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Fire detection and alarm systems —

Part 3: Audible alarm devices

Systèmes de détection et d'alarme d'incendie —

Partie 3: Dispositifs d'alarme sonores

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 7240-3 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 3, *Fire detection and alarm systems*.

ISO 7240 consists of the following parts, under the general title *Fire detection and alarm systems*:

— *Part 1: General and definitions*

— *Part 2: Control and indicating equipment*

— *Part 3: Audible alarm devices*

— *Part 4: Power supply equipment*

— *Part 5: Point-type heat detectors*

— *Part 6: Carbon monoxide fire detectors using electro-chemical cells*

— *Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization*

— *Part 8: Carbon monoxide fire detectors using an electro-chemical cell in combination with a heat sensor*

— *Part 9: Test fires for fire detectors* (Technical Specification)

— *Part 10: Point-type flame detectors*

— *Part 11: Manual call points*

— *Part 12: Line type smoke detectors using a transmitted optical beam*

— *Part 13: Compatibility assessment of system components*

— *Part 14: Guidelines for drafting codes of practice for design, installation and use of fire detection and fire alarm systems in and around buildings* (Technical Report)

— *Part 15: Point type fire detectors using scattered light, transmitted light or ionization sensors in combination with a heat sensor*

— *Part 16: Sound system control and indicating equipment*

— *Part 17: Short-circuit isolators*

— *Part 18: Input/output devices*

— *Part 19: Design, installation, commissioning and service of sound systems for emergency purposes*

— *Part 20: Aspirating smoke detectors*

— *Part 21: Routing equipment*

— *Part 22: Smoke-detection equipment for ducts*

— *Part 23: Visual alarm devices*[1)]

— *Part 24: Sound-system loudspeakers*

— *Part 25: Components using radio transmission paths*

— *Part 27: Point-type fire detectors using a scattered-light, transmitted-light or ionization smoke sensor, an electrochemical-cell carbon-monoxide sensor and a heat sensor*

— *Part 28: Fire protection control equipment*

1) To be published.

Introduction

In a fire detection and alarm system, the purpose of the audible alarm devices is to warn person(s) within, or in the vicinity of, a building of the occurrence of a fire emergency situation in order to enable such a person(s) to take appropriate measures.

Audible alarm devices using voice messages are also for warning the occupants of a building of the occurrence of a fire risk. These use a combination of an attention-drawing signal and dedicated voice message(s). Additional requirements, test methods and performance criteria specific to audible alarm devices with voice are also incorporated in this International Standard.

Attention is drawn to ISO 8201, which specifies the temporal pattern and the required sound pressure level of an audible emergency evacuation signal.

This part of ISO 7240 recognizes that the exact nature of the sound requirements, i.e. its frequency range, temporal pattern and output level, will vary according to the nature of the installation, the type of risk present and appropriate measures to be taken, the type of signals used by other non-emergency alarms (see for example ISO 7731) and national differences in custom and practice. The resulting standard specifies, therefore, a common method for testing of the operational performance of audible alarm devices against the specification declared by the manufacturer, rather than imposing common requirements.

This part of ISO 7240 gives common requirements for the construction and robustness of audible alarm devices, as well as for their performance under climatic, mechanical and electrical interference conditions which are likely to occur in the service environment. Audible alarm devices have been classified in either an indoor or an outdoor application environment category.

Fire detection and alarm systems —

Part 3:
Audible alarm devices

1 Scope

This part of ISO 7240 specifies the requirements, test methods and performance criteria for audible alarm devices intended to signal an audible warning of fire between a detection and alarm system and the occupants of a building. It is intended to cover only those devices which derive their operating power by means of a physical electrical connection to an external source such as a fire alarm system.

This part of ISO 7240 is also intended to cover audible alarm devices capable of giving voice messages by the application of specific requirements, tests and performance criteria.

This part of ISO 7240 specifies fire alarm audible alarm devices for two types of application environment, type A for indoor use and type B for outdoor use.

This part of ISO 7240 is not intended to cover:

a) loudspeaker-type devices primarily intended for emitting emergency voice messages that are generated from an external audio source;

b) supervisory audible alarm devices, e.g. within the control and indicating equipment.

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.

ISO 7240-1, *Fire detection and alarm systems — Part 1: General and definitions*

ISO 8201, *Acoustics — Audible emergency evacuation signal*

IEC 60068-1:1988/Corr. 1:1988/A1:1992, *Environmental testing — Part 1: General and guidance*

IEC 60068-2-1:2007, *Environmental testing — Part 2-1: Tests — Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing — Part 2-2: Tests — Test B: Dry heat*

IEC 60068-2-6:2007, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27:2008, *Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock*

IEC 60068-2-30:2005, *Environmental testing — Part 2-30*: *Tests — Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-42:2003, *Environmental testing — Part 2-42: Tests — Test Kc: Sulphur dioxide test for contacts and connections*

IEC 60068-2-75:1997, *Environmental testing — Part 2-75: Tests — Test Eh: Hammer tests*

IEC 60068-2-78:2001, *Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state*

IEC 60529:2001/Corr. 1:2003/Corr. 2:2007, *Degrees of protection provided by enclosures (IP code)*

IEC 60695-11-10:2003*, Fire hazard testing — Part 11-10: Test flames — 50 W horizontal and vertical flame test methods*

IEC 60695-11-20:2003, *Fire hazard testing — Part 11-20: Test flames — 500 W flame test methods*

IEC 61672-1:2002, *Electroacoustics — Sound level meters — Part 1: Specifications*

EN 50130-4:1995/A1:1998/A2:2003, *Alarm systems — Part 4: Electromagnetic compatibility — Product family standard: Immunity requirements for components of fire, intruder and social alarm systems*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms, definitions and abbreviated terms given in ISO 7240-1 and the following apply.

3.1 Terms and definitions

3.1.1
A-weighted sound pressure level
sound pressure, which is 20 times the logarithm to base ten of the ratio of the A-weighted sound pressure to the reference pressure of 20 µPa at 1 kHz

NOTE The A-weighting characteristics are given in IEC 61672-1.

3.1.2
audible alarm device
a.a.d.
device intended to signal an audible warning of fire between a fire detection and alarm system and the occupants of a building

NOTE Audible alarm devices are sometimes referred to as “fire alarm sounders”.

3.1.3
mode (of operation)
one of a possible number of predefined sounds of the audible alarm device which can be selected by means specified by the manufacturer

EXAMPLE Sound patterns, sound pressure levels.

3.1.4
reference point
point representing the origin of the sound within or on the surface of the audible alarm device as specified by the manufacturer

NOTE The reference point is used in Annex A.

3.1.5
sound pattern
predefined acoustic alarm signal

NOTE Sound pattern is also often referred to as “tone”.

3.1.6
supervisory sounder
audible device on a piece of equipment used for drawing attention to a change of status

NOTE Supervisory sounders are often mounted within the fire detection and fire alarm control and indicating equipment.

3.1.7
type A a.a.d.
device primarily intended for indoor applications

NOTE Type A a.a.d. may be suitable for some protected outdoor situations.

3.1.8
type B a.a.d.
device primarily intended for outdoor applications

NOTE Type B a.a.d. may be more suitable than type A a.a.d. for some indoor situations where high temperature or humidity or both are present.

3.1.9
volume control
means for adjusting sound pressure level

3.2 Abbreviated terms

a.a.d. audible alarm device

AC alternating current

DC direct current

RMS root mean square

4 Requirements

4.1 Compliance

In order to comply with this part of ISO 7240, an a.a.d. shall meet the requirements of this clause which shall be verified by visual inspection or engineering assessment, shall be tested as described in Clause 5 and shall meet the requirements of the tests.

4.2 Sound pressure level

This part of ISO 7240 requires that the manufacturer declare sound pressure levels in the data required by 4.9.2. The manufacturer may declare different sound pressure levels for operation under different conditions, e.g. when operating on different voltage ranges or with different sound patterns. If this is the case, the sound pressure level of each specimen shall be measured under each mode of operation (see 5.3).

When tested in accordance with 5.3, the a.a.d. shall produce A-weighted sound pressure levels of not less than 65 dB in one direction at a distance of 1 m.

NOTE A maximum sound pressure level received by occupants can be specified by national regulations.

4.3 Frequency and sound pattern

This part of ISO 7240 covers a.a.d.s which produce different frequencies and sound patterns and, therefore, does not specify a minimum and maximum frequency or specific sound pattern. However, the main sound frequency(ies), frequency range(s) and sound pattern(s) shall be declared in the data required in 4.9.2.

NOTE The sound patterns and frequencies required can vary in different countries. Reference needs to be made to local regulations. ISO 8201 specifies a standard international evacuation signal.

4.4 Audible alarm devices (a.a.d.s) with voice

4.4.1 A.a.d.s using voice messages shall be capable of producing an audible warning signal and a voice message or messages.

4.4.2 Representative messages related to fire safety shall be declared by the manufacturer and shall be considered by the testing authority. The message determined to be worst case shall be subject to conformance assessment.

When selecting the worst-case message, message length, loudness and repetition timing should be considered.

4.4.3 For messages that require immediate action, the warning signal and message sequence broadcast by the device shall be within the following limits:

a) warning signal, lasting for 2 s to 10 s; followed by

b) silence, lasting for 0,25 s to 2 s; followed by

c) voice message; followed by

d) silence, lasting for 0,25 s to 5 s.

The time for each cycle shall not exceed 30 s.

The periods of silence may need to be longer than indicated in certain circumstances, for example in spaces with long reverberation times, but shall not be such that the time between the start of each cycle exceeds 30 s.

For other messages, it is permitted to extend either or both the silence period after the voice message and the period within which the message is repeated.

