coded alert to the lobby and staff areas. All other auditorium zones are silent. After a delay, or if the fire is confirmed, the evacuate message is broadcast to all zones. An all-call emergency microphone is provided for use by a responsible person to make live emergency broadcasts;

d) a hotel with six or more floors where the detection of fire results in evacuation of the floor in alarm, the alerting of other floors and the phased evacuation of the rest of the building. An all-call emergency microphone is provided for use by a responsible person to make live emergency broadcasts;

e) a shop, school or other building having one or more evacuation zones, where the detection of fire automatically triggers an evacuate message to the emergency loudspeaker zone where the fire has been detected and a coded alert to staff areas. After a delay or if the fire is confirmed, the evacuate message is broadcast to all zones. An all-call emergency microphone is provided for use by a responsible person to make live emergency broadcasts.

Type V3 system

In buildings which require an emergency microphone and have several emergency loudspeaker zones, such as those with phased evacuation plans, it might be inadvisable to have an all-call emergency microphone facility. In these cases, a V3 system, in which the emergency microphone(s) provides a facility to broadcast to individual zones or groups of zones, is appropriate.

In V3 systems, the emergency microphone(s) would normally be sited in a manned control room. However, there may be a need for further emergency microphones provided at fire brigade access points.

Examples of appropriate applications for a V3 system are:

a) a shopping centre with shops on three levels and an attached three-level car park. The VAS is automatically controlled from a fire detection and fire alarm system to broadcast evacuate and coded alert recorded emergency messages to the emergency loudspeaker zones. The emergency microphone is used by a responsible person to make live announcements to any combination of emergency loudspeaker zones;

b) an office building with six or more floors and several tenants where the detection of a fire results in phased evacuation by triggering an evacuate message to the floor of origin and an alert message to all other floors. After a pre-set delay, the evacuate message "steps" out to the two adjacent floors until the whole building is receiving the evacuate message. A zonal emergency microphone is provided for use by a responsible person to make live emergency broadcast to specific emergency loudspeaker zones;

c) a large multi-screen cinema with several auditoriums, one or more lobbies and staff area. The detection of fire automatically triggers an evacuate message to the emergency loudspeaker zone where the fire has been detected and a coded alert to the lobbies and staff areas. All other auditorium zones are silent. After a delay or if the fire is confirmed, the evacuate message is broadcast to all zones. A zonal emergency microphone is provided for use by a responsible person to make live emergency broadcast to specific emergency loudspeaker zones;

d) a hotel with six or more floors that is integrated into a larger complex, such as a conference centre. Within the hotel, the detection of fire results in evacuation of the floor in alarm, the alerting of other floors and the phased evacuation of the rest of the building. An all call emergency microphone is provided for use by a responsible person to make live emergency broadcast. However, if the landlord's system in the conference centre operates, live announcements may be made for use by a responsible (person in a control room) to individual emergency loudspeaker zones within the hotel;

e) a transport terminal such as a main line railway station that covers a large site where the detection of a fire results in a coded alert message to all emergency loudspeaker zones. After a pre-set delay, or if the fire is confirmed, the evacuate message operates in the desired zones and then, after a further delay, "steps" out to further zones or until the whole building is receiving the evacuate message. A zonal emergency microphone is provided for use by a responsible person to make live emergency broadcast to specific emergency loudspeaker zones;

f) a sports stadium where, for crowd control reasons, it is advisable that emergency announcements are made to specific areas whilst music and commentary continue in other areas.

Other examples include any system that could be V2 but where the risk is such that live announcements to specific areas are desirable.

Type V4 system

In certain circumstances it might be necessary that, to supplement automatic operation by the fire detection and fire alarm system, the evacuation of a building be escalated by manual intervention. In such case a V4 system, in which manual controls are provided for the broadcast of pre-recorded evacuate and alert messages, would be appropriate.

In V4 systems, the control panel enabling manual intervention would be located in a dedicated control room. However, there may be a need for further emergency microphones to be provided at fire brigade access points.

Examples of appropriate applications for a V4 system are:

a) a high-rise office building let to several tenants with variable level of occupancy requiring a flexible evacuation strategy. This might comprise 20 floor zones and 4 stair well zones, making 24 emergency loudspeaker zones in total. The VAS would be required to trigger phased evacuation by broadcasting an evacuate message to the floor of origin, the floor above and alert messages to all others zones. The building would have a manned dedicated control room located on *the ground floor that enables authorized and trained personnel to broadcast any pre-recorded messages;*

b) *a large industrial complex, such as a pharmaceutical plant, where automatic messages (and tones) might have to be overridden manually in the light of unforeseen problems. The site would have a manned dedicated control room that enables authorized and trained personnel to broadcast any pre-recorded message or tone to any combination of zones;*

c) *a large transport terminal such as an airport, where automatic messages may have to be overridden manually especially where serious security considerations exist. The building would have a manned dedicated control room that enables authorized and trained personnel to broadcast any pre-recorded message to any combination of zones.*

Type V5 system

The complexity of certain buildings, combined with the dramatic change of occupancy levels and operational requirements, is likely to require a solution to the evacuation strategy not covered by systems V1 to V4. In such cases, a V5 system would be appropriate.

V5 systems, unlike the other categories, might include a facility to isolate the VAS from the fire detection and fire alarm system. This may be particularly appropriate during periods where crowd control is a prime concern.

A V5 system may include subsystems of other categories that are normally autonomous but may be controlled to some extent by the V5 system.

An example of an appropriate application for a V5 system is a building capable of hosting several thousands of people, such as exhibition centres, sport venues and congress centres where the result of an "all call" broadcast is likely to cause fatalities rather than avert them.

8.1 An assessment of the "risk rating" should be conducted in order to determine the most appropriate evacuation plan. This assessment should take into account occupancy factors, the nature of the building and the extent of the life safety risk involved. The type of VAS to be used should be determined from this evacuation plan.

8.2 The results of such an assessment and the evacuation plan together with the selected system type should be agreed by all interested parties and included in all system documentation.

8.3 Any specification for a V5 system should include a description of the objective of the evacuation plan chosen and how this is achieved by the proposed system.

8.4 Where a V1 system is installed in shop units in a shopping centre, they should be linked to the landlord's system such that automatic or live announcements override the locally generated messages if appropriate to the evacuation strategy.

9 Interface between the fire detection and fire alarm system and the VAS

*COMMENTARY ON **9***
The link between the fire detection and fire alarm system and the VAS is of vital importance to maintain the integrity of overall operation.

It is important that alarm messages which have been initiated by the fire detection and fire alarm system continue to be broadcast even in the event of a subsequent fault in the interconnecting link between the two systems. It might be desirable on larger systems, where distributed control equipment is used, to provide a link at more than one control equipment location rather than to rely on a central location.

However, in complex installations it might be possible for networked fire detection and fire alarm systems in a fault condition to issue conflicting information, particularly when the cause and effect program is partially held in the VAS. It is important that *the consequences of such fault be carefully analysed at the design stage and measures taken to mitigate them.*

To maintain the integrity of the fire alarm interface it is important that the wiring be arranged such that a single fault on the wiring does not disable the interface between the fire detection and fire alarm system and the VAS. This can be achieved as follows:

a) with a single set of loop driven interface unit(s) protected against short circuits directly connected and adjacent to the VACIE; or

b) by using two diversely routed cables connected in such a way that a fault on one does not cause an alarm signal to fail to be received.

In some systems, the VACIE and CIE may be combined in one cabinet with access restricted to authorized persons. In such cases it is not necessary to duplicate or protect the link between the two systems.

To ensure the earliest possible broadcast of emergency messages it is important that the interface with the fire detection and fire alarm system does not add any significant delays to those recommended in BS 5839-1 between the initiation of a fire alarm and activation of fire alarm devices.

In complex buildings where activation of an evacuate or alert signal can be manually initiated at the VACIE, it might be appropriate for such actions to be indicated at any central fire detection and fire alarm control and indicating equipment (CIE).

If an emergency broadcast has been initiated automatically or manually from the fire detection and fire alarm system, it might cause confusion if it were cancelled from the VA system. It is therefore preferable that any emergency broadcast initiated from the fire detection and fire alarm system continues, unless it is overridden by a higher priority broadcast initiated from the fire detection and fire alarm system or manually from the VA system, or it is cancelled at the fire detection and fire alarm system.

9.1 A short circuit or disconnection of the link(s) between the fire detection and fire alarm system and the VAS should be indicated at the fire detection and fire alarm system CIE.

9.2 The interlinking cable(s) between the fire detection and fire alarm system and the VAS should be protected against fire and mechanical damage (see Clause **27**) and should, where practicable, pass through areas of low fire risk.

9.3 The fire alarm interface wiring should be arranged such that a single fault on the wiring cannot disable any part of the interface between the fire detection and fire alarm system and the VAS, unless both the fire detection and fire alarm system CIE and the VACIE are separated by less than 10 m and located in the same area of low fire risk.

9.4 If communication between the fire detection and fire alarm system and the VAS is achieved via the fire detection circuit, then the removal of any detector(s) should not inhibit the operation of the VAS. A single fault on a fire detection circuit should not affect communication with the VAS.

9.5 Where multiple links exist between networked fire detection and fire alarm systems and VASs, the system should be designed such that faults do not cause conflicting commands to the VAS.

9.6 The silencing and resetting of messages initiated by the fire detection and fire alarm system should only be possible via a unique instruction from the fire detection and fire alarm system CIE, and not simply by removal of the triggering signal(s).

NOTE For example, a remote silencing facility might be located in close proximity to the VACIE.

10 Systems in explosive gas or dust atmospheres

*COMMENTARY ON **10***
If it is necessary to install voice alarm equipment or wiring in areas where an explosive atmosphere could result from the presence of flammable gases, vapours or mists, or the presence of combustible dusts, special protection measures are essential to ensure that the potential for ignition of the atmosphere by the voice alarm equipment or wiring is minimized.

10.1 Any systems (or part of a system) protecting an area, or with cables passing through an area, in which there may be an explosive gas, vapour or mist atmosphere should conform to BS EN 60079-14.

10.2 Any systems (or part of a system) protecting an area, or with cables passing through an area, in which there may be an explosive dust atmosphere should conform to BS EN 61241-14 and BS EN 61241-17.

11 System components

*COMMENTARY ON **11***
The reliability of the system to perform its functions on demand is, to a significant degree, governed by the reliability of individual components.

In general, it is advisable that all components of the VAS, such as the CIE, loudspeakers and visual alarms, conform to the relevant British Standards.

It is advisable to use components having certification under a recognized product certification scheme (comprising third party certification of product conformity against a relevant standard, based on testing and continuing surveillance, together with assessment of the manufacturer's quality assurance systems to BS EN ISO 9001).

Compatibility of VAS components, e.g. microphones, amplifiers, loudspeakers and interconnecting cables, is essential to achieve an effective broadcast message. Particular care needs to be taken to ensure compatibility with cable parameters, such as capacitance, which can adversely affect signal characteristics.

11.1 The CIE of the VAS, including associated microphones, should conform to BS EN 54-16.

NOTE BS EN 54-16 requires that the power supply equipment conforms to BS EN 54-4.

11.2 Loudspeakers should conform to BS EN 54-24.

11.3 Other audible fire alarm devices such as voice sounders should conform to BS EN 54-3.

11.4 Visual alarm devices should conform to BS EN 54-23.

11.5 Radio-linked components and systems should conform to BS EN 54-25.

11.6 The system provider should check the compatibility of all system components.

12 Monitoring, integrity and reliability of circuits external to the VACIE

*COMMENTARY ON **12***
External circuits need to be arranged such that the probability of faults that could prevent the system from giving a fire warning is minimized. Work on the system, for the purpose of modification, repair or routine attention, might also cause an impairment of the system to operate as designed in the event of fire.

Measures are incorporated within this standard to limit the probability of impairments, whether as a result of faults or work on the system, and to limit the duration of any *impairment. For example, the wiring of all critical signal paths is protected against mechanical damage and damage by fire, and signal paths are monitored throughout the VAS to give confidence that it is operational and that critical faults are identified quickly. Compliance with the recommendations for maintenance arrangements ensures that any such fault is quickly repaired. The probability that a fault will exist at the time of a fire is, therefore, considered to be extremely low. In the event of fire, loss of integrity of wiring during the period required for evacuation is unlikely to occur in view of the recommendations of this standard for the fire resistance of cables.*

Consequently, the use of a single circuit per emergency loudspeaker zone throughout a building is generally sufficient to achieve the objective outlined above as, if fire damages one circuit, it is also likely to damage any other circuit in the same area. In a small building served by a single loudspeaker circuit, additional measures will be necessary to ensure that, if this single circuit fails during a fire, at least one loudspeaker (e.g. on a separate circuit) continues to operate.

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 might be such that the provision of multiple loudspeaker circuits within a loudspeaker zone is justified. Examples include:

a) transport terminal concourses;

b) mall areas of covered shopping complexes;

c) public areas such as: cinemas, theatres and other places of entertainment, large department stores, leisure centres and sports venues.

Even if multiple loudspeaker circuits are provided in large public spaces it is not generally necessary to provide them in small cellular spaces and non-public areas of such buildings. In areas where multiple loudspeaker circuits are installed, the intention in the event of failure of one circuit would be to maintain a level of audibility and intelligibility, albeit at a reduced level.

12.1 Fault monitoring

12.1.1 All fault monitoring, except that for the secondary supply, should continue under conditions of failure of the primary power supply.

12.1.2 A fault indication should be given at the CIE within 100 s of the occurrence of a fault, regardless of whether the VAS is being used for a non-emergency purpose (e.g. the broadcast of background music), for any of the following conditions:

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

b) failure of an emergency microphone including associated control signal paths and the wiring up to the microphone capsule;

c) rupture of any fuses or operation of automatic circuit breaker, isolator or protective devices within the critical signal path that may prevent an emergency broadcast;

d) failure of the transmission paths between components of a distributed system;

e) failure of any part of the ambient noise sensing and compensation controller (ANS) control system, if fitted, including ANS microphones and their associated cables.

NOTE 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.

12.1.3 A fault indication should be given at the CIE, within the times indicated below, and regardless of whether the VAS is being used for a non-emergency purpose (e.g. the broadcast of background music), in the event of any of the following:

a) failure of the main power supply to any part of the system (within 30 min of occurrence);

b) failure of the standby power supply (within 15 min of occurrence);

NOTE 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) failure of the battery charger (within 30 min of occurrence);

d) reduction of the battery voltage to less than the voltage specified in BS EN 54-4 at which a fault warning should be given (within 30 min of occurrence).

12.1.4 Where the standby power supply comprises a number of batteries connected in parallel, the fault indication should be given in the event of disconnection of any one battery or short circuit of a single cell within a battery (within 15 min of occurrence).

12.2 System integrity

12.2.1 A fault on one circuit should not affect any other circuits.

12.2.2 In the event of a single open circuit or short circuit fault in any loudspeaker circuit, at least one loudspeaker, normally located in the vicinity of the control and indicating equipment, should be able to broadcast the emergency message if a fire alarm condition occurs anywhere within the building.

12.2.3 In buildings designed to accommodate the general public in large numbers, multiple loudspeaker circuits should be provided in any uncompartmented public spaces of such buildings if the space is either:

a) greater than 4 000 m^2 in area; or

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

The loudspeakers should be evenly distributed and either the circuits should be interleaved such that adjacent loudspeakers are on different circuits or alternative means, e.g. a protected loop circuit, should be used. Not more than half the loudspeakers' coverage in that area should be lost in the event of a single open or short circuit fault.

12.2.4 Where multiple loudspeaker circuits are used, the circuits should not be contained within a common cable sheath.

NOTE For example, if two circuits are served by a common four core cable this would not adequately protect against loss of both circuits due to fire or mechanical damage.

12.2.5 If the voice alarm CIE is powered by power supply equipment contained in a separate enclosure, the connections between the equipment should be duplicated such that a single open or short circuit in the connections does not completely remove power from the voice alarm CIE. The duplicated cables should be separated by at least 300 mm where practicable. Where a power supply unit or a standby battery(ies) are housed in a separate enclosure from the CIE, any cable between that enclosure and the VACIE should be suitably protected against overcurrent in accordance with BS 7671.

NOTE Where the enclosure is located immediately adjacent to, and in contact with, the VACIE, such that cables run directly between the enclosure and the VACIE, the enclosure need not be regarded as separate from the VACIE; the recommendations of this subclause do not then apply.

13 Loudspeaker zones

*COMMENTARY ON **13***
Effective evacuation of the building depends on the correct design of emergency loudspeaker zones. For example, the simultaneous broadcast of different messages (e.g. alert and evacuate) in the same acoustic space will cause confusion and misinterpretation.

In many buildings, the evacuation strategy is very simple: on receipt of a signal from the fire detection and fire alarm system or by use of an emergency microphone, an emergency message is given throughout the building to indicate the need for evacuation.

In more complex buildings, it is necessary to subdivide the building into a number of emergency loudspeaker zones. Emergency loudspeaker zones are not necessarily the same as other zones such as PA zones or fire detection zones.

13.1 There should be no conflict between the boundaries of fire detection zones and emergency loudspeaker zones. No fire detection zone should contain more than one emergency loudspeaker zone.

NOTE A number of fire detection zones may be contained within a single emergency loudspeaker zone.

13.2 The boundaries of every emergency loudspeaker zone (other than external walls) should comprise fire-resisting construction.

NOTE In some complex public buildings, such as shopping centres, emergency loudspeaker zones are designed to coincide with smoke control zones which are separated from each other by smoke curtains rather than fire resisting construction.

13.3 To aid acoustic separation between emergency loudspeaker zones, their boundaries should, where possible, coincide with walls, permanent partitions or doors.

NOTE 1 This is particularly necessary if two adjacent zones can broadcast different messages simultaneously.

NOTE 2 In systems that have more than one emergency loudspeaker zone adjacent to a staircase, that staircase is normally a separate emergency loudspeaker zone.

13.4 While an emergency loudspeaker zone may include more than one detection zone (but not vice versa), the boundaries of emergency loudspeaker zones should coincide with the boundaries of the relevant detection zone(s).

13.5 The user or purchaser should ensure that, where appropriate, the configuration of emergency loudspeaker zones and the cause and effects controlling emergency messages are approved by the relevant enforcing authorities.

14 Loudspeakers

*COMMENTARY ON **14***
There are several ways of providing intelligible coverage for any particular space. The selection of the type, number, location and orientation of loudspeakers is a critical part of VAS design and is based on information including:

a) acoustic environment, such as:
   - *floor plans;*
   - *building sections;*
   - *finishes;*
   - *RT;*

b) ambient noise level;

c) climatic environment;

d) area coverage requirement;

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

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 commentary, background music, etc.;*

h) *interrelationship between loudspeaker zones and fire compartments;*

i) *requirements for potentially explosive atmospheres;*

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

In simple acoustic spaces, a competent person can estimate types, quantities and locations of loudspeakers required, using the above information.

In the case of acoustically difficult spaces or large spaces used for public entertainment, a computer simulation can predict the types and locations of loudspeakers necessary to meet the intelligibility requirements.

To obtain the required intelligibility, it is important that the type, orientation and location of loudspeakers is not compromised by equipment installed by other trades or by aesthetic considerations. For example, air conditioning plant might take up so much space that the loudspeakers have to be relocated.

