

BRITISH STANDARD

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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Foreword

Publishing information

This standard is published by BSI and came into effect on 30 May 2008. It was prepared by Subcommittee FSH/12/5, *Fire alarm devices, voice alarm evacuation sub-systems 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.

Information about this document

This new edition of BS 5839-8 takes into account changes in technology, custom and practice since the publication of BS 5839-8:1998 and introduces the following principal changes:

- a) “types” of voice alarm systems have been introduced to recognize and identify the different configurations of systems that can be used and their specific operational needs;
- b) the need is clearly identified for the building evacuation plan to be based on a risk assessment by a competent person;
- c) recommendations in the use of voice sounders have been included as a clause in the main part of the code as opposed to an Annex, thus recognizing their increased acceptability in simpler voice alarm systems where manual control is not required;
- d) recommendations for voice alarm control and indicating equipment and power supply equipment have been rewritten taking into account that the new harmonized European standards, BS EN 54-16 and BS EN 54-4, give the applicable product requirements;
- e) the information on standby battery calculation has been consolidated into one informative Annex;
- f) two different levels of fire resistance of cables are recognized, and recommendations given for application of each type;
- g) recommendations for networked systems, for example in respect of cable types, are included;
- h) the use of radio to link parts of the voice alarm system is recognized and recommendations for the implementation of such radio links included;
- i) recommendations for the maintenance of systems, including the periods at which routine servicing should be carried out, have been revised;
- j) the single “commissioning and installation” certificate has been replaced by a modular certification scheme separately covering: design, installation, commissioning, acceptance, verification, inspection and servicing, and modification;

- k) the standard has been simplified by the use of practice specification format, in which commentary on relevant principles is followed by short, succinct recommendations. This is intended to make the standard less ambiguous, simpler for the non-specialist to apply and compliance of installations more straightforward to audit;
- l) the term “deviation” has been replaced with the term “variation”, to avoid any negative connotation associated with the term used to describe an aspect of system design that, for good reasons, does not conform to this standard.

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 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 referenced documents are indispensable for the application of this document. 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 5588 (relevant parts), *Fire precautions in the design, construction and use of buildings*

BS 5839-1:2002+A1:2004, *Fire detection and fire alarm systems for buildings – Part 1: Code of practice for system design, installation, commissioning and maintenance*

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

BS 7629 (all parts), *Specification for 300/500 V fire-resistant electric cables having low emission of smoke and corrosive gases when affected by fire*

BS 7671, *Requirements for electrical installations – IEE Wiring Regulations – Seventeenth edition*

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 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, *Fire detection and fire alarm systems – Part 16: Voice alarm control and indicating equipment*

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 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 area of coverage

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

3.3 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

3.4 audibility

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

3.5 automatic mode

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

3.6 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 electroacoustic 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.*

3.7 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

3.8 emergency loudspeaker zone

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

3.9 emergency microphone

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

3.10 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.

3.11 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).

3.12 listener

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

3.13 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

3.14 manual mode

operator-controlled broadcast of live or pre-recorded sounds

3.15 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.

3.16 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

3.17 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.

3.18 PA zone

sub-division 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.

3.19 pre-announcement tone

short tone or series of tones broadcast before each live message

3.20 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.

**3.21 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.

3.22 voice alarm system

sound distribution system that broadcasts speech messages and/or warning signals in an emergency

4 Need for a voice alarm system

COMMENTARY ON 4

The need for a voice alarm system 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 voice alarm system in all buildings which are subject to a pre-determined 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 voice alarm system would still be appropriate to enhance the management of an evacuation.

Where there is uncertainty regarding the need for a voice alarm system, 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 5588 relevant parts and BS 7827;
- 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

Voice alarm systems are installed in buildings to aid the safe evacuation of occupants in the event of a fire. As such, voice alarm systems can be an essential part of the objective of fire detection and fire alarm systems to protect life (BS 5839-1:2002+A1:2008, 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 should 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 voice alarm system 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 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 pre-determined 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 pre-determined 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 voice alarm system 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 voice alarm system 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 voice alarm system 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 voice alarm system 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 voice alarm system 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 will have the highest priority, there are buildings in which other hazards may 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 voice alarm system 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).

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 voice alarm system 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 voice alarm system.

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 voice alarm systems 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 must take priority without compromise.

b) Selection of type

Type V1 system

A V1 system is used when the voice alarm system 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 Government¹⁾.

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 may 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 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 pre-set 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;*

¹⁾ Available for free download at www.communities.gov.uk

- 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 may 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 voice alarm system is automatically controlled from a fire detection 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 may be necessary that, to supplement automatic operation by the fire detection 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 voice alarm system 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) may 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 voice alarm system from the fire detection system. This may be particularly appropriate during periods where crowd control is a prime concern.

A V5 system may include sub-systems 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 voice alarm system 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 with the fire detection and fire alarm system

COMMENTARY ON 9

The link between the fire detection and fire alarm system and the voice alarm system 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 alarm systems in a fault condition to issue conflicting information, particularly when the cause and effect program is partially held in the voice alarm system. 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 voice alarm system. 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 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.

If an emergency broadcast has been initiated automatically or manually from the fire detection 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 system continues, unless it is overridden by a higher priority broadcast initiated from the fire detection system or manually from the VA system, or it is cancelled at the fire detection system.

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

9.2 The interlinking cable(s) between the fire detection and fire alarm system and the voice alarm system 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 voice alarm system, unless both the fire detection and fire alarm system control and indicating equipment 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 voice alarm system is achieved via the fire detection circuit, then the removal of any detector(s) should not inhibit the operation of the voice alarm system. A single fault on a fire detection circuit should not affect communication with the voice alarm system.

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

9.6 The silencing and resetting of messages initiated by the fire detection and fire alarm system should only be possible via a positive signal(s) from the fire detection and fire alarm system control and indicating equipment 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 voice alarm system, such as the control and indicating equipment, 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 9001).

Compatibility of voice alarm system 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 control and indicating equipment of the voice alarm system, 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 Radio-linked components and systems should conform to BS EN 54-25.

11.5 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 voice alarm system 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 control and indicating equipment within 100 s of the occurrence of a fault, regardless of whether the voice alarm system 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 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 control and indicating equipment, within the times indicated below, and regardless of whether the voice alarm system 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 m² 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 control and indicating equipment 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 control and indicating equipment. 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 control and indicating equipment, 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 voice alarm system design and is based on information including:

- a) *acoustic environment, such as:*
 - *floor plans;*
 - *building sections;*
 - *finishes;*
 - *reverberation time;*
- b) *ambient noise level;*
- c) *climatic environment;*
- d) *area coverage requirement;*
- e) *mounting arrangements, for example ceiling tiles, wall, pole etc.;*
- f) *architectural design and relevance of the appearance of the loudspeaker;*
- g) *type of broadcast, i.e. if used for purposes other than voice alarm, such as 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 acoustically distinguishable area(s) and should be carried out by a competent person.

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

14.3 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.

14.4 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.

14.5 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.

14.6 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.

14.7 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 electroacoustic properties of the loudspeaker.

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

14.8 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 voice alarm systems.

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 5839-1:2002+A1:2008, **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 voice alarm system, 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 voice alarm system is continuously supervised by trained staff, who would be in a position to implement manual substitution of a failed amplifier with a standby amplifier within 5 min of the failure, automatic switching to achieve the performance recommended above 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 electroacoustic 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 continuously 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).