

BS 6259:2015



BSI Standards Publication

Code of practice for the design, planning, installation, testing and maintenance of sound systems

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Contents

Foreword *iii*

Section 1: General 1

- 1 Scope 1
- 2 Normative references 1
- 3 Terms and definitions 2

Section 2: Exchange of information and definition of responsibilities 5

- 4 Technical advice and performance specification 5

Section 3: Sound system design 8

- 5 System-level considerations 8
- 6 Planning 8
- 7 System design 10

Section 4: Installing a sound system 14

- 8 Installation 14
- 9 Commissioning 16
- 10 Documentation 16
- 11 Certification 18
- 12 Lifetime activities 19
- 13 Responsible person 22

Section 5: Operation and maintenance 23

- 14 System components: Application of standards 23

Annexes

- Annex A (informative) Explanation of technical words and phrases 25
- Annex B (informative) Loudspeakers and associated system components 27
- Annex C (informative) Types of microphones 36
- Annex D (normative) Use and siting of microphones 43
- Annex E (informative) STI qualification bands 49
- Annex F (informative) Examples of certificates 50
- Annex G (informative) Dynamics processors (compressors and AGC) 57

Bibliography 58

List of figures

- Figure 1 – Effect of ambient noise sensing 12
- Figure B.1 – Diagram showing the floating-return technique for disabling local loudspeaker attenuators in an emergency 34
- Figure C.1 – Horizontal directional response of an omnidirectional microphone with its axis vertical: decibel scale 37
- Figure C.2 – Directional response of a cardioid microphone: decibel scale 38
- Figure C.3 – Directional response of a supercardioid microphone: decibel scale 38
- Figure C.4 – Directional response of a hypercardioid microphone: decibel scale 39
- Figure C.5 – Directional response of a highly directional shotgun (rifle) microphone where $f = 250$ Hz and barrel length is 275 mm 40
- Figure C.6 – Directional response of a highly directional shotgun (rifle) microphone where $f = 2.5$ kHz and barrel length is 275 mm 41
- Figure C.7 – Directional response of a highly directional shotgun (rifle) microphone where $f = 10$ kHz and barrel length is 275 mm 42
- Figure C.8 – Relative operating distances of directional microphones for equal direct-to-reverberant signal ratios 42
- Figure D.1 – Two methods of positioning microphones on a conference table 46
- Figure D.2 – The 3 to 1 ratio for microphone positioning (normal) 46
- Figure D.3 – A reduced 3 to 1 ratio using angled microphones 47
- Figure D.4 – Illustrations of good and bad microphone placements 47

Figure D.5 – Optimization of the height of the microphone above the Table	48
Figure F.1 – Design certificate	50
Figure F.2 – Installation certificate	51
Figure F.3 – Commissioning certificate	52
Figure F.4 – Acceptance certificate	53
Figure F.5 – Verification certificate	54
Figure F.6 – Servicing certificate	55
Figure F.7 – Modification certificate	56
Figure G.1 – Typical steady-state output/input characteristics	57

List of tables

Table 1 – Overall view of planning stages	9
Table 2 – Documentation	17
Table 3 – Sound system equipment	23
Table E.1 – Examples of STI qualification bands and typical applications	49

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 60, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited under licence from The British Standards Institution and came into effect on 31 March 2015. It was prepared by Technical Committee EPL/100, *Audio, video and multimedia systems and equipment*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 6259:1997, which is withdrawn.

Information about this document

This is a full revision of the standard, updating all aspects.

Use of this document

As a code of practice, this British 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 British Standard is expected to be able to justify any course of action that deviates from its recommendations.

The recommendations of this British Standard are intended to enable a clear understanding, including understanding by non-technical users, of the functions and limitations of a proposed sound system.

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.

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 British Standard gives recommendations for the design, planning, installation, testing and maintenance of sound systems intended for communicating speech, music and/or other signals, including systems conveying emergency messages or signals that are not connected to a fire detection system.