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, which might prevent an emergency message from being broadcast elsewhere in the building.

14.1 The selection of the types, quantities and locations of loudspeakers should be based on relevant information regarding the a.d.a. and should be carried out by a competent person.

14.2 Where the a.d.a. is a simple acoustic space satisfying the following conditions:

a) average reverberation time across 500 Hz, 1 kHz and 2 kHz octave bands is not greater than 1.3 s;

b) reference ambient noise level is less than 65 dBA;

c) sound pressure level of voice messages is greater than 75 dBA_{Leq}, measured over a period of not less than 10 s or the emergency message length whichever is longer,

loudspeaker placement should satisfy the following:

1) the distance between the centres of loudspeakers is not greater than:
   i) 6 m for unidirectional loudspeakers; and
   ii) 12 m for bi-directional loudspeakers.
2) the unobstructed distance between a loudspeaker and any listener is not greater than:
   i) 6 m for unidirectional loudspeakers; and
   ii) 7.5 m for bi-directional loudspeakers.

14.3 Loudspeakers should be chosen primarily for their ability to produce an intelligible result rather than for aesthetic considerations such as size or appearance.

14.4 The response of loudspeakers should not be compromised by their immediate surroundings, for example:

a) rear enclosures of insufficient volume or absorption;

b) grilles with insufficient open air holes;

c) coves or dropped ceilings such that they cannot directly radiate to the listening space.

14.5 To prevent the location of ceiling mounted loudspeakers being compromised by installation from other trades, representatives of the involved trades should be consulted during the design stage.

14.6 Where the failure of the loudspeaker primary fixings might result in damage or injury, consideration should be given to the provision of secondary safety fixings. These secondary fixings should be secured to the main mass of the loudspeaker.

14.7 Loudspeakers used should not comprise materials that could fail in the environment prevalent in the location of operation, e.g. in extreme heat, or should be treated so as to eliminate the risk.

14.8 In order to prevent inadvertent contact with live parts or damage by falling objects, flush-mounted ceiling loudspeakers should be fitted with rear covers. These covers should be constructed from non-combustible material with a melting point of at least 850 °C in order to provide additional protection for the cable terminations. The rear cover should be chosen such that it does not significantly change the electro-acoustic properties of the loudspeaker.

NOTE The rear cover need not be completely sealed unless the ceiling forms part of a fire-resisting barrier.

14.9 Suitable design measures should be taken to minimize the likelihood of a short circuit occurring directly at a loudspeaker terminal block under fire conditions. Such measures include, for example:

a) using terminal blocks capable of withstanding a similar temperature for a similar duration to that of the interconnecting cable used;

   NOTE For example, terminal blocks constructed from ceramic materials are normally suitable.

b) using terminal blocks with a lower temperature resistance but protected with thermal insulation to achieve the same level of protection as a);

c) designing terminal blocks such that, on melting, an open circuit or a short circuit does not occur;

d) using a thermal fuse to isolate the short circuit from the external loudspeaker circuit under local fire conditions.

15 Voice sounders

*COMMENTARY ON **15***
A voice sounder is an audible fire alarm device that contains all the necessary components, except normally a power supply, to generate and broadcast recorded voice messages. Voice sounders cannot normally be used to broadcast non-life-safety material, limiting their use to dedicated VASs.

Voice sounders cannot normally be used to broadcast live speech. This limits their application to Type V1 systems.

Voice sounders are generally suitable for use in small rooms with low background noise and little reverberation such as offices and hotel bedrooms. They are unlikely to be suitable for applications with significant background noise or reverberation such as shopping malls, gymnasiums, airport concourses or railway stations.

It is common to install voice sounders on walls in a similar manner and at a similar spacing to normal fire alarm sounders but this often affects intelligibility, especially in larger rooms. In spaces such as open-plan offices, the intelligibility achieved from wall-mounted voice sounders might not be acceptable and it might be necessary to install voice sounders on the ceilings in order to achieve even coverage.

In some applications, such as public houses, voice sounders may be used in public areas with fire alarm sounders used in staff areas.

15.1 The quantity and locations of voice sounders should be determined as recommended for loudspeakers (see **14.1**).

15.2 Voice sounders should be capable of producing an audible attention-drawing signal and a broadcast message or messages.

15.3 The level and frequency range of the attention-drawing signal should conform to BS 5839-1:2013, **16.2.1**.

15.4 All voice alarm sounders within a building should have an attention-drawing signal with similar characteristics, unless particular conditions, such as an area of high background noise, make this impractical.

15.5 If voice sounders are used in conjunction with fire alarm sounders or a VAS, they should have attention-drawing signals with similar characteristics. Care should be taken to ensure that the intelligibility of the voice messages is not reduced by the fire alarm sounders.

15.6 Messages should be recorded in accordance with **20.6**.

15.7 Where several voice sounders are installed in the same space, they should be synchronized, and they should not drift out of synchronization by more than 0.05 s over a 30 min period.

NOTE This might involve additional wiring.

16 Power amplifiers

*COMMENTARY ON **16***
Power amplifiers designed and built in accordance with BS EN 54-16 afford a high degree of reliability and, when properly installed and maintained, are not expected to fail. Therefore, it is, in most cases, considered unnecessary to make provision for the consequences of an amplifier failure, e.g. standby amplifier, redundant amplifier.

However, in some applications, a risk assessment might show a need for further reducing the effect of an amplifier failure. This can be achieved in a number of ways, e.g. providing standby amplification or additional amplifiers each serving a smaller number of loudspeakers.

In order to make provision for the changes to loudspeaker circuits that are often made to achieve the intelligibility required by this standard, and which often increase the applied loading, it is good practice to design the loudspeaker circuit load below the amplifier's rated power output.

It is important that amplifiers have sufficient frequency response for the system to achieve acceptable intelligibility in a given acoustic environment. For example, increasing the high frequency response beyond the minimum specified in BS EN 54-16 might be necessary to achieve acceptable intelligibility in a difficult acoustic environment.

16.1 If the risk assessment shows that standby amplifier(s) are necessary, the following arrangements should be considered:

a) automatically replacing the failed amplifier with a standby amplifier of at least the same power rating;

b) automatically disconnecting the failed amplifier from the circuit and using the power from paralleled amplifiers to meet the load requirement for the affected loudspeaker circuit(s);

*NOTE Other arrangements might be possible. Where the VAS 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 might not be necessary, subject to the agreement of the interested parties (see Clause **6**).*

16.2 All standby amplifiers (see **16.1**), including those intended for manual substitution, should be kept in a powered up state and be continuously monitored.

16.3 As an alternative to the recommendations of **16.1**, the use of more amplifiers for a larger number of loudspeaker circuits may be considered, in which case the electro-acoustic system should be designed so that failure of an amplifier does not result in a failure of intelligibility.

16.4 The amplifier's rated power output should be at least 20% greater than the initial design for the loudspeaker load.

16.5 In order to achieve acceptable intelligibility in most acoustic environments, the –3 dB frequency response of the amplifier, including any output transformer, should be at least 200 Hz to 8 kHz.

17 Ambient noise sensing and compensation controller (ANS)

*COMMENTARY ON **17***
In certain buildings it might be appropriate to use an ANS controller to adjust the volume of the sound system according to the amount of ambient noise at any particular time. ANS controllers can be used to advantage in spaces that can be subject to significant variation in ambient noise levels, for example airport and railway concourses. Generally an ANS controller is not essential for emergency broadcasts; however its use might reduce unwanted broadcast overspill to an adjacent zone(s) and subsequently improve intelligibility in partially occupied highly reverberant spaces. ANS control may be used to ensure a comfortable intelligible listening level and reduce the annoyance factor to occupants or local residents.

Because ANS controllers operate by analysing ambient noise in order to achieve the required performance, great care and considerable time is normally needed to set the operational parameters during the commissioning process. Further adjustments are likely to be required under operational conditions.

*VA systems with an ANS controller use a sensor (usually a microphone) sited in the associated loudspeaker zone such that a representative sample of the ambient noise is received. The output of the sensor is used to adjust the broadcast level to be at least 10 dB above ambient noise (see Clause **22**).*

It is important that the dynamic range, sensor sensitivity and response time of the ANS controllers can be adjusted and pre-set during commissioning.

17.1 The ANS controller should fail-safe so that, in the event of failure, emergency broadcasts revert to the commissioned or operational maximum level.

17.2 The ANS sensor should be housed such that it has an IP rating to suit the installed environment.

17.3 The ANS sensor should be clearly labelled with the words "VOICE ALARM".

17.4 The cable between the ANS sensor and the VA system should be protected against fire and mechanical damage (see Clause **27**).

18 Emergency microphones

*COMMENTARY ON **18***
BS EN 54-16 places a minimum requirement on the overall VA system frequency limits and, since the microphone is the first element within a sound system, it is important that its response falls easily within the required frequency limits of BS EN 54-16 so as to be able to take account of other system limitations, especially those of the loudspeakers and of areas with different acoustic characteristics.

Except in V1 systems, emergency microphones are provided as a means of ongoing control of evacuation by the building management or the fire and rescue service.

The location of any emergency microphone(s) is important. For example, the fire and rescue service would expect to find an emergency microphone located at the fire detection and fire alarm system control panel intended for their use. It is also important to ensure that messages broadcast from emergency microphones are of adequate intelligibility, and not unduly affected by interference from background noise, reverberation, feedback, etc.

Intelligible broadcasts require the talker to provide sufficient and consistent sound pressure level at the microphone. Whilst electronic processing is useful to establish the optimum level to the rest of the system, visual indication that is unambiguously labelled (e.g. too quiet, correct, too loud) is of great benefit. This could take the form of an electro-mechanical or bar graph. At the same location, a warning indicator that the announcer ought to wait whilst the pre-announcement tone is being broadcast can often be of assistance.

Emergency microphones might either be dedicated purely to the broadcast of emergency messages or, with appropriate precautions against incorrect use, be used for non-emergency functions.

18.1 The emergency microphone should include the following electrical characteristics:

a) frequency response (at the recommended attitude to the mouth of the talker) of 200 Hz to 5 kHz ±3 dB;

b) means to minimize distortion from overloads;

NOTE This could, for example, be compression circuitry.

c) means to ensure that emergency microphone(s) override all other audio sources [see **23.1**a)].

d) means to ensure that only one emergency microphone is active at any one time [BS EN 54-16:2008, Clause **12**d)].

18.2 The emergency microphone should include the following mechanical features:

a) means, such as a pop filter, to prevent plosives causing distortion;

b) means, such as air vents, to create an acoustic gain in the direction of the mouth;

NOTE 1 Examples of directional microphones include cardioid, super-cardioid and noise cancelling types.

c) shock/vibration isolating mountings to reduce any mechanically borne sound;

d) means to allow the mouth to microphone distance to be as consistent as possible.

NOTE 2 For hand-held microphones, devices such as lip-guards enable the talker to achieve the optimum microphone to mouth distance whilst speaking and thus ensure uniformity of input signal.

18.3 A pictogram should be placed immediately adjacent to the microphone showing clearly the optimum speaker to microphone distance (see Figure 1 and Figure 2).

Figure 1 **Example of pictogram for a standard microphone to mouth distance**

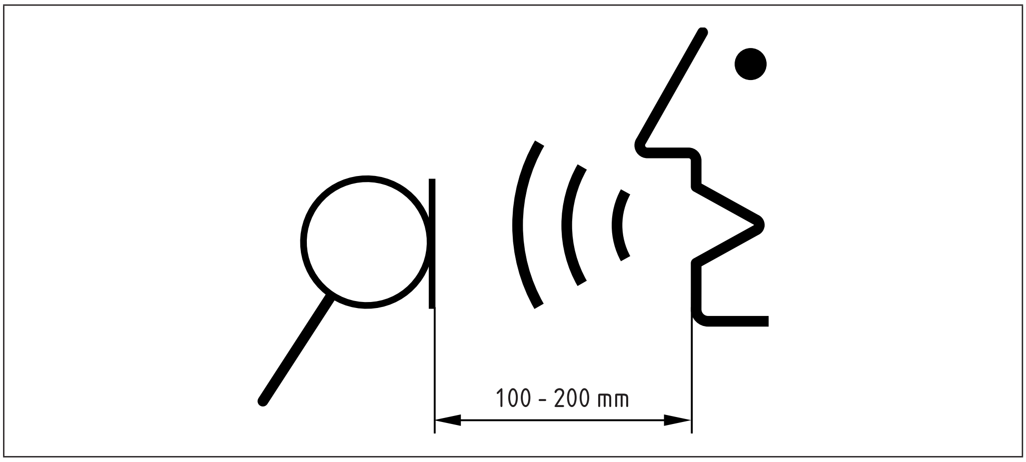
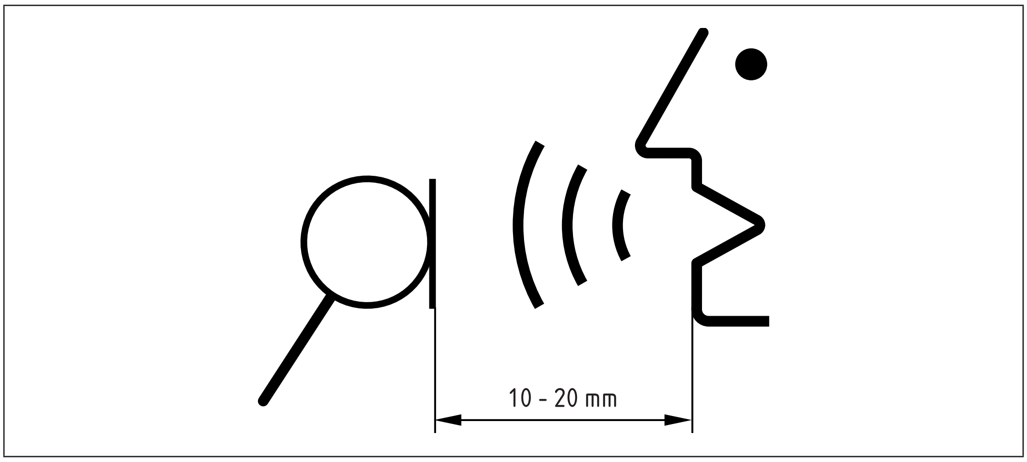


Figure 2 **Example of pictogram for a close-talking microphone to mouth distance**



18.4 The proposed location of emergency microphones should be assessed in order to optimize the intelligibility of the broadcast, covering:

a) typical ambient noise (e.g. the microphone might be in a security hut near a busy road or in an area close to noisy machinery);

b) untypical ambient noise (e.g. a control room where during an emergency there is an increase in the ambient noise due to direct communication between other people or indirect communication such as the base station of a radio system);

c) reverberance of the space.

NOTE The adverse effects of ambient noise and reverberation may be minimized by introducing acoustic absorption in the immediate environment of an emergency microphone by means of an acoustic hood, booth or similar device.

18.5 The emergency microphone should be either:

a) dedicated 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 cabinet; or

b) used for both emergency and non-emergency purposes, in which case means should be provided to prevent non-emergency broadcast from overriding a pre-recorded emergency broadcast.

18.6 Emergency microphones and their associated manual control facilities should be sited at suitable locations where both staff and firefighters can manage an emergency situation. Controls for emergency microphones should be accessible at access level 2 (as defined in BS EN 54-16). There should be consultation between the user or purchaser (or others acting on their behalf) and the fire and rescue services to agree suitable siting.

18.7 Where an emergency microphone is installed in a public place, it should not be possible for it to be easily operated by a member of the public.

18.8 In premises in multiple occupation with communal parts, the emergency microphones and associated controls, if fitted, should be located within a communal area, such as an entrance hall. Where no communal parts exist, this equipment should be sited in an area to which access is possible at all times that the premises are generally occupied.

18.9 If audible fault warnings are available at emergency microphones, there should be a facility to silence them manually or automatically whilst announcements are made.

19 Emergency message generators

*COMMENTARY ON **19***
A VAS relies on the ability to broadcast pre-recorded emergency messages on demand, therefore the reliability and integrity of the associated message generators is important. To this end, solid state electronic memory (e.g. flash memory) is better suited for this application. Memory with moving mechanical moving parts is not considered to be sufficiently reliable, e.g. tape or disk drives.

Intelligibility requires that the messages have the necessary frequency response, signal-to-noise ratio and lack of distortion and therefore the message generators need to provide the appropriate audio performance.

19.1 The message generator should have the following minimum audio specification:

a) frequency response: –3 dB from 200 Hz to 8 kHz;

b) signal-to-noise ratio: 60 dB;

c) THD: 0.5% at 1 kHz at –1 dB from maximum level.

19.2 Recordings should be stored in non-volatile memory, with a data retention of at least 10 years, and should be protected from unauthorized changes.

19.3 Message generators should be continuously monitored (see BS EN 54-16).

19.4 Message generators should not use moving mechanical parts.

20 Emergency messages

*COMMENTARY ON **20***
Broadcast emergency messages need to be immediately recognized as such and appropriate action taken urgently by listeners. It is therefore important that measures are taken to draw attention to that urgency. This could take the form of an attention-drawing signal. Care needs to be taken that this attention-drawing signal does not encourage panic, yet draws the attention of the listener to the message which follows.

It is essential that messages are intelligible. Training is necessary for those delivering live broadcast messages, particularly in the correct use of the microphone. With purposeful intonation, a message can help to convey the desired sense of urgency or, alternatively, provide a calming influence. In certain circumstances, for example where there is a chance that two different messages might be heard at the same time, a different voice, e.g. male instead of female, might be used.

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 beneficial to repeat messages in different languages. However, care needs to be taken that the order and the number of repeat broadcasts given in each language are appropriate for the building.

The duration, format and wording of an emergency message are also important. If the message is too long, listeners might not take in all the details and may await repeats. If the message is too short, it might not convey sufficient information. Also, if the time gaps between repeats of a message are too short, listeners might not realize that the message has ended; conversely, if the gap is too long, listeners' safety could be put at risk while they await a repeat message for clarification.

The intelligibility of the message will depend on the amount of reverberation in the part of the building where it is broadcast. A high amount of reverberation will require a slower speed of delivery of the message.

In a VAS, in addition to the evacuate and alert alarms referred to in BS 5839-1, coded messages might be broadcast as part of a staff alarm arrangement, as well as various announcements relating to system testing. Test messages might also be provided to allow VASs to be tested without unnecessarily disturbing or alarming the occupants of the building. It is important that the content of messages, particularly emergency messages, is as consistent as possible between installations.

20.1 Every emergency message should be preceded by an attention-drawing signal. This should be a non-speech signal in the frequency range 500 Hz to 1 kHz. The characteristics of the attention-drawing signal should be agreed between the building operator and the relevant parties (see Clause **6**).

20.2 The message should be clear and concise, and delivered in a calm and authoritative manner. Consideration should also be given to repetition in order to reinforce the message.

20.3 The speed of delivery of the message should take into account the acoustic characteristics of the most reverberant part of the building.

20.4 The need for broadcast of messages in different languages and sequencing of broadcast should be agreed with relevant parties.

20.5 Live voice messages should only be broadcast by operators trained in the proper use of microphones. The operator should broadcast agreed standard messages, reading from a readily available and durable script, except where a fire officer or trained person in authority needs to make special announcements. Live voice emergency messages should be preceded by a pre-announcement tone.

