

TECHNICAL GUIDE NPL ACOUSTICS 2004/1

INTERIM DOCUMENT

for the

PERIODIC TESTING of IEC 61672 SOUND LEVEL METERS

Edition 2

FEBRUARY 2005

CONTENTS

	Page
1 Scope	4
2 Normative references	4
3 Submission for testing	5
4 Conformance.....	6
5 Preliminary inspection	6
6 Power supply	7
7 Environmental conditions.....	7
8 General test requirements	7
9 Indication at the calibration check frequency.....	7
10 Self-generated noise with microphone replaced by the electrical input signal device	8
11 Acoustical signal test of a frequency weighting	8
12 Electrical signal tests of frequency weightings	10
13 Frequency and time weightings at 1 kHz.....	11
14 Level linearity on the reference level range.....	11
15 Level linearity including the level range control	11
16 Toneburst response.....	12
17 Peak C sound level	13
18 Overload indication	13
19 Documentation	14

Technical Guide NPL Acoustics 2004/1

PERIODIC TESTING of IEC 61672 SOUND LEVEL METERS

INTRODUCTION

The current international standard for sound level meters, published by the IEC (International Electrotechnical Commission) is IEC 61672. The parts of this series published so far are:

IEC 61672-1 : 2002 *Electroacoustics – Sound level meters – Part 1 : Specifications*
(dual - numbered as BS EN 61672-1 : 2003)

IEC 61672-2 : 2003 *Electroacoustics – Sound level meters – Part 2 : Pattern evaluation tests*
(dual-numbered as BS EN 61672-2 : 2003)

IEC is currently preparing:

IEC 61672-3 *Electroacoustics – Sound level meters – Part 3 : Periodic tests*

As sound level meters originally manufactured to IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) are becoming available on the market there is an immediate need for an interim document to cover periodic testing until IEC 61672-3 is published.

This technical guide has therefore been produced as an **interim document** for use in the UK to cover the periodic verification of sound level meters originally manufactured to IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), until Part 3 of IEC 61672 is published.

This technical guide, which was based on drafts of IEC 61672 Part 3, has been prepared by a sub-group of the United Kingdom Accreditation Service's Acoustical Industry Technical Committee, in response to requests for an interim document to be made available. UKAS's Technical Policy Statement TPS 49 advises laboratories and assessors on these interim arrangements.

This technical guide will be withdrawn 6 months after the publication of the BS EN equivalent of IEC 61672 Part 3.

SOUND LEVEL METERS

PERIODIC TESTS

1 Scope

1.1 The purpose of an initial periodic test is to assure the user that the performance of a sound level meter meets the requirements of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) for a limited set of key tests and for the environmental conditions under which the tests were performed. The purpose of subsequent periodic tests is to assure the user that the performance of a sound level meter has not changed significantly from that determined in initial tests. This technical guide describes temporary procedures for periodic testing of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) class 1 or class 2 conventional, integrating-averaging, and integrating sound level meters. The aim of the technical guide is to ensure that periodic testing is performed in a consistent manner by all UK calibration laboratories.

1.2 This technical guide is an interim document and will be withdrawn 6 months after the publication of the BS EN equivalent of IEC 61672 Part 3. When published IEC 61672 Part 3 may require additional and/or different tests to those given in this technical guide.

1.3 The scope of the testing in this technical guide is deliberately restricted to the minimum considered necessary for periodic tests.

1.4 Periodic tests described in this technical guide apply to sound level meters for which the model has, or has not, been pattern approved by an independent testing organization responsible for pattern approvals and in accordance with the test procedures of IEC 61672-2 : 2003 (BS EN 61672-2 : 2003). Because of the limited number and extent of the periodic tests, if evidence of pattern approval is not publicly available no general conclusion about conformance to the requirements of IEC 61672 1:2002 can be made, even if the results of the periodic tests conform to all applicable requirements of this technical guide.