NOTE 1 For systems used for conveying emergency messages, recommendations are given in BS 5839-8.

This standard is intended for use by clients, designers, installers and those responsible for commissioning, testing, operation and maintenance of sound systems.

This standard is not applicable to:

- a) voice alarm systems within the scope of BS 5839-8 or BS EN 54-16 or BS EN 54-24;
- b) emergency voice communication systems within the scope of BS 5839-9;
- c) emergency sound systems within the scope of BS 7827;
- d) simultaneous interpretation systems (see ISO 2603);
- e) some of the aspects associated with recording studios, and applies only to some types of broadcasting studio;
- f) home entertainment systems;
- g) systems intended only to modify the perceived acoustic characteristics of the space;
- h) manual fire detection systems; or
- i) audio conferencing systems.

This standard is not applicable to cinema sound systems.

NOTE 2 Cinema sound technology is evolving very rapidly at present, due partly to the elimination of film stock in favour of digital distribution and the increased practicability of multichannel sound systems with tens of channels. Existing standards such as BS 5550-3.4.9 are likely to be replaced by completely new standards within a few years. It is therefore not at present practicable to give advice on these systems in this standard.

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 7671:2008+A3:2015, *Requirements for electrical installations – IET Wiring Regulations (Seventeenth edition)*

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

NOTE A glossary of technical words and phrases is given in Annex A.

3.1 Acoustics

3.1.1 acoustic feedback

energizing of a microphone by the acoustic output of a loudspeaker of the same sound reinforcement system

NOTE As the effect increases so does the distortion, which might become intolerable, and eventually the system might oscillate continuously at some frequency, usually audible, at which the microphone to loudspeaker gain exceeds the loss in the feedback path. The system is then said to “howl round”.

3.1.2 average sound pressure level (L_p)

twenty times the logarithm to base ten of the ratio of the r.m.s. sound pressure under consideration, p , to the reference r.m.s. sound pressure, p_o

NOTE 1 The average sound pressure level, L_p , expressed in decibels, is calculated as follows:

$$L_p = 20 \lg \frac{p}{p_o}$$

NOTE 2 The standard reference sound pressure p_o is 20 μPa in air.

3.1.3 echo

sound heard as a repetition of a first hearing

NOTE Repetition of a sound can occur in three ways:

- a) if a sound is reflected from an object more than about 10 m away;*
- b) if sound travels to a distant listener by more than one route and the path length difference is more than 10 m; and*
- c) if electronically delayed signals are intentionally generated.*

3.1.4 reverberation time

(of an enclosure for a sound of a given frequency or frequency band)

time that would be required for the sound pressure level in the enclosure to decrease by 60 dB, after the source has been stopped

3.2 Intelligibility

3.2.1 audibility

property of a sound which allows it to be distinguished from other sounds

NOTE The property may include intensity, spectral distribution and variation with time.

3.2.2 clarity

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

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

3.2.3 intelligibility

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

NOTE Intelligibility requires sufficient audibility and sufficient clarity. These can be related to the mathematical basis of the objective method of determining intelligibility though the use of the speech transmission index (STI), but clarity in that case is limited to freedom from reverberation.

3.2.4 speech transmission index

STI

metric ranging between 0 and 1 representing the transmission quality of speech with respect to intelligibility by a speech transmission channel

[SOURCE: BS EN 60268-16:2011]

3.3 People

3.3.1 client

person, group or organization that commissions the design and installation of the sound system

NOTE The client is usually, but not always, the purchaser of the system.

3.3.2 contractor

person or company that enters into a written agreement with the purchaser to supply a sound system

NOTE The contractor might also undertake the system design and/or the installation. In major building projects the sound system may be the subject of a written agreement between the main building contractor and the specialist supplier.

