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Electroacoustics — Sound calibrators

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by Institute of Notice Control Engineering Japan (INCE/J) / Japanese Standards Association (JSA), with the draft being attached, based on the provision of Article 12 clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently JIS C 1515:1991 is revised with this Standard.

Sound calibrators have two principal applications:

- a) the determination of the electroacoustical pressure sensitivity of specified models of microphone in specified configurations;
- b) checking or adjusting the overall sensitivity of acoustical measuring devices or systems.

Sound calibrators are designed to produce one or more known sound pressure levels at one or more specified frequencies when coupled to specified models of microphone in specified configurations, for example, with or without protective grid. The sound pressure level generated by a sound calibrator may depend on environmental conditions such as static pressure, air temperature and relative humidity.

The most significant changes from the previous edition are: the inclusion of maximum permitted uncertainties of measurement within the tolerance limits; the inclusion of a normative annex giving the format for reporting results of pattern evaluation tests; changes to the class designations; specification of the type designation of microphone to be used to determine the class; harmonization of the range of operating environmental conditions with those for sound level meters. Specifications for equivalent free-field and diffuse-field levels have been removed.

This revision has been made based on IEC 60942:2003, *Electroacoustics — Sound Calibrators* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

IEC 60942:2003 has been made based on in concert with related IEC Technical Committee 29 (Electroacoustics) and OIML (International Organization of Legal Metrology).

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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the original JIS is to be the final authority.

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Electroacoustics – Sound calibrators

Introduction This Japanese Industrial Standard has been prepared based on IEC 60942 *Electroacoustics – Sound calibrators* published in 2003 as the third edition without modifying the technical contents.

Portions underlined with dots are the matters not stated in the original International Standard.

1 Scope This Standard specifies the performance requirements for three classes of sound calibrator: laboratory standard (class LS), class 1 and class 2. Tolerance limits are smallest for class LS and greatest for class 2 instruments. Class LS sound calibrators are normally used only in the laboratory; class 1 and class 2 are considered as sound calibrators for field use. A class 1 sound calibrator is primarily intended for use with a class 1 sound level meter and a class 2 sound calibrator primarily with a class 2 sound level meter, as specified in IEC 61672-1.

The tolerance limits for class LS sound calibrators are based on the use of a laboratory standard microphone, as specified in IEC 61094-1, for demonstrations of conformance to the requirements of this Standard. The tolerance limits for class 1 and class 2 sound calibrators are based on the use of a working standard microphone, as specified in IEC 61094-4, for demonstrations of conformance to the requirements of this Standard.

A multi-level and multi-frequency sound calibrator has the same class designation for all sound pressure level and frequency combinations for which the instruction manual states that the instrument conforms to the requirements of this Standard.

This Standard does not include requirements for equivalent free-field or random-incidence sound pressure levels, such as may be used in the overall sensitivity adjustment of a sound level meter.

A sound calibrator may provide other functions, for example, tonebursts. Requirements for these other functions are not included in this Standard.

NOTE : The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21.

IEC 60942:2003 *Electroacoustics – Sound calibrators* (IDT)

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. Only the edition of indicated year constitutes the provision of this Standard but the revision and amendment made thereafter are not applied.

JIS C 61000-4-2:1999 *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test*

NOTE : IEC 61000-4-2:1995 *Electromagnetic compatibility (EMC) —Part 4: Testing and measurement techniques —Section 2: Electrostatic discharge immunity test* is equivalent to the said standard.

JIS C 61000-4-3:1997 *Electromagnetic compatibility (EMC) —Part 4-3: Testing and measurement techniques —Radiated, radio-frequency, electromagnetic field immunity test* is equivalent to the said standard.

NOTE : IEC 61000-4-3:1998 *Electromagnetic compatibility (EMC) —Part 4-3: Testing and measurement techniques —Radiated, radio-frequency, electromagnetic field immunity test* is equivalent to the said standard.

JIS C 61000-6-1:2003 *Electromagnetic compatibility (EMC) —Part 6: Generic standards —Section 1: Immunity for residential, commercial and light-industrial environments*

NOTE : IEC 61000-6-1:1997 *Electromagnetic compatibility (EMC) —Part 6: Generic standards —Section 1: Immunity for residential, commercial and light-industrial environments* is equivalent to the said standard.

JIS Z 8106:2000 *International electrotechnical vocabulary Chapter 801:Acoustical and electroacoustics*

NOTE : IEC 60050 (801):1994 *International Electrotechnical Vocabulary (IEV) —Chapter 801:Acoustics and electroacoustics* is equivalent to the said standard.

CISPR 22:1997 *Information technology equipment —Radio disturbance characteristics —Limits and methods of measurement*

CISPR/IEC 61000-6-3:1996 *Electromagnetic compatibility (EMC) —Part 6: Generic standards —Section 3: Emission standard for residential, commercial and light-industrial environments*

IEC 61094-1:2000 *Measurement microphones —Part 1: Specifications for laboratory standard microphones*

IEC 61094-2:1992 *Measurement microphones —Part 2: Primary method for pressure calibration of laboratory standard microphones by the reciprocity technique*

IEC 61094-4:1995 *Measurement microphones —Part 4: Specifications for working standard microphones*

IEC 61094-5:2001 *Measurement microphones —Part 5: Methods for pressure calibration of working standard microphones by comparison*

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

Information : To be published as the Japanese Industrial Standard titled *Electroacoustics —Sound level meters —Part 1: Specifications*.

ISO 266:1997 *Acoustics —Preferred frequencies*

ISO/IEC Guide :1995 *Guide to the expression of uncertainty in measurement*

ISO Publication:1993 ISBN 92-67-01075-1, *International vocabulary of basic and general terms in metrology*

OIML International Recommendation R 97:1990 *Barometers*

3 Definitions For the purposes of this Standard, the definitions given in JIS Z 8106 and the ISO Publication *International vocabulary of basic and general terms in metrology*, as well as the following definitions, apply. Definitions for other relevant quantities are given in the documents referenced in clause 2.