2 Normative references

The following referenced documents are indispensable for 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 (BS EN 60942), *Electroacoustics — Sound calibrators*

IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) *Electroacoustics — Sound level meters — Part 1: Specifications*

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

ISO/IEC Guide (1995), *Guide to the expression of uncertainty in measurement*

OIML Publication V2:1993, *International vocabulary of basic and general terms in metrology*

3 Submission for testing

3.1 An instruction manual applicable to the model and version of the sound level meter needs to be available in order to perform periodic tests for a sound level meter. If an applicable instruction manual is not submitted along with the sound level meter, or is not available at the calibration laboratory, or not publicly accessible from the Internet web site of the manufacturer or supplier of the sound level meter, then no periodic tests shall be performed.

3.2 The sound level meter submitted for testing shall be accompanied by all items or accessories with which the sound level meter is required to be tested. A device specified in the instruction manual for inserting electrical signals equivalent to signals from the microphone shall also be submitted if requested by the calibration laboratory.

3.3 Periodic tests, as described in this technical guide, shall not be performed unless the markings on the sound level meter are as required by IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) or there is evidence that the sound level meter was originally so marked.

3.4 Key data required to perform the periodic tests shall be available and the source of the data shall be recorded in the laboratory records. The data should include all relevant information required by clause 9 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003). However, as this technical guide relates to recently-manufactured sound level meters, it is possible that some of this information may not yet be available. For the purposes of this interim document, some exceptions are made where the data is not published in the instruction manual or made available by the manufacturer or supplier. Details of these exceptions are given in the relevant sub-clause, and no further exceptions apply.

3.5 A sound calibrator shall be available. This sound calibrator shall either be a model specified in the instruction manual for use with the sound level meter, or a sound calibrator of the same nominal level and frequency as a model specified in the instruction manual. In this latter case, any adjustments to be applied when that model of calibrator is coupled to the model of microphone supplied on the sound level meter shall be known. The sound calibrator shall be supplied with the sound level meter, if requested by the calibration laboratory, or shall be supplied by the calibration laboratory itself. An instruction manual for the sound calibrator shall also be available. If an appropriate sound calibrator is not available, no periodic tests shall be performed.

3.6 The sound calibrator shall be shown by calibration, within the previous year, to conform to the requirements of IEC 60942 for sound pressure level, frequency and total distortion for either the model of microphone supplied with the sound level meter or for an equivalent model of microphone. The calibration shall be performed using instruments with current calibrations for the appropriate quantities. These calibrations shall be traceable to national standards, and the sound calibrator shall be supplied with a calibration certificate. The sound calibrator shall conform to the class 1 requirements of IEC 60942 for a class 1 sound level meter and to the class 1 or class 2 requirements for a class 2 sound level meter.

NOTE 1 Evidence that the sound calibrator conforms to the applicable requirements of IEC 60942 may be provided by documentation from a periodic test performed in accordance with the procedures given in IEC 60942. If such evidence is not available, the calibration laboratory may offer to perform a calibration of the sound calibrator.

NOTE 2 In the UK acoustical calibration laboratories are accredited by the United Kingdom Accreditation Service (UKAS) and the relevant national metrology institute is the National Physical Laboratory (NPL).

4 Conformance

4.1 Conformance to the requirements of this technical guide is demonstrated when the measured deviations from the corresponding design goals given in IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), extended by the actual expanded uncertainties of measurement of the calibration laboratory, lie fully within the applicable tolerance limits given in IEC 61672-1 : 2002 (BS EN 61672-1 : 2003). A positive value for an extended deviation shall not be more positive than the corresponding positive tolerance limit. A negative value for an extended deviation shall not be more negative than the corresponding negative tolerance limit.

4.2 The calibration laboratory shall use instruments that have been calibrated for the appropriate quantities at appropriate intervals. As required, the calibrations shall be traceable to national standards.

4.3 Laboratories performing periodic tests shall calculate the uncertainties associated with all measurements in accordance with the *Guide to the expression of uncertainty in measurement*. Metrological terms shall be as 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 calibration laboratory is only required to make a single measurement, it is necessary for the laboratory to make an estimate of the contribution of random effects to the total uncertainty. The estimate should 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.