20.6 The recordings of emergency pre-recorded messages should be made in a recording studio or a room with a controlled acoustic environment by an experienced announcer. A synthesized voice should not be used unless the resultant broadcast is equivalent to that of a human voice.

20.7 Pre-recorded emergency broadcasts should be as follows.

a) In time sequence, from start to finish, the format of an evacuate broadcast should be as described in Figure 3.

Figure 3 **Evacuate broadcast sequence**

Attention-drawing signal – lasting 2 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

The periods of silence may be longer than indicated in certain circumstances, for example in spaces with long RTs, but should be such that the time between the start of each repeated message is less than 30 s.

The sequence should be repeated continuously until manually silenced.

NOTE 1 Example of an evacuate message:

"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."

NOTE 2 The use of a single, common evacuate message in a building is recommended but, in special circumstances, e.g. where means of escape vary considerably throughout the building, or where phased evacuation is employed, a variety of messages may be used.

b) In time sequence, from start to finish, the format of an alert broadcast should be as described in Figure 4.

Figure 4 **Alert broadcast sequence**

Attention-drawing signal – lasting 2 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

The periods of silence might need to be longer than indicated in certain circumstances, for example in spaces with long RTs, but should be such that the time between the start of each repeated message is less than 45 s.

This sequence should, if pre-recorded and broadcast automatically, be repeated at least twice initially. Thereafter, it should be repeated at intervals of not greater than 3 min, but the actual time intervals should be agreed with the fire officer, the user and other interested parties.

The sequence should continue until manually silenced or until superseded, manually or automatically, by an evacuate broadcast or by a "2nd sequence" alert broadcast (see Note 4).

NOTE 3 Example of an alert message, where sequenced alert messages are not needed:

"May I have your attention, please?

May I have your attention, please?

Fire has been reported in the building.

Please listen for further instructions."

NOTE 4 In certain circumstances, for example in multi-storey buildings, it might be desirable to have two stages of alert broadcast, often referred to as "1st sequence" and "2nd sequence" messages.

Example of a "1st sequence" alert message:

"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."

Example of a "2nd sequence" alert message:

"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."

c) If a coded alert broadcast (see Note 5) is to be used, its content and repetition frequency should be agreed with the fire officer, the user and other interested parties. Coded alert broadcasts should continue until manually silenced or until superseded, manually or automatically, by an evacuate broadcast or by an appropriate alert broadcast.

NOTE 5 Unlike the alert broadcast, which is intended to be understood and acted upon by all the building occupants, a coded alert broadcast (which might 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 are usually similar to:*

"Attention please! Will Mr Frost ring 123?";

or

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

20.8 Where announcements to precede and follow fire alarm tests [see **40.1**a)] are provided (known as test messages), the wording should be such as to allow the fire detection and fire alarm system to be tested without unnecessarily disturbing or alarming the occupants of the building.

NOTE 1 Example of a test message to precede a fire alarm test:

"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."

NOTE 2 Example of a test message to follow the fire alarm test:

"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 cooperation."

*NOTE 3 The use of test messages is not sufficient for the recommended weekly testing of the whole of the fire detection and fire alarm and voice alarm systems (see **40.1**).*

*NOTE 4 Audio system test messages may be used to check the operation of the audio system during routine maintenance (see Clause **40**) and do not include the broadcast of fire warnings. An example of such a message would be: "This is a test of the public address system."*

21 Audibility of non-speech broadcast

*COMMENTARY ON **21***
Attention-drawing signals preceding emergency speech messages need to be audible to fulfil their purpose. In some systems, the emergency broadcast messages may be non-speech, again requiring an acceptable audibility level.

It is essential that the audibility of alarm signals is sufficient to warn all persons for whom the alarm signals are intended. In buildings where people sleep, alarm audibility needs to be sufficient to rouse them from sleep.

Particular care needs to be taken to ensure adequate sound pressure levels in small spaces, such as cellular offices, toilets and plant rooms. However, in small enclosed spaces, such as offices and stairways, it has been found that audibility does not generally need to be quite as high as in open areas.

21.1 The sound pressure level of the attention-drawing signal and of a non-speech alarm broadcast should be:

a) generally, throughout all accessible areas of the building (other than in enclosures of less than 1 m^2), no less than 65 dBA but this may be reduced to 60 dBA in:
   - stairways;
   - enclosures of areas less than 60 m^2 (e.g. cellular offices);
   - small areas of limited extent within the enclosure, for instance the area behind a pillar;

b) where the sound pressure level of background noise is greater than 60 dBA, 5 dB above the sound pressure level of the background noise;

NOTE 1 Other background noise that is unlikely to persist for longer than 30 s may be ignored.

NOTE 2 This recommendation does not apply to noise created by running water in bathrooms and shower rooms.

c) within rooms in which the VAS is intended to rouse people from sleep, no less than 75 dBA at the bedhead;

NOTE 3 Experience has shown that this normally necessitates the provision of a voice alarm loudspeaker within the room in question.

d) at any normally accessible point, no greater than 120 dBA.

21.2 Measurements should be made with all doors shut.

NOTE 1 All these figures are judged to be generally appropriate. However, with the agreement of all interested parties, lower sound pressure levels might be deemed acceptable in specific situations.

*NOTE 2 In carrying out measurements to verify conformity with these recommendations, other than in the case of **21.1**c), account need not be taken of sound pressure levels within 500 mm of any walls or partitions.*

NOTE 3 An instrument conforming to BS EN 61672-1, set to slow response and A-weighting, is suitable for measuring the sound pressure level of the attention-drawing or alarm signal.

NOTE 4 It will often be necessary to measure the sound pressure level of the attention-drawing signal or non-speech alarm broadcast in the presence of background noise. The sound pressure level of the attention-drawing signal or non-speech alarm broadcast (in isolation) can be deemed to be 5 dB above background noise if, when the background noise is present, a sound pressure level increase of 6 dB occurs on operation of the fire alarm system.

22 Intelligibility of speech messages

*COMMENTARY ON **22***
Whilst a broadcast might be intelligible in the sound field of a loudspeaker, there can be parts of a building where the listener is not in the sound field of the loudspeaker and therefore will not receive the necessary sound pressure level and/or frequency response needed to achieve the audibility and clarity required for intelligibility. For example, in a standard office environment fitted with too few ceiling loudspeakers, unless the dispersion patterns of the neighbouring loudspeakers overlap, it is unlikely that adequate intelligibility will be achieved throughout the listening space.

The amount of sound energy which arrives at the listener as a result of reflections, rather than directly from the source, can also have a significant impact on the clarity of the broadcast. Reflections which arrive soon after the original sound are, in fact, helpful to clarity. Reflections, especially multiple arrivals, which arrive a long time after the direct sound, serve to confuse the original sound in the form of echoes. It is the ratio of direct to reverberant sound which is the critical factor for intelligibility. Thus the RT of a space is a critical factor in designing a suitable electro-acoustic solution. Locating loudspeakers close to listeners and reducing the sound pressure level can minimize reflections and thus avoid over-exciting the space. Other methods of improving intelligibility include the use of highly controlled dispersion pattern loudspeakers which beam the sound in a particular direction and thus avoid spraying sound onto reflective surfaces. The use of sound absorption material, for example perforated roof decking, acoustic ceilings, carpets and upholstered seating, will absorb sound and thus reduce reflections.

The correct choice and quantity of loudspeakers in the right locations are essential to achieving intelligibility. Compromises will inevitably lead to a reduction in intelligibility, which might render the result unacceptable.

The acoustic space can be modelled in one of many available computer programmes and the proposed loudspeaker types, quantities, and locations inserted therein. This will provide advanced information as to the likelihood of achieving a suitable result as a guide within the design process. This is especially applicable in large spaces which are likely to have challenging acoustic properties and limited opportunities for loudspeaker locations such as shopping malls, railway stations, swimming pools and buildings with large atria. It is also applicable to spaces which have high levels of ambient noise such as motorway tunnels, bottling plants and power stations. A computer modelling process is only a guide, and most designs rely upon approximations based on experience to determine the final solution. However, computer modelling can be carried out only if the building designer provides detailed information on the space and the acoustic properties of the surfaces.

*Dynamic level control based, for example, upon ambient noise sensing (see Clause **17**) can be very useful in automatically maintaining the signal-to-noise ratio within reasonable parameters. Other forms of dynamic level control such as compressors or a.g.c. (automatic gain control) can be useful in maintaining a consistently high modulation level from the microphone, and thus maintaining a sufficient signal-to-noise ratio.*

Establishing the likely level of ambient, background or occupational noise is essential within any electro-acoustic design since it dictates the power required from the amplifiers and the loudspeakers. It also starts to hone the choice of the types of loudspeakers which can be selected.

It is often not possible to measure the ambient noise for the building concerned, and it is therefore necessary for a measurement to be taken in a representative equivalent building. Published data regarding typical noise levels needs to be used with caution, since it might not be sufficiently qualified to be valid in certain types of buildings.

Annex A gives guidance on typical noise levels in buildings.

22.1 Audibility

22.1.1 In order to achieve a satisfactory level of intelligibility, the VAS should be designed to generate a speech signal level over and above the occupational noise. Generally, a signal-to-noise ratio of at least 10 dB is needed to obtain an acceptable level of speech intelligibility. However, where the RT is high, care should be taken to achieve an acceptable direct to reverberant sound level in order to achieve intelligibility by potentially raising the signal-to-noise ratio.

NOTE BS EN 60268-16 gives further guidance, especially regarding high sound pressure levels.

22.1.2 The noise measurement metric $L_{\mathrm{Aeq,T}}$ should be used for spaces where the extraneous noise tends to be in relatively short bursts. The metric $L_{\mathrm{A10,T}}$ should be used for noise measurements over longer periods. The duration of the measurement should be appropriate to the venue/premises and its usual activities. If any doubt exists regarding the parameters of the measurements, the assistance of a qualified acoustician should be considered for the assessment process.

22.1.3 Where ambient noise sensing systems are included in the VAS (see Clause **17**) these should be set to measure the equivalent continuous sound pressure level ($L_{\mathrm{Aeq,T}}$) for a period of 1 second of ambient noise immediately prior to the start of an announcement. The broadcast level should then be set to have an equivalent continuous sound pressure level over 10 seconds ($L_{\mathrm{Aeq,10}}$), 10 dB higher than the ambient noise.

NOTE For messages of duration shorter than 10 seconds, a pro rata broadcast level may be used.

22.1.4 If the background, occupational or ambient noise within a particular part of a building is, or is considered likely to be, greater than 75 dBA, the assistance of a qualified electro-acoustic designer should be considered for the design process.

22.2 Clarity

22.2.1 The frequency response of the VAS from the acoustic input to the acoustic output should be within the parameters defined in BS EN 54-16:2008, **13.12.3**.

22.2.2 If the RT of a particular part of a building is, or is considered likely to be, greater than 1.5 s (500 Hz to 2 kHz) the assistance of a qualified electro-acoustic designer should be considered for the design process.

22.2.3 If the listener to loudspeaker distance of a particular part of a building is (or is considered likely to be) greater than 10 m, the assistance of a qualified electro-acoustic designer should be considered for the design process.

22.3 Measurement of intelligibility

22.3.1 The extent and method of testing and levels of intelligibility to be achieved should be agreed by interested parties and stated in the system specification (see **6.4**).

NOTE 1 The method of testing intelligibility may be either subjective or objective.

NOTE 2 Objective testing is likely to be necessary when:

*a) RTs exceed 1.5 s at speech frequencies of 500 Hz to 2 kHz (see **22.2.2**);*

*b) background noise levels exceed 75 dBA (see **22.1.4**);*

*c) probable loudspeaker to listener distances exceed 10 m (see **22.2.3**).*

In the event of a dispute, objective intelligibility tests should be carried out.

22.3.2 When using objective testing, intelligibility should be quoted using the speech transmission index (STI), in accordance with BS EN 60268-16.

22.3.3 The minimum value for intelligibility should be 0.5 STI.

*NOTE 1 A lower STI Figure might be acceptable to the interested parties (see Clause **6**):*

a) in some very reverberant spaces, and areas with high background noise;

b) where the persons who are required to understand the messages are, or will be, reasonably familiar with them through regular system tests, but to a minimum of 0.45 STI.

NOTE 2 For persons familiar with the messages, the effective intelligibility tends to increase by approximately 0.05 on the STI scale if the intelligibility is in the range 0.45 to 0.5.

NOTE 3 Some relaxation in STI recommendation might be given to an exhibition centre to take into account the different operational modes of "empty", "half-build", and use by the public. In this respect, the "empty" condition may be mitigated by the requirement for visitors to be accompanied by venue staff, and the "half-build" condition mitigated by venue staff monitoring non-venue workers.

22.3.4 Intelligibility should be assessed under the worst expected noise level conditions, e.g. with smoke extract fans, staircase pressurization fans and other noise sources which would be operating during a fire running. If this cannot be achieved, the noise levels should be simulated for the test. In cases where the measurements are, out of necessity, carried out during non-operational times, a recording of the operational noise either of the building itself or of a representative equivalent building should be taken and replayed during the assessment.

NOTE Where objective measurements are being taken, the noise might be replayed at a representative level close to the measurement microphone; however, subjective assessment will require the assessor to be immersed in a sound field of the noise.

22.3.5 Where it has been agreed by all interested parties that a subjective assessment would be adequate, the tests should be based on both intelligibility and audibility, and conducted by persons with normal hearing (see BS 5330). Messages or text, preferably unknown to the listeners, should be read into a system microphone, where fitted.

NOTE Repeated pre-recorded messages are of a lesser value as the message can be learned by listeners.

22.3.6 When commissioning a system, the intelligibility of the stored messages should be assessed.

23 Priorities

*COMMENTARY ON **23***
It is important that broadcasts, live or recorded, in a VAS are prioritized so that a broadcast of a higher priority overrides a broadcast of lower priority. Even the lowest priority emergency broadcast of the VAS needs to override any non-emergency broadcast.

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

23.1 Priority level in descending order, should be:

a) emergency microphone(s);
b) pre-recorded evacuate message regarding potentially life-threatening situation needing immediate evacuation;
c) pre-recorded alert message regarding dangerous situation nearby requiring warning of potential evacuation;
d) other emergency pre-recorded messages;
e) non-emergency messages.

23.2 Priority levels should be protected from unauthorized changes.

23.3 All emergency broadcasts should override all non-emergency broadcasts.

23.4 A fault in a cable connecting an emergency microphone should not prevent the broadcast of emergency messages from any other source.

23.5 In the event that the PTT switch on the emergency microphone becomes accidentally and permanently operated (thus preventing other emergency broadcast), means should be provided whereby other emergency sources can take priority while the fault condition is indicated on the VACIE.

NOTE Such a means may be a time-out facility for 3 mins to 5 mins.

24 Voice alarm control and indicating equipment (VACIE)

*COMMENTARY ON **24***
Voice alarm control and indicating equipment (see BS EN 54-16) comprises some or all of the following elements: emergency microphones, fire alarm interfaces, emergency message stores, routing and prioritizing matrix, pre-amplifiers, signal processors such as ambient noise sensing level controllers, graphic equalizers, delay lines, and power amplifiers, whether they are separate units or not. A VACIE does not include interconnecting cables and loudspeakers.

See Annex B for further information on VACIE.

24.1 Siting of the VACIE

24.1.1 The VACIE should be sited in areas of low fire hazard, so that the equipment is unlikely to be involved in a fire before adequate warning has been given.

24.1.2 All VACIE likely to need routine attention for maintenance should be sited in readily accessible locations that facilitate safe maintenance work.

24.1.3 The ambient light level in the vicinity of all VACIE should be such that visual indications can be clearly seen, controls easily operated and any instructions or legends easily read.

24.1.4 The ambient noise level in the vicinity of all VACIE should not prevent audible indications (such as the fault warning sounder) from being heard.

24.2 Facilities provided by the VACIE

24.2.1 The minimum facilities provided by the control equipment should be determined after consultation with interested parties (see Clause **6**).

24.2.2 Where the control equipment is distributed, means should be provided for monitoring all interconnections included in the critical signal paths (see Clause **12**).

24.3 Facilities provided for visual indications

24.3.1 The indicating facilities should be suitable for the evacuation procedure intended for the building. There should be adequate consultation between the interested parties (see Clause **6**) to ensure that appropriate indicating facilities are provided.

24.3.2 In Type V4 systems, indication on the VACIE of the area(s) where an evacuate message is broadcast should comprise an indication for each activated voice alarm zone, at least for those broadcasts initiated by manual controls.

24.3.3 The indication of the voice alarm condition should comprise a separate light-emitting indicator for each manually activated voice alarm zone (e.g. LED matrix; LCD or illuminated mimic diagram), such that the indicating equipment is capable of simultaneously displaying the status of every zone.

NOTE In very large premises a hierarchical arrangement of displays may be used with, for example, a central control unit indicating a sector of voice alarm zones, and further equipment in each sector indicating the individual voice alarm zone(s) which have been activated.

24.3.4 If a visual display unit (VDU) is used to provide the display recommended in **24.3.3** it should:

a) provide a simultaneous display of all manually activated voice alarm zones; and

b) because the reliability of a single VDU is not adequate, provide a back-up form of zone indication (this may comprise a second method of indication conforming to **24.3.3**), a second VDU or a printer configured to automatically print out the fire information).

NOTE Printers are not considered suitable as a primary indication since, in the event of ink, ribbon or paper being exhausted, the indication will be lost. They may, however, be acceptable as a back-up or supplement to another display.

24.3.5 There should be a diagrammatic representation of the building, showing at least the building entrances, the main circulation areas and the division into emergency loudspeaker zones. Where the division into zones is not provided by the display recommended in **24.3.3** or **24.3.4**, a correctly orientated plan of the premises should be displayed.

24.4 Facilities provided for control of the VAS

24.4.1 The control facilities should be suitable for the fire and evacuation procedures intended for the building. There should be adequate consultation between the interested parties (see Clause **6**) to ensure that appropriate control facilities are provided.

24.4.2 For emergency broadcasts initiated by the CIE, silencing and resetting of the VAS should be under the control of the CIE.

NOTE VACIE may have provision of an optional fault warning buzzer silence control and/or fault condition reset.

24.4.3 In Type V2, V3 and V4 systems, the VACIE should include an emergency microphone(s) with an all-call "press to talk" switch.

24.4.4 In Type V3 systems, the VACIE should provide controls to allow live messages to be broadcast in separate voice alarm zones, separate groups of voice alarm zones and all voice alarm zones.

NOTE 1 Supplementary emergency microphones as recommended for Type V2 may also be provided.

*NOTE 2 Controls for loudspeaker zone selection (see **24.4.2**) and message activation (see **24.4.3** and **24.4.4**) may be combined.*

24.4.5 In Type V4 systems, the VACIE should provide controls to allow live and pre-recorded emergency messages to be broadcast in separate voice alarm zones, separate groups of voice alarm zones and all voice alarm zones.

NOTE Supplementary emergency microphones as recommended for Type V2 may also be provided.

24.4.6 It should not be possible to stop any messages that have been initiated by the CIE, except to make a live announcement or to select a message of a higher priority. For instance, if an alert message is being broadcast in a voice alarm zone, it should only be possible to make a live announcement or select and broadcast an evacuate message. If full manual control of the system is needed, such as at a football club on a match day or at a theatre during a performance, competent trained staff should be on duty and a manual control provided to disconnect the automatic triggers for the duration of the event.