3.1 sound calibrator device that generates a sinusoidal sound pressure of specified sound pressure level and frequency when coupled to specified models of microphone in specified configurations

3.2 specified sound pressure level sound pressure level(s) generated under reference environmental conditions for use with a particular microphone model and configuration, valid for either an individual sound calibrator (in the case of a class LS calibrator) or all sound calibrators of the same model (in the case of a class 1 or class 2 calibrator)

3.3 nominal sound pressure level close approximation to the specified sound pressure level(s), valid for all sound calibrators of the same model, rounded to the nearest decibel (intended for marking)

3.4 specified frequency frequency(ies) of the sound generated by the sound calibrator under reference environmental conditions, valid for either an individual sound calibrator (in the case of a class LS calibrator) or all sound calibrators of the same model (in the case of a class 1 or class 2 calibrator)

3.5 nominal frequency close approximation to the specified frequency, often rounded according to ISO 266 (intended for marking)

3.6 principal sound pressure level sound pressure level specified in the instruction manual as principal

NOTE : Principal sound pressure level is used during demonstration of conformance of the sound calibrator to the requirements of this Standard.

3.7 principal frequency frequency specified in the instruction manual as principal

NOTE : Principal frequency is used during demonstration of conformance of the sound calibrator to the requirements of this Standard.

3.8 replication repeat of a measurement involving coupling the microphone to the sound calibrator and then completely removing the microphone from the sound calibrator

3.9 total distortion ratio in per cent of the root-mean-square of the total distortion components to the root-mean-square of the entire signal

3.10 reference orientation orientation of a sound calibrator such that the principal axis of the opening of the cavity (the axis along which the microphone is inserted into the cavity) coincides with the principal direction of an emitter or receiver of radiofrequency fields. The opening of the cavity faces away from the emitter or receiver

3.11 reference plane plane of contact between the microphone and the sound calibrator

3.12 effective load volume of a microphone volume of air at reference environmental conditions that has the same acoustic compliance as the cavity bounded by the reference plane, the microphone diaphragm and the outer cylindrical surface of the microphone at the reference plane, including the equivalent volume of the microphone (see IEC 61094-1)

NOTE : Effective load volume is generally expressed in cubic millimetres.

4 Reference environmental conditions Reference environmental conditions for specifying the performance of a sound calibrator are:

- air temperature: 23 °C
- static pressure: 101.325 kPa
- relative humidity: 50 %

5 Requirements

5.1 General

5.1.1 A sound calibrator conforming to the requirements of this Standard shall have the characteristics described in this clause. Adaptors may be provided to accommodate more than one model of microphone. For the purpose of this Standard, any such adaptor is an integral part of the sound calibrator.

5.1.2 The sound calibrator shall conform to the requirements of this Standard for one or more of the sound pressure level and frequency combinations available. All the combinations conforming to the requirements given in this Standard shall conform to the same class designation. Conformance to the requirements of this Standard shall not be stated for sound pressure level and frequency settings for which this Standard provides no tolerance limits.

5.1.3 Class LS sound calibrators shall be supplied with an individual calibration chart containing the information required by 6.2. For class 1 and class 2 sound calibrators, the specified sound pressure level(s) and specified frequency(ies) shall be given in the instruction manual.

5.1.4 Class LS and class 1 sound calibrators that require corrections for the influence of static pressure to conform to the specifications for the appropriate class shall have the letter 'C' added to their class designation. Class LS and class 1 sound calibrators shall not require corrections for any of the other environmental conditions to achieve the requirements specified for the appropriate class. Class 2 sound calibrators that require corrections for any of the environmental conditions to conform to the specified requirements shall have the letter 'C' added to their class designation. Where appropriate, the class designation shall be described as class LS/C, class 1/C, class 2/C. Where corrections are permitted, and are necessary to conform to the specified requirements as an environmental condition varies, these corrections shall be stated in the instruction manual.

5.1.5 Class 1 sound calibrators that require a correction for the influence of static pressure to conform to the specifications of this Standard shall be supplied with a ba-

rometer. The barometer shall enable the static pressure to be measured so that the ability of a sound calibrator to conform to the requirements for the class is not affected. Class 2 sound calibrators that require a correction for the influence of static pressure to conform to the specifications of this Standard shall be supplied with a barometer (which shall enable the static pressure to be measured in such a way that the ability of a sound calibrator to conform to the requirements for the class is not affected), unless the corrections are sufficiently small that for any change in static pressure of ± 6.0 kPa the uncorrected measured sound pressure levels conform to the specifications of this Standard. In this case, the corrections to be applied for the influence of variations in static pressure shall be stated in the instruction manual, together with information on how to calculate the relevant correction when operating the sound calibrator at different heights above sea-level.

- NOTES 1 A class LS sound calibrator is normally used only in the laboratory where a suitable device should be available for measuring static pressure if the sound calibrator has a class 'C' designation. Hence, there is no requirement to supply a barometer for this class.
- 2 The barometer may provide the data directly in the form to be used to correct measured sound pressure levels to the reference static pressure.

5.1.6 Where a class 2 sound calibrator, that requires a correction for the influence of temperature or relative humidity to conform to the specifications of this Standard, is supplied with the means to measure the relevant environmental condition, the supplied means shall enable the condition to be measured in such a way that the ability of a sound calibrator to conform to the requirements for the class is not affected.

5.1.7 The design of the sound calibrator and the materials used in the construction should be such as to provide long-term stability for the operation of the sound calibrator.

5.1.8 If a specific orientation of the sound calibrator is to be used to conform to the requirements of this Standard, this orientation shall either be indicated on the sound calibrator, or the indication on the sound calibrator shall refer to the instruction manual, which shall state the required orientation.

Information : The orientation stated above means the direction along which the sound calibrator can exhibit original performances, and differs from the orientation defined in 3.10 for the test relating with EMC.

5.1.9 All performance requirements relate to the operation of the sound calibrator following stabilizing of the coupling of the microphone and sound calibrator, and after the sound pressure level and frequency have stabilized. The elapsed time necessary for stabilization of the sound pressure level and frequency, which begins once the sound calibrator is switched on with the microphone coupled to it, shall be stated in the instruction manual, and shall not exceed 30 s for any applicable combination of environmental conditions specified in 5.4. The sound calibrator and microphone shall be allowed to reach equilibrium with the prevailing environmental conditions before coupling.

NOTE : The stabilization time required following the coupling of the microphone to the sound calibrator may vary considerably depending on the model of microphone and sound calibrator in use.

Information : The said stabilization time means the time necessary for stabilization of sound pressure level and frequency from the instant when the power supply is switched on after pressure balancing of the microphone and the sound calibrator.

5.1.10 Those components of a sound calibrator that are not intended to be accessible to the user shall be protected by seals or marks.