4.4 For any test, the actual expanded uncertainty of measurement of the laboratory shall not exceed the corresponding maximum uncertainty given in annex A of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003). If an actual expanded uncertainty of measurement for a test performed by the calibration laboratory exceeds the corresponding maximum uncertainty, the result of the test shall not be used to determine conformance to this technical guide for periodic testing.

NOTE Calculation of the expanded uncertainty of measurement for a particular test should consider at least five components, as applicable. The first component is the uncertainty attributed to calibration of the individual instruments and equipment used to perform the test, including the sound calibrator noted in 3.5. The second component is any contribution resulting from environmental effects or adjustments. The third component is any contribution resulting from small errors that may be present in the applied signals and are considered as uncertainties. The fourth component is any contribution to the uncertainty attributed to random effects associated with repeated measurements and dependent on the characteristics of the sound level meter under test. The fifth component is 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.

5 Preliminary inspection

Prior to any measurements, the sound level meter and all accessories shall be visually inspected, paying particular attention to damage to, or accumulation of foreign material on, the protection grid or diaphragm of the microphone. All appropriate essential controls shall be operated to ensure that the sound level meter is in working order. If the controls, display and other essential elements are not in working order, no periodic tests shall be performed.

6 Power supply

Before conducting any test, the voltage delivered by the power supply for the sound level meter shall be checked by the method stated in the instruction manual to ensure that it is within the specified operating limits. If the voltage is not within the operating limits and the reason cannot be attributed to partially discharged batteries or an incorrect selection of the voltage of the public power supply, then no periodic tests shall be performed as a malfunction is indicated.

7 Environmental conditions

7.1 Periodic tests shall be performed within the following ranges of environmental conditions: 80 kPa to 105 kPa for static air pressure, 20 °C to 26 °C for air temperature and 25 % to 70 % for relative humidity.

7.2 As a minimum, the static air pressure, air temperature and relative humidity shall be measured and recorded at the start of the periodic testing described in this technical guide and at the end of the testing.

NOTE. Where the tests of clause 11 are performed in a free-field facility it is recommended that the static air pressure, air temperature and relative humidity are measured and recorded for each set of measurements.

8 General test requirements

8.1 Periodic tests described in subsequent clauses apply only for those design features that are required by IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) and that are available in the sound level meter submitted for test. All such features shall be tested.

8.2 Electrical signals shall be inserted into the sound level meter through the input device or by the means specified in the instruction manual. The frequency of the input signals shall be within $\pm 0,25$ % of the specified value.

8.3 For a sound level meter that has an electrical output that is to be used for the periodic tests, the indications obtained from the electrical output and the corresponding indications on the display device of the sound level meter shall be confirmed to be identical within the tolerance limits given in 5.16.3 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

9 Indication at the calibration check frequency

9.1 The indication of the sound level meter at the calibration check frequency shall be checked by application of the calibrated sound calibrator noted in 3.5 and adjusted, if necessary, to indicate the required sound pressure level under the prevailing environmental conditions. For multi-channel sound level meter systems, the indication shall be checked for as many of the channels as are required to be tested. The indications before and after adjustment shall be recorded. The adjustment shall use the procedure given in the instruction manual for the sound level meter to account for the effect of a windscreen or other accessory submitted for test with the sound level meter.

NOTE Where the sound calibrator is supplied with the sound level meter, but is not calibrated at the time the sound level meter is submitted for test, an additional independent measurement is recommended using a suitable sound calibrator owned by the calibration laboratory. The sound calibrator should be applied to the sound level meter following any adjustment in 9.1 and the indication noted, without any further adjustment being performed. This indication provides a consistency check with the indication obtained in 9.1, and is important to ensure that the sound pressure level generated by the sound calibrator supplied with the sound level meter has not changed significantly

since its latest calibration. Where the indications appear inconsistent, further investigations should be performed by the calibration laboratory to determine the reasons for the inconsistency. Unless the reasons for the inconsistency can be satisfactorily resolved no further measurements should be performed.