NOTE 1 If no message is being broadcast in a voice alarm zone, it might be possible to make a live announcement or select either an alert or an evacuate message.

NOTE 2 When an "activate evacuate message" switch is operated, those zones in which the evacuate signal is not given may automatically receive the alert signal.

24.4.7 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 except when the building has two operating modes, "occupied" (e.g. working day) and "unoccupied" (e.g. night). In that case, such an "all-evacuate" signal should be initiated only in "unoccupied" mode. The method to be used should be as agreed by all the interested parties (see Clause **6**).

25 Networked systems

*COMMENTARY ON **25***
In a networked system, the VACIE is not centralized in one location but instead distributed amongst a number of subsystems located remotely from each other and interconnected by a data highway. Some subsystems may simply gather data. Others may comprise stand-alone VACIE which will continue to operate locally in the event of a failure of the communications link between subsystems.

Networked systems are usually installed in the following circumstances:

a) where the VAS is large and beyond the capacity of single VACIE;

b) where the total VACIE cannot be accommodated in one equipment room due to space limitations, ventilation, etc.;

c) to avoid a single point of failure of the system;

d) to reduce the size (cross-sectional area) and number of cables/conductors between the VACIE and loudspeakers;

e) where there is a need for centralized monitoring and/or control of a number of VASs in different buildings in the same vicinity (e.g. on the same site).

*The effect of a failure of the communications link and the implications for VAS operation will depend on the configuration of the networked system, the type of network and whether or not the network forms part of the critical signal path (see **3.8**).*

Ring or loop networks are more resilient to communications failures than radial type networks. Peer to peer networks are less vulnerable to loss of function than networks with a master central processor controlling equipment to equipment communications.

If all subsystems can function as stand-alone VASs and do not depend on the network to facilitate primary alarm function (e.g. broadcasting the alarm), a communications failure will have no significant effect, and the network can be considered as non-critical. If, however, the cause and effect logic for the operation of the system depends on the network, the communications link needs to be afforded the monitoring, integrity and reliability of a critical signal path. The more the dependence of the networked system upon the communications link to effect primary functions of the VAS, the greater is the need for protection of the communications link.

*In the case of a), b), c) and d), the overall integrity, reliability and availability of the networked system need to be the same as that of a single VAS and need to satisfy the recommendations of all other clauses of this standard. In particular, the network needs to be monitored for faults (see **12.1**), and be wired in a suitable cable (see Clause **27**).*

In the case of e), the communications link also needs to be considered as a critical signal path if the communications link is required to provide centralized control of the overall VAS.

25.1 The normal operating parameters of the network should be defined and agreed at the design specification stage.

NOTE These parameters may include Bit Error Rate (BER), signal latency and Jitter.

25.2 The communications link between subsystems should be monitored in accordance with **12.1** for wired networks and Clause **28** for radio networks.

25.3 A fault on the communications link between subsystems should not affect the stand-alone capability of any subsystem.

25.4 In networked systems in which the communications link forms a critical signal path and comprises one or more cables, the cable installation should conform to Clause **27**, except that standard fire-resisting cables may be used where:

a) the network is configured as a loop;

b) there is diverse routing of incoming and outgoing circuits, except in the immediate vicinity of a VACIE;

c) there will be no loss of communication to any subsystem in the event of a single open or short circuit on the loop;

d) the loop is monitored for loop continuity.

25.5 Once the message initiation command is received by any subsystem, the message should be broadcast by all required subsystems within 1 s.

25.6 Equipment of a networked system not required for indication purposes should be readily accessible for maintenance purposes.

26 Power supplies

*COMMENTARY ON **26***

*In accordance with BS EN 54-4 (see **11.1**), VAS power supply equipment has two power supplies, a main (normal) power supply and a standby power supply.*

The main power supply to the VAS will normally be derived from the low voltage mains supply in the building. The circuit providing the mains supply needs to be reliable and capable of supplying the largest current load that the VAS will use under normal, fire or fault conditions. It is accepted that a low voltage circuit breaker might trip out if a power supply fault causes an over-current condition on the low voltage supply circuit.

In order to minimize the potential for failures, the design of the mains supply to the system needs to be such that it is unlikely to be affected by faults on other circuits or equipment or by isolation of supplies in the building for maintenance or economy in electricity consumption.

There is always a likelihood that the mains supply will fail at some time during the lifetime of the VAS. Accordingly, it is important that the standby power supply is able to reliably support the system while a fault in the mains supply is corrected. Transfer between the two supplies needs to be arranged so that it does not affect the operation of the system.

In most parts of the UK, failures in the public electricity supplies are generally of relatively short duration, and prolonged failures exceeding 24 h are uncommon. Standby batteries need not, therefore, be capable of supplying the system for longer than 24 h. A greater duration might, however, be necessary if the probability of failure of a public or private electricity supply for periods in excess of 24 h is considered significant.

It is important that failure of a final circuit serving the VAS is detected by the user, particularly after a period when the building is unoccupied and the standby battery might be fully discharged. Detection of the failure on reoccupation of the building will be likely only if the presence of a power supply to the system is indicated by a visual indicator at the CIE of the VAS and/or at its power supply equipment.

If the premises are provided with an automatically started standby generator, the capacity of the standby batteries may be reduced, provided the circuits served by the generator include that of the VAS (and associated fire detection and fire alarm system, if applicable).

In some complex buildings, such as shopping centres, additional indicating equipment, such as colour graphics terminals, may be used to assist the user in monitoring and control of fire incidents and evacuation of the building. This equipment can draw substantial current. If such equipment is not essential for full conformity of the VAS with this standard, it might not be necessary for its power supply to comply in full with the recommendations of this Clause. However, if this additional equipment forms the normal user interface, a standby power supply still needs to be provided to prevent possible confusion of operators, degraded monitoring and reduced control of a fire incident.

Complex or high-rise buildings may have extended evacuation times. In such cases, the VAS needs to be capable of broadcasting an evacuate message for an appropriate extended period. This will apply whether the system is powered from normal mains or standby supply.

It is sometimes necessary for certain non-emergency but important messages to continue to be broadcast under mains failure conditions, e.g. passenger information messages in railway stations and airports. In such circumstances, standby power supplies need to have sufficient capacity to allow for this non-emergency use within the necessary overall duration, and for the necessary period of emergency broadcast.

26.1 Mains power supplies

*COMMENTARY ON **26.1**.*
*The mains supply is regarded as an integral part of the VAS, particularly for the purpose of certification of the system (see Clause **37**), regardless of whether the electrical installation within the building is provided by the organization responsible for the installation of the VAS.*

26.1.1 For reasons of electrical safety, the mains supply to all parts of the VAS should be supplied, via an isolating protective device (such as a circuit breaker), from the load ("dead") side of the main isolating device for the building. When the user chooses to isolate the mains supply to the building during closed hours, a separate supply should be provided for the VAS that should not normally be isolated during closed hours.

NOTE The isolating protective device of the VAS may be the same as that used for the fire detection and fire alarm system. In this case, care needs to be taken to ensure that the power handling capability of the device is sufficient for the joint load of the two systems.

26.1.2 The mains supply final circuit(s) to all parts of the VAS should only serve the VAS and the fire detection and fire alarm system, where a common mains supply is used for both systems. The circuit(s) should be derived from a point in the electrical distribution system of the building close to the main isolating device for the building.

*NOTE In certain systems within very large buildings it might be impracticable to meet this recommendation. With the agreement of interested parties (see Clause **6**), it is acceptable that the mains power supply is derived from one or more local distribution boards in the building. In such cases, the number of isolating devices between the main incoming supply and the each local distribution board need to be kept to the minimum practicable. Any need to isolate the supply to the local distribution board (e.g. for maintenance) has to be infrequent, with a low risk of inadvertent isolation.*

26.1.3 To facilitate local isolation during maintenance, means should be provided for double pole isolation of the low voltage supply circuit that serves the power supply to the VAS. The isolation facilities should be sited, in the vicinity of the equipment served, without the need for access to remote parts of the building. It should be possible to lock the facilities in both the normal and the isolate positions to prevent unauthorized use.

26.1.4 In accordance with BS 7671, the number of isolating devices between the incoming mains power supply to the building and the VAS power supply equipment should be kept to the minimum practicable.

NOTE 1 The supply may comprise a dedicated circuit emanating from the first electrical distribution board in the electrical distribution system of the building.

*NOTE 2 See note to **26.1.2**.*

26.1.5 Every isolator and protective device that can isolate the supply to the VAS, other than the main isolator for the building, should be labelled:

a) "VOICE ALARM", in the case of a protective device that serves only the voice alarm circuit, but incorporates no switch;

b) "VOICE ALARM. DO NOT SWITCH OFF", in the case of a switch (whether incorporating a protective device or not) that serves only the voice alarm circuit; or

c) "WARNING. THIS SWITCH ALSO CONTROLS THE SUPPLY TO THE VOICE ALARM SYSTEM", in the case of any switch that disconnects the mains supply to both the VAS and to other circuits.

26.1.6 Where a protective device or isolating switch common to the fire alarm system and the VAS is used, it should be labelled: "FIRE ALARM/VOICE ALARM".

26.1.7 Labels used should be clear, durable and fade-resistant.

26.1.8 Every isolator, switch and protective device that is capable of disconnecting the mains supply to the VAS should be situated in a position inaccessible to unauthorized persons or be protected against unauthorized operation by persons without a special tool.

NOTE A special tool might, for example, be a key actuator (sometimes called a "secret key") for a mains switch device.

26.1.9 Where a residual current device is necessary for electrical safety, a fault on any other circuit or equipment in the building should not be capable of resulting in isolation of the supply to the VAS.

NOTE The circuit supplying the VAS need not be protected by a residual current device unless this is necessary to conform to BS 7671.

26.1.10 Irrespective of the condition of any standby battery, e.g. disconnected or fully discharged, the mains power supply should be capable of supplying the maximum alarm load of the system (see **3.17**).

26.2 VAS power supply units

*COMMENTARY ON **26.2***
The following recommendations apply to every power supply unit that forms part of the VAS.

26.2.1 Power supply equipment should be sited in accordance with **24.1**.

26.2.2 Transition between the main supply and the standby supply, and vice versa, should not cause any interruption to the operation of the system or result in a false broadcast.

26.2.3 A fault in the main supply should not adversely affect the standby supply or vice versa. The operation of a single protective device should not result in failure of both the main and the standby supply.

26.2.4 The presence of the main or the standby supply should be indicated by a green indicator, located in a position that makes it obvious to any person responsible for monitoring faults on the fire alarm system (e.g. at the location of the main indicating equipment).

26.2.5 Main and standby supplies should each be independently capable of supplying the maximum alarm load of the system, irrespective of the condition of the other supply.

26.3 Standby supplies

26.3.1 The standby supply should comprise a secondary (rechargeable) battery with an automatic charger.

26.3.2 The battery should be of a type having a life of at least four years under the conditions of use likely to be experienced in the VAS. Automotive batteries (of the type used for starting car engines) should not be used.

26.3.3 Labels should be fixed to all batteries indicating their date of installation. The labels should be so sited that they can be read without disturbing the batteries.

26.3.4 The charging rate of the battery should be such that, having been discharged to its final voltage, the battery can be charged sufficiently in accordance with **26.3.5** after a charging period of 24 h.

NOTE This BS EN 54-4 requirement is included here as a reminder that connecting larger batteries than originally designed, for example due to an unforeseen extra load, can result in unacceptably long recharge times.

26.3.5 Standby batteries that serve any part of the system should:

a) have sufficient capacity to maintain the system in operation for at least 24 h, after which sufficient capacity should remain to broadcast an evacuate message in all alarm zones for at least 30 min, unless the building is provided with an automatically started standby generator [see **26.3.5**c)];

b) where the total evacuation time of the building is likely to exceed 20 min, have sufficient capacity to extend the minimum period of 30 min by a safety margin agreed by all interested parties;

c) in a building with an automatically started standby generator that serves the VAS, have sufficient capacity to maintain the system in operation for at least six hours, after which sufficient capacity should remain to provide an evacuate broadcast in all alarm zones for at least 30 min.

*NOTE If a circuit serving part of the VAS (e.g. distributed power supply unit) is not served by the standby generator, the capacity of the standby battery ought to conform to **26.3.5**a) or **26.3.5**b), as appropriate.*

26.3.6 The standby battery capacity should be calculated in accordance with Annex C.

26.3.7 If additional equipment (see **24.3**) is used as the normal method of indication and control of the voice alarm condition, a standby supply should be provided. If the equipment is suitably sited for use as a default in the event of failure of the additional equipment, the capacity of the standby batteries serving the additional equipment should be sufficient to operate the system in the quiescent mode for at least four hours. If the equipment is not suitably sited to enable effective control and monitoring of a fire incident, the standby power supplies for the additional equipment should conform to **26.3.5**.

*NOTE If the additional CIE is over and above what is needed, it might not be necessary for any standby battery capacity supplying the additional equipment to conform to **26.3.5**.*

26.3.8 Where it is agreed with all interested parties that the VAS needs to remain capable of broadcasting non-emergency but important messages during a period of mains failure, the capacity of the standby batteries should be such as to allow for this usage, while conforming to **26.3.5**a).

NOTE Relevant important messages might include essential passenger information in transport terminals and airports, but not routine paging or background music.

26.3.9 In a building with an automatically started standby generator that serves the VAS, any equipment which is likely to be affected by the changeover at mains voltage should be protected.

NOTE Electronic units which might not withstand the changeover might benefit from the provision of a dedicated UPS. The remainder of the equipment would be expected to absorb the shock of the changeover.

27 Cables, wiring and other interconnections

*COMMENTARY ON **27***
The satisfactory operation of a VAS depends upon the integrity of the interconnections between its components. Because the primary function of a VAS associated with a fire detection and fire 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.

It is not normally possible to predict with any accuracy those areas of a building in which fire might or might not occur. At the design stage, the exact routes that cables will follow may also be unknown. Therefore to ensure that cables used for the interface between the VACIE and fire detection circuits and the loudspeaker and any other alarm *warning device circuits remain operational for an adequate duration, cables with an inherent ability to resist attack by fire need to be used for the critical signal paths.*

The transmission needs of the voice alarm signals and the environment within which the signals are passed need to be considered, as these may have a significant effect on the type of interconnections to be used. Items for consideration include:

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) the installation environment, including the level of vibration, ambient temperature or humidity, any of which may influence cable selection;

e) hazardous areas and their specific safety requirements.

The recommendations given in this clause apply to the use of electrical cables. A growing interest in the use of optical fibre cables has been noted but standards for these are still in the course of development. It might be possible to use such cable types as a variation, subject to the agreement of all interested parties (see Clause ***6****). In such cases, consideration needs to be given to all the other recommendations of this clause insofar as they are relevant.*

27.1 The electrical characteristics of all cables, such as voltage drop, current carrying capacity, impedance and capacitance, should be suitable for the system. 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.

27.2 Cables used for all parts of the critical signal path, for the extra low voltage (ELV) supply from an external power supply unit and for the final circuit providing low voltage mains supply to the system should adequately resist the effects of fire. They should conform to **27.6** or **27.7** and comprise one of the following:

a) mineral-insulated copper-sheathed cable conforming to BS EN 60702-1 with an overall polymeric covering and with terminations conforming to BS EN 60702-2;

b) cables conforming to BS 7629-1;

c) cables conforming to BS 7846.

NOTE In order to provide flexibility of location and practicality, the final connection between the emergency microphone and the site wiring may use a different cable type.

If a different cable type is used for the final connection between the emergency microphone and the site wiring, it should not exceed 3 m.

27.3 In general, conductors should have a cross-sectional area of at least 1 mm^2, other than in the case of twisted-pair or multicore data cables, where individual conductor diameter should be at least 0.5 mm, there should be,at least, an equivalent of four pairs (or 8 cores) and fire performance should conform to **27.6** or **27.7**, and be assessed in accordance with BS EN 50289-4-16.

27.4 Cable systems used for all parts of a critical signal path should comprise at least standard fire-resisting cables (see **27.6**) with appropriate methods of support and jointing (see **27.9** and **27.10**).

27.5 Cable systems comprising "enhanced" fire-resisting cables (see **27.7**) should be used in:

a) unsprinklered buildings (or parts of buildings) in which the fire strategy involves evacuation of the occupants in four or more phases, except in cases where a networked system is used. In a building with a networked system (see Clause **25**), individual, self-contained VASs may serve parts of the building that are evacuated in fewer than four phases, even though the entire building is evacuated in four or more phases. In such cases, cables of enhanced fire resistance need not be used for these systems, but there might be a need to use cables of enhanced fire resistance for the network (see **25.4**);

b) unsprinklered buildings of greater than 30 m height;

c) unsprinklered premises and sites in which a fire in one area could affect cables of critical signal paths associated with areas remote from the fire, in which it is envisaged people will remain in occupation during the course of the fire. Examples may be large hospitals with central VACIE and progressive horizontal evacuation arrangements, and certain large industrial sites;

d) any other buildings in which the designer, specifier or regulatory authority, on the basis of a fire risk assessment that takes fire engineering considerations into account, considers that the use of enhanced fire-resisting cables is necessary.

27.6 Standard fire-resisting cables should have a duration of survival of 30 min when tested in accordance with BS EN 50200 (which corresponds to a classification of PH30) and a duration of survival of 30 min when tested in accordance with BS EN 50200:2006, Annex E.

27.7 Enhanced fire resisting cables should have a duration of survival of 120 min when tested in accordance with BS EN 50200 (which corresponds to a classification of PH120) and a duration of survival of 120 min when tested in accordance with BS 8434-2.

27.8 Optical fibre cables used for a critical signal path should conform to **27.6** or **27.7** depending on the application. The maximum increase in attenuation under the fire test condition in **27.6** or **27.7** should not exceed that specified by the designer of the system and should be given in the specifier's cable standard. In any case, satisfactory operation of the transmission path should continue for 30 min (standard cable) or 120 min (enhanced cable).

27.9 Methods of cable support should be non-combustible and such that circuit integrity will not be reduced below that afforded by the cable used, and should withstand a similar temperature, duration and water application to that of the cable, while maintaining adequate support.

NOTE 1 Plastic cable clips, cable ties or trunking may be used for cosmetic support only.

NOTE 2 Experience has shown that collapse of cables, supported only by plastic cable trunking, can create a serious hazard for firefighters, who could become entangled in the cables.

27.10 Cables should be installed without external joints wherever practicable. Any such joints should be enclosed in junction boxes, labelled with the words "VOICE ALARM", and should be constructed of materials that will withstand a similar temperature, duration and water application to that of the cable whilst maintaining integrity of the joint.

27.11 In particularly arduous conditions (e.g. the potential impact by forklift trucks or goods trolleys), additional robust protection should be given to cables by burying them in the structure of the building or installation in metal conduit or trunking.

NOTE If arduous conditions are not an issue, cables conforming to BS EN 60702-1 or BS 7846 may be used in all parts of the system without additional mechanical protection.

27.12 Cables conforming to BS 7629-1 should be given mechanical protection in any areas in which physical damage or rodent attack is likely. In particular, mechanical protection should be given to all areas that are less than two metres above floor level, other than in relatively benign environments (e.g. offices, shops and similar premises) in which the cable is clipped directly to robust construction. Conduit should conform to the relevant part of BS EN 50086 and non-metallic trunking should conform to BS 4678-4.