3.3.3 installer

person, group or organization responsible for the installation of the sound system as specified by the system designer

3.3.4 operator

person who controls the sound system manually when it is in use

3.3.5 system designer

person responsible to the client for the design and specification of the sound system

3.3.6 user

person, group or organization who supervises the operation of the equipment in use

NOTE The needs of the user are important factors in the design of a sound system. There might be more than one user and the user might not be the client or owner of the system when a room is hired with a sound system.

3.4 System features

3.4.1 channel

signal path between input and output of a system

3.4.2 control point

place where controls for the operation of the system are located

NOTE A control point can have controls for operating the system only under special conditions, for example a police or fire control point. There can be more than one control point.

3.4.3 line-level voltage

voltage of 0.775 V r.m.s. (corresponding to a power of 1 mW in 600 Ω)

NOTE When this voltage is used as a reference level ("line level") in decibels (0 dB), it is written as 0 dB (0.775 V) or 0 dBu. Although the reference level is derived from a system having a characteristic impedance of 600 Ω , such systems are rarely used now (see BS EN 61938).

3.4.4 mixer

specialized amplifier whose output is at line-level voltage, with facilities to allow input signals from several sources to be controlled or combined or both

3.5 System types**3.5.1 sound system**

system including amplifiers, loudspeakers and sources of speech, music or tone signals, which is intended to present the signals to people outside the household environment

3.5.2 sound reinforcement system

sound system intended to reinforce sound signals from actors, musicians, etc.

NOTE In these systems the microphones are exposed to the sound produced by the loudspeakers.

Section 2: Exchange of information and definition of responsibilities

4 Technical advice and performance specification

4.1 General

NOTE Except for basic systems sold as a complete kit, the engagement of a skilled system designer is advisable and is considered to be essential whenever large or complex installations are involved.

If prospective purchasers wish the sound system to be in accordance with this British Standard, then a reference to the standard should be included in written agreements relating to the installation, modification and extension of the sound system.

4.2 Purpose of the system

Before approaching a supplier, the client should write down, in non-technical terms, what the users of the system require it to do and the environment in which it is to be used. Care should be taken that this is as comprehensive as possible. Anything left out at this stage can result in extra expenditure later. Factors that should be considered include:

- a) the room(s) and other three dimensional space(s) to be covered, their dimensions and the nature of their surfaces and their acoustic characteristics;
- b) the various usages of each space and the background noise associated with them;
- c) what audio signals are to be reproduced and their sources (e.g. microphones, alert signals and recorded messages), including all the sources and places;
- d) methods of controlling the sound system, both manual and automatic;
- e) presentation of user interfaces (e.g. volume control, touch-screen, paging panel);
- f) interconnection with other audio systems [e.g. audio frequency induction loop systems (AFILS) and infrared systems];
- g) priorities of input sources if applicable;
- h) the need to avoid unwanted broadcast of audio information to adjacent environments (e.g. noise pollution in a public space, or confidentiality in a court, where the audio information needs to be kept confidential); and
- i) architectural considerations or restrictions (e.g. listed building status).

4.3 Obtaining technical advice

Wherever possible, technical advice should be obtained during the early planning stages of a sound system. Such advice should cover:

- a) the suitability of a sound system for a particular venue and/or application;
- b) factors that might adversely affect the performance of a sound system;
- c) factors that might add to the cost of installing a sound system; and
- d) the need for, and scope of, an initial site assessment.

NOTE For a small sound system, the cost of a formal initial survey might not be justified, but many contractors conduct an informal survey as a matter of course.

4.4 The nature of the advice

Advice to be obtained depends on the particular installation requirements for each sound system, but should generally include the following:

- a) advice from the contractor to the client on all aspects, from initial quotations for the task in the planning stages through to installation, commissioning and maintenance of the sound system;
- b) advice from the designer to a technically competent installer (e.g. in the case of systems in new buildings where installation is to be carried out by electrical contractors; systems installed by in-house staff); and
- c) advice from an appropriate organization or professional body, such as the Institute of Sound and Communications Engineers.

