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(दूसरा पुनरीक्षण)

Electroacoustics — Sound Level Meters

Part 2 Pattern Evaluation Tests

(Second Revision)

ICS 17.140.50

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
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NATIONAL FOREWORD

This Indian Standard (Part 2) (Second Revision) which is identical with IEC 61672-2 : 2017 **'**Electroacoustics — Sound level meters — Part 2: Pattern evaluation tests' issued by International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendations of the Audio, Video and Multimedia Systems and Equipment Sectional Committee and approval of the Electronics and Information Technology Division Council.

This standard was Originally published in 2005 and was identical to IEC 61672-2 : 2003. The first revision of this standard was published in 2016 and was identical to IEC 61672-2 : 2013. The second revision of this standard aligns this Indian standard with IEC 61672-2 : 2017

The main technical changes with regard to the previous edition are as follows:
In this second edition, conformance to specifications is demonstrated when:

a) Measured deviations from design goals do not exceed the applicable acceptance limits,and

b) The uncertainty of measurement does not exceed the corresponding maximum permitted uncertainty, with both uncertainties determined for a coverage probability of 95 %.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are however not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current Practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their places, are listed below along with their degree of equivalence for editions indicated. For undated references, the latest edition of the referenced document applies, including any corrigenda and amendment:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60942 Electroacoustics — Sound calibrators	IS 15059 : 2022 Electroacoustics — Sound calibrators (*second revision*)	Identical with IEC 60942 : 2017
IEC 61000-4-2 : 2008 Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques electrostatic discharge immunity test	IS 14700 (Part 4/Sec 2) : 2018 Electromagnetic compatibility (EMC): Part 4 testing and measurement techniques, Section 2 Electrostatic discharge immunity test (*second revision*)	Identical with IEC 61000-4-2 : 2008
IEC 61672-1 Electroacoustics — Sound level meters — Part 1: Specifications	IS 15575 (Part 1) : 2016 Electroacoustics — Sound level meters: Part 1 Specifications (*first revision*)	Identical with IEC 616721 : 2013

(*Continued on third cover*)

CONTENTS

Indian Standard

ELECTROACOUSTICS — SOUND LEVEL METERS

PART 2 PATTERN — EVALUATION TESTS

(Second Revision)

1 Scope

This part of IEC 61672 provides details of the tests necessary to verify conformance to all mandatory specifications given in IEC 61672-1 for time-weighting sound level meters, integrating-averaging sound level meters, and integrating sound level meters. Pattern-evaluation tests apply for each channel of a multi-channel sound level meter, as necessary. Tests and test methods are applicable to class 1 and class 2 sound level meters. The aim is to ensure that all laboratories use consistent methods to perform pattern-evaluation tests.

NOTE 1 In this document, references to IEC 61672-1, IEC 61672-2, and IEC 61672-3 refer to the second editions unless stated otherwise.

NOTE 2 Procedures for the pattern-evaluation testing of sound level meters designed to conform to the specifications of IEC 61672-1:2002 were given in IEC 61672-2:2003.

2 Normative references

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

IEC 60942, *Electroacoustics – Sound calibrators*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2010, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic-field immunity test*

IEC 61000-4-6:2008, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-20:2010, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

IEC 61000-6-2:2005, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61094-1, *Measurement microphones – Part 1: Specifications for laboratory standard microphones*

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

IEC 61183, *Electroacoustics – Random-incidence and diffuse-field calibration of sound level meters*

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

IEC 62585, *Electroacoustics – Methods to determine corrections to obtain the free-field response of a sound level meter*

CISPR 16-1-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus* [1]

CISPR 16-1-2:2006, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Conducted disturbances*

CISPR 16-2-1:2010 (Ed. 2.1), *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*

CISPR 16-2-3:2010 (Ed. 3.1), *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*

CISPR 22:2008, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

ISO/IEC Guide 98-3, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM: 1995)*

ISO/IEC Guide 99, *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*

ISO 26101:2012, *Acoustics – Test methods for the qualification of free-field environments*

3 Terms and definitions

For the purposes of this document, in addition to the terms and definitions given in IEC 61672-1 and IEC 62585, the terms and definitions given in IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-6, ISO/IEC Guide 98-3, and ISO/IEC Guide 99 also apply.

4 Submission for testing

4.1 At least three specimens of the same pattern of sound level meter shall be submitted for pattern-evaluation testing. As a minimum, the laboratory shall select two of the specimens for testing. At least one of the two specimens shall then be tested fully according to the procedures of this Standard. The laboratory shall decide whether the full tests shall also be performed on the second specimen or whether additional limited testing is adequate to approve the pattern.

4.2 An Instruction Manual and all items or accessories that are identified in the Instruction Manual as integral components for the normal mode of operation shall be submitted along with the three sound level meters. Examples of additional items or accessories include a microphone extension device or cable and peripheral equipment.

1 In English, CISPR stands for International Special Committee on Radio Interference.

4.3 If the manufacturer of the sound level meter supplies devices that are to be connected to the sound level meter by cables, then the devices and cables shall be submitted with the sound level meter.

4.4 A calibrated sound calibrator of a model specified in the Instruction Manual for the sound level meter shall be supplied with the sound level meter. An Instruction Manual for the sound calibrator shall also be provided. As required by IEC 61672-1, the model of the calibrator shall conform to the relevant specifications of IEC 60942 for the class of sound calibrator.

5 Marking of the sound level meter and information in the Instruction Manual

5.1 It shall be verified that the sound level meter is marked according to the requirements of IEC 61672-1.

5.2 It shall be verified that the Instruction Manual contains all the information that is required by IEC 61672-1, as relevant to the facilities provided by the sound level meter.

5.3 If the sound level meter does not conform to the requirements of 5.1 and 5.2, no pattern-evaluation tests shall be performed.

5.4 After completion of all tests, the information shall be reviewed to ensure that it is correct and that no applicable acceptance limits are exceeded.

6 Mandatory facilities and general requirements

6.1 No test specified in this part of IEC 61672 shall be omitted unless the sound level meter does not possess the facility described for the test. When the design of a sound level meter, which has been pattern approved, is changed and a new pattern approval is requested, then, at the discretion of the laboratory, it is not necessary to repeat those tests for electroacoustical performance characteristics that are not affected by the design change.

6.2 A time-weighting sound level meter shall be verified to be able to display A-frequency-weighted, F-time-weighted sound level and to be able to indicate overload and under-range conditions.

6.3 An integrating-averaging sound level meter shall be verified to be able to display A-frequency-weighted, time-averaged sound level and to be able to indicate overload and under-range conditions.

6.4 An integrating sound level meter shall be verified to be able to display A-frequency-weighted sound exposure level and to be able to indicate overload and under-range conditions.

6.5 All display devices for the sound level meter shall be verified to be able to display sound levels or sound exposure levels with the resolution required by IEC 61672-1. The range of the display shall be at least the minimum specified in IEC 61672-1.

6.6 If a sound level meter is capable of measuring maximum or peak sound levels, or both, it shall be verified that a "hold" feature is provided.

6.7 A class 1 sound level meter shall be verified to have frequency-weighting C.

6.8 If the sound level meter is capable of indicating C-weighted peak sound levels, it shall be verified that the capability to display C-weighted, time-weighted sound level or C-weighted, time-averaged sound level is also provided.

6.9 For sound level meters with multiple level ranges, it shall be verified that overlap of the level ranges conforms to the specifications of IEC 61672-1.

6.10 For sound level meters that can display more than one measurement quantity, it shall be verified that there is a means to ascertain the quantity that is being displayed.

6.11 If the sound level meter does not possess the mandatory facilities listed in 6.2 through 6.10, as applicable, the sound level meter does not conform to the specifications of IEC 61672-1 and no pattern-evaluation tests shall be performed.

6.12 For all pattern-evaluation tests, the configuration of the sound level meter, or the multi-channel sound level meter system, shall be as specified in the Instruction Manual for one of the normal modes of operation, including all required accessories. The configuration shall include a windscreen if a windscreen is an integral component for the normal mode of operation, or if the Instruction Manual states that the sound level meter conforms to the specifications of IEC 61672-1 with a windscreen installed around the microphone. The model of the windscreen shall be as stated in the Instruction Manual for use with the sound level meter. All configurations of the sound level meter that are stated in the Instruction Manual as conforming to the requirements of IEC 61672-1 shall be tested.

6.13 If the Instruction Manual states that the sound level meter conforms to the specifications of IEC 61672-1 with optional facilities installed, the configuration with the optional facilities installed shall also be tested to verify conformance to the relevant specifications.

6.14 If an electrical output is provided on the sound level meter and the laboratory intends to utilize the electrical output instead of the display device, the laboratory shall verify that changes in the levels of applied acoustical or electrical input signals produce changes in the signal levels indicated on the display device and at the electrical output that are in accordance with the specifications of IEC 61672-1. This requirement applies to each channel of a multi-channel system. Where multiple outputs are present, if an output is specified in the Instruction Manual for testing, that output should be used for pattern-evaluation tests.

6.15 For all tests, the sound level meter shall be powered from its preferred supply.

6.16 The sound level meter shall be allowed to reach equilibrium with the prevailing environmental conditions before switching on the power to perform a test.

6.17 Tests for conformance to the specifications for the effects of changes in environmental conditions preferably should be conducted before tests for conformance to the specifications for electroacoustical performance.

6.18 If the sound level meter has more than one signal-processing channel, pattern-evaluation tests shall be performed for each channel that utilizes unique signal processing techniques. For multi-channel systems with the same functional equivalence in all channels, the number of channels to be tested may be less than the number of available channels, at the discretion of the laboratory. For a multi-channel system, the number of channels to be tested should be determined from consideration of a scenario for which there is an array of microphones supplying signals to each input with each channel processing the signals in an identical manner. Selection of how many and which channels to test should consider differences, as described in the Instruction Manual, in the implementation of signal-processing techniques in the various channels. If any special procedure for testing the channels for identical functionality is described in the Instruction Manual, that procedure should be followed.

NOTE If the sound level meter is a multi-channel device (for example, a sound level meter with two or more separate signal inputs with non-parallel processing of digitized data by time-sharing, but quasi-parallel display for the displayed signals), it is usually possible to test the channels for identical functionality either by setting the functions of the channels for identical processing and reading the display(s) or by allowing the channel functionality to rotate by a special test setting procedure thereby allowing comparison of display(s).

6.19 Conformance to a performance specification is demonstrated when the following criteria are both satisfied: (a) a measured deviation from a design goal does not exceed the applicable acceptance limit and (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in IEC 61672-1 for the same coverage probability of 95%. IEC 61672-1 gives example assessments of conformance using these criteria.

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

6.21 Laboratories performing pattern evaluation tests shall calculate all uncertainties of measurements in accordance with the guidelines given in the ISO/IEC Guide 98-3. Actual measurement uncertainties shall be calculated for a coverage probability of 95 %. Calculation of the actual measurement uncertainty for a particular test should consider at least the following components, as applicable.

– The uncertainty attributed to calibration of the individual instruments and equipment used to perform the test, including the sound calibrator, where applicable;

– The uncertainty resulting from environmental effects or corrections;

– The uncertainty resulting from small errors that may be present in the applied signals;

– The uncertainty attributed to effects associated with the repeatability of the results of the measurements. When a laboratory is only required to perform a single measurement, it is necessary for the laboratory to make an estimate of the random contribution to the total measurement uncertainty. The estimate should be determined from an earlier evaluation of several measurements of the performance of similar sound level meters;

– The uncertainty associated with the resolution of the display device of the sound level meter under test. For digital display devices that indicate signal levels with a resolution of 0,1 dB, the uncertainty component should be taken as a rectangular distribution with semi-range of 0,05 dB;

– The uncertainty associated with the device used to mount the sound level meter in the free-field test facility;

– The uncertainty resulting from the deviation of the sound field in the free-field test facility from an ideal free sound field; and

– The uncertainty associated with each correction applied to the measurement data.