NOTE Protection may be provided by laying cable on tray, burying in the structure of the building, or by installation in conduit, ducting or trunking.

27.13 To avoid the risk of mechanical damage to voice alarm cables, they should not be installed within the same conduit as the cables of other services. Where such cables share common trunking, a compartment of the trunking, separated from other compartments by a strong, rigid and continuous partition, should be reserved solely for fire detection, fire alarm and voice alarm cables.

27.14 Where multicore cable is used for the interconnection of the voice alarm circuits, none of the conductors should be used for circuits other than those of the VAS.

27.15 Voice alarm cables handling voltages in excess of ELV should be segregated from ELV voice alarm cables by the use of screened cables conforming to **27.2**. The mains supply cable to any control, indicating or power supply equipment should not enter the equipment through the same cable entry as cables carrying ELV. Within the equipment, low voltage (LV) and ELV cables should be kept separate to the extent practicable.

27.16 To avoid electromagnetic interference with voice alarm signals, any recommendations by the manufacturer of the voice alarm equipment in respect of separation of voice alarm cables from the cables of other services should be followed.

27.17 All VAS cables should be of a single common colour, preferably red, and different to those used for cables of general electrical services in the building, so they can be easily distinguished. Where the specification for the fire detection and fire alarm system requires that cables are to be a different colour to that used for other systems, the voice alarm may be considered to be the same system and use the same colour.

28 Radio-linked systems

*COMMENTARY ON **28***
Some of the recommendations of this standard are unsuitable for, or cannot be applied to, radio-linked VASs. These include, in particular, those relating to power supplies and fault monitoring. Additional recommendations apply to radio-linked systems in order to address the integrity and performance of the radio communications link between components and the VACIE, between the VACIE and its associated fire detection and fire alarm system CIE or between sections of the VACIE.

*Components of a system interconnected by radio links may include emergency microphones and loudspeakers with associated local amplifiers. Other components of a radio-linked system may include radio relay units, which are installed remote from the VACIE so as to extend the range of the system. Where such relay units form separate sections of the VACIE, this is a form of networked system (see Clause **25**).*

Radio communications may also be used to link only some components of the system, e.g. some loudspeakers, to what is otherwise a wired system. The recommendations of this standard apply equally to integral radio-linked systems of this nature.

28.1 Components of a radio-linked system should conform to BS EN 54-25.

28.2 Although BS EN 54-25 permits the use of a single battery in each device, radio-linked systems should also conform to the following.

a) All radio-linked components should be supplied from at least two independent power supplies. These can be either:

   1) the normal mains supply plus a reserve battery (primary or continuously charged secondary); or

   2) a primary battery plus a second primary battery; or

   3) a primary battery plus a secondary battery.

NOTE 1 Where secondary batteries are specified, capacitors may be used as an alternative.

b) Components other than the VACIE may utilize batteries to provide the normal power supply.

c) At the point at which the power supply to any radio-linked component using a primary battery can maintain the component in normal operation for no more than thirty days, and, in addition, in the case of fire alarm devices (e.g., voice sounders or amplifiers/loudspeakers), 30 min in the alarm condition, a fault warning should be given at the VACIE.

NOTE 2 A separate maintenance warning may be given at an earlier stage to indicate an impending need to replace a battery.

28.3 Cables of antennae that are external to components of a radio-linked system should be monitored for open and short circuits. A fault condition should be given at the VACIE within 300 s of the occurrence of such a condition.

28.4 Cables of antennae that are external to components that form part of the critical signal path should conform to **27.4**.

*NOTE Cables that do not conform to **27.4** may be used provided they are routed through areas of low fire risk, and are protected against exposure to fire by burial in at least 12 mm of plaster or by separation from any fire risk by materials that would afford a fire resistance of at least 30 min if tested in accordance with the relevant part of BS 476.*

28.5 Installation of a radio-linked system should only take place after a comprehensive radio survey has been undertaken to ascertain the following:

a) there are no other sources of radio transmission that might interfere with or block radio communication between the VACIE and other components of the system;

b) there is adequate signal strength for communication both to and from components as appropriate in all areas of the building(s) in which radio-linked components are to be located. This should take into account the minimum acceptable signal level defined by the manufacturer in respect of the level of background radio "noise" at the time of the survey;

c) where the system is networked, the communication conditions described in b) are achieved throughout the network;

d) records of signal strength readings for each radio device taken at the time of the survey, and of the background noise level, are kept for future reference.

28.6 Only calibrated radio survey test equipment that has been recommended by the manufacturer should be used.

28.7 At the time of commissioning, and after the installation of all equipment including remote antenna(e), the following records relating to the radio data should be recorded.

a) The system coding (i.e. system address) which should where possible be unique to avoid the possibility of interference from similar systems on the same frequency.

b) Details of the signal level being received at each of the receiver units. These data should include the received signal levels of all the radio devices and the background noise level. In the case of a networked system, this should also include the signal levels for the radio links between sections of the VACIE. These signal records should be updated annually.

28.8 The signal levels recorded should be within the specifications set by the manufacturer of the radio system. If not within the specification, appropriate remedial action should be undertaken.

28.9 A copy of the signal levels should be kept on site with the system logbook.

29 Climatic and environmental conditions

*COMMENTARY ON **29***
As any part of the VAS may be installed inside or outside buildings, under various climatic and environmental conditions, and exposed to possible accidental or wilful mechanical damage, it is important that all the conditions under which the system is required to operate are fully determined and that any associated risks to correct electrical and mechanical operation are reduced to acceptable levels.

Voice alarm equipment incorporates large standby batteries and audio power amplifiers that generate unwanted heat. Therefore, care needs to be taken to ensure the environment is maintained within the required temperature range and ventilation recommended by the voice alarm equipment manufacturer is provided.

29.1 The environmental conditions at each location and measures required to prevent actual or latent damage to the equipment should be identified in the system design documentation. This should include temperature, dust/moisture ingress, humidity, and vibration. Equipment should not be installed in a plant room (or any such location) unless the room is maintained in an acceptable state, including being free of dust from other trades.

NOTE Electronic equipment can fail due to dust-clogged heat sinks or fans. It can also fail due to corrosion of terminals.

29.2 Voice alarm equipment, e.g. loudspeakers, mounted outdoors should be selected for its ability to withstand the environmental conditions expected at that location. If deemed necessary, the equipment should be treated prior to installation.

29.3 The material used in mechanical joints should be selected such that the risk of corrosion and possible falling of equipment is minimized.

NOTE A falling loudspeaker could damage people or property, for example.

29.4 All voice alarm equipment, such as loudspeakers, should be positioned so as to reduce the risk of mechanical damage, for example at a height normally beyond the reach of people.

30 Radio and electrical interference

*COMMENTARY ON **30***
Particular care needs to be taken in the design and installation of the VAS to avoid electromagnetic interference, particularly received from, but also transmitted to, other equipment. Electromagnetic interference to a VAS can result from mobile telephones, radio transmitters, other equipment used within the building, lightning and power transients. Electromagnetic interference might cause a malfunction of some VASs if voice alarm cables are in close proximity to power cables with high current, inductive loads. The extent to which this might occur depends on a number of factors including:

a) the susceptibility of the particular voice alarm equipment to electromagnetic interference;

b) the level of screening afforded by the cable;

c) the separation distance between the voice alarm cables and the cables of other services.

*All cables recommended in Clause **27** provide a degree of screening, but care needs to be taken to ensure good installation practice in, for example, terminations, and that, where practicable, voice alarm cables do not run unnecessarily long distances (i.e. more than 35 m in aggregate) in close proximity to high current power cables, particularly if these serve highly inductive loads.*

Electromagnetic interference can be reduced where there is a metal partition between the voice alarm cables and the power cables (as in the case of compartmented trunking). Achievement of separation between voice alarm cables and the cables of other services *throughout an entire installation might not be practicable; for example, economy of installation might dictate that voice alarm cables share common tray or ducts with cables of other services. Care is necessary, however, to minimize the extent to which separation is not maintained, unless guidance from the system manufacturer indicates that separation is unnecessary; the extent will be minimized if, for example, voice alarm cables always cross the cables of other services at right angles.*

30.1 VASs should be so designed and installed that they do not cause and are not unduly susceptible to electromagnetic interference.

NOTE Attention is drawn to the Electromagnetic Compatibility Regulations 1992 [2], which implement the EMC Directive [3].

30.2 Every system component should satisfy the relevant requirements of the product standard for that component in respect of electromagnetic capability (see Clause **11**).

30.3 Cables should be segregated in accordance with **27.16**.

30.4 Installation workmanship should conform to the relevant recommendations of Section 3, particularly in relation to quality of terminations and continuity of screens. For mineral insulated copper sheathed cables, terminations of screens should be effective around the entire 360° of the screen. For other cables, care should be taken to ensure that the screen of the cable is continued to the appropriate terminal in the voice alarm equipment or external equipment, normally achieved using cables where an uninsulated circuit protective conductor is in constant contact with the screen throughout its length.

30.5 Any cable specifications stipulated by the manufacturer as important for conformity with the EMC Directive [3] should be adhered to. However, cables that do not conform to this standard should only be used with the prior agreement of all interested parties (see Clause **6**) and be recorded as a variation (see Clause **7**).

30.6 Correct earthing of equipment is vital for adequate EMC performance as well as electrical safety; therefore note should be taken of the Clause **31** recommendations, particularly in respect of the differences between protective and functional earth connections.

30.7 Exposure of the cores outside of the screen should be kept to a minimum, consistent with practical installation requirements.

30.8 Where the manufacturers of the voice alarm equipment advise that the system is sensitive to multiple screen earths for each circuit, then their instructions in respect of these should be followed (see Clause **31**).

30.9 Where required, the screen should have continuity throughout the whole circuit.

30.10 Where it is necessary to cross VAS cables with those that can potentially cause interference, the cables should be crossed approximately at right angles.

31 Electrical safety

*COMMENTARY ON **31***
A VAS is a special form of electrical installation, much of which operates at extra low voltage (ELV) but some of which operates at low voltage (LV) whereby the BS 7671 recommendations regarding safety and earthing are applicable.

It is important to understand that mains supplied equipment normally has a circuit protective conductor (CPC) to provide a protective earth. Some electrical equipment, e.g. double insulated, does not have a protective earth because of inherent safety built into the design but, in general, low voltage mains supplied (LV) voice alarm equipment does require a protective earth.

VASs may have one or both of the following types of earth connection:

a) *protective earth (PE), intended to protect from shock hazard anyone touching exposed conductive parts of the installation. In the event of a fault, the CPC is intended to conduct the fault current to earth, causing a final circuit protective device to operate and disconnect the supply, so preventing shock hazard;*

b) *functional earth (FE), an earth provided for purposes not necessarily related to safety, but primarily a screen for electromagnetic compatibility (EMC) purposes (see Clause **30**). The FE needs to have continuity throughout all relevant circuits. It needs to be connected according to the voice alarm equipment manufacturer's instructions. There may be more than one FE, each associated with, for example, a loop, a radial circuit or an interface. Unless the manufacturer advises otherwise, each FE circuit needs to be connected to the PE at one place only. The FE might not necessarily meet the requirements of a CPC. An example of FE for loudspeaker wiring is shown in Figure 5. Note that, in this example, the FE or screen is terminated only at the VACIE, avoiding fortuitous earths and providing the FE to the loudspeaker circuit. An example of FE for a network is shown in Figure 6. Note that in this example, the FE does not interconnect two items of equipment, but is terminated at one only. The whole network in this example would be made up in this way.*

If, according to the manufacturer's instructions, the FE and PE are or are intended to be the same (as would normally be the case when mineral insulated copper sheathed cable is used), it is acceptable to connect the screen to the earth at more than one point.

Particular care is necessary to ensure the adequacy of earthing and of protection against shock from exposed metal parts. Expert advice (for example from the equipment manufacturers) might be necessary in complex sites in which different earth potentials exist, so that electrical safety is not compromised and circulating currents are avoided.

The designer also needs to ensure that the system can be maintained safely. The mains (LV) power supply for each equipment needs to have a double pole isolation facility nearby.

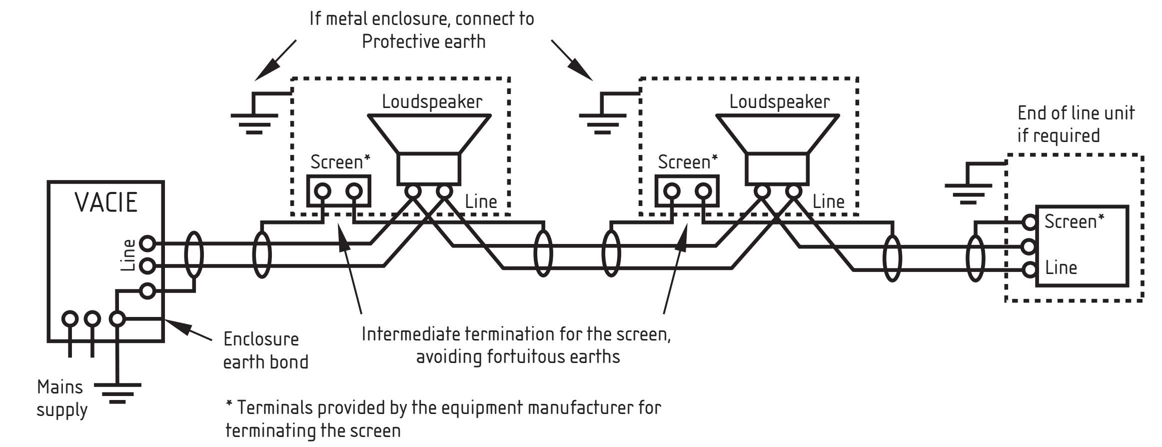
31.1 The system design should conform to BS 7671. In particular, CPCs should be adequately rated.

31.2 The voice alarm manufacturer's instructions or product marking should be followed, particularly in respect of earthing arrangements.

31.3 LV and ELV circuits should be segregated throughout in accordance with **27.15**. In particular, if any voice alarm cables share the same wiring containment with other cables, the cable insulation of the voice alarm cables should be rated for the highest voltage.

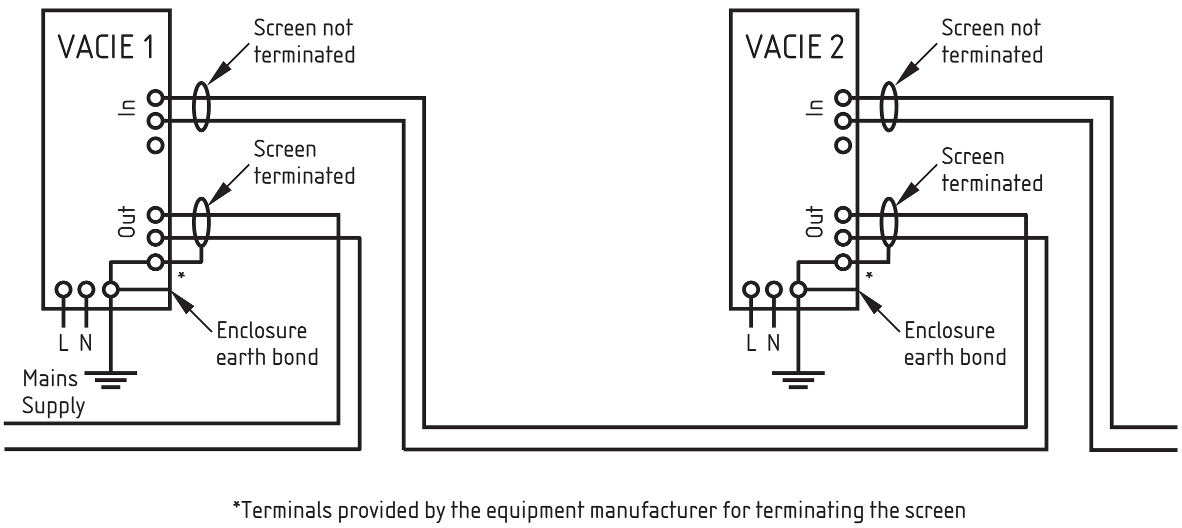
31.4 Means should be provided for isolation of the mains power supply to all parts of the system (see **26.1.3**).

Figure 5 **Example of 70/100 V line loudspeaker circuit**



NOTE This figure shows a separate earth at each metal loudspeaker enclosure. In practice, it might be necessary to run a separate circuit protective conductor (CPC).

Figure 6 **Example of network wiring**



Section 3: Installation

32 Responsibility of installer

*COMMENTARY ON **32***

This section provides recommendations for the work associated with installation of the voice alarm equipment in a building. This work might be undertaken by the same organization that designed the system or by a different organization. For example, the designer and installer might be a single, specialist voice alarm contractor. Alternatively, the purchaser might be responsible for the design of a VAS (which might be undertaken by consultants acting on behalf of the purchaser), and the design might then be communicated, by means of a specification and/or drawings, to a specialist voice alarm contractor or to an electrical installation contractor, which would, in either case, then be responsible for installation.

*Various contractual arrangements are possible but it is important that one organization is responsible for compliance with this section of the standard and that this responsibility is agreed prior to the start of the installation contract (see Clause **6**).*

*It is not, in general, the responsibility of the installer to check or verify whether the design of the system conforms to this standard, unless the installer is also the designer (see commentary on Clause **6**). The responsibility of the installer is to install the system in accordance with the requirements of the design specification and to follow good practice in the installation work. However, in practice, conformity to a number of recommendations in Section 2 impact on both design and installation, and may, therefore, be delegated by the designer to the installer, provided the responsibility for compliance is made clear in any specification or contract, that the installer is competent to address the issues and that the responsibility is accepted by the installer. For example, the designer may delegate decisions regarding cable routes to the installer, by simple reference in the design to compliance with Clause **27**, with which it would then be the responsibility of the installer to comply.*

*At the design stage, the designer might have inadequate information to enable compliance with all recommendations of Section 2. For example, it is rarely possible, at the design stage, to warrant that the recommendations of audibility of non-speech messages and intelligibility of speech messages in respect of sound pressure levels and intelligibility will be satisfied by a particular number and distribution of voice alarm loudspeakers. Similarly, drawings on which the design is based might not show sufficient information about structural features of the building to enable the design to conform to Clause **14** in respect of spacing and siting of loudspeakers. Accordingly, it will often be necessary for compliance with certain clauses of Section 2, or verification of compliance, to rest with the installer.*

Even though identification of design shortcomings is not generally the responsibility of an installer, good practice dictates that, if the installer is aware of such shortcomings, particularly those arising from features of the building that might not have been known to the designer, they be drawn to the attention of the designer, user or purchaser.

VACIE can be heavy and bulky, can need a large amount of space for access for maintenance and can emit considerable heat.

VACIE is often used for non-life-safety purposes and controls may be provided in the same location. Care is needed to ensure that access to these controls does not necessarily include access to emergency controls.

End of line devices of varying complexity are often required for monitoring loudspeaker circuit integrity. There may be several such devices on each circuit, for example where monitoring individual loudspeaker circuit spurs. It is important that end of line devices are accessible for servicing and maintenance, that they are clearly identified and that their locations are recorded.