4.5 Professional (consultancy) advice

Professional advice from a specialist consultant should be obtained when installations are to be undertaken in extra-large or prestigious buildings and those posing special difficulties, such as very reverberant spaces, areas with high ambient noise levels and multi-purpose spaces.

NOTE The advice of an independent consultant or a professional body might also be useful in the event of a dispute between the client and supplier or manufacturer. Such advice can often provide the most economical resolution of a dispute.

4.6 Choosing the system supplier

4.6.1 General

Possible procedures for acquiring a sound system are recommended in 4.6.2, 4.6.3 and 4.6.4. The choice of procedure should depend on the size of the space to be covered and any special complications which might be involved.

4.6.2 Approaching a contractor

For a small and uncomplicated sound system, a contractor may be asked to design, supply and install suitable equipment and all cabling, based on the objective of the system (see Clause 6).

NOTE Names of contractors who specialize in this work may be obtained from business directories and trade associations.

Responsibility for choosing appropriate equipment (microphones, amplifier, etc.) and for installing and setting up the sound system correctly should rest with the contractor.

For some sound systems, the installation contractor may call in a manufacturer to provide detailed technical advice on areas of uncertainty or particular difficulty. On these occasions the agreed obligations of the installation contractor and the manufacturer to the prospective purchaser should be clearly documented, preferably in a single document.

4.6.3 Approaching a manufacturer of sound system equipment

Some manufacturers of sound system equipment are willing to produce the site survey for the proposed installation, design a system and, perhaps, recommend an installation contractor. Manufacturers who are unable to provide this service themselves might offer contact with appropriate designers/installers who can undertake such projects.

NOTE Names of manufacturers can be obtained from business directories and trade associations.

Responsibility for choosing appropriate equipment (microphones, amplifier, etc.) and commissioning the system should rest with the selected manufacturer or designer. The contractor should be responsible to the manufacturer for the correct installation of the sound system and commissioning (where this is also undertaken).

4.6.4 Approaching a specialist consultant

When it is appropriate to engage a specialist consultant, this should be done at the earliest opportunity. The consultant should be responsible for the initial survey, design and commissioning of the sound system, choice of equipment and helping to assess installers' proposals. Where necessary, the consultant should also liaise with architects and construction contractors on matters affecting the sound system.

NOTE Such a consultant might be independent or might be a suitably competent person employed by a manufacturing or contracting organization.

4.7 Performance specification

A performance specification should be prepared by the system designer and agreed with the client. It is this performance to which the system is required to conform at the commissioning stage. If the choice of equipment to be used is not completely under the control of the system designer (for example, if some existing microphones are to be used), any reservations about the suitability of such equipment should be clearly explained to the client in writing.

4.8 Specification for tests of completed installation

Tests of the completed installation to verify that the sound system performs satisfactorily should be specified in writing and should cover:

- a) intelligibility within the covered space, assessed both subjectively and objectively – this may consist of a “walk test” and STI measurements, or a much more intensive assessment using, for example, PB word scores (see BS EN 60268-16);
- b) quality of installation;
- c) functionality of inputs;
- d) correct operation of controls and priorities;
- e) accuracy of documentation;
- f) correct implementation of loudspeaker zones (if any); and
- g) unwanted coverage and noise pollution.

The specification should include documented provisions regarding remedial action in case the system does not pass the test.

NOTE The system designer would normally be responsible for detailing required remedial proposals and their implementation.

Section 3: Sound system design

5 System-level considerations

5.1 Classification of systems

5.1.1 General

Sound systems can be classified into the three categories given in 5.1.2 to 5.1.4.

NOTE Classifications start with the letter *S* (standing for “sound system”) to avoid confusion with fire systems which have *L* and *P* classifications, audio frequency induction loops (AFILS) which have *A* classifications and voice alarm systems which have *V* classifications.

5.1.2 Category S1

Category S1 systems aim mainly at the reproduction of speech with good intelligibility, but not necessarily a high degree of naturalness. They are suitable for broadcasting emergency messages. Music, if reproduced at all, would be of an acceptable quality but not necessarily of artistic merit. Where acoustic conditions are bad, for example because noise levels are high or reverberation is excessive, these systems can be expected to provide the best results that can be achieved.