6.22 If the uncertainty of measurement exceeds the maximum-permitted uncertainty of measurement, the result of the test shall not be used to demonstrate conformance to a specification and pattern approval shall not be granted.

6.23 As appropriate, the laboratory shall utilize the recommendations given in the Instruction Manual for performing the pattern-evaluation tests.

7 Environmental, electrostatic, and radio-frequency tests

7.1 General

7.1.1 Before conducting, but not during, the tests described in the Clause 7, the indication of A-weighted sound level at the calibration check frequency shall be checked by application of the sound calibrator specified in 4.4. If necessary, the sound level meter shall be adjusted to indicate the required sound level under reference environmental conditions. For multi-channel devices, the corresponding indications shall be checked for all channels selected for testing.

7.1.2 Environmental conditions at the time of checking the indication shall be recorded.

7.1.3 The effect of environmental conditions on the sound pressure level produced by the sound calibrator shall be accounted for in accordance with the procedure in the Instruction Manual for the sound calibrator and data from its calibration. The effects shall be evaluated relative to the sound pressure level produced under reference conditions.

7.1.4 For environmental tests, a sound calibrator shall be used to provide a known sound pressure level at the microphone of the sound level meter. For class 1 sound level meters, the calibrator shall conform to either the class LS or class 1 specifications of IEC 60942. For class 2 sound level meters, the calibrator shall conform to either class LS, class 1, or class 2 specifications of IEC 60942. If the sound calibrator conforms to the requirements of the applicable performance class for a nominal frequency of 1 kHz, the environmental tests shall be performed at the nominal frequency of 1 kHz. The effects of static pressure, air temperature, and relative humidity on the sound pressure level produced in the coupler of the sound calibrator, over the range of environmental conditions specified for the tests, shall be known.

NOTE The range of environmental conditions specified for pattern-evaluation tests exceeds the range specified in IEC 60942 for class LS sound calibrators.

7.1.5 The sound level meter shall be set to perform a typical measurement of time-weighted sound level, time-averaged sound level, or sound exposure level on the reference level range. The frequency weighting shall be set to A weighting.

7.1.6 Time-weighted sound levels, time-averaged sound levels, or sound exposure levels indicated by the sound level meter in response to the signal from the sound calibrator shall be recorded for each test condition. When necessary, time-averaged sound levels shall be calculated from the indications of sound exposure level and elapsed time in accordance with IEC 61672-1. Averaging times for time-averaged sound levels or integration times for sound exposure levels shall be recorded.

7.2 Uncertainties for measurements of environmental test conditions

The actual uncertainty of measurement shall not exceed 0,2 kPa for measurements of static pressure. The actual uncertainty of measurement shall not exceed 0,3 °C and 4 % relative humidity for measurements of air temperature and relative humidity, respectively. These measurement uncertainties shall be determined for a coverage probability of 95 %,

7.3 Influence of static pressure

7.3.1 During the measurements of the influence of static pressure, the measured air temperature shall be within ±2,0 °C of the reference air temperature. Measured relative humidity at the reference static pressure shall be maintained within +20 % relative humidity to –10 % relative humidity from the reference relative humidity.

7.3.2 For practical reasons, relative humidity is specified for the reference static pressure. Evacuating or pressurizing an enclosure around a sound level meter will change the relative humidity within the enclosure. No corrections for this effect shall be applied.

7.3.3 The influence of static pressure shall be tested at the reference static pressure and at seven other static pressures. At each static pressure, the sound calibrator of 7.1.4 and the sound level meter (or its relevant components) shall be permitted to acclimatize for at least 10 minutes before recording the indicated sound level. For tests of the influence of static pressure, the sound calibrator shall remain coupled to the microphone of the sound level meter during the acclimatization periods. The electrical power applied to the sound level meter may be on continuously, or may be switched off and on by remote means.

7.3.4 Sound levels shall be measured twice at nominal static pressures spaced at approximately equal intervals between the minimum and the maximum static pressure specified in IEC 61672-1. For each nominal static pressure condition, the two measured static pressures shall not differ by more than 1 kPa. One measurement sequence shall start from

the minimum static pressure and increase to each selected nominal pressure until the maximum is reached. The other sequence shall follow a decrease in pressure from the maximum via each of the selected nominal pressures until the minimum is reached. At the maximum static pressure, only one indication of sound level shall be recorded.

7.3.5 The indicated sound levels shall be corrected for any difference between the sound pressure level generated by the sound calibrator under a test condition and the sound pressure level generated under reference environmental conditions.

7.3.6 At each static pressure test condition, the measured deviation of the indicated sound level from the sound level first indicated at the reference static pressure shall not exceed the applicable acceptance limits specified in IEC 61672-1.

7.4 Limits on air temperature, relative humidity and static pressure

Unless specified otherwise, for each test of the influence of air temperature and relative humidity, including the acclimatization requirements given in 7.5, the measured air temperature shall not exceed ±1,0 °C of a specified air temperature, the measured relative humidity shall not exceed ±5 % relative humidity of a specified relative humidity, and the measured difference between the maximum and minimum prevailing static pressures shall not exceed 6,0 kPa.

7.5 Acclimatization requirements for tests of the influence of air temperature and relative humidity

7.5.1 The sound calibrator of 7.1.4 and the sound level meter (or relevant components) shall be placed in an environmental chamber to test the influence of air temperature and relative humidity on the sound level meter.

7.5.2 For tests of the influence of air temperature and relative humidity, the sound calibrator and the microphone on the sound level meter shall be uncoupled and the power to both instruments switched off during an acclimatization period.

7.5.3 The sound calibrator and sound level meter shall be permitted to acclimatize at the reference environmental conditions for at least 12 h.

7.5.4 For all test conditions other than reference environmental conditions, the sound calibrator and sound level meter shall be permitted to acclimatize for at least an additional 7 h after completion of the initial 12 h acclimatization period, unless the laboratory has applicable evidence that a shorter acclimatization period is sufficient.

7.5.5 After completion of an acclimatization period, the sound calibrator shall be coupled to the microphone of the sound level meter and the power switched on to both instruments.

7.5.6 The laboratory may have the facility to couple the sound calibrator to the microphone of the sound level meter without affecting the temperature and relative humidity in the environmental test chamber. If this facility is available, sound levels may be recorded following the time specified in the Instruction Manual for pressure equalization of the microphone. If this facility is not available, at least a further 3 h acclimatization time shall be allowed before commencing a test.

7.6 Abbreviated test of the combined influence of air temperature and relative humidity

7.6.1 To reduce the time and cost of verifying the influence of air temperature and relative humidity on the performance of a sound level meter, a set of abbreviated tests shall first be performed for certain combinations of air temperature and relative humidity.

7.6.2 For the abbreviated tests of the combined influence of air temperature and relative humidity, the acceptance limits are smaller than those specified in IEC 61672-1. If the sound level meter conforms to the reduced acceptance limits at all specified test conditions, then the sound level meter shall be considered to fully conform to the temperature and humidity specifications of IEC 61672-1. No additional tests are required. If the sound level meter fails to conform to the reduced acceptance limits for any specified test condition, then additional temperature and humidity tests shall be performed to determine conformance to the specifications of IEC 61672-1. The additional tests are described in 7.7 and 7.8.

7.6.3 Following the acclimatization procedures described in 7.5, the sound level indicated in response to application of the sound calibrator of 7.1.4 shall be recorded for certain combinations of air temperature and relative humidity. When setting the test conditions, rapid changes of air temperature in the test chamber should be avoided. Care should be taken to avoid condensation while the temperature is being changed in the environmental test chamber. It is important to monitor the relative humidity in the environmental test chamber each time the air temperature is changed to ensure that the relative humidity does not exceed the specified range.

NOTE The combinations of temperature and relative humidity in 7.6.4 and 7.6.5 were chosen in consideration of the dewpoints that were obtainable within available environmental test facilities. The combinations also reflect the range of environmental conditions for general applications of class 1 and class 2 sound level meters.

7.6.4 For sound level meters where all components can be operated over the wide range of temperature and relative humidity covered by the specifications in IEC 61672-1, the target test conditions are given below. The reference air temperature and the reference relative humidity are given in IEC 61672-1.

- for class 1 sound level meters:
  - reference air temperature and reference relative humidity,
  - air temperature of -10 °C and relative humidity of 65 %,
  - air temperature of +5 °C and relative humidity of 25 %,
  - air temperature of +40 °C and relative humidity of 90 %, and
  - air temperature of +50 °C and relative humidity of 50 %.
- for class 2 sound level meters:
  - reference air temperature and reference relative humidity,
  - air temperature of 0 °C and relative humidity of 30 %, and
  - air temperature of +40 °C and relative humidity of 90 %.

7.6.5 For those components of a sound level meter that are designated in the Instruction Manual as intended only for operation in an environmentally controlled enclosure, the target test conditions are:

- reference air temperature and reference relative humidity,
- air temperature of +5 °C and relative humidity of 25 %, and
- air temperature of +35 °C and relative humidity of 80 %.

7.6.6 For sound level meters that consist of combinations of components, the abbreviated environmental tests shall be performed in three steps.

- In step 1, the components that can operate over a wide range of environmental conditions (for example, a microphone and preamplifier) and the components that operate only in the controlled environment (for example, a computer) shall be exposed to the reference environmental conditions.
- In step 2, the wide-range components shall be exposed to the combinations of environmental conditions of 7.6.4 (four conditions for class 1 or two conditions for class 2 sound level meters) while the controlled-environment components are maintained at reference environmental conditions.

- In step 3, the controlled-environment components shall be exposed to the two combinations of environmental conditions of 7.6.5, while the wide-range components are maintained at reference environmental conditions. When the microphone is exposed to reference environmental conditions, an equivalent electrical input signal may be substituted for the acoustical signal from the sound calibrator if necessary to ensure that the actual uncertainty of measurement does not exceed the maximum-permitted uncertainty.

For each test condition, the acclimatization procedure of 7.5 shall be followed. Indicated sound levels shall be recorded.

7.6.7 For all tests, the indicated sound levels shall be corrected for any difference between the sound pressure level generated by the sound calibrator under the test conditions and the sound pressure level generated under reference environmental conditions.

7.6.8 For sound level meters that do not consist of separate components and for each test condition, the absolute value of the greatest deviation of an indicated sound level from the sound level indicated for reference air temperature and reference relative humidity shall be determined. For those sound level meters consisting of a combination of components, the sum of the absolute value of the greatest deviation of the sound level from step 2 of 7.6.6 from the sound level measured in step 1 and the absolute value of the greatest deviation of the sound level from step 3 from the sound level measured in step 1 shall be determined.

7.6.9 The absolute values or the sums of the absolute values of the greatest deviations from 7.6.8 shall not exceed the reduced acceptance limit of 0,7 dB for class 1 sound level meters and 1,2 dB for class 2 sound level meters.

7.6.10 In addition to the tests described above for the influence of temperature and humidity on the performance of a sound level meter, the test described in 9.8.2 shall also be performed for the influence of elevated temperature on level linearity deviations.

7.7 Influence of air temperature

7.7.1 The following tests for the influence of air temperature on the performance of a sound level meter shall be performed if a sound level meter does not conform to the requirements for the abbreviated tests of 7.6. The specified relative humidity is the reference relative humidity. It is important to monitor the relative humidity in the environmental test chamber each time the air temperature is changed to ensure that it does not exceed the specified ranges. When setting the test conditions, rapid changes of air temperature in the environmental test chamber should be avoided. Care should be taken to avoid condensation while the temperature is being changed in the environmental test chamber.

7.7.2 For sound level meters where all components can be operated over the wide range of air temperatures stated in IEC 61672-1, sound levels indicated in response to application of the sound calibrator of 7.1.4 shall be measured for the following five air temperatures.

– the reference air temperature,
– the minimum applicable air temperature specified in IEC 61672-1,
– the maximum applicable air temperature specified in IEC 61672-1,
– +15 °C, and
– +30 °C.