5.1.11 The tolerance limits in this Standard include the associated expanded uncertainty of measurement calculated for a coverage factor of 2 corresponding to a level of confidence of approximately 95 %, in accordance with the guidelines given in the ISO/IEC Guide *Guide to the expression of uncertainty in measurement*. For testing laboratories the maximum permitted expanded uncertainties of measurement are stated in annexes A and B of this document.

Sound calibrator manufacturers may calculate the proportion of the tolerance limits available for design and manufacturing purposes by subtracting the maximum permitted expanded uncertainties of measurement from the appropriate tolerance limit.

5.1.12 Conformance to the requirements of this Standard is demonstrated when the result of a measurement or the absolute value of the difference between the result and the design goal, as appropriate, extended by the actual expanded uncertainty of measurement of the testing laboratory, lies fully within the specified tolerance limits for the appropriate class. For legal metrology purposes, the tolerance limits stated in this Standard are considered to be the maximum permissible errors for pattern evaluation, initial verification and subsequent verification.

5.1.13 If the actual expanded uncertainty of a measurement performed by the test laboratory exceeds the maximum permitted value given in annexes A and B, the measurement shall not be used to demonstrate conformance to the requirements of this Standard.

5.2 Sound pressure level

5.2.1 General

5.2.1.1 All specified sound pressure level(s) generated shall be stated in the instruction manual with a resolution better than, or equal to, 0.1 dB.

5.2.1.2 All the requirements and tolerance limits specified in this Standard relate to the level of the sound pressure produced at the diaphragm of the inserted microphone.

5.2.1.3 The principal sound pressure level of the sound calibrator shall be at least 90 dB (re 20 μ Pa) when the sound calibrator is applied to the models of microphone in the configurations specified in the instruction manual.

5.2.2 Generated sound pressure level The sound pressure level generated by the sound calibrator shall be measured as an average over 20 s of operation. For sound calibrators with letter 'C' designation the measured level shall be corrected, if neces-

sary, to the reference environmental conditions given in clause 4. The absolute value of the difference between the measured sound pressure level and the corresponding specified sound pressure level, extended by the expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 1 for the class of sound calibrator. These tolerance limits apply to measurements made at and around reference environmental conditions within the following ranges: 97 kPa to 105 kPa, 20 °C to 26 °C and 40 % relative humidity to 65 % relative humidity.

Information 1 The tolerance limits specified in table 1 are originally applicable to the measured values under environmental conditions within the ranges stated above are considered as the measured values under the reference environmental conditions.

2 Here, correction of the measured values of sound pressure level generated from the sound calibrator is stated, it corresponds to such action that correction to the specified sound level is carried out at actual use of the sound calibrator.

5.2.3 Short-term level fluctuation Fluctuation in the sound pressure level shall be measured with time-weighting F (nominal time constant of 125 ms as specified in IEC 61672-1), by making a minimum of 10 measurements at regular intervals during a period of 20 s of operation of the sound calibrator. One-half of the difference between the maximum and minimum levels measured, extended by the expanded uncertainty of measurement, shall not exceed the short-term level fluctuation limits given in table 1 for the class of sound calibrator. These short-term level fluctuation limits apply to measurements made at and around reference environmental conditions within the following ranges: 97 kPa to 105 kPa, 20 °C to 26 °C and 40 % relative humidity to 65 % relative humidity.

Information : The tolerance limits specified in table 1 are originally applicable to the measured values under the reference environmental conditions, however the measured values under the environmental conditions within the ranges stated above are considered as the measured values under the reference environmental conditions.

Table 1 Tolerance limits for sound pressure level and short-term level fluctuation, at and around reference environmental conditions

Range of nominal frequencies Hz	Sound pressure level tolerance limits dB			Short-term level fluctuation limits dB		
	Class LS	Class 1	Class 2	Class LS	Class 1	Class 2
31.5 to <160	—	0.50	—	—	0.20	—
160 to 1 250	0.20	0.40	0.75	0.05	0.10	0.20
>1 250 to 4 000	—	0.60	—	—	0.10	—
>4 000 to 8 000	—	0.80	—	—	0.10	—
>8 000 to 16 000	—	1.00	—	—	0.10	—
NOTES 1 Sound pressure level tolerance limits are for the absolute value of the difference between the sound pressure level generated by the sound calibrator and the specified sound pressure level, extended by the expanded uncertainty of measurement. 2 Short-term level fluctuation limits are for the corresponding measured short-term level fluctuation, extended by the expanded uncertainty of measurement. 3 For a class LS or class 2 sound calibrator the ‘—’ symbols in the table indicate ranges of nominal frequency for which this Standard provides no tolerance limits.						

5.2.4 Sound pressure level over range of supply voltage The absolute value of the difference between the sound pressure level generated by the sound calibrator, determined according to 5.2.2 over the range of supply voltages specified in the instruction manual, and the sound pressure level measured at the nominal supply voltage under reference environmental conditions, extended by the expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 2 for the class of sound calibrator. Also, the tolerance limits given in table 1 for the absolute value of the difference between the measured sound pressure level and the specified sound pressure level shall not be exceeded for any supply voltage within the range.

Table 2 Tolerance limits for the effect of supply voltage on sound pressure level, under reference environmental conditions

Tolerance limits dB		
Class LS	Class 1	Class 2
0.05	0.10	0.20
NOTE : Tolerance limits are for the absolute value of the difference between the sound pressure level generated by the sound calibrator over the range of operating voltage, and the sound pressure level measured at the nominal supply voltage, extended by the expanded uncertainty of measurement.		

5.3 Frequency

5.3.1 General

5.3.1.1 The principal frequency of the sound generated by the sound calibrator shall be in the range from 160 Hz to 1 250 Hz. Specified frequencies shall be calculated from the equation for exact frequency given in 3.1 of ISO 266, or taken from table 1 of ISO 266 which gives the calculated frequency.

5.3.1.2 The principal sound pressure level shall be available at the principal frequency.

5.3.2 Frequency of sound generated by the sound calibrator The absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator and the corresponding specified frequency, extended by the expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 3 for the class of sound calibrator. These tolerance limits apply to measurements made at and around reference environmental conditions within the following ranges: 97 kPa to 105 kPa, 20 °C to 26 °C and 40 % relative humidity to 65 % relative humidity.

Information : The tolerance limits specified in table 3 are originally applicable to the measured values under the reference environmental conditions, however any of measured values under the environmental conditions within the ranges stated above are considered as the measured values under the reference environmental conditions.