5.1.3 Category S2

Category S2 systems are most commonly used. The aim is to produce intelligible and natural sounding speech and/or music of a quality that the average listener considers pleasant. It is desirable that the listening conditions are either already fairly good acoustically or can be made so by suitable acoustic treatment.

5.1.4 Category S3

Category S3 systems aim at the highest possible quality of reproduction. This category is appropriate when the audience is expected to be critically interested in the programme for its own sake and not merely as a background. It is essential that the listening conditions are acoustically very good, and that the input to the system is of adequately high quality, as any defects can sound more objectionable. Signal quality from an amplitude modulated broadcast receiver, for example, can cause the reproduction from a category S3 system to be less satisfactory than that obtained from a category S2 system using similar inputs.

5.2 Provisions for conveying emergency messages

The operation of the system under emergency conditions should be documented in an overall plan for handling emergencies at the site. Priority should be given to emergency messages over all other functions of the system.

6 Planning

The project should be planned over all phases. The detail required depends on the size and complexity of the installation. Table 1 gives a detailed overall plan, which might need to be supplemented by detailed planning tables for some stages.

Table 1 Overall view of planning stages

Stage	Purpose of work and decisions to be reached	Tasks to be undertaken	People directly involved	Usual terminology
A. Inception	To prepare general outline of requirements and plan future action	Identify client organization for briefing. Consider requirements, appoint project team leader	Client organization, Project team leader	Briefing
B. Feasibility	To provide an appraisal and recommendation in order to allow the client to determine the form in which the project is to proceed, ensuring that it is feasible and functional – technically and financially	Carry out studies of use requirements, site conditions, planning, statutory obligations, design, and cost, etc., as necessary to reach decisions	Client's representatives, Project team leader, Building and system acoustic consultant, System electronic designer, according to the nature of the project	
C. Outline proposals	To determine general approach to layout, design and construction in order to get authoritative approval for the client on the outline proposals and accompanying report	Develop the brief further. Carry out studies on the user requirements, technical problems, planning, design and cost, as necessary to reach decisions	Client's representatives, Project team leader, Building and system acoustic consultant, System electronic designer, as required	Sketch plans
D. Scheme design	To complete the brief and decide on particular proposals, including outline specification, and cost, and to obtain all approvals	Final development of the brief, full design of the project by project team leader, preliminary system schematic using BS/ISO standard symbols, prepare cost plan and full explanation report. Submission of proposals for all approvals	Client's representatives, Project team leader, Building and system acoustic consultant, System electronic designer, all statutory and other approving authorities	
<i>Brief should not be modified after this point.</i>				
E. Detailed design	To obtain final decision on all matters related to design, specification, construction and cost	Full design or selection of all parts and components of the sound system. Complete cost checking of design	Project team leader, Building and system acoustic consultant, System electronic designer, Sound system installer (if appointed)	Working drawings
<i>Any further changes in location, size, shape or cost after this point will result in abortive work.</i>				
F. Bills of quantity	To prepare and complete all information and arrangements for obtaining tender	Preparation of Bills of Quantities and tender documentation	Project team leader, Sound system installer (if appointed)	

Table 1 Overall view of planning stages

Stage	Purpose of work and decisions to be reached	Tasks to be undertaken	People directly involved	Usual terminology
G. Works planning	To enable the contractor to programme the work in accordance with the written agreement	Prepare workshop drawings for approval by project team leader	Project team leader, Contractor, Subcontractor sound system installer	Site operations
H. Sound system installation	To follow the plan through to practical completion of the sound system installation	Off-site assembly and testing, installation and testing by the installer	Project team leader, Contractor, Subcontractor sound system installer	
I. Completion	To hand over the sound system to the project team leader for use by the client, remedy any defects, settle the final account, and complete all work in accordance with the written agreement	Project team leader commissioning: agree and carry out any remedial works as required	Project team leader, Contractor, Subcontractor sound system installer	

7 System design

7.1 Overview

When designing a sound system, the following factors should be taken into account:

- a) loudness, which is controlled by amplifier power and loudspeaker sensitivity and siting;

NOTE 1 An increase of 3 dB in loudness requires a doubling of amplifier power. An increase of 10 times in amplifier power is required to produce an apparent doubling of loudness.