4.4.4 Access to the message recording function shall be restricted as specified in 4.6.4.

Persons trained in the proper use of microphones should be used to recording the messages. The recordings should be made in a room with a controlled acoustic environment having an ambient A-weighted noise level not greater than 30 dB and a reverberation time not greater than 0,5 s from 150 Hz to 10 kHz.

4.5 Synchronization — Optional function

To prevent acoustic interaction of a.a.d.s installed in close proximity, a.a.d.s shall have provision for synchronizing warning signals and messages with that of other devices. Synchronization shall meet the requirements of 5.20.4.

Power interruption used for synchronization purposes shall not adversely affect the warning signal or the voice message.

NOTE Synchronization can be achieved by internal circuitry, the addition of a trigger wire connected between devices or by other means as defined by the manufacturer.

4.6 Construction

4.6.1 Provision for external conductors

4.6.1.1 The a.a.d. shall provide space within its enclosure for entry and termination of external conductors. Entry holes for conductors or cables shall be provided or the location where such holes can be made shall be indicated by providing a template or some other suitable means.

4.6.1.2 Terminals for connecting external conductors shall be designed so that the conductors are clamped between metal surfaces without being damaged.

4.6.2 Materials

The a.a.d. shall be constructed of material(s) capable of withstanding the tests described in 5.2 to 5.17. In addition, the material(s) of plastic enclosures shall meet the following flammability requirements:

a) IEC 60695-11-10 Class V-2 or HB75 for devices operating from a voltage source less than or equal to 30 V RMS, or 42,4 V DC and consuming less than 15 W of power;

b) IEC 60695-11-20 Class 5VB for devices operating from a voltage source greater than 30 V RMS, or 42,4 V DC and consuming more than 15 W of power.

NOTE Verification of conformance to 4.6.2 a) and 4.6.2 b) can be carried out by examination of a certificate of conformity or equivalent (see Annex C).

4.6.3 Ingress protection

The degree of protection provided by the enclosure of the a.a.d. shall meet or exceed the following requirements:

a) type A – IP21C of IEC 60529.

b) type B – IP33C of IEC 60529.

4.6.4 Access

Means shall be provided (e.g. special tool, codes, hidden screws, seals, etc.) to limit access for removal of parts or the whole device and to make adjustments to the mode of operation.

NOTE The use of a special tool is intended to discourage unauthorized persons from easily accessing the equipment.

4.7 On-site adjustment of the mode of operation

If there is provision for on-site adjustment of the mode of operation of the a.a.d.:

a) for each setting at which the manufacturer claims compliance with this part of ISO 7240, the a.a.d. shall comply with 4.6.4;

b) any setting(s) at which the manufacturer does not claim compliance with this part of ISO 7240, shall comply with 4.6.4 and:

   1) for volume controls, the limits of the compliant range of sound pressure levels shall be clearly marked on the a.a.d. and shown in the associated data,

   2) for sound pattern, the compliant setting(s) shall be clearly marked in the associated data.

NOTE These adjustments can be carried out at the a.a.d. or at the control and indicating equipment.

4.8 Durability

The a.a.d. shall be rated for at least 100 h of operation. No limitation by the manufacturer on duty factor or maximum on-time shall prevent the device from operating the 1 h “on” 1 h “off” cycle required by the test procedure described in 5.4.

This requirement does not apply to the capacity of batteries which may be used within a.a.d.s as a means of local storage of operating power. The capacity and charging requirements of such batteries need to meet the requirements of the system.

4.9 Marking and data

4.9.1 Marking

Each a.a.d. shall be clearly marked with the following information:

a) number of this part of ISO 7240 (i.e. ISO 7240-3:2010);

b) environmental type, [i.e. type A or type B (see Clause 3)];

c) name or trademark of the manufacturer or supplier;

d) manufacturer or supplier model designation (type or number);

e) terminal designations;

f) rated supply voltages or voltage ranges (AC or DC);

g) mark(s) or code(s) (for example, serial number or batch code) by which the manufacturer can identify, at least, the date or batch and place of manufacture, and the version number(s) of any software contained within the device.

Where any marking on the device uses symbols or abbreviations not in common use then these shall be explained in the data supplied with the device.

The marking need not be discernible when the device is installed and ready for use but shall be visible during installation and shall be accessible during maintenance.

The markings shall not be placed on screws or other easily removable parts.

4.9.2 Data

The information required in 4.9.1, together with the following, shall be supplied with the device, or shall be given in a data sheet or technical manual identified on, or with each device:

a) operating voltage range(s);

b) maximum or average current consumption, where applicable;

   For a.a.d.s used in an addressable system, it may not be relevant to declare the current consumption as system configuration and the loading of addressable circuit(s) is configured at the control and indicating equipment.

c) for all specified modes of operation for which compliance with this part of ISO 7240 is claimed, the minimum A-weighted sound pressure level in dB at a distance of 1 m from the reference point of the device for the following directions of radiation:

1) surface-mounted device: at 30° intervals from 15° to 165° through a semi-circular arc in front of the device and centered at the intersection of its normal mounting surface and its principal axis, for two perpendicular planes corresponding to the horizontal and vertical planes of the device in its designed position (see Annex A, Figure A.2),

2) pole-mounted device: at 30° intervals through a 360° circle centered at the intersection of the horizontal plane containing its principal axis and the vertical line through the geometric centre of the sound diffusing assembly, for two perpendicular planes corresponding to the horizontal and vertical planes of the device in its designed position (see Annex A, Figure A.3);

d) sound pattern(s) that comply with this part of ISO 7240 and, where applicable, sound pattern(s) that comply with national standards;

e) IP code to IEC 60529;

f) any other information necessary to allow correct installation, operation and maintenance of the device.

4.10 Requirements for software-controlled a.a.d.s

4.10.1 General

For a.a.d.s which rely on software control in order to fulfil the requirements of this part of ISO 7240, the requirements of 4.10.2, 4.10.3 and 4.10.4 shall be met.

4.10.2 Software documentation

4.10.2.1 The manufacturer shall submit documentation which gives an overview of the software design. This documentation shall be in sufficient detail for the design to be inspected for compliance with this part of ISO 7240 and shall include at least the following:

a) a functional description of the main program flow (e.g. as a flow diagram or structogram), including a brief description of the following:

1) the modules and the functions that they perform,

2) the way in which the modules interact,

3) the overall hierarchy of the program,

4) the way in which the software interacts with the hardware of the a.a.d.,

5) the way in which the modules are called, including any interrupt processing;

b) a description of which areas of memory are used for the various purposes (e.g. the program, site-specific data and running data);

c) a designation by which the software and its version can be uniquely identified.

4.10.2.2 The manufacturer shall prepare and maintain detailed design documentation. This shall be available for inspection in a manner that respects the manufacturers' rights for confidentiality. It shall comprise at least the following:

a) an overview of the whole system configuration, including all software and hardware components;

b) a description of each module of the program, containing at least:

1) the name of the module,

2) a description of the tasks performed;

c) a description of the interfaces, including the type of data transfer, the valid data range and the checking for valid data;

d) full source code listings, as hard copy or in machine-readable form (e.g. ASCII-code), including all global and local variables, constants and labels used, and sufficient comment for the program flow to be recognized;

e) details of any software tools used in the design and implementation phase (e.g. CASE-tools, compilers).

NOTE This detailed design documentation can be reviewed at the manufacturers' premises.

4.10.3 Software design

In order to ensure the reliability of the a.a.d., the following requirements for the software design shall apply:

a) the software shall have a modular structure;

b) the design of the interfaces for manually and automatically generated data shall not permit invalid data to cause error in the program operation;

c) the software shall be designed to avoid the occurrence of deadlock of the program flow.

4.10.4 The storage of program and data

The program necessary to comply with this part of ISO 7240 and any preset data, such as manufacturer's settings, shall be held in non-volatile memory. Writing to areas of memory containing this program and data shall only be possible by the use of some special tool or code and shall not be possible during normal operation of the a.a.d.

Site-specific data shall be held in memory which will retain data for at least two weeks without external power to the a.a.d., unless provision is made for the automatic renewal of such data, following loss of power, within 1 h of power being restored.

5 Tests

5.1 General

5.1.1 Atmospheric conditions for tests

Unless otherwise stated in a test procedure, carry out the testing after the test specimen has been allowed to stabilize in the standard atmospheric conditions for testing as specified in IEC 60068-1 as follows:

— temperature: (15 to 35) °C;

— relative humidity: (25 to 75) %;

— air pressure: (86 to 106) kPa.

The temperature and humidity shall be substantially constant for each environmental test where the standard atmospheric conditions are applied.

5.1.2 Operating conditions for tests

If a test method requires a specimen to be sounding, then the specimen shall be connected to suitable power supply equipment as specified in the data provided by the manufacturer. Where, in order to be sounding, a specimen also requires the application of a control signal or signals, this shall be provided in accordance with the manufacturer's specification.

If a test method requires a specimen to be in the quiescent state, then the specimen shall not be supplied with power unless it is an a.a.d. of the type which has electronic circuits for analysing control signals and triggering the sound operation. In this case the specimen shall be connected to suitable power supply and control equipment, as specified in the data provided by the manufacturer and the control signals shall be arranged so that the specimen is in a non-sounding state.

Unless otherwise specified in the test procedure, the supply parameters applied to the specimen shall be set within the manufacturer's specified range(s) and shall remain constant throughout the tests. The value chosen for each parameter shall be the nominal value, or the mean of the specified range.

If the manufacturer has declared different sound pressure levels for operation under different conditions (see 4.9.2), then, unless otherwise specified by the test procedure, the tests shall be conducted under one selected mode of operation only. Selection of the mode of operation shall be made with the aim to use the one which consumes the most power. This will normally be the most continuous or the loudest mode.

NOTE All modes of operation and all voltage ranges are tested in 5.3.