9.2 The effect of the prevailing environmental conditions on the sound pressure level produced in the coupler of the sound calibrator, relative to the sound pressure level produced under the reference environmental conditions of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), shall be accounted for in accordance with the procedure from the instruction manual for the sound calibrator and data from its calibration.

10 Self-generated noise with microphone replaced by the electrical input signal device

10.1 With the microphone replaced by the electrical input signal device (or the specified means of inserting electrical signals), and terminated in the manner specified in the instruction manual for measurements of the level of the corresponding self-generated noise, the indicated level of the time-averaged or time-weighted self-generated noise shall be recorded for all frequency weightings available in the sound level meter.

10.2 The indication of time average A-weighted sound level shall be averaged over 30 s, or longer if so required by the instruction manual. Time-average sound level may be measured directly or calculated from an indication of sound exposure level and integration time. If time-average sound level cannot be determined, the time-weighted sound level from the average of 10 observations taken at random over a 60 s interval shall be recorded. If time-weighted sound level is recorded, the S time weighting shall be used if available, otherwise the F time weighting shall be used.

11 Acoustical signal test of a frequency weighting

11.1 The sound level meter shall be set for frequency weighting C, if available, otherwise for frequency weighting A. The frequency weighting shall be tested using a calibrated multi-frequency sound calibrator, an electrostatic actuator or a free-field facility. In the latter case, the test procedures given in 9.4.1 to 9.4.4 of IEC 61672-2 : 2003 (BS EN 61672-2 : 2003) shall be followed, but only for the three test frequencies specified in 11.4 of this clause. Evidence shall be available to demonstrate that the multi-frequency sound calibrator conforms to the requirements of IEC 60942 for class 1 performance.

NOTE To minimise testing time, it is preferable to perform this test using a sound calibrator or electrostatic actuator if the appropriate adjustment data are available.

11.2 If the frequency-weighting test is performed using either a multi-frequency sound calibrator or an electrostatic actuator, data to adjust the indications on the sound level meter to equivalent free-field levels shall be available for the model of the multi-frequency sound calibrator or electrostatic actuator and the model of microphone supplied with the sound level meter. The adjustments shall include the influence of a specified windscreen or accessory on the response of the microphone if the sound level meter is submitted for test with the windscreen or accessory installed, and if the instruction manual or the Internet web site of the manufacturer or supplier of the sound level meter provides the applicable adjustment data as required by 5.2.4 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003). If an accessory, other than a windscreen or extension lead, is part of the configuration of the sound level meter submitted for test but the relevant data on the influence of the accessory on the response of the microphone are not available from the instruction manual or from the Internet web site of the manufacturer or supplier of the sound level meter, then periodic testing of the sound level meter cannot be performed in accordance with this standard, except in a free-field facility.

Where an extension lead is in use, this requires data, which excludes any effects due to the case of the sound level meter, to be used to adjust the indications on the sound level meter. This data may not always be available, in which case the approach given in 11.3 shall be followed.

11.3 The adjustment data, and their associated uncertainties of measurement, shall be as given in the instruction manual of the sound level meter, or obtained from the manufacturer or supplier of the sound level meter. Where a windscreen and/ or an extension lead is in use, and data on the influence of the windscreen and/or data which excludes any effects due to the case of the sound level meter are not available, the windscreen and/or case corrections shall be assumed to be numerically zero, and a statement added to the Certificate to that effect. Similarly, where the associated uncertainties of measurement are not published or made available, then the uncertainties of measurement shall be assumed to be numerically zero, and a statement added to the Certificate to that effect.

11.4 The frequency weighting shall be determined at 125 Hz, 1 kHz and either 4 kHz or 8 kHz in accordance with 5.2.8 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003). The choice of 4 kHz or 8 kHz will depend on the free-field adjustment data that are provided, or at the discretion of the calibration laboratory for tests in accordance with 9.4 of IEC 61672-2 : 2003 (BS EN 61672-2 : 2003).