NOTE 2 Loudspeakers vary considerably in sensitivity (maximum sound pressure produced by a given amplifier power). Details of loudspeakers and associated system components are given in Annex B.

- b) frequency range; and
- c) echoes and reverberation, whose effects are minimized by the siting and selection of microphones.

NOTE 3 Details of microphones are given in Annex C.

Microphones should be used and sited in accordance with Annex D.

NOTE 4 A sound system consists essentially of the following four basic components:

- 1) microphone(s) and other signal source(s);
- 2) pre-amplifier (control unit);
- 3) power amplifier(s); and
- 4) loudspeakers (normally more than one).

NOTE 5 In order to obtain the maximum performance from a system, to maintain an adequate signal-to-noise ratio and provide an appropriate frequency response, a number of other additional elements may be added, such as compressors and equalizers. Additionally, loudspeaker zoning or group switching might be required.

7.2 Loudspeaker siting

Good siting of loudspeakers is very important for uniform sound coverage. A position above audience listening can help to establish a clear line-of-sight path to every listener and also helps to equalize the distances between loudspeakers and listeners. Difficult compromises might have to be reached to accommodate objections to the visibility of the loudspeakers.

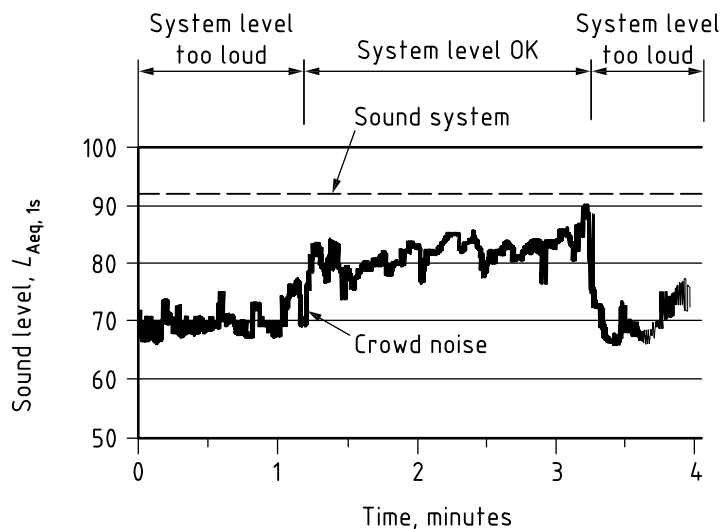
NOTE Fewer, more costly, loudspeakers of high sensitivity might reduce aesthetic difficulties over their visibility.

The relationship between the power supplied to the loudspeaker and the sound level achieved depends on the sensitivity of the loudspeaker, the distance from the loudspeaker to the listener and the acoustics of the room. Near to the loudspeaker, the sound pressure is proportional to the voltage input to the loudspeaker; as the distance between listener and loudspeaker increases, so the sound reflected from the room boundaries becomes more important. At a certain ("critical") distance from the loudspeaker, the sound level stops decreasing with distance because of the addition of reflected sounds.