For each test condition, the acclimatization procedures of 7.5 shall be followed.

7.7.3 For sound level meters that consist of combinations of components, the influence of air temperature shall be tested in three steps.

- In step 1, all components shall be exposed to the reference air temperature.

- In step 2, the wide-range components shall be exposed (a) to the minimum and (b) to the maximum air temperature specified in IEC 61672-1, (c) to +15 °C, and (d) to +30 °C, while the controlled-environment components are maintained at reference air temperature.
- In step 3, the controlled-environment components shall be exposed (a) to the minimum and (b) to the maximum air temperature specified in IEC 61672-1, while the wide-range components are maintained at reference air temperature.

For each test condition, the acclimatization procedure of 7.5 shall be followed. The sound levels indicated in response to application of the sound calibrator shall be recorded.

7.7.4 The indicated sound levels shall be corrected for any difference between the sound pressure level generated by the sound calibrator under the test conditions and the sound pressure level generated under reference environmental conditions.

7.7.5 For sound level meters that do not consist of separate components and for each test condition, the absolute value of the greatest deviation of an indicated sound level from the sound level indicated for reference air temperature and reference relative humidity shall be determined. For those sound level meters consisting of a combination of components, the sum of the absolute value of the greatest deviation of the sound level from step 2 of 7.7.3 from the sound level measured in step 1 and the absolute value of the greatest deviation of the sound level from step 3 from the sound level measured in step 1 shall be determined.

7.7.6 The absolute values or sums of the absolute values of the greatest deviations determined in 7.7.5 shall not exceed the applicable acceptance limits given in IEC 61672-1.

7.8 Influence of relative humidity

7.8.1 Tests for the influence of relative humidity shall be performed if a sound level meter does not conform to the requirements for the abbreviated tests of 7.6.

7.8.2 During the tests for the influence of relative humidity, the deviation of a static pressure from a specified static pressure shall not exceed the limits stated in 7.4. The deviation of an actual relative humidity from a target relative humidity specified in 7.8.3 and 7.8.4 shall not exceed the limits stated in 7.4.

7.8.3 For sound level meters where all components can be operated over the range of relative humidities specified in IEC 61672-1, sound levels indicated in response to application of the sound calibrator of 7.1.4 shall be measured for four combinations of relative humidity and air temperature. The test conditions are:

– the reference relative humidity at the reference air temperature,

– the minimum relative humidity at an air temperature of +40 °C,

– the maximum relative humidity at an air temperature of +40 °C, and

– 70 % relative humidity at an air temperature of +40 °C.

For each test condition, the acclimatization procedures of 7.5 shall be followed.

7.8.4 For sound level meters that consist of combinations of components, the influence of relative humidity shall be tested in three steps.

- In step 1, all components shall be exposed to the reference relative humidity at the reference air temperature.
- In step 2, with an air temperature of +40 °C, the wide-range components shall be exposed (a) to the minimum and (b) to the maximum relative humidity specified in IEC 61672-1 and (c) to 70 % relative humidity, while the controlled-environment

components are maintained at reference relative humidity and reference air temperature.

- In step 3, with an air temperature of +35 °C, the controlled-environment components shall be exposed (a) to the minimum and (b) to the maximum relative humidity specified in IEC 61672-1, while the wide-range components are maintained at reference relative humidity and reference air temperature.

For each test condition, the acclimatization procedure of 7.5 shall be followed. The sound levels indicated in response to application of the sound calibrator shall be recorded.

7.8.5 The indicated sound levels shall be corrected for any difference between the sound pressure level generated by the sound calibrator under the test conditions and the sound pressure level generated under reference environmental conditions.

7.8.6 For sound level meters that do not consist of separate components and for each test condition, the absolute value of the greatest deviation of an indicated sound level from the sound level indicated for reference air temperature and reference relative humidity shall be determined. For those sound level meters consisting of a combination of components, the sum of the absolute value of the greatest deviation of the sound level from step 2 of 7.8.4 from the sound level measured in step 1 and the absolute value of the greatest deviation of the sound level from step 3 from the sound level measured in step 1 shall be determined.

7.8.7 The absolute values or sums of the absolute values of the greatest deviations determined in 7.8.6 shall not exceed the applicable acceptance limits given in IEC 61672-1.

7.9 Influence of electrostatic discharges

7.9.1 The equipment required to determine the influence of electrostatic discharges on the operation of a sound level meter shall conform to the specifications given in Clause 6 of IEC 61000-4-2:2008. The test set-up and test procedure shall be in accordance with the specifications given in clauses 7 and 8 of IEC 61000-4-2:2008.

7.9.2 Electrostatic discharge tests shall be conducted with the sound level meter operating and set to have the least immunity to electrostatic discharge, as determined by preliminary testing. If the sound level meter can be fitted with connection devices that are not required for the configuration of the normal mode of operation as specified in the Instruction Manual, then no cables shall be fitted during the electrostatic discharge tests. Sound level meter systems with two or more signal-processing channels shall have at least two microphone systems installed.

7.9.3 Discharges of electrostatic voltages shall not be made to electrical connector pins that are recessed below the surface of a connector or below the surface of the case of the sound level meter.

7.9.4 Electrostatic discharges of the greatest positive and greatest negative voltage specified in IEC 61672-1 shall be applied ten times by contact and ten times through the air. Discharges shall be applied to any point on the sound level meter that is considered appropriate by the laboratory. The points shall be limited to those that are accessible during normal usage. If user access is required to points inside the sound level meter, those points shall be included, unless the Instruction Manual prescribes precautions against damage by electrostatic discharges during this access. Care should be taken to ensure that any effects of a discharge to the sound level meter under test are fully dissipated before repeating the application of a discharge.

7.9.5 After a discharge, the sound level meter shall return to the same operating state as before the discharge. Any data stored by the sound level meter before the discharge shall be unchanged after the discharge. Un-quantified changes in the performance of the sound level meter are permitted when a discharge is applied.

7.10 Influence of a.c. power-frequency and radio-frequency fields

7.10.1 Sound signal

7.10.1.1 The manner of applying the sound signal to the microphone shall cause no interference to the applied a.c. power-frequency or radio-frequency field. The method of applying the sound signal also shall not interfere with normal operation of the sound level meter or with the immunity of the sound level meter to the power-frequency or radio-frequency field.

7.10.1.2 The sound signal, having the characteristics specified in IEC 61672-1, shall be adjusted to produce an indication of A-weighted, time-averaged sound level or A-weighted, F-time-weighted sound level of 74 dB ± 1 dB. The averaging time shall be recorded for indications of time-averaged sound level. The level range shall be that for which the sound level at the specified lower boundary is closest to, but not greater than, 70 dB if more than one level range is provided. If the sound level meter only indicates sound exposure level, the corresponding time-averaged sound level should be calculated as specified in IEC 61672-1 for the averaging time.

7.10.2 AC power-frequency tests

7.10.2.1 Tests for the influence of a.c. power-frequency fields shall use a device capable of producing an essentially uniform root-mean-square magnetic field strength of 80 A/m. The device shall permit immersion of the complete sound level meter, or the relevant components designated in the Instruction Manual, in the magnetic field. The frequency of the alternating magnetic field shall be 50 Hz or 60 Hz. The uncertainty for measurements of magnetic field strength shall not exceed 8 A/m.

7.10.2.2 The sound level meter under test shall be oriented as specified in the Instruction Manual for least immunity to an a.c. power-frequency field. For sound level meters that require the microphone to be on an extension cable to conform to the specifications of IEC 61672-1, the a.c. power-frequency tests shall also include the microphone unit.

7.10.2.3 Before initiating the tests of the influence of alternating magnetic fields, the sound level meter shall be exposed to the sound signal as specified in 7.10.1.2 and the indicated sound level recorded. The sound level indicated when the sound level meter is immersed in the alternating magnetic field shall be recorded for the same sound signal at the microphone as for the initial test. The duration of exposure shall be at least 10 s. The deviation of the indicated A-weighted sound level from the A-weighted sound level indicated before immersion in the magnetic field shall be determined.

NOTE The maximum-permitted uncertainties of measurement given in IEC 61672-1 do not include any contribution from the uncertainty of the measurement of magnetic field strength.

7.10.2.4 The deviation determined in 7.10.2.3 shall not exceed the applicable acceptance limits given in IEC 61672-1.

7.10.3 Radio-frequency tests

7.10.3.1 The equipment required to determine the influence of radio-frequency fields on the operation of a sound level meter shall conform to the specifications in Clause 6 of IEC 61000-4-3:2010. The characteristics of suitable facilities for testing immunity to radio-frequency fields are given in Annex C of IEC 61000-4-3:2010. Antennas for generating radio-frequency fields are described in Annex B of IEC 61000-4-3:2010. The uniformity of the radio-frequency fields in the test facility shall be determined by the procedure given in 6.2 of IEC 61000-4-3:2010. The test set-up and test procedure shall be in accordance with the specifications given in Clauses 7 and 8 of IEC 61000-4-3:2010. An alternative test method using Transverse Electromagnetic (TEM) waveguides may be employed for immunity testing. The requirements that shall be applied for the TEM waveguide are specified in IEC 61000-4-20, and Annex B of IEC 61000-4-20:2010 defines methods of implementing the testing. The

performance requirements for the instrument under test are unchanged including the range of frequencies tested and step size.

7.10.3.2 Tests for the influence of radio-frequency fields shall be conducted with the sound level meter set to the normal mode of operation as stated in the Instruction Manual. For sound level meters for which the specified configuration includes a microphone attached by a cable, the microphone shall be positioned centrally above the case of the sound level meter at a height of approximately 250 mm. If the cable is longer than 250 mm, it shall be folded back on itself in a figure-of-eight pattern. There shall be an even number of folds of equal length, with all parts secured together at each end of the folds and in their centre. The reference orientation of the sound level meter, as stated in the Instruction Manual, shall initially be aligned with the principal axis of the emitter of radio-frequency fields.

7.10.3.3 If the sound level meter has any connection device that permits the attachment of interface or interconnection cables, the influence of radio-frequency fields shall be tested with cables connected to all available connection devices. The lengths of the cables shall be as recommended in the Instruction Manual. All cables shall be unterminated and arranged as described in 7.3 of IEC 61000-4-3:2010 unless the manufacturer of the sound level meter also supplies the device that is connected to the sound level meter by a cable. In the latter event, the influence of radio-frequency fields shall be determined with all items connected together.

7.10.3.4 Where several connections may be made to the same connecting device, the influence of radio-frequency fields shall be tested with the configuration stated in the Instruction Manual that has minimum immunity to radio-frequency fields. Other configurations, which are equally, or more, immune to the influence of radio-frequency fields, may be included in the Instruction Manual in a list of conforming configurations. The other configurations may be included without further testing if the tested configuration fully conforms to the specifications given in IEC 61672-1.

7.10.3.5 In accordance with IEC 61000-4-6:2008, for group Z hand-held sound level meters, during the tests of the influence of radio-frequency fields, an artificial hand shall be placed around the hand-held accessories or keyboard, as required.

7.10.3.6 The root-mean-square electric field strength (when unmodulated) shall be as specified in IEC 61672-1. The carrier frequency of the modulated signal shall be varied in increments of up to 4 % over the range from 26 MHz to 500 MHz. The interval shall be up to 2 % for frequencies from 500 MHz to 1 GHz and for frequencies from 1,4 GHz to 2,7 GHz. The root-mean-square electric field strength shall be not less than -0 % or greater than +40 % of the target radio-frequency electric field strength.

NOTE A frequency increment of 2 % or 4 % means that the next signal frequency is greater than the previous signal frequency by a factor of 1,02 or 1,04, respectively. Although carrier frequency increments of 1 % are specified in IEC 61000-4-3:2010, frequency increments of up to 2 % and up to 4 % are considered appropriate for the purposes of this Standard.