Loudspeakers are commonly provided with several power tappings which, if incorrectly set, can result in overloading of the amplifier circuit or difficulty in adjusting the system *for intelligibility. To minimize corrective adjustment at commissioning, it is important that the power tapping of each loudspeaker is correctly set according to the agreed design during the installation (while access is available). A clear record of each loudspeaker setting is desirable for future reference.*

Some voice alarm loudspeakers can be heavy and so there is a risk of injury if they are not adequately secured.

32.1 The responsibilities associated with the installation of the system should be clearly defined, agreed and documented prior to the commencement of work.

32.2 The installer should conform to **6.3** and Clause **7**.

32.3 The installer should ensure that:

a) adequate space is provided around the equipment for access;

b) the structure can accept the weight of the equipment;

c) adequate cooling/ventilation is provided to keep the equipment within its rated temperature range.

32.4 All cables should be clearly identified, at least at each end and all the joints on route. These should be accurately recorded for future reference.

32.5 The installation of emergency microphones should be in accordance with the recommendations of **18.2**c) and **18.3** to **18.7**.

32.6 The loudspeakers should be installed according to the agreed design in respect of type, location, orientation and power tapping. The installer should record the power tappings of loudspeakers as set during the installation.

32.7 End of line devices should be clearly identifiable and their locations should be accessible and accurately recorded on the as-fitted drawings.

32.8 Consideration should be given to the weight of each loudspeaker to determine if a secondary fixing device is necessary.

NOTE For example, a safety chain is often used for suspended loudspeakers over 5 kg.

32.9 The installer of the mains power supplies should only use supplies in accordance with **26.1**.

32.10 To facilitate safe maintenance work, the installer should site VACIE and power supply equipment likely to need routine attention in accessible locations.

32.11 All metallic parts of the installation, including conduit, trunking, ducting, cabling and enclosures, should be separated from any metalwork forming part of a lightning protection system.

*NOTE Further guidance is given in BS 6651:1999+A1:2005, Clause **19** and **A.2**.*

32.12 The installer should provide as-fitted drawings which include, but are not limited to, the following:

a) the positions of all VACIE and power supply equipment;

b) the positions of all loudspeakers;

c) the position(s) of microphone(s);

d) the positions of all equipment that might require routine attention or replacement (e.g. ancillary equipment, end of line devices and short circuit isolators);

e) the type, sizes and actual routes of cables.

*NOTE See **36**c).*

32.13 In the case of extensions or alterations, the installer should update the existing as-fitted drawings.

32.14 On completion of the installation work, the installer should issue a certificate in accordance with the model certificate given in **D.2**, signed by a competent person.

NOTE Under BS 7671, the installer of the mains supply is required to issue an electrical installation certificate in accordance with the requirements of that standard. If the installer of the fire detection and fire alarm system does not install the mains supply, the installer of the mains supply ought also to issue a certificate in accordance with the model given in ***D.2*** *solely in respect of the mains supply.*

32.15 If the designer accepts responsibility for variations and this is communicated in the form of specific written requirements (e.g. within a specification) the installer should record these variations within the installation certificate.

33 Installation practices and workmanship

COMMENTARY ON ***33***
The nature and quality of the installation work needs to be such as to maintain the integrity of the VAS and minimize the duration and extent of disablement of the system during maintenance or modifications.

Penetration of construction (e.g. for the passage of cables, conduit, trunking or tray) needs to be made good to prevent the free passage of fire or smoke, regardless of whether the construction has a recognized degree of fire resistance.

33.1 Installation practices and workmanship should, where applicable, conform to BS 7671.

NOTE In general, the recommendations of this standard supplement, but do not conflict, with BS 7671. Where any such conflict is considered to exist, the recommendations of this standard take precedence.

33.2 Cables that are directly fixed to surfaces should be neatly run and securely fixed at suitable intervals, in accordance with the cable manufacturer's recommendations. Cables should not rely on suspended ceilings for their support.

33.3 All wiring should conform to Clause **27**.

33.4 Cables should be installed without external joints wherever practicable. All terminations and other accessories should be such as to minimize the probability of early failure in the event of fire. Other than in the case of joints at or within system components such as VACIE, power supply equipment and loudspeakers, terminals used to joint cables should be constructed of materials that will withstand a similar temperature and duration to that of the cable. All joints, other than those within system components, should be enclosed within junction boxes, labelled with the words "VOICE ALARM" to avoid confusion with other services.

NOTE Examples of suitable terminals include metal components mounted in ceramic terminal blocks.

33.5 No definitive guidance can be given on the means for ensuring that the entire cable system, as opposed to the cable itself, can provide adequate resistance to the effects of fire; therefore the manufacturer's recommendations should be followed.

33.6 Arrangements for earthing should be in accordance with the recommendations of the manufacturer. Care should be taken to ensure the electrical continuity of electromagnetic screens, including metallic sheaths of cables.

33.7 Where new conduit, trunking or tray is installed, its capacity should be in accordance with BS 7671.

33.8 Where a cable passes through an external wall, it should be contained in a smooth-bore sleeve of metal or other non-hygroscopic material sealed into the wall. This sleeve should slope downwards towards the outside and should be plugged with a suitable non-hardening waterproof compound to prevent the entry of rain, dust or vermin.

33.9 Where a cable passes through an internal wall, a small clearance hole should be provided. If additional mechanical protection is necessary, a smooth-bore sleeve should be sealed into the wall.

33.10 Care should be taken to ensure that the ends of any sleeves are free from sharp edges which might damage cables during installation.

33.11 When a cable passes through a floor, the recommendations of **33.8** to **33.10** should be applied. The sleeve should extend as far above floor level as is necessary to provide adequate protection of the cable, but no less than 300 mm.

33.12 Where cables, conduits, trunking or tray pass through floors, walls, partitions or ceilings:

a) the surrounding hole should be as small as reasonably practicable and made good with fire stopping materials that ensure that the fire resistance of the construction is not materially reduced;

b) spaces through which fire or smoke could spread should not be left around the cable, conduit, trunking or tray.

33.13 If cables or conduits are installed in channels, ducts, trunking or shafts that pass through floors, walls, partitions or ceilings, barriers with the appropriate level of fire resistance should be provided within the channels, etc., to prevent the spread of fire unless, in the case of ducts and shafts, the construction of the duct or shaft affords equivalent fire resistance to the structure penetrated.

NOTE In the latter case fire stopping need only be provided where cables pass into, or out of, the duct or shaft.

34 Inspection and testing of wiring

*COMMENTARY ON **34***
*On completion of wiring, or sections of wiring, the installer needs to carry out tests to ensure the integrity of cable insulation and adequacy of earthing. Usually, the tests on cables will be carried out with equipment disconnected and prior to completion of the entire system. Further tests need, therefore, to be carried out on completion of the system and these tests will form part of the commissioning process. In some systems, maximum circuit impedance or minimum circuit capacitance might be specified by the system manufacturer, in which case any measurements of impedance or capacitance recommended by the manufacturer also need to be carried out, either on completion of installation or at commissioning (see Clause **35**).*

34.1 All installed cables with a manufacturer's voltage rating suitable for mains use should be insulation tested at 500 V DC. Cables should be disconnected from all equipment that could be damaged by the test.

34.2 When tested in accordance with **34.1**, insulation resistance between conductors, between each conductor and earth, and between each conductor and any screen, should be at least 2 MΩ.

NOTE VACIE can have fault sensing for wiring insulation resistance to earth. If this is, for example, set at 1 MΩ, the combined effect of all wiring earth insulation resistance ought to be well above this to avoid nuisance fault indications. For large systems, this 2 MΩ minimum needs to be much higher to achieve something in excess of 1 MΩ overall.

34.3 Continuity of all circuits should be tested.

34.4 Earth continuity and, for mains supply circuits, earth fault loop impedance, should conform to BS 7671.

34.5 On completion of the installation work, after connection of all loudspeakers, the following tests should be carried out, unless there is specific agreement that they will form part of the commissioning process:

a) the 1 kHz impedance of every loudspeaker circuit;

b) correct polarity of circuits where this is required;

c) any other tests specified by the manufacturer of the system.

34.6 The results of all tests should be recorded and made available to the organization responsible for commissioning the system.

Section 4: Commissioning and handover

35 Commissioning

*COMMENTARY ON **35***
*The process of commissioning involves thorough testing of the installed VAS. At completion of commissioning, it needs to be confirmed that all relevant documentation has been handed over to the user (see Clause **36**). The organization responsible for commissioning the system might, or might not, be the same organization that designed and/or installed the system, but the responsibility for commissioning needs to be clearly defined prior to the start of the installation work.*

*The responsibility of the commissioning engineer is to verify that the system operates correctly in the manner designed and that the installation workmanship is of an adequate standard. However, in practice, it might be difficult to ensure that the system conforms to Section 2 until the time of commissioning. For example, commissioning might represent the first (and only) opportunity to determine whether the number and distribution of voice alarm loudspeakers is sufficient to conform to Clause **21** and Clause **22** in respect of sound pressure levels and intelligibility. Similarly, commissioning presents an opportunity to ensure that structural features of the building, of which the designer might have been unaware, do not compromise the effectiveness of the system as it was originally designed.*

Accordingly, it will be necessary for anyone responsible for commissioning a VAS to possess at least a basic knowledge of voice alarm design practices and of the recommendations of Section 2 and Section 3 of this standard. It will also be necessary for the commissioning engineer to be provided with the agreed specification for the system.

35.1 The system should be commissioned by a competent person (see BS 5839-1), who has access to the requirements of the designer (i.e. the system specification) and any other relevant documentation or drawings.

35.2 Any person responsible for commissioning a VAS in accordance with the recommendations of this standard should possess, at least, a basic knowledge and understanding of Section 2, Section 3 and Section 4 of this standard.

35.3 At commissioning, the entire system should be inspected and tested to ensure that it operates satisfactorily and that, in particular:

a) labelling or other means of visual identification, if specified, have been carried out;

b) sound pressure levels throughout all areas of the building conform to Clause **21**;

c) an acceptable level of intelligibility is achieved throughout all areas of the building in accordance with Clause **22**;

d) the agreed "cause and effect" requirements (e.g. message distribution) are correctly implemented;

e) all alarm control, indicating, printing and ancillary functions of the system operate correctly and are adequately labelled or identified;

f) no changes to the building since the time of the agreed design have compromised the system's conformity (e.g. by erection of new partitioning that affects the effectiveness of the VAS);

g) siting of control, indicating and power supply equipment conforms to **24.1** and **26.2.3**);

h) a suitable evacuation zone plan is displayed in accordance with **24.3.5**);

i) the provision of any visual alarms conforms to the system specification;

j) mains power supplies are inspected as far as reasonably practicable to check conformity with **26.1**;

k) standby power supplies conform to **26.3** and the actual load currents of the system, in all circumstances, are close to the predictions used by the designer to determine the battery capacity;

l) labels, visible when batteries are in their normal position, are fixed to batteries, indicating the date of installation (see **26.3.3**);

m) as far as it is reasonably practicable to ascertain, the specified cable type has been used in all parts of the system and the workmanship conforms to Clause **33**;

n) in radio-linked systems, radio signal strengths are adequate throughout all areas of the protected premises to ensure reliable operation of the system;

o) all fault monitoring functions operate correctly by simulation of fault conditions;

p) all relevant documentation (see Clause **36**) has been provided to the user or purchaser;

q) on completion of commissioning, a certificate signed by a competent person in accordance with the example given in **D.3** has been issued.

35.4 All results obtained during the commissioning process should be clearly recorded.

36 Documentation

*COMMENTARY ON **36***
*On completion of the system, it needs to be ensured that adequate records and other documentation are provided to the user or purchaser. The responsibility for provision of the documentation may rest with more than one organization and needs to be defined before an order for the system is placed. On completion of commissioning, it needs to be ensured that either the documentation has been provided to the relevant parties, or that any absent documentation is identified for appropriate action (see Clause **35**).*

Particular importance needs to be attached to the preparation and accuracy of as-fitted drawings and operation and maintenance manuals. Without these drawings and manuals, maintenance or future modification of the system might be difficult.

The following documentation should be provided to the purchaser or user of the system:

NOTE 1 The contract for design, supply, installation and commissioning of the system needs to define the type of documentation which is to be provided to each organization involved.

a) certificates for design, installation and commissioning of the system (see Clause **37**);

b) an adequate operation and maintenance manual for the system; this should provide information, specific to the system in question, regarding the following:

- a list of equipment provided and its configuration (e.g. schematic diagram), including, for radio-linked equipment to which **28.7**b) applies, the background RF noise level and achieved signal strengths;
- use and operation of the system;
- routine weekly and monthly testing of the system by the user or their appointed agent, in accordance with Clause **40**;
- service and maintenance of the system, in accordance with Clause **41**;
- the need to keep a clear space around all emergency microphones and controls;

- the importance of ensuring that changes to the building, such as relocation of partitions, do not affect the standard of protection;
- other user responsibilities (see Section 6).

c) as-fitted drawings indicating but not limited to the following:
- the positions of all control, indicating and power supply equipment;
- the positions of all emergency microphones, loudspeakers and other fire alarm devices;
- the positions of all equipment that may require routine attention or replacement (e.g. ANS microphones);
- where applicable, the power tappings of all loudspeakers;
- the type, sizes and actual routes of cables;

NOTE 2 The cable routes shown need to comprise a reasonable representation of the route followed, such as to enable a competent person to locate the cable in the event of a fault or need for modification or extension of the system; a simple schematic showing the sequence in which devices are wired is unlikely to satisfy this recommendation, other than in small, simple systems. In some complex buildings a cabling schedule cross-referencing the drawings may be necessary in order to help explain the cable routes.

*NOTE 3 In the case of extensions or alterations, existing as-fitted drawings need to be updated. See **32.13**.*

d) a logbook for recording the information as recommended in Clause **44**;

e) a record of any agreed variations from the original design specification;

f) records in accordance with Clause **34** and Clause **35**.

37 Certification

*COMMENTARY ON **37***
On completion of design, installation and commissioning, a separate certificate needs to be issued for each process, confirming conformity to this standard for the stage in question (i.e. design, installation or commissioning) or identifying variations. Each process might be undertaken by one organization or different organizations. Whichever arrangement applies, three separate certificates need to be issued. An organization may issue a certificate for the process for which they are responsible, regardless of whether a certificate has been issued for either of the other processes.

It is essential that the person(s) who sign(s) these certificates is competent to verify whether the recommendations of this standard in respect of the process to which the certificate refers have, or have not, been satisfied. The purchaser or user might, subsequently, rely on the certificate as, for example, evidence of compliance with legislation. Liability could arise on the part of any organization that issues a certificate without due care in ensuring its validity.

The purchaser will be asked to complete an acceptance certificate provided by the organization bearing contractual responsibility for the system upon completion. The purpose of this certificate is to provide a record that the purchaser is satisfied that the requirements of the specification have been met. The certificate also needs to confirm that adequate documentation has been handed over to the user, that the user has been instructed in the use of the system and understands their obligations in respect of the maintenance of the system. The purchaser might wish to carry out an independent inspection of the system, or to witness certain tests (which may include any or all commissioning tests) as a prerequisite for completion of the acceptance certificate.

For certain (usually large and/or complex) systems, the purchaser or user might wish to arrange for independent verification of conformity with this standard. If so, a verification certificate needs to be issued by the verifier.

37.1 On, or as soon as practicable after, completion of each of the following processes, a certificate should be issued by the organization responsible for the process, certifying compliance with the recommendations of this standard in respect of the process or, if variations exist, clearly identifying these variations:

a) design;

b) installation;

c) commissioning;

d) acceptance;

e) verification.

37.2 If a purchaser or user commissions an independent audit to verify, as far as practicable, conformity (see Clause **39**), the purchaser should request that the auditor issues a verification certificate.

37.3 Where modifications are carried out to a system (see **42.3**), the purchaser should request that the organization responsible for the work issues a modification certificate.

37.4 Information and statements of compliance within the certificate models for design, installation, commissioning, acceptance, verification and modification provided (see Annex D) should be included on the certificate, but the certificate may vary in format from those models.

NOTE Where a single organization is responsible for the appropriate design, installation and/or commissioning of both the fire detection and fire alarm system and the VAS, it is acceptable for BS 5839-8 and BS 5839-1 modular certificates to be combined.

38 Acceptance

*COMMENTARY ON **38***
On completion of the system, arrangements need to be made for formal handover of the system to the purchaser or user, and formal acceptance of the system by the purchaser (or representative of the purchaser).

Before accepting the handover of the system, the purchaser or a representative needs to ensure that they are satisfied with the installed system, that the user has an adequate understanding of the operation of the system and the emergency messages that could be broadcast, and that relevant documentation has been provided. In the case of small, simple systems, or systems installed in the premises of small organizations with little relevant in-house expertise, acceptance might involve little more than a brief inspection of the system by the user, demonstration of its operation by the commissioning engineer, and handover of the relevant documents to the user. In large, complex systems, it is likely that the purchaser would wish to witness relevant tests, as part of a formal and structured acceptance procedure.

*As evidence of acceptance, an acceptance certificate needs to be signed by the purchaser (see Clause **37**).*

38.1 Acceptance procedures should be carried out in accordance with the agreed purchase specification [see **6.6**d)], including any tests that are to be witnessed and details of the witnessing procedure.

38.2 Before accepting a system, the purchaser (or appropriate representative of the purchaser) should check that:

a) all installation work appears to be satisfactory;

b) the system is capable of giving an emergency message broadcast when initialized from the fire detection equipment and, if provided, from the VACIE;

c) the system is capable of giving an emergency live microphone broadcast from all emergency microphones (if installed);

d) all emergency broadcasts are at the correct priority (see **23.1**);

e) the system is capable of providing intelligible and audible emergency broadcasts in accordance with Clause **21** and Clause **22**;

f) the system fully operates when the primary power supply is removed;

g) the following documents have been provided to the purchaser or user:

- as-fitted drawings;
- operating and maintenance instructions;
- certificates of design, installation and commissioning (see Clause **37**);
- a logbook (see Clause **44**);

h) sufficient representatives of the user have been adequately trained in the operation of the system, including but not limited to means of broadcasting emergency signals and the correct use of emergency microphones (if installed);

i) the relevant member of the premises management (see **3.22**) has been advised of their responsibilities and how these might be discharged (see Clause **43**);

j) all relevant tests, defined in the purchase specification, have been witnessed.

38.3 As evidence of acceptance, the purchaser (or appropriate representative of the purchaser) should sign an acceptance certificate (see Clause **37**).

39 Verification

*COMMENTARY ON **39***
The purchaser or user might decide that there is a need for verification of conformity of the installed system as a result of one or more of the following:

a) the division of work elements between different organizations;

b) the evolution of the building design during construction;

c) the lack of detailed information at the time of design.

The verifying organization might be one of those involved in the design, supply, installation or commissioning processes (e.g. the system supplier or the designer) or an independent third party.

It is important that any person assigned to carry out the verification process is competent and experienced in the design of VASs conforming to BS 5839, and familiar with the relevant installation practices.

39.1 Where a purchaser or user considers that there is significant potential for the installed system to deviate from this standard, verification of conformity should be arranged.

NOTE In the event that the verification process identifies areas of non-conformity, the purchaser or user might request a further verification of the affected areas after correction.

39.2 Any person responsible for verification should be competent in the design of VASs in accordance with this standard and familiar with the relevant installation practices.

39.3 The scope and extent of the verification process should be agreed between the purchaser or user and the organization responsible for verification.