11.5 The sound level meter shall be set to measure F-time-weighted sound level, or S-time-weighted sound level, or time-average sound level, or sound exposure level, if provided. If sound exposure level is measured, the corresponding time-average sound level shall be calculated by application of Equation (5b) of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) for the integration time. Averaging time or integration time shall be at least 10 s and shall be recorded. The sound level meter shall be set for the reference level range or for the level range closest to the reference level range that will permit displays of the signals from the multi-frequency sound calibrator or electrostatic actuator.

11.6 For frequency-weighting tests using a multi-frequency sound calibrator, the sound pressure level in the coupler of the sound calibrator shall be in the range from 70 dB to 125 dB and preferably the reference sound pressure level at 1 kHz. The sound pressure level produced in the coupler of the sound calibrator, when coupled to the microphone of the sound level meter, shall be known at each test frequency.

11.7 For frequency-weighting tests using an electrostatic actuator, the electrostatic actuator shall be coupled to the microphone in accordance with the instructions of the manufacturer of the device. The signal voltage applied to the electrostatic actuator shall be adjusted to display a sound level between 70 dB and 125 dB at 1 kHz.

11.8 The sound level displayed in response to the input signals shall be recorded for each test frequency. As a minimum, one repetition of the measurements shall be performed to give a total of two tests. For the repetition, the sound calibrator and microphone, or electrostatic actuator and microphone, shall be de-coupled, re-coupled and then the sound calibrator, or electrostatic actuator, and microphone shall be allowed an appropriate time to stabilize. The differences between the input signal level at a test frequency and the input signal level at 1 kHz shall be added as corrections to the indicated sound levels.

11.9 At each test frequency, the average sound level shall be calculated as the arithmetic average of the suitably corrected indications of frequency-weighted sound level from 11.8.

11.10 At each test frequency, for tests using a multi-frequency sound calibrator or an electrostatic actuator, the average sound level shall be adjusted to equivalent free-field frequency-weighted sound levels by application of the free-field adjustment data.

11.11 The relative frequency weighting, normalized to the response at 1 kHz, shall be determined as the difference between the average equivalent free-field sound level at a test frequency and the average equivalent free-field sound level at 1 kHz.

11.12 The deviations of the measurements of relative frequency weighting from the corresponding design goals given in Table 2 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), extended by the actual expanded uncertainties of measurement, shall be within the applicable tolerance limits from Table 2 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

12 Electrical signal tests of frequency weightings

12.1 Frequency weightings shall be determined relative to the response at 1 kHz using steady sinusoidal electrical input signals and for as many of the three frequency weightings for which design goals and tolerance limits are specified in IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) and which are provided in the sound level meter. The sound level meter shall be set to display F-time-weighted sound level, time-average sound level or sound exposure level. If sound exposure level is measured, the corresponding time-average sound level shall be calculated by application of Equation (5b) of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) for the integration time. Averaging time or integration time shall be at least 10 s and shall be recorded.

12.2 On the reference level range and for each frequency weighting to be tested, the level of a 1 kHz input signal shall be adjusted to display an indication that is 45 dB less than the upper limit stated in the instruction manual for the linear operating range at 1 kHz on the reference level range.

12.3 At other frequencies, the input signal level shall be adjusted to provide the same indication on the display device as was displayed at 1 kHz (that is, according to the procedure of 9.5.3 of IEC 61672-2 : 2003 (BS EN 61672-2 : 2003)).

12.4 The levels of the input signals and the corresponding indications on the display device shall be recorded for the following frequencies:

- For tests of class 1 sound level meters: the 10 frequencies at nominal octave intervals from 31,5 Hz to 16 kHz
- For tests of class 2 sound level meters: the 8 frequencies at nominal octave intervals from 63 Hz to 8 kHz.