Table 3 Tolerance limits for frequency, at and around reference environmental conditions

Tolerance limits %		
Class LS	Class 1	Class 2
1.0	1.0	2.0
NOTES 1 Tolerance limits are for the absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator and the specified frequency, extended by the expanded uncertainty of measurement. 2 Tolerance limits are expressed as a percentage of the specified frequency.		

5.4 Influence of static pressure, air temperature and humidity

5.4.1 For environmental conditions outside the range of 97 kPa to 105 kPa, 20 °C to 26 °C and 40 % relative humidity to 65 % relative humidity, sound calibrators shall operate within the tolerance limits given in tables 4 and 5 relative to the values measured under reference environmental conditions, and shall not exceed the tolerance limits for table 6, for the class of sound calibrator, over any combination of the range of environmental conditions given below.

Class LS static pressure : 65 kPa to 108 kPa
 air temperature : +16 °C to +30 °C
 relative humidity : 25 % to 90 %

Class 1 static pressure : 65 kPa to 108 kPa
 air temperature : -10 °C to +50 °C
 relative humidity : 25 % to 90 %

Combinations of air temperature and relative humidity that would yield a dewpoint greater than +39 °C are excluded from the tests of conformance with these specifications.

Class 2 static pressure : 65 kPa to 108 kPa
 air temperature : 0 °C to +40 °C
 relative humidity : 25 % to 90 %

NOTE : The range of environmental conditions for class 1 and class 2 sound calibrators is the same as specified in IEC 61672-1 for class 1 and class 2 sound level meters.

5.4.2 Class LS and class 1 sound calibrators that conform to the requirements of tables 4, 5 and 6 for the given class of sound calibrator, over the appropriate range of environmental conditions specified in 5.4.1, but which require corrections for the influ-

ence of static pressure to achieve conformance to the requirements specified in table 4 and table 5, shall be designated class LS/C or class 1/C sound calibrator, as appropriate. Similarly, class 2 sound calibrators that conform to the requirements of tables 4, 5 and 6 for the class of sound calibrator, over the appropriate range of environmental conditions specified in 5.4.1, but which require corrections for any of the environmental conditions to achieve conformance to the requirements specified in tables 4 and 5, shall be designated class 2/C sound calibrators. All relevant corrections, together with their associated expanded uncertainties of measurement corresponding to a confidence level of approximately 95 %, shall be given in the instruction manual. A statement shall be included in the instruction manual giving the maximum expanded uncertainty of the measurement of environmental conditions required so that the ability of a sound calibrator to conform to the requirements for the relevant class is not affected.

Table 4 Tolerance limits for sound pressure level, over the specified range of environmental conditions

Range of nominal frequencies Hz	Tolerance limits dB		
	Class LS	Class 1	Class 2
31.5 to <160	—	0.50	—
160 to 1 250	0.20	0.40	0.60
>1 250 to 4 000	—	0.60	—
>4 000 to 8 000	—	0.80	—
>8 000 to 16 000	—	1.00	—

NOTES 1 Tolerance limits are for the absolute value of the difference between the sound pressure level generated by the sound calibrator over the specified range of environmental conditions (excluding the conditions covered by table 1) and the sound pressure level measured under reference environmental conditions, extended by the expanded uncertainty of measurement.

2 For a class LS or class 2 sound calibrator the ‘—’ symbols in the table indicate ranges of nominal frequency for which this Standard provides no tolerance limits.

**Table 5 Tolerance limits for frequency,
over the specified range of environmental conditions**

Tolerance limits %		
Class LS	Class 1	Class 2
1.0	1.0	2.0
NOTES 1 Tolerance limits are for the absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator over the specified range of environmental conditions (excluding the conditions covered by table 3) and the frequency measured under reference environmental conditions, extended by the expanded uncertainty of measurement. 2 Tolerance limits are expressed as a percentage of the specified frequency.		

5.5 Total distortion The total distortion, measured over the frequency range from at least 22.5 Hz to 20 kHz, extended by the expanded uncertainty of measurement, shall not exceed the maximum values given in table 6, for the applicable range of environmental conditions specified in 5.4.1.

NOTE: A distortion metre may indicate the ratio of the magnitude of the unwanted components to the magnitude of the fundamental component of the signal. For the maximum distortion limits specified in this Standard, the difference between distortion measured as a ratio of the root-mean-square of the total distortion components to the root-mean-square of the entire signal, or to the root-mean-square of the fundamental, is insignificant compared with the uncertainty of measurement.

Table 6 Maximum total distortion

Range of nominal frequencies Hz	Total distortion %		
	Class LS	Class 1	Class 2
31.5 to <160	—	4.0	—
160 to 1 250	2.5	3.0	4.0
>1 250 to 16 000	—	4.0	—
NOTES 1 Tolerance limits are for the maximum total distortion generated by the sound calibrator, extended by the expanded uncertainty of measurement. 2 For a class LS or class 2 sound calibrator the '—' symbols in the table indicate ranges of nominal frequency for which this Standard provides no tolerance limits.			

5.6 Power supply requirements The sound calibrator shall include as an integral part some means of checking that the supply voltage is sufficient to operate the sound

calibrator in accordance with the requirements of this Standard, or shall ensure that the sound calibrator ceases to produce any sound output when the supply voltage falls below that required to operate the sound calibrator in accordance with the requirements of this Standard.

5.7 Specification and calibration of microphones

5.7.1 Microphone models and adaptors

5.7.1.1 The instruction manual for the sound calibrator shall state the microphone configuration as designated in IEC 61094-1 or IEC 61094-4, or alternatively (and in addition if desired), the name of the manufacturer or supplier, model designation and configurations (for example, with or without protective grid) of those microphones with which the sound calibrator is specified to operate in conformity with the requirements of this Standard. In each case, the instruction manual shall state the required adaptor configuration (if any).

5.7.1.2 For class LS sound calibrators, at least one of the microphone configurations or models specified shall be a laboratory standard microphone as specified in IEC 61094-1.

Information : The standard capacitor microphones of type and type specified in JIS C 5515 correspond the standard microphones of type LS1 and type LS2b specified on IEC 61094-1, respectively, however JIS C 5515 does not specify the ones corresponding to the standard microphones of type LS2a specified in IEC 61094-1.

5.7.1.3 For class 1 and class 2 sound calibrators, at least one of the microphone models specified shall be a working standard microphone as specified in IEC 61094-4.