7.10.3.7 Before initiating the tests of the influence of radio-frequency fields, the sound level meter shall be exposed to the sound signal as specified in 7.10.1.2 and the indicated sound level recorded. At each carrier frequency, the indicated sound level shall be recorded for the same sound signal at the microphone as for the initial test. At each carrier frequency, the time-averaged sound level (or sound exposure level) shall be reset at the start of the measurement. The measurement duration shall be at least 10 s in both the presence and the absence of a radio-frequency field.

7.10.3.8 The measured deviation of the indicated A-weighted sound level from the A-weighted sound level indicated before immersion in a radio-frequency field shall not exceed the applicable acceptance limits given in IEC 61672-1.

NOTE The maximum-permitted uncertainties of measurement given in IEC 61672-1 do not include any contribution from the uncertainty of the measurement of electric field strength.

7.10.3.9 If the Instruction Manual states that the sound level meter conforms to the specifications given in IEC 61672-1 for electric field strengths greater than that specified in IEC 61672-1, then all tests for the influence of radio-frequency fields shall be repeated for the greatest of those electric field strengths.

7.10.3.10 Testing at the discrete frequencies noted in 7.10.3.6 does not eliminate the requirement to conform to the specifications given in IEC 61672-1 at all carrier frequencies within the range specified in IEC 61672-1. Tests shall be performed at other carrier frequencies if there are indications that the acceptance limits given in IEC 61672-1 might be exceeded at carrier frequencies between any two successive frequencies from 7.10.3.6.

7.10.3.11 Maintaining the configuration described in 7.10.3.2 to 7.10.3.5, the tests of 7.10.3.6 to 7.10.3.10 shall be repeated to measure the influence of radio-frequency fields in at least one other plane. The other plane shall be approximately orthogonal to the principal plane of the reference orientation, within the limits of positioning for the test fixture. The measured deviation of the indicated A-weighted sound level from the A-weighted sound level indicated before immersion in a radio-frequency field shall not exceed the acceptance limits of IEC 61672-1.

7.10.3.12 When a radio-frequency field is applied, the sound level meter shall remain operational and in the same configuration as before the radio-frequency field was applied.

7.10.3.13 The Instruction Manual may state that the sound level meter conforms to the specifications given in IEC 61672-1 at sound levels less than 74 dB. In this event, an additional test of the influence of radio-frequency fields shall be performed on each applicable level range. The additional test shall be conducted at the lowest sound level stated in the Instruction Manual for conformance to the specifications of IEC 61672-1. The sound source described in 7.10.1.1 and the sound signal described in 7.10.1.2 shall be employed for the additional tests.

7.10.3.14 The measured deviation of the indicated A-weighted sound level from the A-weighted sound level indicated before immersion in a radio-frequency field at each step in the signal level from the sound source shall not exceed the applicable acceptance limits given in IEC 61672-1.

7.10.3.15 For group Y or group Z sound level meters, additional tests described in Table 4 of IEC 61000-6-2:2005 shall be performed to verify conformance to the specifications of IEC 61672-1 for immunity to radio-frequency interference at a.c. input and output ports. The root-mean-square electric field strength shall be not less than -0 % or greater than +40 % of the target radio-frequency electric field strength.

7.10.3.16 For group Z sound level meters utilizing or specifying interconnecting cables longer than 3 m, the additional tests described in Table 2 of IEC 61000-6-2:2005 shall be performed to verify conformance to the specifications given in IEC 61672-1 for the immunity of signal and control ports to radio-frequency interference. The a.c. power-supply voltage shall be not less than −0 % or greater than +5 % of the target voltage.

8 Radio-frequency emissions and public power supply disturbances

8.1 Radio-frequency field-strength emission levels, in decibels relative to a reference value of 1 μV/m, shall be measured by the method of CISPR 16-2-3:2010. The quasi-peak-detector instrument shall be as specified in CISPR 16-1-1 for the frequency ranges specified in IEC 61672-1. Measuring receivers, antennas, and test procedures shall be as specified in clause 10 of CISPR 22:2008. All emission levels shall conform to the specifications given in IEC 61672-1. Environmental conditions prevailing at the time of the tests shall be recorded. Radio-frequency emission tests shall be conducted with the sound level meter operating, powered by its preferred supply, and set to the mode and level range, as stated in the Instruction Manual, that produce the greatest radio-frequency emission levels.

8.2 All fixtures and fittings used to maintain the position of the sound level meter, including the microphone and extension cable, if appropriate, shall have negligible influence on the measurement of radio-frequency emissions from the sound level meter.

8.3 Radio-frequency emission levels shall be measured over the frequency ranges specified in IEC 61672-1 with the sound level meter in the specified reference orientation. For sound level meters for which the specified configuration includes a microphone attached by a cable, the microphone and cable shall be arranged as described in 7.10.3.2. Multi-channel sound level meter systems shall be equipped with a microphone connected to every channel input.

8.4 Maintaining, if appropriate, the microphone-cable-to-case arrangement specified in 8.3, the radio-frequency emission levels shall be measured in one other plane chosen by the laboratory. The other plane shall be approximately orthogonal to the principal plane of the reference orientation, within the limits of positioning for the system employed to measure radio-frequency emission levels.

8.5 If the sound level meter has any connection device that permits attachment of interface or interconnection cables, radio-frequency emission levels shall be measured with cables connected to all available connection devices. The length of the cables shall be the maximum recommended in the Instruction Manual. All cables shall be unterminated and arranged as described in 8.2 of CISPR 22:2008 unless the manufacturer of the sound level meter also supplies the device connected to the sound level meter by a cable. In this latter case, the radio-frequency emission levels shall be measured with all items connected together.

8.6 Where several connections may be made to the same connection device, radio-frequency emission levels shall be measured with the configuration stated in the Instruction Manual as producing the greatest radio-frequency emission levels. Other configurations with the same, or lower, radio-frequency emission levels may be included in the Instruction Manual in a list of conforming configurations, without further testing, if the tested configuration fully conforms to the limits given in IEC 61672-1.

8.7 For a group Y or group Z sound level meter that is operated from a public power supply, the disturbance to the public power supply shall be measured as described in Clause 9 of CISPR 22:2008. The method of measuring the disturbance caused by conducted emissions shall be as given in CISPR 16-1-2:2006 and CISPR 16-2-1:2010. For these tests, the sound level meter shall be set to the reference level range unless the Instruction Manual specifies another level range. The sound level meter shall conform to the specifications given in IEC 61672-1 and to the limits given in IEC 61672-1 for conducted disturbances.

9 Electroacoustical performance tests

9.1 General

9.1.1 Tests described in this clause are performed with acoustical or electrical signals as specified for each test. An operator shall not be present in the sound field during tests with acoustical signals. Electrical signals equivalent to the output of the microphone shall be applied to the sound level meter through the input device specified in the Instruction Manual. The difference between changes in the levels of the signal indicated on the display device and the corresponding changes in the levels of the signal at the electrical output, if used, shall be verified to not exceed the limit given in IEC 61672-1.

9.1.2 For tests with acoustical signals, the sound pressure level at the position of the microphone of the sound level meter shall be measured with a calibrated laboratory standard microphone conforming to the specifications given in IEC 61094-1. The frequency response of the laboratory standard microphone shall be taken into account when establishing the sound pressure level at a test frequency. For multi-channel sound level meter systems with identical microphone units and identical installation configurations, at least one of the microphone channels shall be tested, and any further microphone channels shall be tested at the

discretion of the laboratory. Where the microphone units or installation configurations are not nominally identical, then each different microphone channel shall be tested.

9.1.3 The stability of the sound level between measurements with the laboratory standard microphone and measurements with the sound level meter shall be known either by previous evaluation or by measurements of the stability of the sound level at a monitor microphone during the tests with acoustical signals.

9.1.4 The deviation of the frequency of an input signal from a specified frequency shall not exceed ±0,25 % of the specified frequency.

9.1.5 For tests with acoustical signals and for measurements of self-generated noise, the environmental conditions at the time of a test shall be within the following ranges: 97 kPa to 103 kPa for static pressure, 20 °C to 26 °C for air temperature and 40 % to 70 % for relative humidity.

9.1.6 Where the location of the laboratory is such that it is not practical to maintain the static pressure within the range specified in 9.1.5, the laboratory may use the results of the tests performed according to 7.3 to establish the performance of the sound level meter at the reference static pressure. In this case, the actual uncertainties of measurement shall include additional components for corrections applied to account for the effects of differences between the prevailing static pressure and the reference static pressure.

9.1.7 Environmental conditions at the time of a test shall be recorded.

9.1.8 For tests performed in a free-field test facility, the contribution to the uncertainty of the measurements of the acoustical response of a sound level meter from the uncertainty caused by deviations of the sound field in the facility from an ideal sound field free of reflections shall be evaluated for the properties of the particular free-field facility and for the particular test method that is used.

NOTE 1 Practical considerations for measurements in free-field facilities are discussed in IEC 61094-8.

NOTE 2 The basic qualification criteria recommended by ISO 26101 for specifying the performance of an anechoic chamber are not appropriate for calculating the uncertainty of measurement in the acoustical response of a sound level meter. Annex D of ISO 26101 contains information about the criteria to be considered. The uncertainty contributed by deviations from ideal free-field conditions is a component of the total uncertainty of measurements of the performance of a sound level meter.

9.2 Indication at the calibration check frequency

9.2.1 Before conducting, but not during, the tests in Clause 9 with acoustical signals, the indication at the calibration check frequency shall be checked by application of the sound calibrator specified in 4.4. The sound level meter shall be adjusted, if necessary, to indicate the required sound pressure level under reference environmental conditions.

9.2.2 The effects of environmental conditions on the sound pressure level produced by the sound calibrator shall be accounted for by the procedure given in the Instruction Manual for the sound calibrator and data from its calibration. The effects shall be determined relative to the sound pressure level produced under reference environmental conditions.

9.2.3 Adjustment data from the Instruction Manual at the calibration check frequency shall be verified by the method given in IEC 62585, or an equivalent method. Adjustment data are verified if the difference between a measured adjustment and the corresponding adjustment from the Instruction Manual does not exceed the applicable acceptance limit given in IEC 61672-1.

9.3 Directional response

9.3.1 The directional response of a sound level meter shall be determined with plane progressive sinusoidal sound waves in a free-field test facility. All configurations of the sound level meter that are stated in the Instruction Manual as conforming to the directional response requirements of IEC 61672-1 shall be tested.

9.3.2 If an electrical output is available and used for directional response tests, preliminary tests shall be performed to determine the correspondence between the level of a frequency-weighted signal indicated on the display device and the level of the corresponding voltage at the electrical output. For sound level meters without an electrical output, directional response tests may be performed on an acoustically and electrically equivalent device supplied by the manufacturer of the sound level meter and having exactly the same physical dimensions and shape, but with an electrical output.

9.3.3 Time-averaged sound levels or F-time-weighted sound levels shall be measured. When necessary, time-averaged sound levels shall be calculated from the indications of sound exposure levels as specified by IEC 61672-1 for any convenient integration time. Frequency weighting C or Z shall be selected, if available; otherwise, frequency weighting A shall be selected.

9.3.4 For sound level meters that are symmetric about the principal axis through the microphone or for which the microphone is connected to the sound level meter by means of an extension cable or other device, directional response may be measured in any plane through the axis of symmetry. Sound levels indicated on the display device, or equivalent indications of sound levels at an electrical output, shall be recorded for sounds incident on the microphone over the applicable ranges of angles relative to the reference direction from IEC 61672-1. One of the sound incidence angles shall be for the reference direction.

9.3.5 For sound level meters, including a windscreen and accessories if part of the configuration for normal use, that are not symmetric around the principal axis through the microphone or for which the microphone is not connected to the sound level meter by means of an extension cable or other device, directional response shall be measured in two planes perpendicular to each other. Each plane shall contain the principal axis of the microphone. One plane shall be perpendicular to the surface of the sound level meter that contains the controls and the display device, as applicable.

