

Electroacoustics — Sound level meters —

Part 2: Pattern evaluation tests

The European Standard EN 61672-2:2003 has the status of a
British Standard

ICS 17.140.50

National foreword

This British Standard is the official English language version of EN 61672-2:2003. It is identical with IEC 61672-2:2003. Together with part 1 supersedes BS EN 60651:1994 and BS EN 60804:2001 which are withdrawn. The UK participation in its preparation was entrusted to Technical Committee EPL/29, Electroacoustics, which has the responsibility to:

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**Electroacoustics –
Sound level meters
Part 2: Pattern evaluation tests
(IEC 61672-2:2003)**

Electroacoustique –
Sonomètres
Partie 2: Essais d'évaluation d'un modèle
(CEI 61672-2:2003)

Elektroakustik –
Schallpegelmesser
Teil 2: Baumusterprüfungen
(IEC 61672-2:2003)

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Foreword

The text of document 29/532/FDIS, future edition 1 of IEC 61672-2, prepared by IEC TC 29, Electroacoustics, in cooperation with the International Organization of Legal Metrology (OILM), was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61672-2 on 2003-06-01.

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with the EN have to be withdrawn (dow) 2006-06-01

Annexes designated "normative" are part of the body of the standard.

In this standard, annex A is normative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61672-2:2003 was approved by CENELEC as a European Standard without any modification.

CONTENTS

1	Scope	5
2	Normative references	5
3	Terms and definitions	6
4	Submission for testing	6
5	Marking of the sound level meter and information in the instruction manual	6
6	Mandatory facilities and general requirements	7
7	Environmental, electrostatic and radio-frequency tests	9
7.1	General	9
7.2	Expanded uncertainties for measurements of environmental test conditions	10
7.3	Influence of static pressure	10
7.4	Tolerance limits on air temperature, relative humidity and static pressure	11
7.5	Acclimatization requirements for tests of the influence of air temperature and relative humidity	11
7.6	Abbreviated test of the influence of air temperature and relative humidity combined	12
7.7	Influence of air temperature	14
7.8	Influence of relative humidity	15
7.9	Influence of electrostatic discharges	16
7.10	Influence of a.c. power frequency and radio-frequency fields	16
8	Radio-frequency emissions and public power supply disturbances	20
9	Electroacoustical performance tests	21
9.1	General	21
9.2	Indication at the calibration check frequency	21
9.3	Directional response	22
9.4	Tests of frequency weightings with acoustical signals	24
9.5	Tests of frequency weightings with electrical signals	27
9.6	Combined effect of reflections, diffraction and corrections for nominal microphone frequency response and for the influence of a windscreen	29
9.7	Adjustments to obtain free-field sound levels	29
9.8	Level linearity	30
9.9	Under-range indication	32
9.10	Self-generated noise	32
9.11	Decay time constants for time weightings F and S	33
9.12	Toneburst response for sound level meters that measure time-weighted sound level	33
9.13	Toneburst response for sound level meters that measure sound exposure level or time-average sound level	34
9.14	Response to sequences of repeated tonebursts for sound level meters that measure time-average sound level	35
9.15	Overload indication	36
9.16	Peak C sound level	37

9.17 Reset 38

9.18 Electrical output..... 38

9.19 Timing facilities 38

9.20 Crosstalk in multi-channel sound level meter systems 38

9.21 Power supply 38

10 Pattern evaluation report..... 39

Annex ZA (normative) Normative references to international publications with their
corresponding European publications 40

ELECTROACOUSTICS – SOUND LEVEL METERS –

Part 2: Pattern evaluation tests

1 Scope

This part of IEC 61672 provides details of the tests necessary to verify conformance to all mandatory specifications given in IEC 61672-1:2002 for conventional 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 appropriate. Tests and test methods are applicable to class 1 and class 2 sound level meters. The aim is to ensure that all testing laboratories use consistent methods to perform pattern evaluation tests.

2 Normative references

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

IEC 60942, *Electroacoustics – Sound calibrators*

IEC 61000-4-2:2001, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test* – Basic EMC Publication¹

IEC 61000-4-3:2002, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test* – Basic EMC Publication²

IEC 61000-4-6:2001, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields* – Basic EMC Publication³

IEC 61000-6-2:1999, *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 61183, *Electroacoustics – Random-incidence and diffuse-field calibration of sound level meters*

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

¹ Edition 1.2 consisting of Edition 1:1995 consolidated with amendments 1:1998 and 2:2000.