NOTE : A measurement microphone that conforms to the requirements of IEC 61094-1 for laboratory standard microphones also conforms to the requirements of IEC 61094-4 for working standard microphones.

5.7.2 Microphone sensitivity level For the microphone models specified, it shall be possible to determine the pressure sensitivity level of the microphone by at least one of the following:

- a) a method specified in IEC 61094-2, or
- b) a method specified in IEC 61094-5, or by an alternative comparison method.

5.8 Electromagnetic compatibility

5.8.1 General Sound calibrators shall conform to the requirements of this Standard for radiofrequency emissions, and immunity to electrostatic discharges and power- and radiofrequency fields.

5.8.2 Radiofrequency emissions

5.8.2.1 The upper limits for the electromagnetic field strength of radiofrequency emissions from the sound calibrator are 30 dB (re 1 $\mu\text{V/m}$) quasi-peak, measured at 10 m, for frequencies in the range from 30 MHz to 230 MHz, and 37 dB (re 1 $\mu\text{V/m}$) quasi-peak, measured at 10 m, for frequencies in the range from 230 MHz to 1 GHz.

NOTES 1 The upper limits are defined for compatibility with many different standards. The limits given in table 1 of CISPR/IEC 61000-6-3 form the basic requirements for sound calibrators.

2 The characteristics of a quasi-peak receiver are specified in 4.1.2 of CISPR 16-1.

5.8.2.2 The instruction manual shall state the mode of operation of the sound calibrator that produces the greatest radiofrequency emissions.

5.8.3 Electrostatic discharges

5.8.3.1 Sound calibrators shall withstand contact discharges up to 4 kV and air discharges up to 8 kV, for both positive and negative voltages relative to earth ground.

NOTE : The requirements are as specified in 1.4 of table 1 in IEC 61000-6-1.

5.8.3.2 Performance criterion B as specified in IEC 61000-6-1 applies during and after these electrostatic discharge tests.

5.8.3.3 Following the completion of the electrostatic discharge tests, the sound calibrator shall be fully operational and in a configuration identical to that set before the start of the tests.

5.8.4 Immunity to power- and radiofrequency fields

5.8.4.1 Sound calibrators shall exhibit, as a minimum, immunity over the following ranges of power- and radiofrequencies and field strengths:

- root-mean-square electromagnetic field strength up to 10 V/m (unmodulated) with 80 % sinusoidal amplitude modulation at 900 Hz; frequency range from 26 MHz to 1 GHz;
- uniform root-mean-square alternating magnetic field strength of 80 A/m; frequency 50 Hz and 60 Hz.

NOTES 1 The requirements are those specified in 1.1 of table 1 in JIS C 61000-6-1 and 1.2 of table 1 in JIS C 61000-6-2 with minor amendments.

- extend the range of radiofrequency fields to cover from 26 MHz to 1 GHz,
- change the modulation frequency from 1 kHz to 900 Hz,
- increase the field strength for the power- frequency field to 80 A/m,
- exclude the reduced field strength requirements listed in table 1, note 3 of IEC 61000-6-2.

2 A sound calibrator may conform to the specifications of this Standard at an unmodulated root-mean-square electromagnetic field strength greater than 10 V/m. If so, the applicable field strength should be stated in the instruction manual.

5.8.4.2 With the sound calibrator in the reference orientation and with the opening of the cavity where the microphone is inserted facing away from the emitter of the power

or radio-frequency field, when the field is applied no change in operating state shall occur. The absolute value of the difference between the measured sound pressure level generated by the sound calibrator in the presence of the field, and in the absence of the field, shall not exceed 0.15 dB for a class LS sound calibrator, 0.3 dB for a class 1 sound calibrator, and 0.5 dB for a class 2 sound calibrator. For multi-level or multi-frequency sound calibrators, or both, the requirements apply for each combination of frequency and sound pressure level for which the instruction manual states that the sound calibrator conforms to the requirements of this Standard.

5.8.4.3 The instruction manual for the sound calibrator shall state the configuration and the connecting devices (if any) that produce the minimum immunity (maximum susceptibility) to power- and radiofrequency fields.

6 Instrument marking and documentation

6.1 Marking of the sound calibrator A space shall be allowed for marking on the sound calibrator, and sound calibrators conforming to the requirements of this Standard shall be supplied with the following minimum information. Items a) and b) shall be marked on the sound calibrator. The remaining items shall be marked on, or displayed during operation of, the sound calibrator:

- a) manufacturer's or supplier's name or trade mark;
- b) model designation and serial number;
- c) reference to this Standard by number and year of publication;
- d) the class of instrument, including the letter 'C' designation where applicable and the environmental condition(s) for which corrections need to be applied, for example, for static pressure;
- e) a clear indication of all available combinations of sound pressure level and frequency that conform to the requirements of the class;
- f) the nominal sound pressure level or sound pressure levels;
- g) the nominal frequency or frequencies;
- h) where possible, and if required for the sound calibrator, an indication of the orientation required for installation on a microphone;
- i) if the sound calibrator is battery operated, the preferred battery type;
- j) model designations marked on adaptors, where provided.

6.2 Individual calibration chart for a class LS sound calibrator A class LS sound calibrator shall be supplied with an individual calibration chart from the manufacturer or supplier. The chart shall state the specified sound pressure level(s) and frequency(ies) for the models and configuration of microphone for which the sound calibrator conforms to the requirements of this Standard.

6.3 Instruction manual The sound calibrator shall be supplied with an instruction manual which shall contain the information required by clause 5 and by 6.1. It shall also contain the following information:

- a) identification of the microphone models (and of the configurations in which they are used) and of the relevant adaptors required, together with detailed instructions which need to be followed to ensure that the sound calibrator functions as intended when used as described in the instruction manual;
- b) for class LS sound calibrators at least the nominal sound pressure level(s) and frequency(ies), and for class 1 and class 2 sound calibrators the specified sound pressure level(s) and frequency(ies) of the output signal when the sound calibrator is coupled to the specified microphone models and configurations;
- c) if a specific orientation of the sound calibrator is to be used to conform to the requirements of this Standard, this orientation shall be stated;
- d) the elapsed time before the specified sound pressure level and frequency stabilize, for any available combination of sound pressure level and frequency, once the sound calibrator is switched on with the microphone coupled to it. In addition, the instruction manual shall give information on the elapsed time necessary to stabilize the microphone and sound calibrator combination, after they are coupled together;
- e) the principal sound pressure level. For a sound calibrator with only one available sound pressure level, this is the principal sound pressure level;
- f) the principal frequency. For a sound calibrator with only one available frequency, this is the principal frequency;
- g) the range of environmental conditions over which the sound calibrator is specified to operate, and the correction data, if applicable, specified in 5.4, together with the expanded uncertainties of measurement corresponding to a confidence level of approximately 95 % associated with the correction data; for class 2 sound calibrators with letter 'C' designation that are not required to be supplied with a barometer, information on how to calculate the correction when operating the calibrator at different heights above sea-level;
- h) identification of the available combinations of sound pressure level and frequency that conform to the requirements of this Standard for the class;
- i) a recommended procedure to ensure that the ambient sound level is sufficiently low during operation of the sound calibrator so that the calibrator operates as intended at each level setting;
- j) for class LS sound calibrators, including those with letter designation 'C', the typical change in sound pressure level produced by the sound calibrator with changes in the effective load volume of the inserted microphone;
- k) types of battery which may be used, if applicable, together with the typical operation lifetime, details of any battery status indicator and its operation, and the nominal, maximum and minimum supply voltages; method of connection to an external power supply, where applicable;
- l) for sound calibrators with letter 'C' designation, a statement giving the maximum

expanded uncertainty of the measurement of environmental conditions so that the ability of a sound calibrator to conform to the requirements of the relevant class is not affected; where a barometer is supplied with the sound calibrator, the expanded uncertainty of measurement of the static pressure when using the barometer;

- m) for class LS sound calibrators where a barometer is required but not supplied, details of a suitable device to measure static pressure;
- n) a statement of the configuration for the normal mode of operation;
- o) the cables and accessories, if any, for use with the sound calibrator with which the calibrator conforms to the electromagnetic compatibility requirements of 5.8;
- p) a description of the reference orientation for testing the effects of exposure to radiofrequency fields;
- q) if applicable, the unmodulated root-mean-square electromagnetic field strength greater than 10 V/m for which the sound calibrator conforms to the specifications of this Standard;
- r) the configuration, sound pressure level and frequency settings for greatest radiofrequency emissions;
- s) the configuration and connecting devices, if any, that produce minimum immunity (maximum susceptibility) to power- and radiofrequency fields;
- t) details of the combinations of sound pressure level and frequency that do not conform to the requirements for the class, together with a description of their acoustical characteristics, and a statement of the nominal tolerance limits maintained about the design goals.

NOTE : Where a sound calibrator has additional features not specified in this Standard, the instruction manual should include a statement to this effect together with a description of the manufacturer's design goals for the additional features and a statement of the corresponding nominal tolerance limits, including the expanded uncertainties of measurement.

Annex A (normative)

Pattern evaluation tests

A.0 Introduction

A.0.1 This annex gives details of the tests necessary to demonstrate conformance to all the requirements specified in this Standard for a model of sound calibrator. The tests are applicable to class LS, class 1 and class 2 sound calibrators, and aim to ensure that pattern evaluation tests are performed in a consistent manner at all testing laboratories. All applicable tests described in this annex shall be performed.

A.0.2 Conformance to the requirements of this Standard is demonstrated when the result of a measurement or the absolute value of the difference between the result and the design goal, as appropriate, extended by the actual expanded uncertainty of measurement of the testing laboratory, does not exceed the specified tolerance limit. Laboratories performing these tests shall calculate the uncertainties associated with all the measurements in accordance with the guidelines given in the *ISO/IEC Guide Guide to the expression of uncertainty in measurement*. Actual expanded uncertainties shall be calculated for a level of confidence of 95 %, using the necessary coverage factor. Where a testing laboratory is only required to make a single measurement, it is necessary for the laboratory to make an estimate of the random contribution to the total uncertainty, using an earlier evaluation based on several measurements for a similar sound calibrator.

NOTE : Generally, a coverage factor of 2 approximates to a level of confidence of 95 %, unless the contributions are such that it is necessary to use a different coverage factor to maintain the 95 % level of confidence.

A.0.3 The expanded uncertainties of measurement given in this annex are the maximum permitted for demonstration of conformance, under this annex, to the requirements of this Standard. If the actual expanded uncertainty of a measurement performed by the test laboratory exceeds the maximum permitted value, the measurement shall not be used to demonstrate conformance to the requirements of this Standard.

A.0.4 In this annex, tables are given for the maximum permitted expanded uncertainties of measurement. For sound calibrators at and around reference environmental conditions, table A.1 gives the data for the generated sound pressure level and short-term level fluctuation and table A.2 gives the data for the frequency of the sound generated. table A.3 gives the data for the total distortion in the output signal over the specified range of environmental conditions. For sound calibrators over the specified range of environmental conditions, table A.4 gives the data for the generated sound pressure level and table A.5 gives the data for the frequency of the sound generated.

A.0.5 The test laboratory shall use instruments with current calibrations for the appropriate quantities. The calibrations shall be traceable to national standards, as required.

A.1 Submission for test

A.1.1 Five specimens of the same pattern of sound calibrator shall be submitted for pattern evaluation testing. As a minimum, the testing laboratory shall select two of the five specimens for testing. At least one of these two specimens shall then be tested fully according to the procedures given in this annex. The testing laboratory shall decide whether the full tests shall also be performed on the second specimen, or whether limited testing is adequate to provide approval of the pattern.

NOTE : Depending on the number of specimens tested, the pattern approval may be limited to two years so that further experience with the pattern may be gained.

A.1.2 Each sound calibrator, together with all relevant accessories (such as adaptors or barometer), shall be submitted for test together with a copy of the instruction manual. Each class LS sound calibrator shall also be supplied with an individual calibration chart.

A.2 Principal values

A.2.1 It shall be confirmed that the principal sound pressure level of the sound calibrator conforms to the requirement of 5.2.1.3.

A.2.2 It shall be confirmed that the principal frequency of the sound calibrator conforms to the requirement of 5.3.1.1.

A.3 Marking of the sound calibrator and supplied documentation

It shall be verified that the markings on the sound calibrator and the information in the instruction manual supplied conform to the requirements and contain all the information specified in 6.1 and 6.3. For class LS sound calibrators, it shall be verified that the individual calibration chart contains all the information required by 6.2.

A.4 Performance tests at and around reference environmental conditions

A.4.1 General

A.4.1.1 All tests in clause A.4 shall be performed within the ranges of environmental conditions specified in 5.2.2.