9.3.6 The following test procedure shall be used when the Instruction Manual does not provide tables of detailed information indicating that the directional response of the complete sound level meter conforms to the specifications in IEC 61672-1.

- For class 1 and class 2 sound level meters, the frequency of the sound signal shall range from 500 Hz to 2 kHz at one-third-octave intervals and then from greater than 2 kHz to 8 kHz at one-sixth-octave intervals.
- For class 1 sound level meters, the frequency of the sound signal shall range from greater than 8 kHz to 12,5 kHz at one-twelfth-octave intervals.
- Test frequencies at one-third-octave, one-sixth-octave, and one-twelfth-octave intervals shall be determined in accordance with IEC 61672-1.
- At each test frequency, angular intervals for measurement of directional response shall not exceed 10°.

9.3.7 If the Instruction Manual provides detailed tables of directional-response information including, if applicable, the directivity indexes for random incidence, directional response shall then be measured in each plane of symmetry over the entire range of sound incidence angles from IEC 61672-1, but at intervals not exceeding 30°. The frequency of the test signal shall range from 500 Hz to 12,5 kHz at one-third-octave intervals for class 1 sound level meters and from 500 Hz to 8 kHz at octave intervals for class 2 sound level meters.

9.3.8 For sound level meters designed to measure sounds with random incidence, measurements of directional response shall cover the range of sound incidence angles to ±180° around the reference direction for each plane of measurement.

9.3.9 Measurements of directional response at different sound incidence angles, obtained by moving the sound level meter or by moving the sound source, shall maintain the axis of rotational symmetry for the microphone and the principal axis of the sound source in the same plane, usually horizontal. The movement of the sound level meter in a horizontal plane is preferably a rotation about a vertical axis through the microphone reference point; see IEC 61183. If time-averaged sound level or sound exposure level is measured, sufficient integration time shall be allowed to obtain a stable indication at each angular increment.

NOTE If the sound source and the microphone reference point remain at fixed positions during measurements of directional response, the effect of small variations in the sound field of the test room is minimized.

9.3.10 At any test frequency, the level of the signal from the sound source shall be maintained constant as the sound level meter is positioned at the various sound incidence angles. For all tests, the sound level indicated when the sound source is operating shall be at least 30 dB greater than the sound level indicated when the sound source is not operating.

9.3.11 An alternative test procedure is to measure the directional response by varying the frequency of the signal from the sound source while maintaining a given sound-incidence angle. The test is repeated for each sound-incidence angle. The sound pressure level at the microphone of the sound level meter should be the same for a given test frequency at any sound incidence angle. For each sound-incidence angle, the same signal from the sound source should be used at each test frequency.

9.3.12 In each measurement plane and for all applicable frequencies, the greatest absolute difference between the sound levels at any two sound-incidence angles in each range of sound-incidence angles specified in IEC 61672-1 shall not exceed the applicable acceptance limits of IEC 61672-1.

9.3.13 When detailed directional-response information is supplied in the Instruction Manual and directional response is measured at a limited number of sound-incidence angles and signal frequencies, in addition to the requirements in 9.3.12, the measured values of the greatest absolute differences between sound levels shall not exceed the corresponding nominal values of the greatest absolute differences in sound level that are given in the Instruction Manual.

9.4 Tests of frequency weightings with acoustical signals

9.4.1 General

9.4.1.1 The procedure described in 9.4.3 for verifying a frequency weighting by tests in a free-field test facility assumes that the sound level meter does not have an electrical output and that the sound pressure level at the position of the sound level meter is first determined by means of a calibrated laboratory standard microphone. When an electrical output is available, it may be convenient to carry out the measurements in reverse order, that is, the sound level meter is first installed in the test facility and the sound source is adjusted to give a particular indication on the sound level meter. Then, the sound level meter is removed and the laboratory standard microphone is placed at the position of the microphone of the sound level meter to determine the corresponding free-field sound pressure level.

9.4.1.2 If an electrical output is available and used for the frequency-weighting tests, preliminary tests shall be performed to determine the correspondence between the levels of a frequency-weighted signal indicated on the display device and the levels of the voltages at the electrical output. No attempt shall be made to account for level linearity deviations in any test of a frequency weighting.

9.4.1.3 At least one of the frequency weightings for which specifications are given in IEC 61672-1 shall be tested with sinusoidal acoustical and electrical signals. Other frequency weightings that are provided in the sound level meter for which design goals and acceptance limits are specified in IEC 61672-1, or in the Instruction Manual, shall be tested using either acoustical signals or electrical signals. For tests of the other frequency weightings with electrical signals, the test methods account for deviations of the frequency-weighted response of the sound level meter from the design-goal frequency weighting and the average effects of reflections from the case of the sound level meter and diffraction around the microphone.

9.4.1.4 The sound level meter shall be set to measure F-time-weighted sound level, if available; otherwise, it shall be set to measure time-averaged sound level or sound exposure level, as available. When necessary, time-averaged sound levels shall be calculated from measurements of sound exposure levels as specified by IEC 61672-1 for any convenient integration time.

9.4.1.5 Where possible, all tests of frequency weightings and other frequency responses shall be performed with the sound level meter set for the reference level range. Where the laboratory considers that the setting of the level range control may influence conformance to the specifications for a frequency weighting, additional tests shall be performed on other level ranges.

9.4.1.6 Acoustical signal tests shall be performed with the C or Z frequency weighting, if available in the sound level meter. If C weighting or Z weighting is not available, tests shall be performed with the A frequency weighting. Tests with acoustical signals shall be performed with plane progressive sound waves in a free-field test facility for frequencies greater than the lower limiting frequency of the free-field test facility. Tests at frequencies less than the lower limiting frequency shall be performed by use of a comparison coupler.

9.4.1.7 For sound level meter configurations where the specified reference direction is not along the microphone's principal axis of symmetry, the frequency weighting shall be verified at the reference direction for a specified azimuth angle around the principal axis and at least at three other positions on the conical surface generated by rotation of the reference direction around the principal axis of the microphone.

9.4.2 Windscreen corrections

9.4.2.1 If a windscreen is required by 6.12 and the Instruction Manual states that the sound level meter conforms to the specifications of this standard both in a configuration that includes a windscreen and in a configuration that does not include a windscreen, the frequency weighting determined with acoustical signals shall be measured in a free-field test facility with and without a windscreen of specified model installed around the microphone. The differences between the frequency weightings are the measured windscreen corrections for sound incident from the reference direction in a specified measurement plane through the principal axis of the microphone. At each test frequency, windscreen correction data and the associated uncertainties of measurement, given in the Instruction Manual shall have been determined in accordance with a procedure given in IEC 62585. The difference between a measured windscreen correction and the corresponding windscreen correction given in the Instruction Manual shall not exceed the applicable acceptance limits given in IEC 61672-1.

9.4.2.2 For sound level meter configurations where the specified reference direction is not along the microphone's principal axis of symmetry, the windscreen correction shall be determined at the reference direction for a specified azimuth angle around the principal axis and at least at three other positions on the conical surface generated by rotation of the reference direction around the principal axis of the microphone.

9.4.3 Free-field tests

9.4.3.1 If frequency weighting C or Z is selected for free-field tests with acoustical signals, then, for the purpose of verifying the free-field corrections needed for periodic testing,

the frequency-weighting tests shall also be performed for frequency weighting A, but only for test frequencies for which free-field correction data are provided in the Instruction Manual.

9.4.3.2 For tests of class 1 and class 2 sound level meters, the frequency of the sound signal in the free-field test facility shall range from the lower limiting frequency of the free-field test facility up to 2 kHz at one-third-octave intervals and then from greater than 2 kHz to 8 kHz at one-sixth-octave intervals. For class 1 sound level meters, the frequency of the sound signal shall range from greater than 8 kHz to 20 kHz at one-twelfth-octave intervals. IEC 61672-1 lists the required frequencies.

9.4.3.3 If tables of detailed frequency-weighting information are given in the Instruction Manual, the tests to verify the data in the Instruction Manual may be restricted to one-third-octave intervals for class 1 sound level meters and octave intervals for class 2 sound level meters.

9.4.3.4 For all test frequencies, the sound pressure level, at the position of the reference point for the microphone on the sound level meter, shall be determined by means of a laboratory standard microphone in the absence of the sound level meter. Sound waves shall arrive at the reference point of the laboratory standard microphone from the direction for which the microphone was calibrated. At any test frequency, the sound pressure level with the sound source operating shall be at least 30 dB greater than the sound pressure level with the sound source not operating.

9.4.3.5 At each test frequency, the output from the sound source shall be adjusted to produce the reference sound pressure level at a selected location in the free-field test facility. If the reference sound-pressure level cannot be maintained at any test frequency, other sound pressure levels may be used. The sound pressure levels and all corrections that were applied shall be recorded.

9.4.3.6 The sound level meter shall then be substituted for the laboratory standard microphone. The reference point of the microphone on the sound level meter shall occupy the same position as previously occupied by the reference point for the laboratory standard microphone. Sounds shall arrive at the microphone from the specified reference direction. At each test frequency, the signals from the sound source shall be the same as they were for the tests with the laboratory standard microphone. The signal level indicated by the sound level meter shall be recorded at each test frequency.

9.4.3.7 At each test frequency, the frequency weighting shall be calculated from the frequency-weighted sound level indicated by the sound level meter minus the sound pressure level measured with the laboratory standard microphone.

9.4.3.8 The tests described in 9.4.3.2 to 9.4.3.7 shall be repeated for at least two other appropriate sound-source-to-microphone distances or locations in the free-field test facility.

9.4.3.9 At each test frequency, the measured frequency weighting shall be calculated from the arithmetic average of the frequency weightings determined at the different sound-source-to-microphone distances and locations.

9.4.4 Comparison coupler tests

9.4.4.1 For frequencies less than the lower limiting frequency of the free-field test facility, frequency weightings for class 1 sound level meters shall be measured at one-third-octave intervals from 10 Hz up to the lower limiting frequency and from 20 Hz up to the lower limiting frequency for class 2 sound level meters. For comparison coupler tests, the microphone of the sound level meter and the reference microphone shall be exposed to the sound field in a comparison coupler or equivalent device. Sound levels measured by the sound level meter and the sound pressure levels measured by the laboratory standard microphone shall be recorded. The windscreen, if installed, may be removed for comparison coupler tests. A

working standard microphone, calibrated by a method of IEC 61094-5, may be used instead of a calibrated laboratory standard microphone for comparison coupler tests.

9.4.4.2 If the vent of the microphone is exposed to the sound field in a comparison coupler, the pressure response measured with a microphone inserted in the coupler may be assumed to equal the corresponding free-field or random-incidence response at frequencies less than approximately 250 Hz. If the upper limit of the comparison coupler tests exceeds approximately 250 Hz, the laboratory should ensure the equivalence between the pressure response measurements and the corresponding measurements for the reference direction in a free-field facility and for random incidence. If the vent of the microphone is not exposed to the sound field in the comparison coupler, the laboratory shall account for the difference between the pressure response and the free-field or random-incidence response of the microphone.

9.4.4.3 To perform tests of frequency weighting A down to 10 Hz, the linear operating range of the sound level meter would need to be greater than 70 dB. If necessary, the tests of frequency weighting A shall be performed down to the lowest frequency for which the indicated sound level is 5 dB greater than the lower boundary of the linear operating range.

9.4.4.4 For comparison-coupler tests, measured frequency weightings shall be calculated from the frequency-weighted sound levels indicated by the sound level meter minus the corresponding sound pressure levels measured with the laboratory standard microphone.

9.4.4.5 Measurements of frequency weightings in the comparison coupler shall be performed at least three times. The microphones shall be removed from the coupler and then re-installed for each test. At each test frequency, the measured frequency weighting shall be calculated from the arithmetic average of the separate determinations.