5.1.3 Mounting arrangements

Unless otherwise specified, the specimen shall be mounted by its normal means of attachment in accordance with the manufacturer's instructions on a flat rigid backing board. If these instructions describe more than one method of mounting then the method considered to be most unfavourable shall be chosen for each test.

The detailed mounting arrangements are given in Annex A or Annex B for the different sound pressure level tests used.

5.1.4 Tolerances

Unless otherwise stated, the tolerances for the environmental test parameters shall be as given in the basic reference standards for the test (e.g. the relevant part of IEC 60068).

If a specific tolerance or deviation limit is not specified in a requirement or test procedure, then a tolerance of ± 5 % shall be applied.

5.1.5 Provision for tests

The following shall be provided for testing compliance with this part of ISO 7240:

a) eight specimens of type A or ten specimens of type B a.a.d.s with any mounting, bases, boxes or accessories, etc.;

b) any equipment, such as control and indicating equipment, as may be necessary for the correct operation of the device in accordance with the manufacturer's specification;

c) the data required in 4.9.2.

The specimens submitted shall be deemed representative of the manufacturer's normal production with regard to their construction and settings.

NOTE The details of the power supply equipment used or the equipment used for generating the control signal(s) or both shall be given in the test report.

5.1.6 Test schedule

The specimens shall be tested and inspected according to the schedule given in Table 1.

All the specimens shall be first submitted to the reproducibility test described in 5.2. On completion of the reproducibility test, the specimen with the lowest loud sound pressure level shall be numbered 1 and the rest shall be arbitrarily numbered from 2 to 8 for type A or 2 to 10 for type B.

Unless otherwise required by the test procedure, the mode of operation selected for conducting the reproducibility test shall be used for the other tests.

Where, after one of the tests specified in 5.5 to 5.16, the sound pressure level of the specimen differs from that measured during the reproducibility test by more than 6 dB, a new specimen shall be used for the next test on the schedule for that specimen. The sound pressure level shall be first measured as specified in 5.2.

The tests on an individual specimen may be carried out in any order except that the reproducibility test (5.2) shall be performed first on all specimens and the tests on specimens 1 and 2 shall be carried out in the order listed (i.e. 5.20 last).

Table 1 — Test schedule

Test	Subclause	Specimen number(s)	
		Type A	Type B
Reproducibility	5.2	all specimens	all specimens
Operational performance[a]	5.3	1	1
Durability	5.4	2	2
Dry heat (operational)	5.5	3	3
Dry heat (endurance)	5.6	—	9
Cold (operational)	5.7	3	3
Damp heat, cyclic (operational)	5.8	3	3
Damp heat, steady state (endurance)	5.9	3	3
Damp heat, cyclic (endurance)	5.10	—	10
SO_2 corrosion (endurance)	5.11	4	4
Shock (operational)	5.12	5	5
Impact (operational)	5.13	6	6
Vibration, sinusoidal (operational)	5.14	7	7
Vibration, sinusoidal (endurance)	5.15	7	7
Electromagnetic compatibility (EMC), immunity (operational)	5.16[b]		
Electrostatic discharge		8	8
Radiated electromagnetic fields		8	8
Conducted disturbance induced by electromagnetic fields		8	8
Fast transient bursts		8	8
Slow high-energy voltage surges		8	8
Enclosure protection	5.17	1, 2	1, 2
Operational performance, additional test for a.a.d.s with voice	5.18	1	1
Sequence timing for a.a.d.s with voice	5.19	2	2
Synchronization (optional)	5.20	1, 2	1, 2

[a] For voice a.a.d.s, only the warning signal shall be measured.

[b] The tests specified in 5.16 are not required for a.a.d.s which do not rely on active electronic components for their operation.

5.1.7 Test report

The test results shall be reported in accordance with Clause 6.

5.2 Reproducibility

5.2.1 Object of the test

The object of the test is to show that the sound output of the a.a.d. does not vary unduly from specimen to specimen and to establish sound output data for comparison with the sound output measured during or after the environmental tests.

5.2.2 Test procedure

Measure the A-weighted sound pressure level of all the specimens as described in Annex B.

Record the measurement in dB for each specimen.

Designate the maximum sound pressure level L_{max}, and the minimum sound pressure level L_{min}.

5.2.3 Requirements

The difference between L_{max} and L_{min} shall not be greater than 6 dB.

5.3 Operational performance

5.3.1 Object of the test

The object of the test is to show that the sound pressure levels declared by the manufacturer can be achieved within the specified range(s) of supply parameters (e.g. voltage) and are not unduly dependent on these parameters.

5.3.2 Test procedure

For each mode of operation declared by the manufacturer, measure the sound pressure level of the specimen in free field conditions using the test method described in Annex A with the supply parameters, first the maximum and then the minimum of the specified range(s) [see 4.9.2 a) and b)].

For each mode of operation, designate the maximum sound pressure level L_{max}, and the minimum sound pressure level L_{min}.

5.3.3 Requirements

For each mode of operation:

a) the A-weighted sound pressure level shall be not less than 65 dB at 1 m in at least one direction;

b) the sound pressure level measured at each of the specified angles shall not be less than that declared by the manufacturer [see 4.9.2 d)];

c) the difference between L_{max} and L_{min} shall not be greater than 6 dB.

5.4 Durability

5.4.1 Object of the test

The object of the test is to show that the sound output of the specimen does not change significantly after prolonged operation.

5.4.2 Test procedure

Subject the specimen to the following durability cycle 100 times: operate the specimen for 1 h at the maximum supply parameters declared by the manufacturer (see 4.9.2) and then pause the operating condition for 1 h.

Measure the sound pressure level as described in Annex B within 1 h of the final period of operation.

5.4.3 Requirements

The sound pressure level shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.5 Dry heat (operational)

5.5.1 Object of the test

The object of the test is to demonstrate the ability of the specimen to function correctly at high ambient temperatures appropriate to the anticipated service environment.

5.5.2 Test procedure and apparatus

5.5.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-2, Test Bb for non-heat dissipating specimens or Test Bd for heat dissipating specimens, except that the test shall be conducted in a reverberation chamber as specified in Annex B and in 5.5.2.2 to 5.5.2.5.

5.5.2.2 State of specimen during conditioning

Mount the specimen in a reverberation test chamber as specified in Annex B. Maintain the specimen in the quiescent state during the conditioning period, except during the last hour, when it shall be sounding (see 5.1.2).

5.5.2.3 Conditioning

Apply the following conditioning:

— temperature: (55 ± 2) °C for type A or (70 ± 2) °C for type B;

— duration: 16 h.

NOTE Test Bb specifies rates of change of temperature of <1 °C/min for the transitions to and from the conditioning temperature.

5.5.2.4 Measurements during conditioning

Except during the final 15 min of conditioning, monitor those devices requiring power during the quiescent state (see 5.1.2) for false operation and fault signals during the conditioning period.

During the last 15 min of the conditioning, measure the sound pressure level as specified in Annex B.

5.5.2.5 Final measurements

After the recovery period specified in IEC 60068-2-2, measure the sound pressure level of the specimen as specified in Annex B.

5.5.3 Requirements

No false operation or fault signals shall be given during the transition to or the period at the conditioning temperature.

The specimen shall operate correctly during the conditioning period.

The sound pressure level measured during the conditioning period and after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

If the a.a.d. is combined with a heat detector which could operate at the conditioning temperature, then the response of the heat detector may be disabled or ignored during the test.

5.6 Dry heat (endurance)

5.6.1 Object of the test

The object of the test is to demonstrate the ability of the type B specimen to withstand long-term ageing effects.

5.6.2 Test procedure

5.6.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-2, Test Bb for non-heat dissipating specimens or Test Bd for heat dissipating specimens, and in 5.6.2.2 to 5.6.2.4.

5.6.2.2 State of the specimen during conditioning

Do not supply power to the specimen during the conditioning.

5.6.2.3 Conditioning

Apply the following conditioning:

— temperature: (70 ± 2) °C for type B;

— duration: 21 d.

NOTE Test Bb specifies rates of change of temperature of <1 °C/min for the transitions to and from the conditioning temperature.

5.6.2.4 Final measurements

After the recovery period specified in IEC 60068-2-2, measure the sound pressure level of the specimen as specified in Annex B.

5.6.3 Requirements

The sound pressure level measured after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.7 Cold (operational)

5.7.1 Object of the test

The object of the test is to demonstrate the ability of the specimen to function correctly at low ambient temperatures appropriate to the anticipated service environment.

5.7.2 Test procedure

5.7.2.1 General

Use the test apparatus and perform the procedure in IEC 60068-2-1, Test Ab for non-dissipating specimens, or Test Ad for heat dissipating specimens, except conduct the test in a reverberation chamber as specified in Annex B and in 5.7.2.2 to 5.7.2.5.

5.7.2.2 State of specimen during conditioning

Mount the specimen in a reverberation test chamber as specified in Annex B. Maintain the specimen in the quiescent state during the conditioning period, except during the last hour, when it shall be sounding (see 5.1.2).

5.7.2.3 Conditioning

Apply the following conditioning:

— temperature: (-10 ± 3) °C for type A or (-25 ± 3) °C for type B;

— duration: 16 h.

NOTE Test Ab and Test Ad specify rates of change of temperature of <1 °C/min for the transitions to and from the conditioning temperature.

For countries with very cold outside temperatures, a test temperature of (-40 ± 3) °C should be used for type B and the results included in the test report (see Clause 6).

5.7.2.4 Measurements during conditioning

For a.a.d.s which require power during the quiescent state (see 5.1.2), monitor the specimen for false operation and fault signals during the conditioning period.

Measure the sound pressure level as described in Annex B during the final 15 min of the conditioning.

5.7.2.5 Final measurements

After the recovery period specified in IEC 60068-2-1, measure the sound pressure level of the specimen as specified in Annex B.