A.4.1.2 For class LS and class 1 sound calibrators with a letter designation 'C', where appropriate, data supplied in the instruction manual shall be applied for the influence of static pressure, to correct measured sound pressure levels to reference environmental conditions. If a barometer is supplied with the sound calibrator, it shall be used to measure the static pressure and then the data supplied in the instruction manual shall be applied, where appropriate, to correct measured sound pressure levels to the reference environmental conditions.

A.4.1.3 For class 2 sound calibrators with a letter designation 'C', data supplied in the instruction manual, for the influence of static pressure, temperature and relative humidity, shall be applied, where appropriate, to correct measured sound pressure levels to the reference environmental conditions. If a means of measuring the relevant environmental condition is supplied with the sound calibrator, the means shall be used

to measure the relevant environmental condition and then the data supplied in the instruction manual shall be applied, where appropriate, to correct measured sound pressure levels to the reference environmental conditions.

A.4.1.4 Except for the tests described in A.4.3.7, A.4.3.8, A.4.5.2, A.4.5.4 and A.4.6.2, all measurements shall be performed at an operating voltage within 20 % of the nominal operating voltage and without exceeding the specified maximum or minimum operating voltage.

A.4.2 Orientation If a specific orientation for application of the sound calibrator is stated in the instruction manual, this orientation shall be used for testing. If no specific orientation is prescribed, at least 3 different orientations shall be used for the measurements of sound pressure level described in A.4.3.3.

A.4.3 Sound pressure level

A.4.3.1 The sound pressure level generated by the sound calibrator shall be measured, as an average over 20 s of operation, at the principal sound pressure level specified in the instruction manual at each of the frequency settings for which the instruction manual states that the instrument conforms to the requirements of this Standard.

A.4.3.2 For class LS sound calibrators the microphone shall be a laboratory standard microphone as specified in IEC 61094-1. For class 1 and class 2 sound calibrators the microphone shall be a working standard microphone as specified in IEC 61094-4.

- NOTES**
- 1 A measurement microphone that conforms to the requirements of IEC 61094-1 for laboratory standard microphones also conforms to the requirements of IEC 61094-4 for working standard microphones.
 - 2 It is recommended that the sound pressure levels be measured using the insert voltage technique (see 5.3 of IEC 61094-2) or by an equivalent method to measure the open-circuit voltage from the microphone.
 - 3 Where a choice of microphone model is available, a microphone model should be used for which the electroacoustical characteristic is designated by the letter P in IEC 61094-1 or IEC 61094-4.

A.4.3.3 The measurement of sound pressure level shall be replicated twice to give a total of three tests. The absolute value of the difference between the mean measured sound pressure level and the corresponding specified sound pressure level, extended by the actual expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 1 for the class of sound calibrator. Actual expanded uncertainties of measurement shall not exceed those given in table A.1 for the class of sound calibrator.

A.4.3.4 Measurements of sound pressure level as described in A.4.3.3 shall be repeated for at least one other specimen of the same model of laboratory standard or working standard microphone as applicable, for each frequency setting of the sound calibrator for which the instruction manual states that the instrument conforms to the requirements of this Standard.

A.4.3.5 For multi-level sound calibrators, the sound pressure level generated by the sound calibrator shall also be measured as described in A.4.3.3, at each level setting at

each of the frequency settings for which the instruction manual states that the instrument conforms to the requirements of this Standard, using one specimen of the model of microphone.

A.4.3.6 The procedure given in the instruction manual shall be followed to ensure that the level of ambient sound reaching the microphone during testing is sufficiently low that the sound calibrator operates as intended.

A.4.3.7 The measurement(s) of the sound pressure level shall be repeated (excluding replications) within 5 % of the minimum operating voltage of the power supply consistent with operation of any battery condition indicator or acoustic signal cut-off facility supplied as an integral part of the sound calibrator, using one specimen of microphone. Measurements shall be made for the following combinations of sound pressure level and frequency:

- the principal sound pressure level and principal frequency;
- the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
- the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
- the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;
- the maximum frequency and the minimum and maximum sound pressure levels available at that frequency

for which the instruction manual states that the instrument conforms to the requirements of this Standard.

A.4.3.8 The measurements shall be performed in terms of the variation of the level of the output voltage from the microphone at the reduced operating voltage for the sound calibrator, relative to the level of the output voltage from the microphone at the nominal supply voltage for the sound calibrator under reference environmental conditions. For each combination, the absolute value of the difference between the sound pressure level generated at the reduced operating voltage and the sound pressure level generated by the sound calibrator at the nominal supply voltage at reference environmental conditions, extended by the actual expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 2 of the text. The actual expanded uncertainty of measurement of the difference shall not exceed 0.04 dB. Also, the absolute value of the difference between the measured sound pressure level and the specified level, extended by the actual expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 1 of the text.

NOTE : The uncertainty specified in this A4.3.8 is included in the maximum permitted expanded uncertainty given in table A.1.

A.4.3.9 Where the sound calibrator is designed to be connected to an external power supply, the measurement(s) of sound pressure level shall be repeated (excluding replications) at the principal sound pressure level and principal frequency at the maximum

permitted supply voltage. The measurements shall be performed in terms of the variation of the level of the output voltage from the microphone at the maximum permitted supply voltage for the sound calibrator, relative to the level of the output voltage from the microphone at the nominal supply voltage for the sound calibrator under reference environmental conditions. The absolute value of the difference between the sound pressure level generated at the maximum permitted supply voltage and the sound pressure level generated by the sound calibrator at the nominal supply voltage at reference environmental conditions, extended by the actual expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 2 of the text. The actual expanded uncertainty of measurement of the difference shall not exceed 0.04 dB. Also, the absolute value of the difference between the measured sound pressure level and the specified level, extended by the actual expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 1 of the text.

NOTE : The uncertainty specified in this A.4.3.9 is included in the maximum permitted expanded uncertainty given in table A.1.

A.4.3.10 Where the instruction manual states that the sound calibrator conforms to the requirements of this Standard for the same class when used with microphone models or microphone configurations other than that used in A.4.3.2, the measurements described in A.4.3 shall be repeated for those microphone models or configurations, unless the testing laboratory is satisfied that it has reliable, justifiable evidence of the equivalence of various models of microphone, or of corrections to be applied. In these cases, it may not be necessary for the laboratory to perform measurements using all models and configurations of microphones, but to use a representative sample of these equivalent models.