9.4.5 Conformance

Measured deviations of the frequency weightings from the corresponding design goals shall not exceed the applicable acceptance limits given in IEC 61672-1. Design goal frequency weightings shall be those given in IEC 61672-1, or as calculated from equations given in IEC 61672-1 and rounded to the tenth of a decibel.

9.4.6 Random incidence

9.4.6.1 For sound level meters designed to measure sounds arriving simultaneously from random directions, tests with acoustical signals shall use the free-field method described in IEC 61183 to determine the relative frequency-weighted random-incidence response data given in the Instruction Manual. If applicable, random-incidence tests shall be performed with and without a windscreen installed around the microphone to verify the random-incidence windscreen corrections.

9.4.6.2 Relative frequency-weighted random-incidence response shall be determined at one-third-octave intervals over the frequency range from the lower limiting frequency of the free-field test facility up to 16 kHz for class 1 sound level meters and from the lower limiting frequency up to 8 kHz for class 2 sound level meters. For frequencies less than the lower limiting frequency, random-incidence frequency weightings shall be determined as described for the comparison coupler tests.

9.4.6.3 Directivity indexes for random incidence shall be determined by the procedure given in IEC 61183 using data acquired during the directional-response tests of 9.3. The measured directivity indexes shall be used to determine the measurements of relative frequency-weighted random-incidence response as the sum of the relative frequency-weighted free-field response in the reference direction and the corresponding directivity indexes.

9.4.6.4 At each test frequency, the measured random-incidence frequency weighting is the relative frequency-weighted random-incidence response. Measured deviations of the

random-incidence frequency weightings from the design-goal frequency weightings shall not exceed the applicable acceptance limits given in IEC 61672-1.

NOTE Until better information is available, the maximum-permitted uncertainties of measurement from IEC 61672-1 were considered applicable for measurements of frequency weighting for sounds with random incidence.

9.5 Tests of frequency weightings with electrical signals

9.5.1 General

9.5.1.1 Electrical signal tests shall be performed for all frequency weightings that are provided in the sound level meter for which design goals and acceptance limits are given in IEC 61672-1 or in the Instruction Manual. Sinusoidal input signals at the same test frequencies as used for the tests in 9.4 shall be used for all tests with electrical signals, except that the frequency increments shall be not larger than one-third octave. All tests in this subclause shall be performed with the sound level meter set for the level range used for the tests in 9.4.

9.5.1.2 Two alternative procedures are provided for tests of frequency weightings with electrical signals. For each test frequency and frequency weighting, the first alternative procedure requires that the input signal level be adjusted to produce the same indication on the display device for electrical signals as for acoustical signals. This procedure minimizes the influence of level linearity deviations but may lead to the inability to measure a frequency weighting at some frequencies because the input signal voltage is so high that it might cause an overload condition to occur. If preliminary testing indicates that an overload condition occurs at some test frequencies for some frequency weightings, then the second alternative test procedure shall be used for all tests.

9.5.1.3 For either test procedure, no attempt shall be made to account for level linearity deviations in the response of a sound level meter.

NOTE If the linear operating range on the selected level range is sufficiently great, the second test procedure enables a frequency weighting to be measured at any test frequency, although the influence of level linearity deviations is likely to be somewhat greater than for the first test procedure.

9.5.2 First alternative test procedure (variable input signal level)

9.5.2.1 Starting with the frequency weighting selected for the acoustical signal tests of 9.4, at each test frequency, the level of the input electrical signal shall be adjusted to give the same indication on the display device of the sound level meter as was obtained at that frequency for the acoustical signal tests of 9.4. The test shall then be repeated for the other frequency weightings. The levels of the input signals and the corresponding indications on the display device shall be recorded.

NOTE Input signal levels can be measured as the levels of root-mean-square voltages or as the settings, in decibels, of an input signal attenuator.

9.5.2.2 Frequency weightings equivalent to those that would have been obtained with acoustical signals shall be calculated as follows. At each test frequency, the differences, in decibels, shall be calculated between the input signal level recorded for a frequency weighting and the input signal level recorded for the frequency weighting that was selected for the acoustical signal tests of 9.4. The differences in input signal levels shall then be subtracted from the frequency weighting determined from the tests with acoustical signals to give the equivalent frequency weightings for the electrical signal tests.

NOTE Differences between electrical input signal levels can be determined from the differences in the settings of an input signal attenuator or from $10 \lg(V_2/V_1)^2$ dB, where V_2 and V_1 are the root-mean-square voltages measured for a frequency weighting and for the frequency weighting that was selected for the acoustical-signal tests, respectively.

9.5.3 Second alternative test procedure (constant input signal level)

9.5.3.1 Beginning with the frequency weighting used for the tests in 9.4, the level of a 1 kHz input signal shall be adjusted to give an indication that is 5 dB less than the upper boundary of the linear operating range at 1 kHz. At any other test frequency, the input signal level shall be that for the 1 kHz signal. The levels of the input signals and the corresponding indications on the display device shall be recorded.

9.5.3.2 For all other frequency weightings, at each test frequency, the level of the input signal shall be the same as noted for the tests in 9.5.3.1. The indications of the display device shall be recorded.

9.5.3.3 At each test frequency, the differences shall be calculated between the indications of the display device from 9.5.3.2 and the indication from 9.5.3.1. These differences in indicated levels shall be added to the corresponding frequency weighting measured with acoustical signals to obtain the equivalent frequency weightings for electrical signal tests.

9.5.4 Conformance

Measured deviations of the equivalent frequency weightings from the design goals shall not exceed the applicable acceptance limits given in IEC 61672-1 or in the Instruction Manual, as appropriate.

9.5.5 Frequency weightings C or Z at 1 kHz

9.5.5.1 A sound level meter provided with frequency weightings C or Z shall be tested with a steady 1 kHz sinusoidal electrical signal. The input signal shall be adjusted to indicate the reference sound pressure level on the reference level range with frequency weighting A and the indication recorded. For the same input signal, the F or S time-weighted sound level, time-averaged sound level, or sound exposure level indicated with the C and Z weightings shall then be recorded.

9.5.5.2 Measured deviations of the level of the C-weighted and Z-weighted measurement quantity from the corresponding level of the A-weighted measurement quantity shall not exceed the applicable acceptance limits of IEC 61672-1.

9.6 Corrections for the effect of reflections from the case of a sound level meter and diffraction around a microphone

9.6.1 The tests in this subclause are intended to verify the corrections, and the associated uncertainties of measurement, that are provided in the Instruction Manual for the typical effects on frequency response caused by reflections from the case of a sound level meter and diffraction around the microphone. The corrections and uncertainties provided in the Instruction Manual shall have been determined in accordance with a procedure given in IEC 62585. The tests shall be performed for the sound level meter set for the normal mode of operation as specified in the Instruction Manual, except that no microphone or windscreen is installed.

9.6.2 The corrections shall be verified with steady sinusoidal electrical signals. The frequency weighting shall be that selected for the frequency weighting tests with acoustical signals. The corrections shall be verified for a microphone of each model specified in the Instruction Manual for use on the sound level meter for which different corrections are specified for the effects of case reflections and diffraction around the microphone.

9.6.3 Input signal frequencies shall range at one-third-octave intervals from greater than the lower limiting frequency of the free-field test facility up to 16 kHz for class 1 sound level meters and from greater than the lower limiting frequency up to 8 kHz for class 2 sound level meters.

9.6.4 At 1 kHz, the input signal shall be adjusted to indicate the same sound level on the same level range as was indicated at 1 kHz for the acoustical signal tests of 9.4. The level of the electrical input signals and the corresponding indication of signal levels shall be recorded.

NOTE The level of the electrical input signal can be recorded as the level of a root-mean-square voltage or as the setting, in decibels, of an input signal attenuator.

9.6.5 With the input signal level maintained constant, the signal level indicated by the sound level meter shall be recorded for test frequencies other than 1 kHz.

9.6.6 The relative electrical-signal frequency weighting shall be calculated from the level indicated at a test frequency minus the level indicated at 1 kHz.

9.6.7 At each test frequency, the measured effects of reflection from the case of the sound level meter and diffraction around the microphone shall be calculated from the acoustical-signal frequency weighting determined according to a method from 9.4 minus the relative electrical-signal frequency weighting determined according to 9.6.6.

9.6.8 At each test frequency, the differences between the measured effects of reflections and diffraction and the corresponding data given in the Instruction Manual shall not exceed the values of uncertainty given in the Instruction Manual for the corrections for case reflections and diffraction around the microphone.

NOTE This method for verifying the effects of reflections and diffraction does not account for any level non-linearity between the sound levels measured in the free-field test facility and the signal levels indicated in response to electrical signals.

9.7 Corrections to obtain free-field or random-incidence sound levels

9.7.1 If the Instruction Manual recommends a calibrated multi-frequency sound calibrator, comparison coupler, or an electrostatic actuator to check a frequency weighting during periodic testing, then the Instruction Manual is required to provide data to correct the indicated sound levels to sound levels equivalent to those that would be indicated in response to plane sound waves incident from the reference direction in a free field or in response to a random-incidence sound field, as appropriate. Correction data, and the associated uncertainties of measurement, shall have been determined in accordance with a procedure given in IEC 62585. The free-field correction data and the associated uncertainties shall be verified as part of the pattern evaluation tests.

9.7.2 Before conducting the tests to verify the correction data from the Instruction Manual, measured deviations of the measured frequency-weighting A from the design goal at 1 kHz shall have been verified during the frequency weighting tests of 9.4 with acoustical signals to not exceed the applicable acceptance limits from IEC 61672-1. The A-weighted sound level indicated in response to application of a sound calibrator, comparison coupler, or electrostatic actuator shall then be recorded for each frequency for which correction data are provided in the Instruction Manual.

9.7.3 The indications of sound levels shall be corrected, if necessary, for the difference between the sound pressure level generated by the sound calibrator at a test frequency and the sound pressure level generated at 1 kHz, or by the corresponding difference in the relative frequency-response level of the comparison coupler or electrostatic actuator. The correction data from the Instruction Manual shall be applied to the corrected sound levels to determine equivalent free-field sound levels for sound incident from the reference direction or equivalent random-incidence sound levels, as appropriate. At each frequency, the relative equivalent A-weighted sound level shall then be calculated relative to the equivalent A-weighted sound level at 1 kHz. The result is the relative equivalent A-weighted frequency response.

9.7.4 At frequencies other than 1 kHz, measured deviations of the relative equivalent A-weighted frequency response, determined from application of the sound calibrator, comparison coupler, or electrostatic actuator from the arithmetic mean of the relative A-

weighted frequency response measured in the free-field test facility, or from the relative frequency-weighted random-incidence response measured according to 9.4.6, shall not exceed the values of uncertainty given in the Instruction Manual for the correction data.

9.7.5 The procedure to verify the correction data from the Instruction Manual shall be repeated for a microphone of each model specified for the sound level meter for which different free-field or random-incidence correction data are provided.

9.8 Level linearity

9.8.1 Tests at an air temperature near the reference air temperature

9.8.1.1 Level linearity shall be tested with steady sinusoidal electrical signals. The air temperature shall be between 18 °C and 28 °C with any convenient relative humidity and static pressure. The frequencies of the signals shall be 31,5 Hz, 1 kHz, and 12,5 kHz for class 1 sound level meters and 31,5 Hz, 1 kHz, and 8 kHz for class 2 sound level meters.

9.8.1.2 Level linearity shall be tested with the sound level meter set to indicate A-weighted, F-time-weighted sound level, if available, and also with the sound level meter set to indicate A-weighted, time-averaged sound level, if available. If only A-weighted sound exposure level is displayed, level linearity deviations shall be determined from A-weighted, time-averaged sound levels calculated from indications of A-weighted sound exposure level as specified in IEC 61672-1 for any convenient integration time.

9.8.1.3 For all input signals, a level linearity deviation is the difference between an indicated sound level and the corresponding anticipated sound level. At any test frequency and for any level range, the anticipated sound level shall be calculated from the sound level at the starting point specified in the Instruction Manual on the reference level range plus the difference between the level of the input signal and the level of the input signal that caused the display of the sound level at the starting point.