5.7.3 Requirements

No false operation or fault signals shall be given during the transition to or the period at the conditioning temperature.

The specimen shall operate correctly during the conditioning period.

The sound pressure level measured during the conditioning period and after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.8 Damp heat, cyclic (operational)

5.8.1 Object of the test

The object of the test is to demonstrate the immunity of the specimen to an environment with high relative humidity, where condensation on the device may occur.

5.8.2 Test procedure

5.8.2.1 General

Use the test apparatus and perform the procedures as specified in IEC 60068-2-30, using the Variant 1 test cycle and controlled recovery conditions, in 5.8.2.2 to 5.8.2.5.

5.8.2.2 State of the specimen during conditioning

Maintain the specimen in the quiescent state during the conditioning period, except during the last half hour of the high temperature phase of the last cycle, when it shall be sounding (see 5.1.2).

5.8.2.3 Conditioning

Apply the following conditioning:

— lower temperature: (25 ± 3) °C at >95 % RH;

— upper temperature: (40 ± 5) °C for type A or (55 ± 2) °C for type B;

— relative humidity at upper temperature: (93 ± 3) %;

— number of cycles: two.

5.8.2.4 Measurements during conditioning

Except during the final 30 min of conditioning, monitor those devices requiring power during the quiescent state (see 5.1.2) for false operation and fault signals.

During the last 30 min of the high-temperature phase of the last cycle, check the audible operation of the specimen.

5.8.2.5 Final measurements

After the recovery period specified in IEC 60068-2-30, measure the sound pressure level of the specimen as specified in Annex B.

5.8.3 Requirements

No false operation or fault signals shall be given during the transition to or the period at the conditioning period.

The specimen shall operate correctly during the conditioning period.

The sound pressure level measured during the conditioning period and after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.9 Damp heat, steady state (endurance)

5.9.1 Object of the test

The object of the test is to demonstrate the ability of the specimen to withstand the long-term effects of humidity in the service environment (e.g. changes in electrical properties due to absorption, chemical reactions involving moisture, galvanic corrosion).

5.9.2 Test procedure

5.9.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-78, Test Cab, and in 5.9.2.2 to 5.9.2.4.

5.9.2.2 State of the specimen during conditioning

Do not supply the specimen with power during the conditioning.

5.9.2.3 Conditioning

Apply the following conditioning:

— temperature: (40 ± 2) °C;

— relative humidity: (93 ± 3) %;

— duration: 21 d.

5.9.2.4 Final measurements

After the recovery period specified in IEC 60068-2-78, measure the sound pressure level of the specimen as specified in Annex B.

5.9.3 Requirements

The sound pressure level measured after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.10 Damp heat, cyclic (endurance)

5.10.1 Object of the test

The object of the test is to demonstrate the ability of the type B specimen to withstand the longer term effects of high humidity and condensation.

5.10.2 Test procedure

5.10.2.1 General

Use the test apparatus and perform the procedure specified in IEC 60068-2-30, using the Variant 1 test cycle and controlled recovery conditions, in 5.10.2.2 to 5.10.2.4.

5.10.2.2 State of the specimen during conditioning

Do not supply the specimen with power during the conditioning.

5.10.2.3 Conditioning

Apply the following conditioning:

— temperature: (55 ± 2) °C for type B;

— number of cycles: 6.

5.10.2.4 Final measurements

After the recovery period specified in IEC 60068-2-30, measure the sound pressure level of the specimen as specified in Annex B.

5.10.3 Requirements

The sound pressure level measured after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.11 Sulfur dioxide (SO_2) corrosion (endurance)

5.11.1 Object of the test

The object of the test is to demonstrate the ability of the specimen to withstand the corrosive effect of sulfur dioxide as an atmospheric pollutant.

5.11.2 Test procedure

5.11.2.1 General

Use the test apparatus and procedure as generally specified in IEC 60068-2-42, except for the relative humidity of the test atmosphere, which shall be maintained at (93 ± 3) % instead of (75 ± 5) %, and use the test apparatus and procedure as specified in 5.11.2.2 to 5.11.2.4.

5.11.2.2 State of the specimen during conditioning

Do not supply the specimen with power during the conditioning, but equip it with untinned copper wires of the appropriate diameter, connected to a sufficient number of terminals to allow the final measurement to be made without making further connections to the specimen.

5.11.2.3 Conditioning

Apply the following conditioning:

— temperature: (25 ± 2) °C;

— relative humidity: (93 ± 3) %;

— SO_2 concentration: (25 ± 5) µl/l;

— duration: 21 d.

5.11.2.4 Final measurements

Immediately after the conditioning, subject the specimen to a drying period of 16 h at (40 ± 2) °C and <50 % RH, followed by a recovery period of at least 1 h at the standard atmospheric conditions.

After the recovery period, measure the sound pressure level of the specimen as specified in Annex B.

5.11.3 Requirements

The sound pressure level measured after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.12 Shock (operational)

5.12.1 Object of the test

The object of the test is to demonstrate the immunity of the specimen to mechanical shocks, which are likely to occur, albeit infrequently, in the anticipated service environment.

5.12.2 Test procedure

5.12.2.1 General

Use the test apparatus and perform the procedure as generally specified in IEC 60068-2-27, Test Ea, and in 5.12.2.2 to 5.12.2.5.

5.12.2.2 State of the specimen during conditioning

Mount the specimen on a rigid fixture and maintain it in the quiescent state (see 5.1.2).

5.12.2.3 Conditioning

For specimens with a mass <4,75 kg, apply the following conditioning:

— shock pulse type: half sine;

— pulse duration: 6 ms;

— peak acceleration: 10 (100 – 20m) m/s^2 (where m is the mass of the specimen in kilograms);

— number of directions: six;

— pulses per direction: three.

Do not test specimens with a mass >4,75 kg.

5.12.2.4 Measurements during conditioning

Monitor the specimen during the conditioning period and for a further 2 min for false operation and fault signals.

5.12.2.5 Final measurements

After the conditioning, measure the sound pressure level of the specimen as specified in Annex B.

5.12.3 Requirements

No false operation or fault signals shall be given during or after the conditioning period.

The sound pressure level measured during the conditioning period and after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.13 Impact (operational)

5.13.1 Object of the test

The object of the test is to demonstrate the immunity of the specimen to mechanical impacts upon its surface, which it may sustain in the normal service environment, and which it can reasonably be expected to withstand.

5.13.2 Test procedure

5.13.2.1 General

Use the test apparatus and procedure described in IEC 60068-2-75, Test Eh, and in 5.13.2.2 to 5.13.2.5.

5.13.2.2 State of the specimen during conditioning

Maintain the specimen in the quiescent state during the conditioning period (see 5.1.2).

5.13.2.3 Conditioning

Apply the impact to each accessible surface of the specimen at any point(s) considered likely to suffer damage or to impair the operation of the specimen.

Use the following test parameters during the conditioning:

— impact energy: $(0{,}5 \pm 0{,}04)$ J;

— number of impacts: three.

5.13.2.4 Measurement during conditioning

Monitor the specimen for false operation and fault signals during the conditioning period and for a further 2 min after the end of the conditioning period.

5.13.2.5 Final measurements

Measure the sound pressure level of the specimen as specified in Annex B.

5.13.3 Requirements

No false operation or fault signals shall be given during or after the conditioning period.

The sound pressure level measured during the conditioning period and after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.14 Vibration, sinusoidal (operational)

5.14.1 Object of the test

The object of the test is to demonstrate the immunity of the specimen to vibration at levels considered appropriate to the normal service environment.

5.14.2 Test procedure

5.14.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-6, Test Fc, and in 5.14.2.2 to 5.14.2.5.

5.14.2.2 State of the specimen during conditioning

Mount the specimen on a rigid structure. Apply the vibration in each of three mutually perpendicular axes, in turn, so that one of the three axes is perpendicular to the normal mounting plane of the specimen.

Apply the conditioning to the specimen in both the quiescent state and when sounding (see 5.1.2).

5.14.2.3 Conditioning

Apply the following conditioning:

— frequency range: (10 to 150) Hz;

— acceleration amplitude: 5 m/s^2 (≈0,5 g_n);

— number of axes: three;

— sweep rate: one octave/min;

— number of sweep cycles: two/axis.

The vibration operational and endurance tests may be combined such that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in one axis before changing to the next axis. It is necessary to make only one final measurement.

5.14.2.4 Measurements during conditioning

Monitor the specimen during the conditioning period for any false operation or fault signals when in the quiescent state, and any interruption of the sound output when sounding.

5.14.2.5 Final measurements

Measure the sound pressure level of the specimen as specified in Annex B.

5.14.3 Requirements

No false operation or fault signals shall be given during or after the conditioning period.

When sounding, no interruption to the sound output shall occur during the conditioning period.

The sound pressure level measured during the conditioning period and after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.15 Vibration, sinusoidal (endurance)

5.15.1 Object of the test

The object of the test is to demonstrate the ability of the specimen to withstand the long-term effects of vibration at levels appropriate to the shipping, installation and service environment.

5.15.2 Test procedure

5.15.2.1 General

Use the test apparatus and perform the procedure as specified in IEC 60068-2-6, Test Fc, and in 5.15.2.2 to 5.15.2.4.

5.15.2.2 State of the specimen during conditioning

Mount the specimen on a rigid structure. Apply the vibration in each of three mutually perpendicular axes, in turn, so that one of the three axes is perpendicular to the normal mounting plane of the specimen.

Do not supply the specimen with power during the conditioning.

5.15.2.3 Conditioning

Apply the following conditioning:

— frequency range: (10 to 150) Hz;

— acceleration amplitude: 10 m/s^2 ($\approx$1,0 g_n);

— number of axes: three;

— sweep rate: one octave/min;

— number of sweep cycles: 20/axis.