39.4 On completion, a verification certificate should be issued (see **D.5**). The verification certificate should also contain information on the scope and extent of the verification carried out or identify where this information is available (e.g. a report).

Section 5: Maintenance

40 Routine testing

*COMMENTARY ON **40***
*Although modern VASs incorporate a high degree of automatic fault monitoring it is still necessary for the named member of the premises management (see Clause **43**) to ensure that fault indications at the VACIE or CIE are acted on.*

It is also important that regular tests are carried out to ensure that there has not been any major failure of the VAS and its link(s) with the fire detection and fire alarm system.

It is advisable that routine testing of the system with the emergency messages generally takes place at times of low occupancy. However, it is also advisable for staff and members of the public present to have some exposure to those emergency messages during testing, preferably on a monthly basis, but no less frequently than quarterly. The actual test intervals can be based upon an appropriate risk assessment for the building. For any further testing during occupied times, a test message may be used to allow people to report areas of low intelligibility.

If live emergency announcements or pre-recorded message control are possible, it is important that these facilities are fully understood by staff, who ought to be regularly drilled in their application. Routine testing can also provide an opportunity for operators to practice the use of manual controls and making emergency announcements.

In large or complex systems, it may be impractical to carry out all the required tests on one occasion and it may be necessary for tests to be carried out to a defined programme over a fixed period.

40.1 On a weekly basis, the nominated member of the premises management should ensure that:

a) the system is tested by operating a manual call point on the fire detection and fire alarm system and the correct emergency message is broadcast in the correct emergency loudspeaker zone according to the cause and effect plan;

   NOTE 1 It is not sufficient to test emergency messages from controls at the VACIE alone.

   NOTE 2 The test ought to be preceded by a pre-test announcement and followed by a "test complete'" announcement.

b) a minimum number of staff and public are exposed to the emergency message during the weekly testing of the VAS recommended in **40.1**a), except that, at intervals of not more than three months, but preferably monthly, depending upon an appropriate risk assessment for the building, the VAS test recommended in **40.1**a) should be carried out in normal working hours, so that all or most building occupants hear the emergency message broadcast;

c) an emergency microphone and its associated controls is checked for correct operation, including tests of emergency loudspeaker zones and emergency message controls as follows:

   - for Type V2 systems, check that a live message is broadcast;
   - for Type V3 and V4 systems, check that the live message is broadcast correctly in at least one zone;
   - for Type V4 systems, check that the pre-recorded message is broadcast correctly in at least one zone.

40.2 The weekly test should be carried out at approximately the same time each week and occupants instructed to report any instance of poor intelligibility of the voice alarm messages.

40.3 Type V5 systems should be tested in accordance with the system instructions.

40.4 A message should be broadcast to advise occupants that a test is about to commence and that no action is necessary. After the test, another broadcast should advise that the test is over and that action should be taken on all future announcements.

NOTE 1 The "test over" announcement may also ask that any lack of intelligibility is reported to the premises management.

*NOTE 2 See **20.8** for recommendations on test messages.*

NOTE 3 These test messages need to be pre-recorded for Type V1 systems but may be live for Type V2 to Type V5 systems.

40.5 Where the evacuation strategy requires live scripted announcements to be made, all operators who are expected to use the system should practise making announcements.

NOTE These exercises may form part of ongoing training for operators as part of the evacuation plan. Operator shift patterns may need to be altered to accommodate ongoing training for every operator.

40.6 Routine test results should be recorded in the system logbook (see Clause **44**).

41 Inspection and servicing

*COMMENTARY ON **41***
Periodic inspection and servicing is essential so that unmonitored faults are identified, preventive measures can be taken to ensure the continued reliability of the system, and the user is made aware of any changes to the building that affect the protection afforded by the system.

Periodic inspection and servicing needs to be carried out by a competent person with specialist knowledge of VASs, adequate access to spares and sufficient information regarding the system. Competence can be assured by using organizations that are third-party certificated by a UKAS-certificated certification body, to carry out inspection and servicing of VASs.

It is also important that the period between successive inspection and servicing visits is based upon a risk assessment, taking into account the type of system installed, the environment in which it operates and other factors that may affect the long term operation of the system.

Inspection and servicing might identify areas of potential non-compliance for consideration by the premises management. Prior to instigating corrective measures, care needs to be taken to check whether such cases represent an agreed variation in the original contract.

Routine servicing of a fire alarm system does not constitute a fresh review of system design; it is a verification of the functionality and serviceability of the existing system. Accordingly, it will not necessarily be the case that non-compliances with Section 2 of this Standard will be identified at the time of routine servicing; in any case, the maintenance technician might not be aware as to whether an apparent non-compliance is, in fact, simply an agreed variation, particularly if the design certificate is not available. However, at their own prerogative, the maintenance organization may point out aspects of non-compliance with Section 2. Nevertheless, any such advice provided to the user by the maintenance organization cannot be regarded (by users, enforcing authorities or any other party) as an implication that the maintenance technician has identified, or has endeavored to identify, all such areas of non-compliance, or that there has been any review of the original design.

41.1 At intervals not exceeding three months:

a) the date of installation of the batteries should be checked against the battery life recommended by the supplier and replacement batteries installed, if appropriate;

b) all vented batteries and their connections should be examined quarterly. Electrolyte levels should be checked and topped up as necessary.

41.2 At intervals not exceeding six months:

a) the system logbook should be examined, checking that any faults recorded received appropriate attention;

b) a visual inspection should be made to check whether structural or occupancy changes have affected the siting of loudspeakers. Particular care should be taken to verify whether:

- any new or relocated partitions have been erected affecting intelligibility and audibility;
- any changes to the use or occupancy of an area makes the existing loudspeaker design unsuitable, e.g. increase in ambient noise;
- any building alterations or extensions require the installation of additional loudspeakers and voice alarm equipment;

c) any structural or occupancy changes found in accordance with **41.2**b) should be reported to the premises management so that corrective works can be commissioned;

d) the organization commissioned for the corrective works [see **41.2**c)] should be competent in electro-acoustic design as recommended in Section 2. Following modification, the system should be recommissioned to the extent needed, all documentation brought up to date to reflect the new status and a modification certificate issued.

NOTE The organization carrying out the maintenance of the VAS is not necessarily competent in electro-acoustic design for the corrective works.

e) all emergency microphones should be visually examined for damage and tested to check that the selected areas receive an intelligible broadcast;

f) at least one automatic fire alarm initialization input should be operated to check that the correct messages broadcast to the correct areas are intelligible and audible. Sound pressure levels should be recorded in the logbook and compared to previous test results carried out at the same locations;

g) if applicable, any associated ANS should be checked for correct operation in accordance with the instructions of the supplier of the system;

h) the standby supply should be disconnected, checking that the system continues to operate correctly, when powered from the primary supply, under full alarm load condition;

i) batteries and their connections should be examined to check they are in a serviceable condition and not likely to fail before the next inspection;

j) vented batteries, where used, should be examined to ensure that the specific gravity of each cell is correct;

k) the primary power supply should be disconnected to check that the system continues to operate correctly, when powered from the standby supply, under full alarm load condition;

l) all controls and visual indicators at CIE should be checked;

m) all fault indicators and their circuits should be checked, where practicable, by simulation of fault conditions;

n) all ancillary functions of the CIE should be tested;

o) all printers should be tested to ensure that they operate correctly and that characters are legible;

p) radio systems should be serviced in accordance with the recommendations of the manufacturer;

q) all further checks and tests recommended by the manufacturer of the voice alarm equipment and other components of the system should be carried out.

41.3 At intervals not exceeding 12 months:

NOTE The work described might be carried out over the course of two or more service visits during each 12 month period.

a) all automatic fire alarm initialization inputs should be operated to check that the correct messages broadcast to the correct areas are intelligible and audible. Sound pressure levels should be recorded in the logbook and compared to previous test results carried out at the same locations;

b) when carrying out **41.3**a), all loudspeakers should be checked for their correct operation and, where appropriate, orientation;

c) if applicable, the cause and effect of the phased evacuation programme should be confirmed as being correct;

d) all manual initialization of emergency recorded messages should be operated in accordance with **41.3**a);

e) all loudspeakers should be visually examined for damage;

f) all unmonitored, permanently illuminated filament lamp indicators at control and indicating equipment should be replaced;

g) electromagnetic field strengths in radio-linked systems (see Clause **28**) should be checked;

h) a visual inspection should be made to confirm that all readily accessible cable fixings are secure and undamaged;

i) all further annual checks and tests recommended by the manufacturer of the VACIE and other components of the system should be carried out.

41.4 Following the work carried out in **41.1**, **41.2** and **41.3**, any outstanding defects should be reported to the premises management and the system logbook (see Clause **44**) should be completed.

41.5 On successful completion of the work, an inspection and servicing certificate should be issued (see **D.6**).

42 Non-routine attention

*COMMENTARY ON **42***
*The arrangements in Clause **41** are intended to maintain the system in operation under normal circumstances. However, from time to time, the VAS is likely to require non-routine attention, including special maintenance. Non-routine maintenance includes:*

- *a special inspection of an existing VAS when a new organization takes over maintenance of the system;*
- *repair of faults or damage;*
- *modification to take account of extensions, alterations or changes in occupancy;*
- *inspection and test of the system following a fire.*

42.1 On appointment of a new maintenance organization:

a) a special inspection of the existing VAS should be commissioned, including the records (see Clause **36**) in order to produce a plan for effective maintenance of the system;

b) areas of non-compliance should be documented and identified to the premises management and, although the degree of a non-compliance is subjective, the following non-compliances should be regarded as requiring resolution:

NOTE Not all non-compliances need to be rectified; this is a matter for the user to determine, based on the advice of the maintenance organization, the enforcing authorities, the insurer and any third-party advisers engaged by the user, as appropriate.

- levels of audibility of non-speech broadcast that fail to conform to Clause **21**;
- levels of intelligibility of speech messages that fail to conform to **22.3**;
- standby power supplies that fail to conform to **26.3**;
- cabling with fire resistance that fails to conform to Clause **27**;
- monitoring for faults of circuits that fail to conform to **12.1**;
- standards of electrical safety that fail to conform to Clause **31**;

c) if no logbook suitable for enabling conformity with Clause **44** exists, the maintenance organization should provide a suitable logbook.

42.2 For arranging repair of faults or damage:

a) where maintenance is carried out by a third party, such as a fire alarm or voice alarm maintenance organization, there should be an agreement for emergency call out to deal with any fault or damage that occurs to the system and this agreement should be such that, on a 24 h basis, a technician of the maintenance organization can normally attend the premises within eight hours of a call from the user;

NOTE It is accepted that this might not be possible in very remote areas and certain offshore islands, in which case this may be regarded as a variation from the recommendations of this standard in respect of maintenance arrangements; and will need to be recorded in the system logbook.

b) the name and telephone number of any third party responsible for maintenance of the system should be prominently displayed at the main VACIE, and the records and documentation as identified in Clause **36** kept updated;

c) the user should record all faults or damage in the system logbook, and arrange for repair to be carried out as soon as possible.

*COMMENTARY ON **42.2***
Modifications to the system can arise for a number of reasons, including:

- *extension of the system to cover previously uncovered or newly constructed areas of the building;*
- *changes to the cause and effect logic as a consequence of changes to the evacuation strategy or other changes within the fire detection and fire alarm system.*

It is possible, in some systems, for modification of the system configuration to be carried out remotely, e.g. via a modem.

Whether modifications are undertaken on site or remotely, great care needs to be taken to ensure that they do not affect conformity with this standard, or that existing non-conformities are not exacerbated.

Although the modifications may be carried out remotely by the maintenance organization, it would be appropriate for a competent person from the maintenance organization to visit the premises before the modification is carried out, to confirm the validity of the modification and consider its effect on conformity with this standard.

42.3 For modification work, regardless of whether it is carried out on site or remotely:

a) the responsibility of modifying a VAS should rest with a person who is competent in the principles of VAS design, and is conversant with this standard and the installed system, with access to the as-fitted drawings;

NOTE 1 This person may, for example, be the original designer, or a competent representative of the user or maintenance organization.

b) before modifying a VAS, care should be taken to ensure that the proposed modifications do not detrimentally affect the compliance of the system with fire safety legislation;

c) the premises management (see Clause **43**) should be aware of and agree in writing any modifications proposed for the system;

d) all components, circuits, system operations and site-specific software functions known to be affected by the modifications should be tested for correct operation following the modifications; in particular:

- if any additional load has been placed on the system, the rating of the power supply unit and the capacity of the standby batteries;
- if any additional load has been placed on the loudspeaker circuits, the amplifier(s) output rated power;
- if any changes have been made to the loudspeaker circuits, the fault monitoring system;
- if software has been modified, selective testing of other aspects of the system;

NOTE 2 The nature and extent of these tests cannot be specified in this standard; this will depend on the nature and extent of the software changes and needs to be defined by the organization responsible for the software changes.

e) on completion of the modifications, all as-fitted drawings and other relevant system records should be updated as appropriate;

f) on commissioning of the work and completion of the tests, a modification certificate should be issued, confirming that the work has been carried out in accordance with the recommendations of this standard, or identifying any variations (see **D.7** for a model modification certificate);

NOTE 3 A modification certificate will generally be necessary where the system changes include addition or removal of e.g. more than 5% of the loudspeakers or voice sounders, addition or removal of any emergency microphone or power amplifier, any change to the number of emergency loudspeaker zones, or any change to the VACIE that will alter the previously agreed "cause and effect" requirements.

g) where responsibility for the compliance, or otherwise, of the modified system with the recommendations of Section 2 of this standard rests with any person other than the organization carrying out the modification, that person should sign the appropriate section of the modification certificate and make it available with the system documentation (see Clause **36**).

42.4 After a fire:

a) every voice alarm loudspeaker, emergency microphone and visual warning device that might have been affected by the fire should be inspected and tested in accordance with **41.3**;

b) a visual examination and suitable tests should be carried out on any other part of the system that lies within the fire area and other areas affected by corrosive smoke from the fire and that might have been damaged by the fire (e.g. power supplies, VACIE and cable). Where there is evidence of damage, suitable action should be taken;

c) circuits external to the VACIE that might have been affected by the fire should be tested for correct operation;

d) on completion of the work, any defects found should be recorded in the system logbook, and the premises management notified accordingly.

42.5 After long periods of disconnection of the VAS, inspection and testing should be carried out in accordance with **41.3**.

Section 6: User responsibilities

43 Premises management

*COMMENTARY ON **43***
The role of the premises management is to ensure that the system is tested and maintained in accordance with this standard, that appropriate records are kept and that relevant occupants in the protected premises are aware of their roles and responsibilities in connection with the VAS. It is important that the premises management ensures that steps are taken to avoid situations that could be detrimental to the standard of protection afforded by the system.

Operator training is also an important role for the premises management and is essential to ensure correct functioning of the system.

43.1 A single, named member of the premises management should be appointed to supervise all matters pertaining to the VAS. This person should be given sufficient authority to carry out the following duties and should normally be the keeper of the documentation as described in Clause **36**.

a) Ensuring that the personnel involved in the operation of the system are trained on a regular basis, and the training programme is designed to include at least the following items:
   - where appropriate, microphone technique;
   - the function and use of all system controls;
   - the purpose of all system indicators;
   - the position, type and function of every part of the system;
   - the location and contents of the operation (user) manual.

b) Ensuring that the VACIE is checked at least once every 24 h to confirm that there are no faults on the system.

c) Ensuring that arrangements are in place for testing and maintenance of the system in accordance with Section 5.

d) Ensuring that the system logbook (see Clause **44**) is kept up to date and is available for inspection by any authorized person (e.g. representatives of enforcing authorities).

e) Establishing a liaison between those responsible for changes in, or maintenance of, the building fabric (including redecoration, etc.) to ensure that the work does not unnecessarily compromise the performance of the system or create system faults. If structural or occupancy changes occur or are planned, the named person should ensure that any necessary changes to the VAS are considered at an early stage.

f) Ensuring that, when changes are made to the system, operating instructions and as-fitted drawings, supplied in accordance with **36.1**b) and **36.1**c), are updated.

g) Ensuring that the spare parts agreed between the user and the organization responsible for the maintenance of the system are held within the premises.

44 Logbook

*COMMENTARY ON **44***
A logbook is kept for the purpose of recording all events that occur in respect of the system, including fire signals, fault signals and work on the system. This information might be of value to the organization that maintains the system. The logbook is called for under certain fire safety legislation, for example, the Regulatory Reform (Fire Safety) Order 2005 [4] or the Fire (Scotland) Act 2005 [5].

The logbook for the VAS may be combined with the fire detection and fire alarm system logbook.

The following information should be recorded in the logbook:

a) the name of the nominated member of the premises management;

b) any emergency broadcast not initialized by the fire detection and fire alarm system or manually from the VACIE;

c) details of the maintenance organization;

d) brief details of maintenance arrangements;

e) dates, times and types of all tests;

f) dates, times and types of all faults, disablements and defects;

g) dates and types of all maintenance (e.g. maintenance visit or non-routine attention).

Where the VAS logbook is combined with the fire detection and fire alarm system logbook, this should be clearly indicated in the combined logbook.

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

The design of any electro-acoustic system requires a minimum signal-to-noise ratio in order for it to be effective. The signal-to-noise ratio is the amount by which the sound pressure level (SPL) of the system exceeds the ambient noise. In the case of a VAS a signal-to-noise ratio of at least 10 dB is desirable to achieve intelligibility of speech messages (see **22.1**).

An increase of 3 dB in the system design SPL requires a doubling of amplifier power and possibly an increase in the number of loudspeakers. Therefore, it is important that the most realistic ambient noise level is taken as the design datum. This noise level ought preferably to be determined and agreed between the relevant parties (see Clause **6**) prior to any design.

Having stated how important the ambient noise level is in the design process, the question of how it is determined is now paramount. For existing buildings this is not too onerous since direct measurement is possible. For existing buildings which are to be redeveloped, some direct measurements might be appropriate. However, for new or substantially modified buildings, the determination of ambient noise is far more difficult. A valid assessment would be to take ambient noise measurements in a directly equivalent existing building. However, if this is not possible, then the nearest equivalent plus some rational extrapolation would be the most appropriate.

The ambient noise is rarely constant but changes according to the occupancy level and the activity within the space. The ambient noise level will also change throughout the building and a measurement or assessment in one part of the building might be irrelevant for use in another part of the building. An occupied building might have a mean ambient noise level under normal conditions. However, this could increase dramatically under emergency conditions and this needs to be considered when designing the system.

The assessment of ambient noise might usefully be tabulated according to the use of each area and annotated with the likely increase from the norm during worst case usage. When agreed by the interested parties, this table may then form the basis of the design criteria. The table might usefully include other parameters such as the design frequency response as a parameter for perceived quality of sound. Uniformity of coverage might not be feasible throughout the entire space and the table might also record a minimum design coverage for each area of the installation.

Table A.1 gives an example of design criteria for public spaces in a hotel.

Table A.2 gives actual measurements in differing circumstances in order to demonstrate realistic sound pressure levels. Note that the signal-to-noise ratio of only 1 dB in the station cafe renders the announcement unintelligible whereas the 13 dB signal-to-noise ratio of the mainline station platform provides the basis for good intelligibility. The range of SPL is given as guidance to assist when agreeing the ambient noise levels which will apply to a particular design.