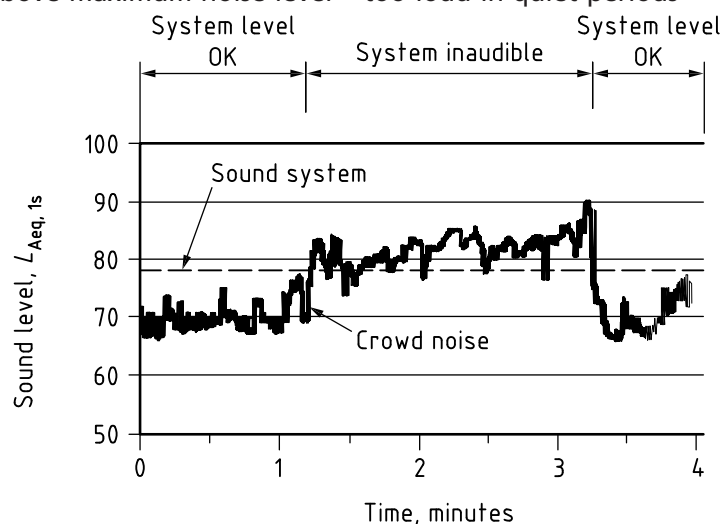
7.3 Ambient noise level sensing

In many locations, for example sports stadia, railway stations and airports, the background noise level is not constant. It might fluctuate over long or short periods, or both. A sound system having a fixed output level might be too loud when the noise is least, or inaudible when the noise is greatest. (See Figure 1 for examples.) The technique of ambient noise level sensing should be considered and may be applied to overcome this defect. It can also eliminate or mitigate noise nuisance.

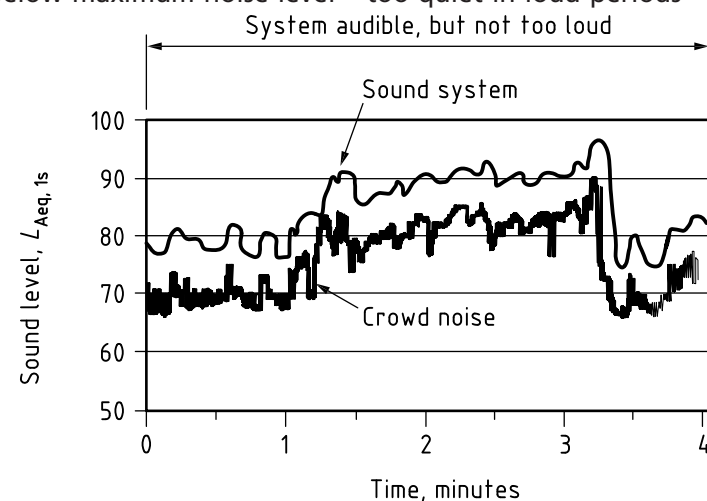
Figure 1 Effect of ambient noise sensing



a) System level fixed above maximum noise level – too loud in quiet periods



b) System level fixed below maximum noise level – too quiet in loud periods



c) System level varied by sensing noise level – acceptable in all periods

7.4 Frequency range

Historical limitations of frequency range have largely been eliminated in modern equipment, but there is a cost penalty (and possibly unnecessary technical difficulties) if the design is based on an excessively wide range. The following factors should be taken into account:

- a) extended low-frequency reproduction requires large loudspeakers or high amplifier power, or both; and
- b) high frequencies are absorbed by the atmosphere over long path lengths, and this effect varies greatly with the humidity.

7.5 Speech intelligibility and quality of reproduction

The intelligibility (which depends on both audibility and clarity) of speech signals, the audibility of any warning tones, and the desired quality of reproduction of any music signals are of prime importance. The quality of reproduction of music signals depends on factors additional to audibility and clarity.

Audibility is related to loudness, but excessive loudness results in a reduction of intelligibility. Clarity is related to freedom from echoes and reverberation. Non-linearity distortion is very seldom an issue with modern equipment, but has much less effect on speech than on the quality of music reproduction. On the other hand, the quality of music reproduction is little affected by reverberation, and echo may even be used for artistic effect.

Several methods currently exist of objectively measuring speech intelligibility, one of which is STI (see BS EN 60268-16). However, no objective method is absolutely reliable, so a subjective assessment should be also carried out.

NOTE Annex E gives examples of STI qualification bands and typical applications.