The vibration operational and endurance tests may be combined such that the specimen is subjected to the operational test conditioning followed by the endurance test conditioning in one axis before changing to the next axis. It is necessary to make only one final measurement.

5.15.2.4 Final measurements

Measure the sound pressure level of the specimen as specified in Annex B.

5.15.3 Requirements

The sound pressure level measured during the conditioning period and after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.16 Electromagnetic compatibility (EMC), immunity (operational)

5.16.1 Object of the tests

The object of the test is to demonstrate the immunity of the specimen to electrostatic discharges, electromagnetic fields, and fast low energy and slow high energy transients.

5.16.2 Test procedures

5.16.2.1 General

Perform the EMC immunity tests as specified in EN 50130-4:

a) electrostatic discharge;

b) radiated electromagnetic fields;

c) conducted disturbances induced by electromagnetic fields;

d) fast transient burst;

e) slow high energy voltage surges.

5.16.2.2 State of the specimen during conditioning

a) For tests a), d) and e) in 5.16.2.1, apply the conditioning to the specimen in the quiescent state.

b) For tests b) and c) in 5.16.2.1, apply the conditioning to the specimen in both the quiescent state and when sounding.

5.16.2.3 Conditioning

Apply the tests conditions specified in EN 50130-4 for the tests listed in 5.16.2.1.

5.16.2.4 Measurements during conditioning

Monitor the specimen during the conditioning period to detect:

a) any false operation or fault signals when in the quiescent state, and

b) any interruption of sound output when sounding.

NOTE 1 Interruption of sound output means that the specimen stops sounding altogether during conditioning. Any variations in volume, tone or pattern during conditioning are allowed.

NOTE 2 It may be necessary to look further into any anomalies to confirm performance of the specimen.

5.16.2.5 Final measurements

The sound pressure level of the specimen shall be measured as described in Annex B after the conditioning.

5.16.3 Requirements

The criteria for compliance specified in EN 50130-4 and the following shall apply:

a) no false operation or fault signals shall be given during or after the conditioning period;

b) when sounding, no interruption to the sound output shall occur during the conditioning period;

c) the sound pressure level measured during the conditioning period and after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

5.17 Enclosure protection

5.17.1 Object of the test

The object of the test is to demonstrate that the degree of protection provided by the enclosure of the specimen, with regard to the ingress of solid foreign objects and the harmful effects due to the ingress of water, meets the requirements of 4.6.3.

5.17.2 Test procedures

5.17.2.1 General

Use the test apparatus and perform the procedures as specified in IEC 60529 and 5.17.2.2 to 5.17.2.5. The following tests shall be conducted:

a) protection against solid foreign objects indicated by the first characteristic numeral;

b) protection against access to hazardous parts indicated by the additional letter;

c) protection against water indicated by the second characteristic numeral.

For the purpose of this test, the enclosure of the specimen shall be taken as comprising any parts of the outer physical envelope of the device which prevent or restrict access of solid foreign objects to the sound transducer, internal components and cable termination block.

Ingress of liquid inside the enclosure may be possible, but should not adversely affect the operation of the device.

5.17.2.2 State of the specimen during conditioning

Mount the specimen, including all wiring termination boxes which form part of the a.a.d. when installed, as specified in IEC 60529.

For tests of protection against solid foreign objects and of protection against access to hazardous parts, do not supply power to the specimen.

For tests of protection against water, apply the test when the specimen is sounding.

5.17.2.3 Conditioning

Apply the test conditions specified in IEC 60529 for the following IP Codes:

a) type A, indoor use: IP21C,

b) type B, outdoor use: IP33C.

5.17.2.4 Measurements during conditioning

During the conditioning for the test for protection against water, monitor the specimen to check that the a.a.d. continues to sound, in the selected mode of operation, without interruptions.

5.17.2.5 Final measurements

At the end of the conditioning period for the test for protection against water:

a) measure the sound pressure level of the specimen as specified in Annex B;

b) examine the specimen for ingress of water inside the enclosure.

5.17.3 Requirements

The specimen shall satisfy the acceptance conditions for the test for protection against solid foreign objects as specified in 13.3 of IEC 60529:2001.

The specimen shall satisfy the acceptance conditions for the protection test against access to hazardous parts as specified in 15.3 of IEC 60529:2001.

Following the conditioning period for the test for protection against water (see 5.17.2.5):

a) the sound pressure level measured during the conditioning period and after the recovery period shall be less than 6 dB from that measured for the same specimen in the reproducibility test (see 5.2).

b) no water has penetrated the enclosure or, if water has penetrated the enclosure, the device incorporates adequate provision for drainage.

5.18 Operational performance for a.a.d.s with voice

5.18.1 Object of the test

The object of the test is to verify that the output level of the message from a.a.d.s with voice, in relation to the output level of the warning signal, is sufficient.

5.18.2 Test procedure

Measure the sound pressure level of the voice message and the warning signal as specified in Annex A, except that only measurements at 15° and 90° from the axis of the specimen are required (see Figures A.2 and A.3).

For each angle, record the voice message measurements in dB as equivalent A-weighted sound pressure level, L_{eq}, over 1 min.

5.18.3 Requirements

For each angle, the sound pressure level of the voice message, L_{eq}, shall be less than 6 dB from that measured for the warning signal.

NOTE The difference in the measurement of the sound pressure levels of the voice message and that of the warning signal will vary depending on the frequency of the warning signal.

5.19 Sequence timing for a.a.d.s with voice

5.19.1 Object of the test

The object of the test is to verify that the signal sequence and timing of the voice message and the warning signal are within the requirements.

5.19.2 Test procedure

Connect the specimen to a suitable power supply and set it to the minimum voltage declared by the manufacturer.

Activate the signal sequence.

Repeat the measurements six times.

Repeat the procedure with the power supply set to the maximum voltage declared by the manufacturer.

5.19.3 Measurements during conditioning

At each voltage setting, measure the sequence and duration of the warning signal, silence periods and voice message.

5.19.4 Requirements

The measurements of 5.19.3 shall be within the limits specified in 4.4.3.

5.20 Synchronization (optional)

5.20.1 Object of the test

The object of the test is to show the ability of a.a.d.s to be synchronized over time.

5.20.2 Test procedure

Install two specimens in separate areas that have no significant acoustic interaction, have a low background noise level and have low reverberation.

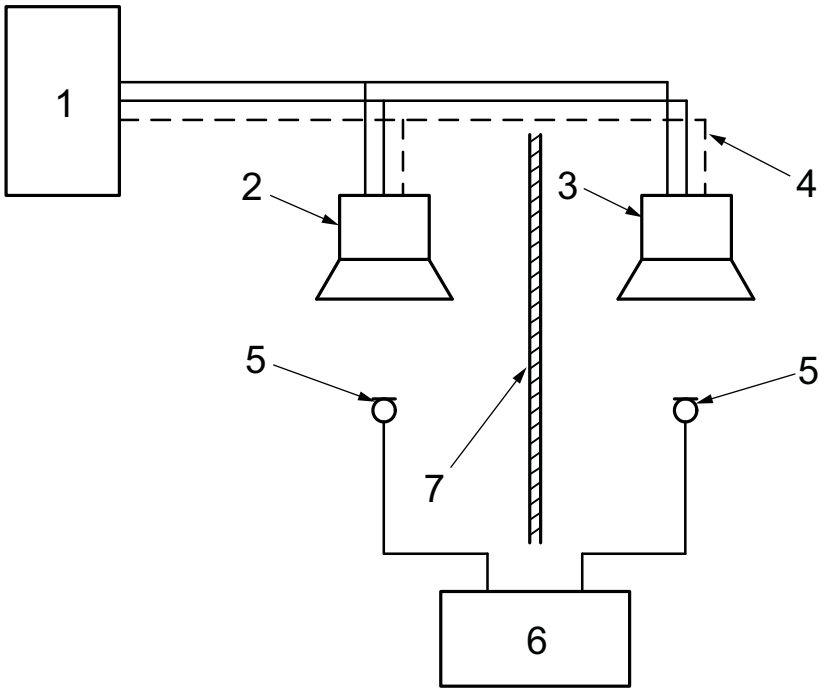
If required by their mode of synchronization, connect a trigger between the two specimens under test.

Place identical microphones 100 mm in front of each specimen. Connect the two microphones to a dual channel measuring instrument (see Figure 1).

Connect the specimens to a suitable power supply and set it to the minimum voltage declared by the manufacturer.

Activate the specimens such that the same sound pattern or aural message sequence is initiated and generated for 15 min.

Repeat the procedure with the power supply set to the maximum voltage declared by the manufacturer.



Key

1 power supply/control equipment
2 specimen under test 1
3 specimen under test 2
4 trigger wire (if required)
5 microphones
6 dual channel signal measurement/recording instrument
7 acoustic screen

Figure 1 — Test arrangement to measure synchronization

5.20.3 Measurements during conditioning

Measure the time differences between the signals from the two specimens at a representative point in the sequence every 5 min (i.e. three measurements during the conditioning period).

Designate the maximum measured time difference Δt_{MIN}.

5.20.4 Test requirements

At each power supply voltage setting, the maximum time difference, Δt_{MIN}, shall be less than 0,05 s.

6 Test report

The test report shall contain as a minimum the following information:

a) identification of the device tested;

b) reference to this part of ISO 7240;

c) results of the test: the individual response and the minimum, maximum and arithmetic mean values, where appropriate;

d) classification (i.e. type A or type B);

e) conditioning period and the conditioning atmosphere;

f) temperature and the relative humidity in the test room throughout the test;

g) details of the supply and monitoring equipment and the alarm criteria;

h) details of any deviation from this part of ISO 7240 or from the International Standards to which reference is made;

i) details of any operations regarded as optional.