A.4.4 Sound pressure level stability – short-term level fluctuation

A.4.4.1 Short-term fluctuation of the sound pressure level in the cavity of the sound calibrator shall be determined at the principal sound pressure level and principal frequency, with the microphone used in A.4.3.2. A minimum of ten measurements at regular intervals using time weighting F (specified in IEC 61672-1) shall be made over a period of 20 s of operation of the sound calibrator, to find the maximum and minimum output sound pressure level. One-half of the difference between the maximum and minimum measured sound pressure levels, extended by the actual expanded uncertainty of measurement, shall not exceed the applicable tolerance limits given in table 1 for the class of sound calibrator. Actual expanded uncertainties of measurement shall not exceed those given in table A.1 of the text for the class of sound calibrator.

A.4.4.2 Short-term level fluctuation shall be measured with one microphone only.

A.4.4.3 For multi-level sound calibrators, the measurement of short-term level fluctuation as described in A.4.4.1 and A.4.4.2, shall be repeated at the principal frequency and at the minimum sound pressure level setting for which the instruction manual states that the instrument conforms to the requirements of this Standard.

Table A.1 Maximum permitted expanded uncertainty of measurement for sound pressure level and short-term level fluctuation, at and around reference environmental conditions

Range of nominal frequencies Hz	Uncertainty of measurement for generated sound pressure level dB			Uncertainty of measurement for short-term level fluctuation dB		
	Class LS	Class 1	Class 2	Class LS	Class 1	Class 2
31.5 to <160	—	0.20	—	—	0.10	—
160 to 1 250	0.10	0.15	0.35	0.02	0.03	0.05
>1 250 to 4 000	—	0.25	—	—	0.03	—
>4 000 to 8 000	—	0.35	—	—	0.03	—
>8 000 to 16 000	—	0.50	—	—	0.03	—
NOTE : For a class LS or class 2 sound calibrator the ‘—’ symbols in the table indicate ranges of nominal frequency for which this Standard provides no tolerance limits.						

A.4.5 Frequency

A.4.5.1 The frequency of the sound generated by the sound calibrator shall be measured with the microphone used in A.4.3.2, at the principal sound pressure level, for each frequency setting of the sound calibrator for which the instruction manual states that the instrument conforms to the requirements of this Standard. The absolute value of the difference in per cent between each measured frequency and the corresponding specified frequency, extended by the actual expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 3 of the text for the class of sound calibrator. Actual expanded uncertainties of measurement shall not exceed those given in table A.2 of the text for the class of sound calibrator.

A.4.5.2 Measurements of frequency shall be repeated within 5 % of the minimum operating voltage of the power supply consistent with operation of any battery condition indicator or acoustic signal cut-off facility supplied as an integral part of the sound calibrator. The measurements shall be for the following combinations of sound pressure level and frequency:

- the principal sound pressure level and principal frequency;
- the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
- the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
- the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;

- the maximum frequency and the minimum and maximum sound pressure levels available at that frequency

for which the instruction manual states that the instrument conforms to the requirements of this Standard.

A.4.5.3 The absolute value of the difference in per cent between each measured frequency and the corresponding specified frequency, extended by the actual expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 3 of the text for the class of sound calibrator. Actual expanded uncertainties of measurement shall not exceed those given in table A.2 for the class of sound calibrator.

A.4.5.4 Where the sound calibrator is designed to be connected to an external power supply, the measurement of frequency shall be repeated at the principal sound pressure level and principal frequency at the maximum permitted supply voltage. The absolute value of the difference in per cent between each measured frequency and the corresponding specified frequency, extended by the actual expanded uncertainty of measurement, shall not exceed the tolerance limits given in table 3 of the text for the class of sound calibrator. Actual expanded uncertainties of measurement shall not exceed those given in table A.2 for the class of sound calibrator.

Table A.2 Maximum permitted expanded uncertainty of measurement for frequency, at and around reference environmental conditions

Uncertainty of measurement for frequency %		
Class LS	Class 1	Class 2
0.3	0.3	0.3
NOTE : The permissible limits are extended by taking the uncertainty of actual measurements of the frequency generated from the sound calibrator into consideration, and are applicable as the deviation in percentage from the specified frequency.		

A.4.6 Total distortion

A.4.6.1 Total distortion of the sound pressure signal generated by the sound calibrator shall be measured, over the frequency range from at least 22.5 Hz to 20 kHz, with the microphone used in A.4.3.2 at each frequency setting, at the maximum and minimum sound pressure level setting for which the instruction manual states that the instrument conforms to the requirements of this Standard. The measured total distortion, extended by the actual expanded uncertainty of measurement, shall not exceed the limit given in table 6 of the text for the class of sound calibrator. Actual expanded uncertainties of measurement shall not exceed those given in table A.3 for the class of sound calibrator.

A.4.6.2 Distortion measurements shall be repeated within 5 % of the minimum operating voltage of the power supply consistent with operation of any battery condition

indicator or acoustic signal cut-off facility supplied as an integral part of the sound calibrator. The measurements shall be for the following combinations of sound pressure level and frequency:

- the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
- the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
- the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;
- the maximum frequency and the minimum and maximum sound pressure levels available at that frequency

for which the instruction manual states that the instrument conforms to the requirements of this Standard.

The measured total distortion, extended by the actual expanded uncertainty of measurement, shall not exceed the limit given in table 6 of the text of the text for the class of sound calibrator. Actual expanded uncertainties of measurement shall not exceed those given in table A.3 for the class of sound calibrator.

- NOTES 1 The total distortion may be measured using a rejection filter device (distortion factor meter) or an appropriate analyser.
- 2 Where a choice of microphone model is available, a microphone model should be used for which the electroacoustical characteristic is designated by the letter P in IEC 61094-1 or IEC 61094-4.

Table A.3 Maximum permitted expanded uncertainty of measurement for total distortion, over the appropriate range of environmental conditions

Range of nominal frequencies Hz	Uncertainty of measurement for total distortion %		
	Class LS	Class 1	Class 2
31.5 to <160	—	1.0	—
160 to 1 250	0.5	0.5	1.0
>1 250 to 16 000	—	1.0	—
NOTES 1 The above uncertainties are expressed in percentage distortion.			
2 For a class LS or class 2 sound calibrator the '—' symbols in the table indicate nominal frequency ranges for which this Standard provides no tolerance limits.			

A.5 Environmental tests

A.5.1 General

A.5.1.1 If the instruction manual specifies a battery of particular model and type,