² Edition 2.1 consisting of Edition 2:2002 consolidated with amendment 1:2002.

³ Edition 1.1 consisting of Edition 1:1996 consolidated with amendment 1:2000.

CISPR 16-1:1999, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*⁴

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

ISO Express Guide, *Guide to the expression of uncertainty in measurement*

ISO/IEC, *International vocabulary of basic and general terms in metrology*

3 Terms and definitions

For the purposes of this standard, in addition to the terms and definitions given in IEC 61672-1, the terms and definitions given in IEC 61000-4-2:2001, IEC 61000-4-3:2002, IEC 61000-4-6:2001, the *Guide to the expression of uncertainty in measurement* and the *International vocabulary of basic and general terms in metrology* 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 testing 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 testing laboratory shall decide whether the full tests shall also be performed on the second specimen or whether 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 sound level meters. Examples of additional items or accessories include a microphone extension device or cable and peripheral equipment.

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. The model of the calibrator shall conform to the specifications of IEC 60942 for the class, as required by 5.2.2 of IEC 61672-1:2002.

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 Clause 8 of IEC 61672-1:2002.

5.2 Before conducting any tests, it shall be verified that the instruction manual contains all the information that is required by Clause 9 of IEC 61672-1:2002 as relevant to the facilities provided by the sound level meter.

⁴ In English, CISPR stands for International Special Committee on Radio Interference.

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 within the appropriate tolerance limits.

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.

NOTE Where 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 testing laboratory, it is not necessary to repeat those tests for electroacoustical performance characteristics that are not affected by the design change.

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

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

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

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 5.15.3 of IEC 61672-1:2002. The range of the display shall be at least the minimum specified in 5.15.3 of IEC 61672-1:2002.

6.6 Where 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, at least for pattern evaluation testing.

6.8 If the sound level meter is capable of indicating peak C sound levels, it shall be verified that the capability to display C-weighted, time-weighted sound level or C-weighted, time-average sound level is also provided, at least for pattern evaluation testing.

6.9 For sound level meters with multiple level ranges, it shall be verified that the level range overlap conforms to the specifications of 5.5.8 of IEC 61672-1:2002.

6.10 For sound level meters that can display more than one measurement quantity, it shall be verified that there is a clear 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 61672-1:2002 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 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 combination 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 testing 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 in accordance with 5.16.3 of IEC 61672-1:2002. This requirement applies to each channel of a multi-channel system.

NOTE Where multiple outputs are present, if an output is specified in the instruction manual for testing, this output should be used for the pattern evaluation tests.

6.15 For all tests, the sound level meter shall be powered from its preferred supply. If the instruction manual specifies internal batteries of a particular type, such batteries shall be installed for the pattern evaluation tests.

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 channels, at the discretion of the testing laboratory.

NOTE 1 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.

NOTE 2 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 should be 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 the specifications of IEC 61672-1 is verified when measured deviations from design goals, extended by the actual expanded uncertainties of measurement of the testing laboratory, lie fully within the applicable tolerance limits. A positive value for a measured extended deviation shall be not greater than the corresponding positive tolerance limit. A negative value for a measured extended deviation shall be not less than the corresponding negative tolerance limit.

6.20 The testing 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 *Guide to the expression of uncertainty in measurement*. Metrological terms are defined in the *International vocabulary of basic and general terms in metrology*. Actual expanded uncertainties shall be calculated for a level of confidence of 95 %, using the necessary coverage factor.

NOTE 1 When a testing 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 may be determined from an earlier evaluation of several measurements for a similar sound level meter.

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

6.22 The actual expanded uncertainties of measurement shall not exceed the corresponding maximum expanded uncertainties of measurement from Annex A of IEC 61672-1:2002. When this condition is not achieved, the result of the test shall not be used to demonstrate conformance to a specification and pattern approval shall not be granted.

NOTE Calculation of the expanded uncertainty of measurement for a particular test should consider at least five components. The first component is the uncertainty attributed to calibration of the individual instruments and equipment used to perform the test, including the sound calibrator, where applicable. The second component is any contribution resulting from environmental effects or adjustments. The third component is any small errors that may be present in the applied signals and are considered as uncertainties. The fourth component is any random uncertainty attributed to repeated measurements and dependent on the characteristics of the sound level meter under test. The fifth component is, where applicable, an uncertainty contribution for reading the indication from 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.

6.23 For legal metrology purposes, the tolerance limits around the design goals specified in IEC 61672-1 shall be considered to be the maximum permissible errors for pattern evaluation, initial verification and subsequent verification.