Annex A
(normative)

Sound pressure level test for a.a.d.

A.1 General

An environment shall be considered to be equivalent to a free-field environment if the sound pressure decreases with the distance r from a point source according to a $1/r$ law, with an accuracy of ± 10 %, in the region that will be occupied by the sound field between the specimen to be tested and the measuring microphone. Free-field environment conditions shall be deemed to exist if this requirement is met along the axes joining the measuring microphone and the reference point on the specimen to be tested.

NOTE An anechoic room or quiet outdoor spaces are regarded as being free-field environments.

Free-field conditions shall exist over the whole frequency range of measurement.

A.2 Mounting arrangements

A.2.1 The manufacturer's normal mounting conditions shall be simulated.

A.2.2 For surface-mounted devices, the specimen shall be rigidly mounted on a smooth flat block with dimensions as specified in Figure A.1. The mounting block shall be of a material of thickness adequate to ensure negligible vibration such as plywood of at least (19 ± 2) mm. The surface of the mounting block shall be reflective with a coefficient of absorption less than 0,15 at 1 kHz.

NOTE A suitable mounting arrangement is shown in Figure A.1.

A.2.3 For pole-mounted devices, the specimen shall be mounted by its normal means to a suitable rigid structure with sufficient mass to resist the inertial effect of the specimen to be tested. Care shall be taken to ensure that the mounting structure does not obstruct the measurement field.

A.3 Instrumentation

A sound level meter conforming to IEC 61672-1:2002 Class 2 or better shall be used.

A.4 Background noise level

Measurement shall be deemed valid if, at the microphone positions, the background A-weighted sound pressure level is at least 10 dB below the nominal A-weighted sound pressure level of the device under test.

A.5 Measurement of sound pressure level

A.5.1 Measure the A-weighted sound pressure level using the F (Fast) detector indicator characteristic (see IEC 61672-1) and record the result in L_p. In the case of fluctuating sound, the maximum value indicated during at least a complete cycle of the sound pattern shall be taken.

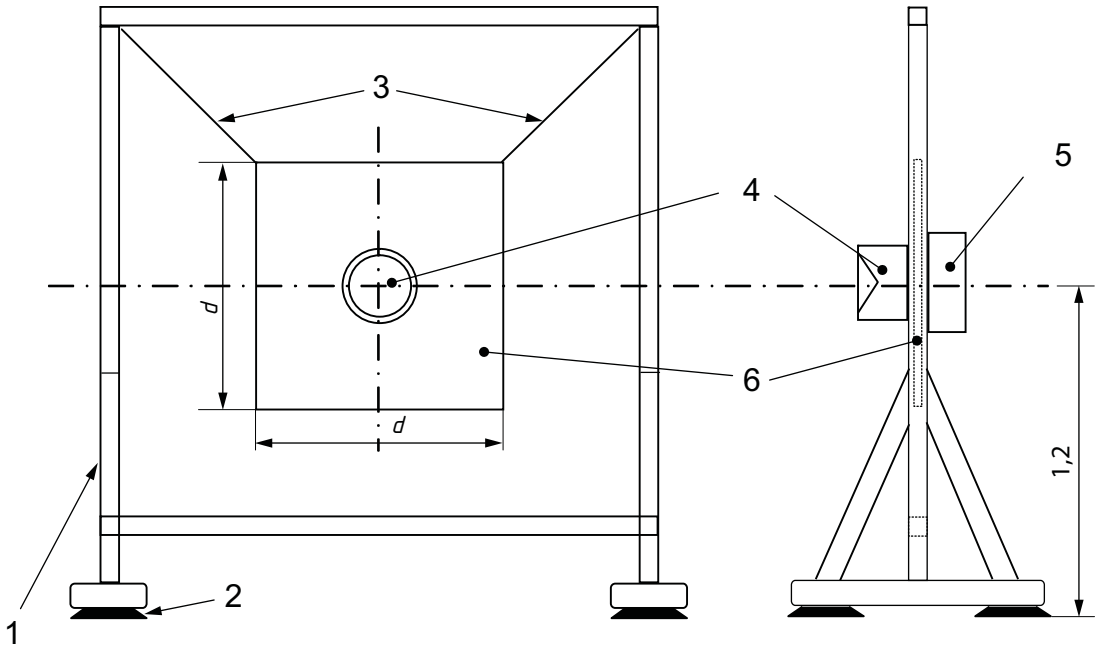
A.5.2 Measure one value of sound pressure level at a radius of 3 m from the reference point of the device for each of the following microphone positions:

a) surface-mounted device: at 30° intervals from 15° to 165° through a semi-circular arc centered at the reference point of the device for two perpendicular planes corresponding to the horizontal and vertical planes of the device in its designed position (see Figure A.2).

b) pole-mounted device: at 30° intervals through a 360° circle centered at the reference point of the device, for two perpendicular planes corresponding to the horizontal and vertical planes of the device in its designed position (see Figure A.3).

A.5.3 Derive the A-weighted sound pressure level at 1 m by adding a conversion factor of 9,54 dB to the value obtained at 3 m.

Dimensions in metres



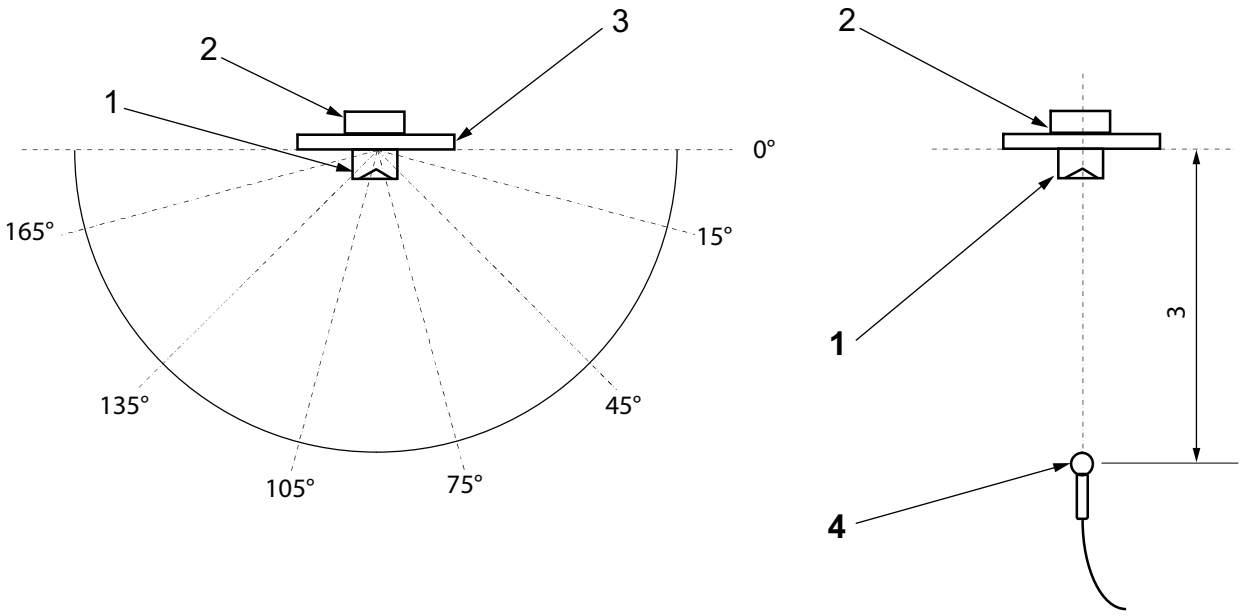
$d > 1{,}2$

Key

1 timber construction suitable for load
2 shock pads to minimize vibration transmission
3 suspension wires
4 a.a.d.
5 balancing mass
6 mounting block