7.6 Electronic equipment and wiring

7.6.1 Electronic equipment

Electronic equipment should be sited where it is accessible to authorized people but not others. Responsibility for providing any housing, support or other accessories should be agreed and documented. Care should be taken that the equipment is sited so that it will not overheat or become excessively damp. The equipment should conform to the appropriate safety standard for the environment in which it is used.

7.6.2 Wiring

The installation of mains wiring and protective devices should conform to BS 7671. Microphone and other signal cables are Category 2 circuits as defined in BS 7671 and should be segregated from mains and other cables in Category 1 circuits.

Section 4: Installing a sound system

8 Installation

8.1 General

One organization should be responsible for the installation of the sound system and this responsibility should be agreed prior to the start of the work.

NOTE It is not, in general, the responsibility of the installer to verify whether the design of the system is in accordance with the recommendations of this standard, unless the installer is also the designer.

The responsibility of the installer should be 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, compliance with a number of these recommendations impacts on both design and installation, and may, therefore, be delegated by the designer to the installer, provided the responsibility for compliance is clearly documented, that the installer is competent to address the issues and that the responsibility is accepted by the installer.

8.2 Installation of cables

NOTE The designer may delegate decisions regarding cable routes to the installer, by simple reference in the design to compliance with this clause. At the design stage, the designer might have inadequate information to enable compliance with all the relevant recommendations. For example, drawings on which the design is based might not show sufficient information about structural features or final fittings of the building.

The installer should ensure that all wiring and cable types conform to the design documentation. All cables should be clearly identified, at least at each end and at all the joints on the route. These should be accurately recorded for future reference.

Cables should be installed without external joints wherever practicable. All terminations and other connectors should be such as to minimize the probability of early failure. Other than in the case of joints at or within system components such as amplifiers and microphones, terminals and connectors used to joint cables should be constructed of materials that will withstand a similar environment and be of similar durability to that of the cable. All joints, other than those within system components, should be enclosed within junction boxes, labelled with the words "Sound system" to avoid confusion with other services.

Care should be taken to ensure the electrical continuity of electromagnetic screens, including those of microphone cables.

Cables that are directly fixed to surfaces should be neatly run and securely fixed at suitable intervals, in accordance with the recommendations of the cable manufacturer. Cables should not be supported by suspended ceilings. Where new conduit, trunking or tray is installed, its capacity should be in accordance with the requirements of BS 7671.

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. 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. Care should be taken to ensure that the ends of any sleeves are free from sharp edges which might damage cables during installation. Where a cable passes through a floor, the recommendations above should be applied. The sleeve should extend as far above floor level as is required to provide adequate protection of the cable, but not less than 300 mm.

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

8.3 Inspection and testing of wiring

Continuity of all circuits should be tested. Insulation resistance between conductors, between each conductor and earth, and between each conductor and any screen, should be at least 2 M Ω . Care should be taken not to measure the insulation resistance with a voltage high enough to damage the equipment. Alternatively, any such equipment should be disconnected before applying the test, but this latter procedure is less reliable.

8.4 As-fitted drawings

As-fitted drawings should be produced, which include at least:

- a) the positions of all sound system equipment;
- b) the positions of all cables, including the type, sizes and actual routes of cables;
- c) the position(s) of microphone(s); and
- d) the positions of all equipment that might require routine attention or adjustment.

The cable routes shown should be a reasonable representation of the routes followed, to enable any cable to be located in the event of a fault or need for modification or extension of the system.

NOTE A simple schematic showing the sequence in which devices are wired is unlikely to be sufficient, other than in small, simple systems.

In the case of extensions or alterations, existing as-fitted drawings should be updated. Where necessary, in complex buildings, a cabling schedule cross-referencing the drawings should be produced in order to help explain the cable routes.

8.5 Check list

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 or ventilation is provided to keep the equipment within its rated temperature range; and
- d) the installation of microphones and loudspeakers is strictly in accordance with the design specification.