The measurements in Table A.2 were mostly made as $L_{eqA,1min}$, which is an arithmetic average of a 1 min sample, since the period for which some events take place is quite short. For buildings which have a more sustained activity taking place, such as sports venues, exhibition centres and the like, the better unit of measurement is L_{A10}, which is the noise level exceeded for 10% of the measurement period with "A" frequency weighting calculated by statistical analysis over a representative period, T. The advice of an acoustician might be needed in order to specify a realistic noise parameter that can be agreed by all interested parties in order to establish a design SPL.

Table A.1 **Example of design criteria for public spaces in a hotel**

Area/room	Likely ambient noise dBA	Usage noise increase dB	Design SPL dBA	Design coverage	Design frequency response
cultural centre	70	3	83	80%	300 Hz – 6 kHz ±3 dB
lounge	70	4	84	80%	125 Hz – 12 kHz ±3 dB
toilets	60	9	79	80%	300 Hz – 6 kHz +3 dB
entrance lobby and lounge	73	6	89	90%	300 Hz – 6 kHz ±3 dB
bar lounge	65	9	84	80%	300 Hz – 6 kHz ±3 dB
speciality restaurant	65	9	84	80%	300 Hz – 6 kHz ±3 dB
conference room	70	6	86	95%	125 Hz – 12 kHz ±3 dB
meeting room	70	6	86	95%	125 Hz – 12 kHz ±3 dB
health club – internal	68	6	84	80%	300 Hz – 6 kHz ±3 dB
health club – aerobics	75	12	97	80%	300 Hz – 6 kHz ±3 dB

Table A.2 **Example of typical real life noise levels**

Typical level (L_{eq}) dBA	Location	Comments
45	domestic kitchen	quiet, no activity
50	rural garden	good breeze in trees, birdsong
50	general office	financial institution
58	suburban train carriage	slow speed, quiescent
62	mainline station platform	no trains
65	restaurant/canteen	financial institution
67	call centre office	financial institution
69	carriage of a train	high speed (approx. 100 mph)
70	saloon bar of pub	typical weekday crowd
72	station cafe (reverberant with ceramic floor)	quiescent, not many customers, background music, espresso coffee machine
73	station cafe (reverberant with ceramic floor)	as above but during an announcement (unintelligible)
75	mainline station platform	during an announcement (intelligible)
78	London Underground train carriage	Victoria Line (boarding)
85	mainline station platform	train passing through slowly
85	London Underground train carriage	Central Line (during journey)
87	London Underground train carriage	Victoria Line (approaching station and disembarking)
95 [A)]	football match crowd noise	30 000+ seater stadium
97 [A)]	vehicular traffic in a motorway tunnel	
98 [A)]	pop concert (outdoors)	at the mixer riser
100 [A)]	pop concert (indoors)	at the mixer riser

[A)] Measured as $L_{A10,T}$.

Annex B (informative) Voice alarm control and indicating equipment

B.1 The VACIE performs four principal functions, namely:

a) receipt and processing of commands from a fire alarm CIE and from manual controls, if provided;

b) automatic monitoring and control of circuits external to the equipment (such as loudspeaker circuits and fire alarm device circuits, if provided) and supply of power to these circuits;

c) indication of message status, fault signals and their location;

d) manual controls to facilitate actions such as testing, disablement of devices, triggering of messages, silencing of audible warnings and resetting the system after an evacuation signal.

As these facilities are used by different people at different times, not all facilities need to be provided at a single location. For example, depending on the premises, a general indication of faults might be sufficient for a site engineer, whereas accurate information on the location and status of an emergency message is essential to the operator of an emergency microphone with manual message control facilities.

In small, simple systems, the CIE and power supply equipment will normally be housed within a single enclosure. In large, complex premises, the main CIE might be installed at one location, power supplies and amplifiers might be distributed around the building, while the main emergency microphone and some manual controls might be installed at another location, such as a manned control room. Emergency microphones might be installed adjacent to CIE repeat indicating equipment at further locations such as alternative points of entry for the fire and rescue service.

Since premises vary in size, complexity and fire strategy, it is essential that the nature and siting of manual controls and indicating equipment, in particular, are suitable for the fire and evacuation procedures that are to be adopted and for the persons that will use the system, including security or reception staff and firefighters attending a fire. Siting of routing and prioritizing equipment, amplification and power supplies will probably be determined by engineering considerations and the preference of the purchaser or user.

It is important that emergency microphones and their associated manual control facilities are sited at an appropriate location where both staff and firefighters can manage an emergency situation (see Clause **18**).

For optimum efficiency during an emergency situation, it is important that labelling and layout of controls and indicators are clear and unambiguous, and they will preferably use the terms employed by the operators to describe particular areas.

It is essential that there is regular and effective training in the use of the controls. In general, the more manual controls that operators have, such as the ability to manually start and stop recorded messages, the more training in the use of these controls will be necessary.

In VASs, where spaces are acoustically linked and comprise multiple emergency loudspeaker zones, it might be necessary to delay the initiation of a particular message, to avoid playing it at the same time as another message. In those acoustically linked spaces comprising a single emergency loudspeaker zone, it is preferable that the message is synchronized throughout the zone.

B.2 In addition to the mandatory functions, controls and visual indications, BS EN 54-16 specifies a number of options with requirements. Some of these options were incorporated to meet requirements and practices in certain European countries. Other options with requirements are related to system size and/or complexity. The following options specified in BS EN 54-16 need to be considered.

a) The provision of audible indication of a voice alarm condition at the VACIE can contribute to background noise and interfere with live broadcast (BS EN 54-16:2008, **7.3**).

b) In general, the VACIE enters the voice alarm condition as soon as an initiating signal is received from the CIE and therefore no provision for delays at the VACIE before entering the voice alarm condition need be made at the VACIE (BS EN 54-16:2008, **7.4**).

c) Although, in many VASs, phased evacuation will be controlled by the CIE, alternatively, all systems may have provision, at the VACIE, to phase the warning signals to the emergency loudspeaker zones (BS EN 54-16:2008, **7.5**).

d) In V4 and V5 systems where the voice alarm condition has been manually triggered at the VACIE, provision for manually silencing and resetting the system at the VACIE may need to be made (BS EN 54-16:2008, **7.6.2** and **7.7.2**).

e) Provision may also be made for an output to non-voice fire alarm devices such as sounders, beacons and vibrating devices that will operate during a voice alarm condition (BS EN 54-16:2008, **7.8**).

f) Provision may be made at the VACIE for a common output to signal the presence of a voice alarm condition (BS EN 54-16:2008, **7.9**).

g) Faults related to the transmission path between the VACIE and the CIE will be given at the CIE. Optionally, faults related to the transmission path between the VACIE and the CIE may also be given at the VACIE [BS EN 54-16:2008, **8.2.4**c)].

h) In order to provide critical information for the management of the system during an emergency situation, it is important that, for V3, V4 and V5 systems, faults related to voice alarm zones are given at the VACIE [BS EN 54-16:2008, **8.2.4**d)].

i) In order to facilitate service and maintenance of the system, an option for disabling loudspeaker zones may be provided (BS EN 54-16:2008, Clause **9**).

j) For V3, V4 and V5 systems, where recorded messages are to be broadcast during an emergency situation, the VACIE will need manual controls (BS EN 54-16:2008, Clause **10**).

k) An optional interface to external control device(s) may be provided, for example, to connect graphic user panels (BS EN 54-16:2008, Clause **11**).

l) The option of emergency microphone(s) applies to V2, V3, V4 and V5 systems which have the ability to give live emergency broadcast (BS EN 54-16:2008, Clause **12**).

m) When more than one emergency microphone is connected to the VACIE, only one microphone may be active at any one time [BS EN 54-16:2008, **12**e)].

n) The optional provision of "redundant power amplifiers" is subject to a risk analysis (see Clause **16**) (BS EN 54-16:2008, **13.14**).

B.3 In Type V5 systems, the VACIE may provide indication and control facilities that are tailored to the specific evacuation needs of a complex building. In such a case, it is important that these are adequately documented and agreed with all the interested parties.

Annex C (normative) Standby battery calculations

C.1 Equation for calculating battery capacity

C.1.1 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 should be used for calculating the minimum total capacity of VLRA 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)];

D_1 is a derating factor derived from the battery manufacturer's data, based upon the standby quiescent current I_1 and the discharge time T_1.

This factor is the derating 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 BS 5839-1:2013, **25.4**e)2)], D_1 is the derating factor, read from the battery manufacturer's data, which takes into account that the discharge time is 6 h (and therefore not greater than 20 h);

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;

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

D_2 is a derating 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 derating from the 20 h rate and takes into account that the discharge time is normally 30 min (and therefore not greater than 20 h);

T_2 is the alarm condition period (in hours) [normally 30 min but may need to be longer; see BS 5839-1:2013, **25.4**e)]. A minimum period of 30 min 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 **C.2** 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 for a VAS automatically broadcasting speech messages.

C.1.2 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 Derating 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 **C.2**) and knowing T_2 (normally 30 min), 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.*

C.2 Equation for calculating I_2

C.2.1 Where the VAS broadcasts speech messages, the exact calculation of I_2 (see **C.1**) 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 an emergency microphone to override the emergency message. A method of calculating I_2 approximately is given in **C.2.2**.

C.2.2 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); and

f) the efficiency of the power amplifiers used as a percentage, η (100 × output power/input power).

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 ought to be taken into account at the design stage, resulting in an increased value for L.

NOTE 3 Where the exact efficiency of the power amplifiers is not known, η can be assumed to be about 50% for a class AB, or 80%–90% for a class D amplifier.

C.2.3 To derive from the output power requirement the associated input power from the battery, an allowance has to be made for amplifier efficiency. The maximum input power for a sinusoidal signal is $100L/\eta$ 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 $50L/\eta$ watts. I_2 can then be calculated from the following formula.

$$I_2 = \frac{100L(X/M)\eta + 50L(Y/M)/\eta}{V}$$

$$I_2 = \frac{50L(2X+Y)/\eta}{MV}$$

C.2.4 The calculated value of I_2 can now be used to determine the derating factor D_2 from the battery manufacturer's information.

Example:

Calculation of the standby battery capacity required, in ampere hours, for a VLRA battery to satisfy the following requirements for a VAS broadcasting speech messages (reference being made to **C.1**):

V = 24 V (standby battery voltage)

T_1 = 24 h (standby period)

T_2 = 30 min (period on full alarm load)

I_1 = 2 A (total quiescent current, including any monitoring current)

L = 1 000 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)

η = 90% (power amplifier efficiency for class D amplifiers)

$$I_2 = \frac{50L(2X+Y)}{\eta MV}$$

$$= \frac{50\ 000 \times (2 \times 8 + 24)}{90 \times 32 \times 24}$$

$$= \frac{50\ 000 \times (16+24)}{69\ 120}$$

$$= \frac{2\ 000\ 000}{69\ 120}$$

$$= 28.94\ \text{A}$$

$$= 28.9\ \text{A (approximately).}$$

The minimum battery capacity, C_{min}, required can now be calculated as follows (see **C.1**):

D_1 = 1

D_2 = 1.9 (from the manufacturer's data relating to a 52.1 A discharge rate for ½ h, for example, but see also **C.2.2**, Note 2)

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

$C_{min} = 1.25\ ([1 \times 24 \times 2] + [1.9 \times 0.5 \times 28.9])$

$C_{min} = 1.25\ (48 + 27.5)$

$C_{min} = 1.25 \times 75.5$

$C_{min} = 94.375$ 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 95 Ah.

Where the VAS broadcasts tones only (except for possible use of an emergency microphone for speech broadcast), it is suggested that:

a) where the VAS broadcasts only coded warning signals and/or live voice messages, I_2 can be calculated as follows:

I_2 = 100LX/ ηMV.

NOTE It is assumed that any use of the emergency microphone will override coded warning signals.

b) where the VAS broadcasts emergency signals simulating bells or sounders, and constituting "Evacuate" or "Alert" signals as described in BS 5839-1, I_2 should be calculated on the basis of the broadcast of a continuous "Evacuate" signal, i.e.:

$I_2 = 100L/\eta V$.

Annex D (informative) Model certificates

D.1 Design certificate

Certificate of design of the voice alarm system at:

Address: ....

....

.... Postcode: . ...

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the design of the voice alarm system, particulars of which are set below, CERTIFY that the said design for which I/we have been responsible complies to the best of my/our knowledge and belief with BS 5839-8:2013, Section 2 except for the variations, if any, stated in this certificate.

Name (in block letters):... Position: ....

Signature: .... Date:..

For and on behalf of: ....

Address: ....

....

.... Postcode: . ...

Variations from the recommendations of BS 5839-8:2013, Section 2:

....

....

....

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Extent of system covered by the certificate: ....

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Installation and commissioning

It is strongly recommended that installation and commissioning be undertaken in accordance with BS 5839-8:2013, Section 3 and Section 4.

Verification

Verification that the system conforms to BS 5839-8:2013 should be carried out, on completion, in accordance with BS 5839-8:2013, Clause **39**.

Yes ☐ No ☐ To be decided by the purchaser ☐

Maintenance

It is strongly recommended that, after completion, the system is maintained in accordance with BS 5839-8:2013, Section 5.

User responsibilities

The user should appoint a member of the premises management to supervise all matters pertaining to the voice alarm system in accordance with BS 5839-8:2013, Section 6.

D.2 Installation certificate

Certificate of installation of the voice alarm system at:

Address: ....

....

.... Postcode: . ...

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the installation of the voice alarm system, particulars of which are set below, CERTIFY that the said installation for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 5839-8:2013, Section 3, except for the variations, if any, stated in this certificate.

Name (in block letters):.. Position: ....

Signature: .... Date:..

For and on behalf of: ....

Address: ....

....

.... Postcode: . ...

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

....

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....

Specification against which the system was installed:

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....

....

....

Variations from the specification and/or BS 5839-8:2013, Section 3:

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....

Wiring has been installed and tested in accordance with BS 5839-8:2013, Clause **34**. Test results have been recorded and are provided on the appended BS 7671 electrical installation certificate:

....

Unless supplied by others, the as-fitted drawings have been supplied to the person responsible for commissioning the system (see BS 5839-8:2013, **32.13**.)

D.3 Commissioning certificate

Certificate of commissioning for the voice alarm system at:

Address: ....

....

.... Postcode: . ...

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the commissioning of the voice alarm system, particulars of which are set below, CERTIFY that the said installation for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 5839-8:2013, Clause **34**, except for the variations, if any, stated in this certificate.

Name (in block letters):.. Position: ....

Signature: .... Date:..

For and on behalf of: ....

Address: ....

....

.... Postcode: . ...

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

....

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....

....

Variations from BS 5839-8:2013, Clause **34**.

....

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☐ All equipment operates correctly.

☐ Installation work is, as far as can be reasonably ascertained, of an acceptable standard.

☐ The entire system has been inspected and tested in accordance with BS 5839-8:2013, Clause **34**.

☐ The system performs as required by the specification prepared by:

....

a copy of which I/we have given.

☐ The documentation described in BS 5839-8:2013, Clause **35**, has been provided to the user.

The following work should be completed before/after (delete as applicable) the system becomes operational:

....

....

....

D.4 Acceptance certificate

Certificate of acceptance for the voice alarm system at:

Address: ....

....

.... Postcode: . ...

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the acceptance of the voice alarm system, particulars of which are set below, ACCEPT the system on behalf of:

....

....

....

Name (in block letters):.. Position: ....

Signature: .... Date:...

For and on behalf of: ....

Address: ....

....

.... Postcode: . ...

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

....

....

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....

☐ All installation work appears to be satisfactory.

☐ The system is capable of giving an audible and intelligible voice alarm signal.

The following documents have been provided to the purchaser or user:

☐ As-fitted drawings.

☐ Operating and maintenance instructions.

☐ Certificate of design, installation and commissioning.

☐ A logbook.

☐ Sufficient representatives of the user have been properly instructed in the use of the system, including, at least, all means of triggering voice alarm announcements, silencing and resetting the system.

☐ All relevant tests, defined in the purchasing specification, have been witnessed. (Delete if not applicable.)

The following work is required before the system can be accepted:

....

....

....

D.5 Verification certificate (optional)

Certificate of verification for the voice alarm system at:

Address: ....

....

....

.... Postcode: . ...

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the verification of the voice alarm system, particulars of which are set below, CERTIFY that the verification work for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 5839-8:2013, Clause **39**.

Name (in block letters):... Position: ....

Signature: .... Date:...

For and on behalf of: ....

Address: ....

....

....

.... Postcode: . ...

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

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Scope and extent of the verification work:

....

....

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☐ In my/our opinion, as far as can reasonably be ascertained from the scope of work described above, the system conforms to, and has been commissioned in accordance with BS 5839-8, other than in respect of variations already identified in the certificates of design, installation or commissioning.

The following non-compliances with BS 5839-8 have been identified (other than those recorded as variations in the certificates of design, installation or commissioning):

....

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D.6 Inspection and servicing certificate

Certificate of servicing for the voice alarm system at:

Address: ....

....

....

.... Postcode: . ...

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the servicing of the voice alarm system, particulars of which are set below, CERTIFY that the said installation for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 5839-8:2013, Clause **41**, except for the variations, if any, stated in this certificate.

Name (in block letters):... Position: ....

Signature: .... Date:..

For and on behalf of: ....

Address: ....

....

....

.... Postcode: . ...

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

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Variations from BS 5839-8:2013, Clause **34**:

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☐ Relevant details of the work carried out and faults identified have been entered in the system logbook.

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D.7 Modification certificate

Certificate of modification for the voice alarm system at:

Address: ....

....

....

.... Postcode: . ...

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the modification of the voice alarm system, particulars of which are set below, CERTIFY that the said installation for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 5839-8:2013, Clause **34**, except for the variations, if any, stated in this certificate.

Name (in block letters):.. Position: ....

Signature: .... Date:..

For and on behalf of: ....

Address: ....

....

....

.... Postcode: . ...

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

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....

Variations from BS 5839-8:2013, Clause **34**:

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☐ Following the modifications, the system has been tested in accordance with BS 5839-8:2013, Clause **34**. Test results have been recorded and are provided on the appended BS 7671 electrical installation minor works certificate.

☐ Following the modifications, as-fitted drawings and other system records have been updated as appropriate.

I/we the undersigned confirm that the modifications have introduced no additional variations from BS 5839-8:2013 other than those recorded above:

Signed: ....

Capacity: ....

(e.g. maintenance organization, system designer, consultant or user representative)

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 476, *Fire tests on building materials and structures*

BS 5330, *Method of test for estimating the risk of hearing handicap due to noise exposure*

BS EN 61672-1, *Electroacoustics – Sound level meters – Part 1: Specifications*

BS EN ISO 9001, *Quality management systems – Requirements*

Other publications

[1] UNITED KINGDOM. Building Regulations Approved Document B Volume 2, *Fire Safety: Buildings other than dwelling houses*, as amended. London: NBS. 2006.

[2] GREAT BRITAIN. The Electromagnetic Compatibility Regulations 1992. London: HMSO. SI No. 2372.

[3] PARLIAMENT AND COUNCIL OF THE EUROPEAN UNION. Directive 2004/108/EC on the approximation of the laws of Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC.

[4] GREAT BRITAIN. The Regulatory Reform (Fire Safety) Order 2005. London: The Stationery Office.

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