Figure A.1 — Suggested method of mounting

Dimensions in metres



a) Plan view **b) Side view**

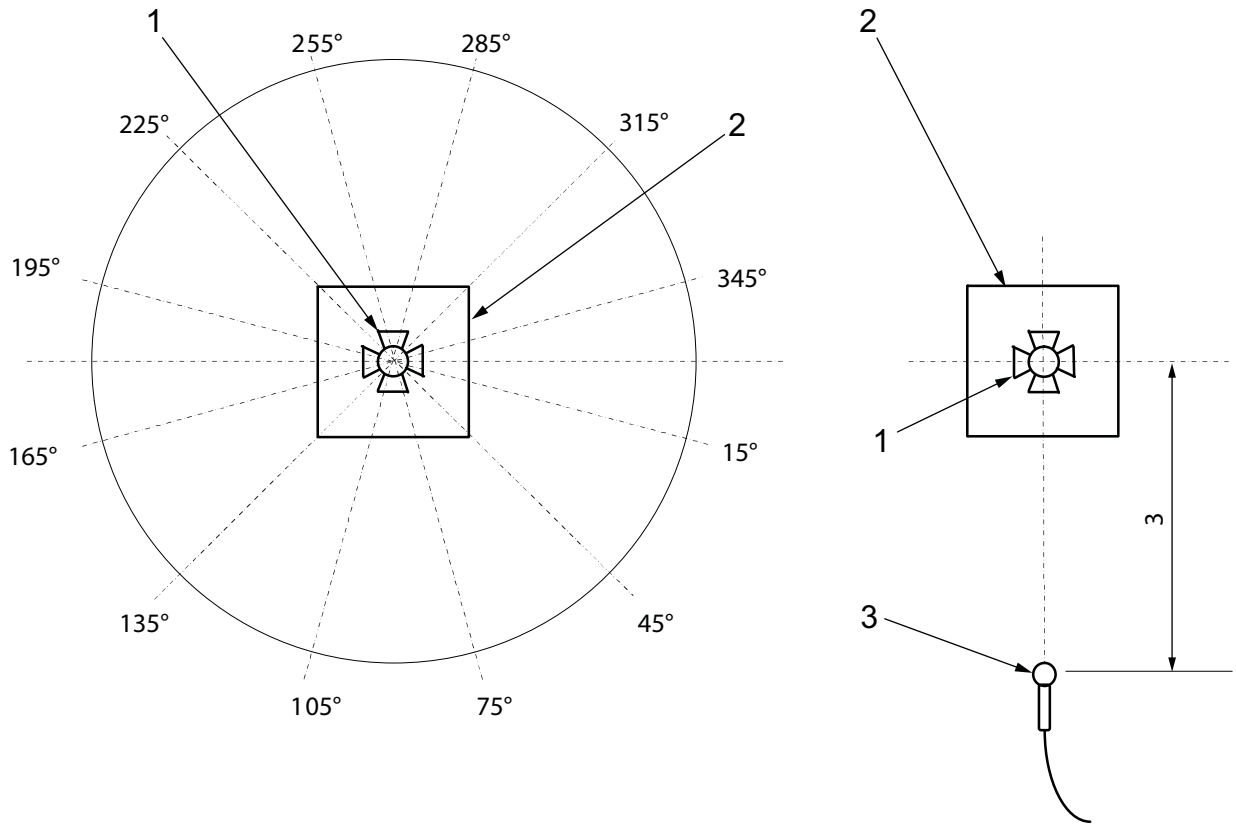
Key

1 a.a.d. under test
2 balancing mass
3 mounting block
4 microphone connected to sound level meter

NOTE a.a.d. may be rotated 90° to carry out measurements in the vertical plane.

Figure A.2 — Measurement positions — Surface-mounted devices

Dimensions in metres



a) Plan view **b) Side view**

Key

1 a.a.d. under test

2 mounting block

3 microphone connected to sound level meter

NOTE a.a.d. may be rotated 90º to carry out measurements in the vertical plane.

Figure A.3 — Measurement positions — Pole-mounted devices

Annex B
(normative)

Comparative sound pressure level test during environmental conditioning

B.1 General

B.1.1 The test chamber and sound pressure level measurement method described are for comparative assessments of the performance of an a.a.d. before, during and following the environmental conditioning specified in this part of ISO 7240 (see 5.2 and 5.5 to 5.17).

B.1.2 The specimen to be tested shall be placed in a reverberation test chamber as described in B.2, which shall have a sufficiently uniform repartition of sound energy throughout its volume to ensure consistent reading of sound pressure for differing environmental conditioning.

NOTE As the test method is concerned with establishing comparative test results on a single device, some of the parameters which would apply to the design of reverberation chambers for precision measurement have been relaxed.

The same test chamber construction and the same mounting conditions shall be used for all tests carried out on a given specimen and these shall be fully described in the test report.

B.2 Test chamber

B.2.1 Size

The volume of the test chamber expressed in cubic metres shall not be less than 0,5 or $125 \times 10^6 / f^3$, where 90 % of the sound power is at frequencies above f, whichever is greater.

The specimen to be tested shall not exceed 5 % of the volume of the test chamber.

B.2.2 Shape

The test chamber shall have six walls and shall be constructed so that either:

a) no surfaces are parallel, the angles between each surface are such as to minimize the resonant mode and the maximum length, width and height are the same; or

b) it is rectangular and the ratio of the length of each side, y/x and z/x conforms to the value in Table B.1.

Table B.1 — Ratios of lengths

y/x	z/x
0,83	0,47
0,83	0,65
0,79	0,63

NOTE Examples of suitable test chambers of the type described in B.2.2 a) and B.2.2 .b) are shown in Figure B.1 and Figure B.2 respectively.

B.2.3 Rigidity

The materials used, the thickness of each wall and the way the walls are joined shall be adequate to minimize measuring uncertainties caused by induced vibrations.

For example, a chamber constructed of marine plywood with a minimum thickness of 25 mm or $25\,V^{1/3}$ (where V is the volume of the chamber in cubic metres), whichever is greater, and with walls joined together using a recognized carpentry joint supplemented by a suitable waterproof adhesive and screws, is suitable.

Where removable panels are provided to permit the mounting of the specimen under test and other measuring equipment, these shall be of the same material and thickness as the rest of the chamber and shall be secured in place along the perimeter of the aperture at intervals not greater than 100 mm.

B.2.4 Surface treatment

The inner surface of each side of the chamber shall be equally reflective with an average absorption coefficient not exceeding 0,06 within the frequency band of interest. For example, the use of a Formica[2)] laminate bonded to plywood walls is suitable.

B.3 Mounting arrangements

The specimen to be tested shall be rigidly mounted by its normal means to the centre of one of the walls of the chamber.

B.4 Instrumentation

The basic instrumentation shall consist of a rotating microphone, an amplifier with A-weighting network, a squaring and averaging circuit and an indicating device. A sound level meter conforming to IEC 61672-1 Class 2 or better is suitable.

NOTE If, at extremes of environmental conditioning, e.g. temperature or humidity, the sensitivity of the complete instrument, including the microphone, is outside the specified value for the type of equipment used, it might be necessary to take into account the correction information provided by the manufacturer of the instrument.

B.5 Background noise level

Measurements are deemed valid if, at the microphone positions, the background A-weighted sound pressure level is at least 10 dB below the nominal A-weighted sound pressure level of the device under test.

B.6 Test procedure

B.6.1 Number and positioning of microphones

In order to reduce the effect of non-uniformity within the chamber, measurements shall be made with a rotating microphone over a circumference having a diameter of not less than 300 mm.

The microphone traverse shall not lie in any plane within 10° of a surface of the chamber. No point on the traverse shall be closer than $\lambda/4$, where λ is the wavelength of the lowest frequency range of interest, to any wall of the chamber.

2) Formica is an example of a suitable product available commercially. This information is given for the convenience of users of this part of ISO 7240 and does not constitute an endorsement by ISO of this product.

The minimum distance in metres between any microphone position and the specimen under test shall not be less than $0{,}3\,V^{1/3}$, where V is the volume of the test chamber in cubic metres.

The same microphone arrangement shall be used for all the tests carried out on a given specimen and this shall be fully described in the test report.

NOTE Care should be exercised in mounting the microphone to eliminate interferences from connecting cables and from vibrations that may be induced by the test chamber or the rotating mechanism or both.

B.6.2 Measurement of sound pressure level

The sound pressure level shall be measured by averaging the A-weighted sound pressure level for a whole number of revolutions of the microphone, either in a continuous sweep or at, at least, eight evenly distributed positions per revolution.

If the measurement is made in a continuous sweep, then the measuring path shall be traversed by the microphone at a constant speed, such that a single period of the microphone traverse is not less than 60 s. The average sound pressure level expressed in Lp is measured as the L_{AeqT}

NOTE L_{AeqT} is specified in 3.9 of IEC 61672-1:2002, time-average sound pressure level or “equivalent continuous sound pressure level”.

If the measurement is made at, at least, eight evenly distributed positions, the maximum A-weighted sound pressure level shall be measured at each point using the F (Fast) detector indicator characteristic. The measurement at each point shall be made for a period of (60/n)s (where n is the number of points) or for at least a complete cycle of the sound pattern, whichever is the greater.

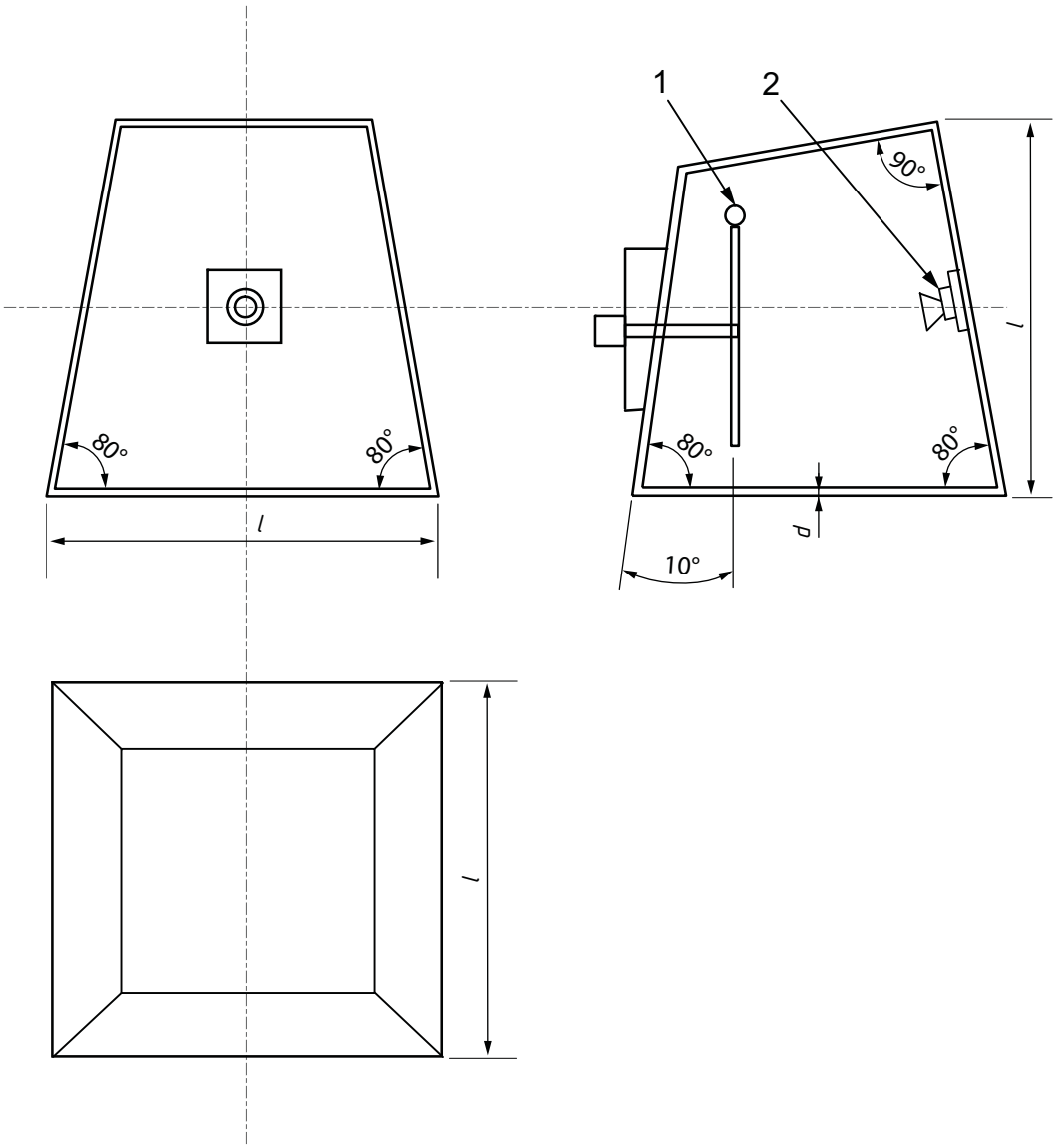
$$\overline{L_{\mathrm{p}}} = 10 \log \frac{1}{n}\left(10^{\frac{L_{\mathrm{p1}}}{10}} + 10^{\frac{L_{\mathrm{p2}}}{10}} + \ldots\ldots 10^{\frac{L_{\mathrm{p}n}}{10}} \right)$$