NOTE 1 For any test frequency, level linearity deviation is zero at the starting point on the reference level range.

NOTE 2 Changes in the level of the input signal, in decibels, can be determined from changes to the setting of an input signal attenuator or calculated from the level of the ratio of two sequential measurements of the root-mean-square voltages of the input signals.

9.8.1.4 At any test frequency, tests of level linearity shall begin with the input signal adjusted to display the sound level at the starting point on the reference level range. Level linearity deviations shall be measured in steps of input signal level of not greater than 1 dB. Tests shall proceed from the starting point up to the first indication of overload and then down through the starting point to the first indication of under-range. The tests then shall be continued back up to the starting point. The same input signal levels shall be used for ascending as for descending measurements.

9.8.1.5 On level ranges other than the reference level range, level linearity deviations shall be measured in steps of input signal level of not greater than 10 dB toward the upper boundary specified for the linear operating range and then toward the lower boundary. On each of the other level ranges, tests of level linearity shall begin at the sound level indicated for the input signal that gave the display of the starting point on the reference level range and adjusted by the nominal change in the level range control relative to the setting for the reference level range. On each level range, within 5 dB of the stated upper boundary, and within 5 dB of the stated lower boundary, the steps of input signal level shall be not greater than 1 dB to the first indication of overload and to the first indication of under-range, respectively.

NOTE For any test frequency, level linearity deviation is not necessarily zero at the starting point on level ranges other than the reference level range (see Note 1 to 9.8.1.3).

9.8.1.6 At each test frequency and over the extent of the linear operating range specified in the Instruction Manual for each level range, measured level linearity deviations shall not exceed the applicable acceptance limits of IEC 61672-1.

9.8.1.7 Measured level linearity deviations corresponding to 1 dB to 10 dB changes in input signal level shall not exceed the applicable acceptance limits given in IEC 61672-1.

9.8.1.8 At each test frequency, the total range of A-weighted sound levels for which the measured level linearity deviations do not exceed the applicable acceptance limits shall be not less than the corresponding total range stated in the Instruction Manual.

9.8.2 Tests at elevated air temperature

9.8.2.1 As noted in 7.6.10, level linearity deviations also shall be measured at an elevated air temperature. This test shall be performed with steady sinusoidal 1 kHz electrical signals. For this test, the components of the sound level meter that are intended for use in a wide range of environmental conditions shall be exposed to an air temperature that is within 2 °C of, but not more than, the maximum applicable air temperature specified in 7.6.4. The relative humidity and static pressure may have any convenient values.

9.8.2.2 The test procedure of 9.8.1 shall be followed for these elevated-temperature tests except that the level linearity deviations shall be measured only on the reference level range and only in 10 dB steps from the starting point up toward the specified upper boundary for the linear operating range, down toward the lower boundary and back to the starting point, and shall include the upper and lower boundaries.

9.8.2.3 Measured level linearity deviations shall not exceed the applicable acceptance limits given in IEC 61672-1. The total range of A-weighted sound levels for which the measured level linearity deviations do not exceed the applicable acceptance limits also shall be not less than the corresponding total range stated in the Instruction Manual.

9.9 Under-range indication

On each level range and for each frequency used for level linearity tests, it shall be verified that the indication of an under-range condition is not displayed when the time-weighted sound level, time-averaged sound level, or sound exposure level is greater than, or equal to, the lower boundary specified in the Instruction Manual for the linear operating range. When an under-range condition is indicated, it shall be verified that the under-range indicator operates as specified in IEC 61672-1.

9.10 Self-generated noise level

9.10.1 Levels of self-generated noise shall be measured with a microphone installed on the sound level meter. The sound level meter, in the configuration specified in the Instruction Manual for the normal mode of operation, shall be placed in a low-level sound field. When a microphone extension device is specified for the normal mode of operation, all components of the sound level meter at the non-microphone end of the extension device do not have to be placed in the low-level sound field. Self-generated noise levels shall be measured for a microphone of each model specified in the Instruction Manual for use on the sound level meter. Levels of self-generated noise shall also be measured with the microphone replaced by the specified electrical input device and terminated as specified in the Instruction Manual.

9.10.2 Self-generated noise levels shall be measured on the level ranges for which the Instruction Manual provides statements of the highest anticipated levels of self-generated noise.

9.10.3 For the measurements of the levels of self-generated noise, air temperature and relative humidity shall not exceed the ranges specified in 9.1.5.

9.10.4 Levels of self-generated noise shall be recorded for all available frequency weightings and frequency responses. F- and S-time-weighted sound levels shall be determined from the arithmetic average of ten observations taken at random over a 60 s interval. For measurements of time-averaged sound levels, the averaging time shall be that specified in the Instruction Manual for the highest anticipated levels of self-generated noise.

9.10.5 For each model of microphone and for the tests with the microphone replaced by the electrical input device, the indicated sound levels should not exceed by more than 10 dB the corresponding highest anticipated levels of self-generated noise that are stated in the Instruction Manual for a level range.

NOTE The level of self-generated noise is reported for information only and is not used to assess conformance to a requirement. The level of self-generated noise is reported for information only.

9.11 Decay time constants for time weightings F and S

9.11.1 The F and S exponential decay time constants shall be tested with steady 4 kHz sinusoidal electrical signals. The signal level shall be adjusted to indicate a sound level that is 3 dB less than the upper boundary specified for the linear operating range on the reference level range. The steady signal shall be applied for at least 10 s.

9.11.2 The signal shall be suddenly shut off and the rate of decay of the displayed sound level measured from the time of shut off. Measured decay rates for the F and S time weightings shall not exceed the acceptance limits given in IEC 61672-1.

NOTE Exponential decay rates can be measured from visual observations of the sound levels shown on the display device along with corresponding elapsed times as determined by a stopwatch or equivalent timing device or from the sampling rate specified as the update rate for display of digital signal levels. Another technique is to use a video camera, or equivalent device, to record the sound levels shown on the display device along with a digital clock displaying time to the millisecond.

9.11.3 For a sound level meter where time weighting S is provided, a steady 1 kHz sinusoidal electrical input signal shall be adjusted to produce an indication of the reference sound pressure level on the reference level range with time weighting F. The A-weighted sound level shall be recorded. With the same input signal, the A-weighted sound level indicated with time weighting S shall then be recorded.

9.11.4 The measured deviation of the sound level measured with time weighting S from the sound level measured with time weighting F shall not exceed the acceptance limits given in IEC 61672-1.

9.11.5 If the sound level meter can display an indication of sound level as a function of time with appropriate resolution, this function may be used to verify the decay time constants.

9.12 Toneburst response for sound level meters that measure time-weighted sound level

9.12.1 Toneburst response for sound level meters that measure F- and S-time-weighted sound levels shall be tested using 4 kHz sinusoidal electrical signals on the reference level range.

9.12.2 Toneburst response tests shall begin with a steady signal applied to the sound level meter set for frequency weighting A. With time weighting F, the input signal shall be adjusted to give an indication that is 3 dB less than the upper boundary specified for the linear operating range. The indication of F-time-weighted sound level shall be recorded. The process shall be repeated for S-time-weighted sound level, if applicable.

9.12.3 Tonebursts, extracted from the steady signal, then shall be applied for all toneburst durations given in IEC 61672-1 for time weightings F and S, as available. The indications of maximum sound levels in response to the tonebursts shall be recorded.

9.12.4 Toneburst response tests shall be repeated with the indicated level of the steady signal reduced in steps of 20 dB starting from the indication established in 9.12.2. The 20 dB steps shall be repeated until the final step would indicate a sound level that is less than 20 dB greater than the lower boundary specified for the linear operating range. Toneburst responses also shall be measured for a steady signal that produces an indication that is 10 dB greater than the lower boundary specified for the linear operating range.

9.12.5 At each step, the indications of F-time-weighted and S-time-weighted sound level of the steady signal and the corresponding indications of maximum F-time-weighted and maximum S-time-weighted sound level for the tonebursts shall be recorded. At each step, toneburst responses shall be measured for all toneburst durations specified in IEC 61672-1 for which maximum F-time-weighted and maximum S-time-weighted sound levels can be observed on the display device with indications that are at least 16 dB greater than the anticipated A-weighted level of self-generated noise specified in the Instruction Manual for the reference level range.

9.12.6 Tests of toneburst response also shall be performed with the indicated level of the steady signal increased, in steps of 1 dB above the signal level established in 9.12.2, until the first indication of overload. The durations of the tonebursts shall be the shortest applicable durations specified in IEC 61672-1 for F and S time weightings.

9.12.7 Measurements of toneburst responses shall be calculated from the maximum F-time-weighted and maximum S-time-weighted sound levels indicated for the toneburst signals minus the corresponding F-time-weighted and S-time-weighted sound levels indicated for the corresponding steady signals.

9.12.8 Deviations of measured toneburst responses from the corresponding reference toneburst responses shall not exceed the applicable acceptance limits given in IEC 61672-1.

9.13 Toneburst response for sound level meters that measure sound exposure level or time-averaged sound level

9.13.1 Toneburst response for sound level meters that measure sound exposure level or time-averaged sound level, or both, shall be tested using 4 kHz sinusoidal electrical signals on the reference level range. If only sound exposure levels are measured, time-averaged sound levels for the steady signal shall be calculated from the measurements of sound exposure level and integration time. If only time-averaged sound levels are measured, the sound exposure levels of the tonebursts shall be calculated from the measurements of time-averaged sound level and averaging time.

9.13.2 Toneburst response tests shall begin with a steady signal applied to the sound level meter set for frequency weighting A. The input signal shall be adjusted to give an indication that is 3 dB less than the upper boundary specified in the Instruction Manual for the linear operating range. If the sound level meter only displays sound exposure level, the input signal shall be adjusted to obtain an indication of a sound exposure level for which the corresponding time-averaged sound level is as specified. An integration time of 10 s is recommended for which, the sound exposure level is 10 dB greater than the corresponding time-averaged sound level. The time-averaged sound level and averaging time, or sound exposure level and integration time, shall be recorded. If provided, averaging times or integration times shall be those indicated on the display device.

9.13.3 Tonebursts, extracted from the steady signal, shall be applied for all toneburst durations specified in IEC 61672-1 for sound exposure levels. For each test, the indication of sound exposure level, or time-averaged sound level and averaging time, shall be recorded. Integration times for indications of sound exposure level shall be long enough to include all contributions from a toneburst. If only time-averaged sound level is displayed by the sound level meter, then the sound exposure level of a toneburst shall be determined from the time-averaged sound level and corresponding averaging time as specified in IEC 61672-1. Averaging times for measurements of time-averaged sound level shall be greater than the duration of a toneburst.

9.13.4 Toneburst response tests shall be repeated with the indicated level of the steady signal reduced in steps of 20 dB starting from the indication established in 9.13.2. The 20 dB steps shall be repeated until the next step would indicate a time-averaged level that is less than 20 dB greater than the lower boundary specified for the linear operating range. Toneburst responses also shall be measured for a steady signal that produces an indication that is 10 dB greater than the lower boundary specified for the linear operating range. At each step, the indication of the time-averaged sound level of the steady signal and the indication of the sound exposure level of the toneburst shall be recorded. Toneburst responses shall be measured for all toneburst durations specified in IEC 61672-1 for which sound exposure levels or time-averaged sound levels are indicated and are not less than the lower boundary of the linear operating range at 4 kHz.

9.13.5 Tests of toneburst response shall also be performed with the indicated level of the steady signal increased, in steps of 1 dB above the signal level established for 9.13.2, until the first indication of overload. The duration of the tonebursts for these tests shall be 0,25 ms.

9.13.6 Measurements of toneburst responses shall be calculated from the sound exposure levels indicated or calculated for the toneburst signals minus the time-averaged sound levels indicated or calculated for the corresponding steady signals.