7 Environmental, electrostatic and radio-frequency tests

7.1 General

7.1.1 Before conducting, but not during, the tests described in the various subclauses of Clause 7, the indication at the calibration check frequency shall be checked by application of the sound calibrator specified in 4.4 and adjusted, if necessary, to indicate the required sound pressure level under reference environmental conditions. The adjustment shall use the procedure given in the instruction manual for the sound level meter. 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 signal of known sound pressure level at the microphone of the sound level meter. The sound calibrator shall be a class 1 device as specified in IEC 60942. 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 A class LS sound calibrator as specified in IEC 60942 may be used if the effects of static pressure, air temperature and relative humidity, as applicable, on the sound pressure level produced in the coupler of the sound calibrator, over the range of environmental conditions specified for these tests, are known. It should be noted that the range of environmental conditions specified for these 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-average sound level or sound exposure level on the reference level range. The frequency weighting shall be set to A weighting. F-time-weighted sound level or time-average sound level is preferred.

7.1.6 Time-weighted sound levels, time-average 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. Where necessary, time-average sound levels shall be calculated in accordance with Equation (5b) of IEC 61672-1:2002 from the indications of sound exposure level and elapsed time. Averaging times for time-average sound levels or integration times for sound exposure levels shall be recorded.

7.2 Expanded uncertainties for measurements of environmental test conditions

The actual expanded uncertainty of measurement shall not exceed 0,2 kPa for measurements of static pressure. The actual expanded uncertainty of measurement shall not exceed 0,3 °C and 4 % relative humidity for measurements of air temperature and relative humidity, respectively.

7.3 Influence of static pressure

7.3.1 During the measurements of the influence of static pressure, air temperature shall be maintained within $\pm 2,3$ K ($\pm 2,3^\circ$ C) of the reference air temperature. Relative humidity at the reference static pressure shall be maintained within +24 % relative humidity to -14 % relative humidity of the reference relative humidity. The variation limits refer to the measured air temperatures and relative humidities with allowance for measurement uncertainty from 7.2.

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 min 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 power 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 6.2 of IEC 61672-1:2002. For each nominal static pressure condition, the two measured static pressures shall be the same within 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 the test condition and the sound pressure level generated under reference environmental conditions.

7.3.6 At each static pressure test condition, the deviation of the indicated sound level from the sound level first indicated at the reference static pressure shall be extended by the actual expanded uncertainty of measurement. Each extended deviation shall be within the applicable tolerance limits specified in 6.2 of IEC 61672-1:2002.

7.4 Tolerance 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 air temperature shall be within $\pm 1,3$ K ($\pm 1,3$ °C) of a specified air temperature, the relative humidity shall be within ± 9 % relative humidity of a specified relative humidity, and the difference between the maximum and minimum values of the prevailing static pressure shall not exceed 6,2 kPa. The variation limits refer to the measured air temperatures, relative humidities and static pressure with allowance for measurement uncertainties from 7.2.

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 testing 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 testing 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 influence of air temperature and relative humidity combined

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 influence of air temperature and relative humidity combined, the tolerance limits are smaller than those specified in 6.3 and 6.4 of IEC 61672-1:2002. If the sound level meter conforms within the reduced tolerance limits at all specified test conditions, then the sound level meter shall be considered to fully conform to the specifications of 6.3 and 6.4 of IEC 61672-1:2002. No additional tests are required. If the sound level meter fails to conform within the reduced tolerance 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.

NOTE 1 When setting the test conditions, rapid changes of air temperature in the test chamber should be avoided.

NOTE 2 Care should be taken to avoid condensation while the temperature is being changed in the environmental test chamber.

NOTE 3 It is important to monitor the relative humidity in the environmental test chamber each time the air temperature is changed to ensure that it remains within the specified tolerance limits.

NOTE 4 The indicated combinations of temperature and relative humidity 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 air temperature and relative humidity covered by the specifications in 6.3 and 6.4 of IEC 61672-1:2002, the target test conditions are:

- for class 1:
 - reference air temperature and reference relative humidity,
 - air temperature of $-10\text{ }^{\circ}\text{C}$ and relative humidity of 65 %,
 - air temperature of $+5\text{ }^{\circ}\text{C}$ and relative humidity of 25 %,
 - air temperature of $+40\text{ }^{\circ}\text{C}$ and relative humidity of 90 %, and
 - air temperature of $+50\text{ }^{\circ}\text{C}$ and relative humidity of 50 %.