where

$\overline{L_{\mathrm{p}}}$ is average sound pressure level (dB);

$L_{\mathrm{p1}}, L_{\mathrm{p2}}, \ldots . L_{\mathrm{p}n}$ is individual sound pressure levels (dB);

n is the number of individual sound pressure levels to be averaged.



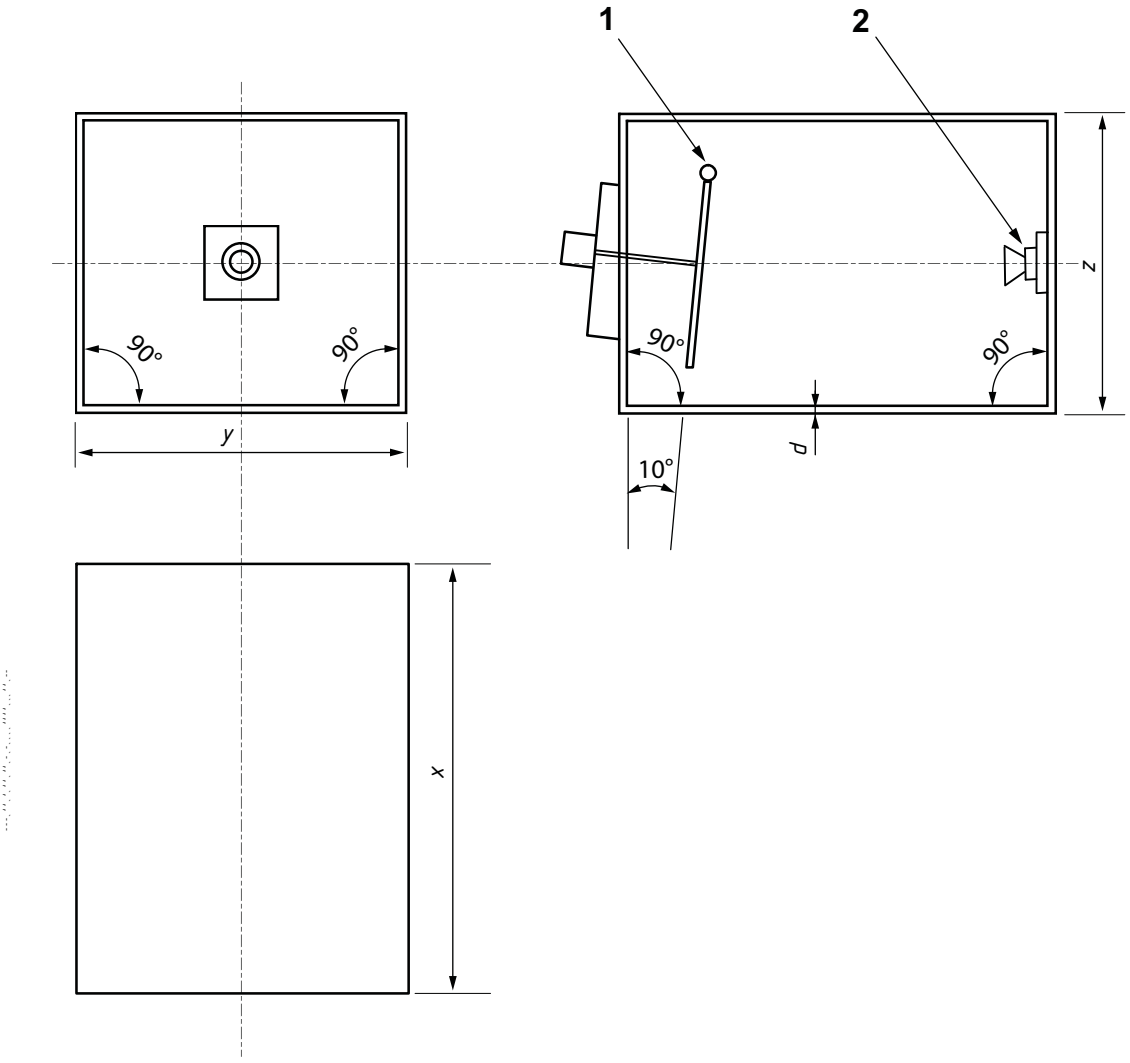
d
⩾25 mm

Key

1 rotating microphone

2 a.a.d. under test

Figure B.1 — Example of reverberation chamber specified in B.2.2 a)



d	y/x	z/x
⩾25 mm	0,83	0,65

Key

1 rotating microphone

2 specimen under test

Figure B.2 — Example of reverberation chamber specified in B.2.2 b)

Annex C
(informative)

Comparison of flammability test requirements in various standards

C.1 Introduction

This annex is intended to inform on the test requirements for the flammability of plastics (see 4.6.2) given in some relevant standards. In particular, it gives a comparison of flammability ratings between UL 94 and relevant IEC International Standards.

C.2 Relevant standards

The following standards are covered in this annex:

— IEC 60695-11-10:2003, *Fire hazard testing — Part 11-10: Test flames — 50 W horizontal and vertical flame test methods*;

— IEC 60695-11-20:2003, *Fire hazard testing — Part 11-20: Test flames — 500 W flame test methods (IEC 60695-11-20:1999/A1:2003)*;

— UL 94:1996 — *Tests for flammability of plastic materials for parts in devices and appliances*.

The test apparatus, conditioning applied, number of specimens, size of the specimens and procedure for the horizontal and vertical tests are very similar between UL 94 and IEC 60695-11-10. The number of specimens specified in UL 94 is less than that specified in IEC 60695-11-10.

C.3 Vertical burning tests

For the vertical burning test, the categories given in Table C.1 can be regarded as being similar.

Table C.1 — Equivalence of flammability categories between IEC 60695-11-10 and UL 94

IEC 60695-11-10	UL 94 categories
V-0	V-0
V-1	V-1
V-2	V-2

C.4 Horizontal burning tests

C.4.1 IEC 60695-11-10 and UL 94

The classification for the horizontal burning tests differs between IEC 60695-11-10 and UL 94, making a direct comparison difficult. To assist in such a comparison, the performance criteria for each standard are given in Table C.2 and Table C.3.

Table C.2 — Horizontal flammability classification in IEC 60695-11-10

HB	HB40	HB75
The test specimens do not visibly burn with a flame after the ignition source is removed.	The test specimens do not visibly burn with a flame after the ignition source is removed.	If the flame front passes the 100 mm mark, the test specimens do not have a linear burning rate exceeding 75 mm/min.
If the test specimens continue to burn with a flame after removal of the ignition source, the flame is less than 100 mm.	If the test specimens continue to burn with a flame after removal of the ignition source, the flame is less than 100 mm.	
If the flame front exceeds 100 mm, the linear burning rate of the specimens is less than 40 mm/min for a thickness of 3,0 mm to 13,0 mm or less than 75 mm/min for a thickness of less than 3,0 mm.	If the flame front exceeds 100 mm, the linear burning rate of the specimens is less than 40 mm/min.	
If the linear burning rate does not exceed 40 mm/min for tests with 3,0 mm ± 0,2 mm thickness, the specimen is automatically accepted down to a 1,5 mm minimum thickness.		

Table C.3 — Horizontal flammability classification in UL 94

HB
— For specimens having a thickness of 3,0 mm to 13,0 mm, the burning rate shall not exceed 40 mm/min over a 75 mm span, or — for specimens having a thickness less than 3,0 mm, the burning rate shall not exceed 75 mm/min over a 75 mm span, or — the specimens cease to burn before the flame exceeds 100 mm.

C.4.2 IEC 60695-11-20 and UL 94

For the horizontal burning test, the categories given in Table C.4 can be regarded as being similar.

Table C.4 — Equivalence of flammability categories between IEC 60695-11-20 and UL 94

IEC 60695-11-20	UL 94
5VA	94-5VA
5VB	94-5VB

Bibliography

[1] ISO 7731, *Ergonomics — Danger signals for public and work areas — Auditory danger signals*

[2] ISO 9001:2008, *Quality management systems — Requirements*

[3] UL 94:1996, *Test for flammability of plastic materials for parts in devices and appliances*

[4] IEC 61672-1:2002, *Electroacoustics — Sound level meters — Part 1: Specifications*

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