9.13.7 Deviations of measured toneburst responses from the corresponding reference toneburst responses shall not exceed the applicable acceptance limits given in IEC 61672-1.

9.14 Response to sequences of repeated tonebursts for sound level meters that measure time-averaged sound level

9.14.1 For sound level meters that measure time-averaged sound level, the response to sequences of repeated 4 kHz sinusoidal electrical tonebursts shall be tested on the reference level range.

9.14.2 Tests of responses to sequences of repeated tonebursts shall begin with a steady signal applied to the sound level meter set for frequency weighting A. The input signal shall be adjusted to give an indication of time-averaged sound level that is 3 dB less than the upper boundary specified in the Instruction Manual for the linear operating range. The time-averaged sound level and the corresponding averaging time shall be recorded.

9.14.3 Sequences of tonebursts shall be extracted from the steady signal. Single tonebursts in sequences of repeated tonebursts shall have the durations specified for sound exposure levels in IEC 61672-1. Each sequence of repeated tonebursts shall contain a sufficient number of tonebursts to provide a stable measure of time-averaged sound level. Each individual toneburst in a sequence shall begin and end on a zero crossing. The time between individual tonebursts in a sequence shall be at least three times the duration of an individual toneburst. Time-averaged sound levels shall be recorded for each sequence. The averaging time shall be that used to determine the time-averaged sound level of the steady signal.

9.14.4 Tests of responses to sequences of repeated tonebursts shall be repeated with a steady input signal that produces an indication of time-averaged sound level that is 10 dB greater than the lower boundary specified for the linear operating range. Tests of responses to sequences of repeated tonebursts shall be performed for all individual toneburst durations specified for sound exposure levels specified in IEC 61672-1 that give indications of time-averaged sound levels. The time-averaged sound levels and the corresponding averaging times shall be recorded for the steady signals and the sequences of repeated tonebursts.

9.14.5 Measurements of the response to a sequence of repeated tonebursts shall be calculated from the time-averaged sound level of the sequence minus the time-averaged sound level of the corresponding steady signal.

9.14.6 Deviations of the measured responses to sequences of repeated tonebursts from the corresponding theoretical toneburst responses shall not exceed the applicable acceptance

limits given in IEC 61672-1 for sound exposure level. Theoretical toneburst responses shall be determined as specified in IEC 61672-1.

9.15 Overload indication

9.15.1 Overload indication is partially tested during measurements of level linearity and toneburst response. Additional overload indication tests are described here.

9.15.2 Overload indications shall be tested on the reference level range with the sound level meter set to display A-weighted, time-weighted sound level or A-weighted, time-averaged sound level. The overload indication for time-weighted sound levels shall be verified for the F time weighting and, if provided, for the S time weighting. Single positive and negative one-half-cycle sinusoidal electrical signals at frequencies of 31,5 Hz, 1 kHz, and 4 kHz shall be used. At each test frequency, the one-half-cycle signals shall be extracted from steady signals of the same signal level and shall begin and end at zero crossings.

9.15.3 At each test frequency, the test for overload indication shall begin at the indicated time-weighted or time-averaged level of the steady input signal corresponding to 1 dB less than the upper boundary specified for the linear operating range. The level of the positive one-half-cycle input signals, extracted from the steady signal, shall be increased in steps of 0,1 dB until the first indication of overload. The process shall be repeated for negative one-half-cycle signals. The levels of the one-half-cycle input signals that produced the first indications of overload shall be recorded to a tenth of a decibel.

NOTE Relative levels of the one-half-cycle input signals can be determined from the setting of an input attenuator.

9.15.4 Measurements of overload indication with positive and negative one-half-cycle signals shall be repeated with the sound level meter set to measure C-weighted peak sound levels, if available.

9.15.5 Measured differences between the positive and negative one-half-cycle input signals that first caused the displays of overload indication shall not exceed the acceptance limits given in IEC 61672-1.

9.15.6 Where the sound level meter is used to measure F- or S-time-weighted sound levels, it shall be verified that the overload indication is displayed as specified in IEC 61672-1. When time-averaged sound levels, sound exposure levels, maximum sound levels, or C-weighted peak sound levels are measured, it shall be verified that the overload indicator latches on as specified in IEC 61672-1 when an overload condition occurs.

9.16 C-weighted peak sound level

9.16.1 Indications of C-weighted peak sound level shall be tested with steady sinusoidal electrical signals, and with one-cycle and one-half-cycle electrical signals. The one-cycle and one-half-cycle signals shall be those specified in IEC 61672-1 and shall be extracted from the steady signals. One-cycle and one-half-cycle signals shall begin and end on a zero crossing.

9.16.2 On the reference and least-sensitive level ranges, indications of C-weighted peak sound level shall be tested at the levels of three steady input signals. One steady input signal is that which gives an indication of C-weighted, F-time-weighted sound level or C-weighted, time-averaged sound level that is 4 dB less than the upper boundary specified in the Instruction Manual for the peak level range. The second steady input signal is that which gives an indication of C-weighted sound level that is 1 dB greater than the lower boundary specified in the Instruction Manual for the peak level range. The third steady input signal is that which produces an indication midway, to the nearest decibel, between the C-weighted sound levels specified for the upper and lower boundaries of the peak level range.

9.16.3 For the three signal levels specified in 9.16.2, C-weighted peak sound levels shall be measured for the one-cycle and one-half-cycle signals specified in IEC 61672-1. Time-

averaged or F-time-weighted sound levels shall be measured for the corresponding steady signals. The differences shall be calculated between the indications of C-weighted peak sound level for the one-cycle and the one-half-cycle signals and the corresponding indications of time-averaged or F-time-weighted sound level of the steady signals.

9.16.4 Deviations of the measured differences between C-weighted peak sound levels and the corresponding steady-signal sound levels from the corresponding design-goal differences shall not exceed the applicable acceptance limits given in IEC 61672-1.

9.16.5 It shall be verified that no overload indication is present for all measurements of C-weighted peak sound levels made in accordance with the procedure described above.

9.17 Reset

Where provided, it shall be verified that operation of the reset facility cancels the previous indication on the display device. It shall also be verified that operation of the reset facility does not give rise to spurious indications on any display device.

9.18 Electrical output

A 1 kHz sinusoidal electrical signal shall be applied to the electrical input facility of the sound level meter. The sound level meter shall be set to measure A-weighted, F-time-weighted sound level or A-weighted, time-averaged sound level. The signal shall be adjusted to produce an indication of the reference sound pressure level on the reference level range and the indication recorded. A short circuit shall then be applied in turn across all analogue electrical outputs and the indications recorded. The measured difference between the indicated sound levels shall not exceed the acceptance limits specified in IEC 61672-1.

9.19 Timing facilities

The minimum averaging time for measurement of time-averaged sound level, or the minimum integration time for measurement of sound exposure level, shall be verified to be not greater than the corresponding minimum times stated in the Instruction Manual. The maximum averaging time or maximum integration time shall be verified to be not less than the corresponding maximum times stated in the Instruction Manual. The maximum averaging or integration time to be verified under this Standard should not exceed 24 h.

9.20 Crosstalk in multi-channel sound level meter systems

9.20.1 Crosstalk between pairs of channels of a multi-channel system shall be tested with steady electrical signals applied to the electrical input facility for one channel of a pair at frequencies of 31,5 Hz, 1 kHz, and 8 kHz.

9.20.2 At each test frequency, the input signal shall be adjusted to indicate the upper boundary stated in the Instruction Manual for the linear operating range. The signal level indicated for the channel and for all other channels shall be recorded. Differences between indicated signal levels shall be not less than the applicable minimum difference specified in IEC 61672-1. The frequency weighting shall be the C or Z weighting or, if necessary, the A weighting.

9.21 Power supply

9.21.1 The sound level meter shall first be tested with its power supply delivering the nominal voltage specified in the Instruction Manual. The sound calibrator supplied with the sound level meter shall be applied to the microphone and the sound level meter set for the reference level range. The indication of A-weighted, F-time-weighted sound level or A-weighted, time-averaged sound level shall be recorded. The test shall be repeated with the power supply delivering the maximum voltage and then the minimum voltage specified in the Instruction Manual.

9.21.2 Measured deviations of the sound level indicated at the maximum voltage and at the minimum voltage from the sound level indicated at the nominal voltage shall not exceed the acceptance limits given in IEC 61672-1.

NOTE The term "power supply" includes batteries.

10 Pattern evaluation report

10.1 For each sound level meter that is tested, the pattern evaluation report shall give full details of the configuration that was tested including the windscreen and accessories that were installed, sound level meter orientations, test conditions including environmental conditions, and test results. Each test result shall give the measured deviation from the design goal and the associated actual uncertainty of measurement along with an indication of conformance or non-conformance. A standard format is preferred for reporting the results of pattern evaluation tests.

10.2 For the tests of self-generated noise level, the report shall include, as applicable, a statement that an indicated sound level exceeds by more than 10 dB the corresponding highest anticipated level of self-generated noise that is stated in the Instruction Manual for a level range.

10.3 The test report shall state that the model of the complete sound level meter conforms to, or does not conform to, the mandatory specifications of IEC 61672-1 for the stated performance class and hence whether the pattern for the model of the sound level meter is, or is not, approved. If the model of the sound level meter is pattern approved, notice of such approval should be made publicly available for use during subsequent periodic tests.

10.4 The test information noted in clause 10 of IEC 61000-4-3:2010 shall be included in the test report. The report shall describe any temporary degradation in performance, loss of function, or loss of data noted at the end of a series of tests with electrostatic discharges, a.c. power-frequency fields, or radio-frequency fields.

Bibliography

IEC 61094-8, *Measurement microphones – Part 8: Methods for determining the free-field sensitivity of working standard microphones by comparison*

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(*Continued from second cover*)

The technical committee has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard. For undated references, the latest edition of the referenced document applies, including any corrigenda and amendment:

International Standard	*Title*
IEC 61000-4-6 : 2008	Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields
IEC 61000-4-20 : 2010	Electromagnetic compatibility (EMC) — Part 4-20: Testing and measurement techniques — Emission and immunity testing in transverse electromagnetic (TEM) waveguides
IEC 61000-6-2 : 2005	Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments
IEC 61094-1	Measurement microphones — Part 1: Specifications for laboratory standard microphones
IEC 61094-5	Measurement microphones — Part 5: Methods for pressure calibration of working standard microphones by comparison
IEC 61183	Electroacoustics — Random-incidence and diffuse-field calibration of sound level meters
IEC 62585	Electroacoustics — Methods to determine corrections to obtain the freefield response of a sound level meter
CISPR 16-1-2 : 2006	Specification for radio disturbance and immunity measuring apparatus and methods — Part 1-2: Radio disturbance and immunity measuring apparatus – Ancillary equipment — Conducted disturbances
CISPR 16-1-1 : 2019	Specification for radio disturbance and immunity measuring apparatus and methods — Part 1-1: Radio disturbance and immunity measuring apparatus measuring apparatus
CISPR 16-2-1 : 2010 (Ed. 2.1)	Specification for radio disturbance and immunity measuring apparatus and methods — Part 2-1: Methods of measurement of disturbances and immunity — Conducted disturbance measurements
IEC 61000-4-3 : 2006	IEC 61000-4-3 : 2006 Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques radiated, radio-frequency, electromagnetic field immunity test
ISO 26101 : 2012	Acoustics — Test methods for the qualification of free-field environments
ISO/IEC Guide 99	International vocabulary of metrology — Basic and general concepts and associated terms (VIM)
ISO/IEC Guide 98-3	Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM: 1995)
CISPR 22 : 2008,	Information technology equipment — Radio disturbance characteristics — Limits and methods of measurement
CISPR 16-2-3 : 2010 (Ed. 3.1)	Specification for radio disturbance and immunity measuring apparatus and methods — Part 2-3: Methods of measurement of disturbances and immunity — Radiated disturbance measurements

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Amendments Issued Since Publication

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