12.5 For each frequency weighting, at each test frequency, the corrections from the instruction manual shall be applied to the indicated frequency-weighted sound levels to account for the deviation of the average microphone frequency response from a uniform frequency response, and for the average effects of reflections from the case of the sound level meter and diffraction of sound around the microphone and, if applicable, the influence of a windscreen. Where a windscreen and/ or an extension lead is in use, and data on the influence of the windscreen and/or data which excludes any effects due to the case of the sound level meter are not available, the windscreen and/or case corrections shall be assumed to be numerically zero, and a statement added to the Certificate to that effect.

12.6 For each frequency weighting, the relative frequency weighting, normalized to the response at 1 kHz, shall be determined as the difference between the adjusted sound level at a test frequency and the adjusted sound level at 1 kHz.

12.7 At each test frequency, deviations of the relative frequency weightings from the corresponding design goals given in Table 2 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), extended by the actual expanded uncertainties of measurement, shall be within the applicable tolerance limits from Table 2 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

13 Frequency and time weightings at 1 kHz

13.1 For a steady sinusoidal electrical input signal at 1 kHz on the reference level range and with an input signal level that yields an indication of the reference sound pressure level with frequency weighting A, the indications shall be recorded for frequency weightings C and Z and the FLAT response, as available, with the sound level meter set to display F-time-weighted sound level, or time-average sound level, as available. In addition, the indications with frequency weighting A shall be recorded with the sound level meter set to display F-time-weighted sound level, S-time-weighted sound level and time-average sound level, as available.

13.2 The deviations of the indicated level of a C-weighted, Z-weighted, and FLAT-response measurement quantity from the level of the corresponding A-weighted measurement quantity, extended by the actual expanded uncertainties of measurement, shall be within the tolerance limits given in 5.4.14 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

13.3 The deviations of the indication of A-weighted sound level with S time weighting and the indication of A-weighted time-average sound level from the indication of A-weighted sound level with F time weighting, extended by the actual expanded uncertainties of measurement, shall be within the tolerance limits given in 5.7.3 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

14 Level linearity on the reference level range

14.1 Level linearity shall be tested with steady sinusoidal signals at a frequency of 8 kHz with the sound level meter set for frequency-weighting A. For each test of level linearity, the indications of F-time-weighted sound level or time-average sound level, and the corresponding anticipated sound level, shall be recorded.

14.2 Tests of level linearity shall begin with the input signal adjusted to display the starting point given in the instruction manual for tests of level linearity at 8 kHz on the reference level range. The calculation procedure described in 9.8.1.3 of IEC 61672-2 : 2003 (BS EN 61672-2 : 2003) shall be used to determine the level linearity errors.

14.3 Level linearity shall be measured in 5 dB steps of increasing input signal level from the starting point up to within 5 dB of the upper limit stated in the instruction manual for the linear operating range at 8 kHz, then at 1 dB steps up to, but not including, the first indication of overload. The test of level linearity shall then be continued at 5 dB steps of decreasing input signal level from the starting point down to within 5 dB of the specified lower limit, then at 1 dB steps down to, but not including, the first indication of an under-range condition.

14.4 At least over the extent of the linear operating range stated in the instruction manual for 8 kHz, level linearity errors, extended by the actual expanded uncertainties of measurement, shall be within the applicable tolerance limits given in 5.5.5 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

14.5 In accordance with 5.10.2 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), from the upper limit of the linear operating range up to, but not including, the first indication of overload, the level linearity errors, extended by the actual expanded uncertainties of measurement, shall be within the applicable tolerance limits given in 5.5.5 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003). Similarly, in accordance with 5.11.1 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), the level linearity errors, extended by the actual expanded uncertainties of measurement, also shall be within the applicable tolerance limits given in 5.5.5 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) from the lower limit of the linear operating range down to, but not including, the first indication of an under-range condition.

15 Level linearity including the level range control

15.1 The level linearity of the level range control shall be tested with steady sinusoidal electrical input signals at a frequency of 1 kHz with the sound level meter set for frequency-

weighting A. For each test the indications of F-time-weighted sound level or time-average sound level, and the corresponding anticipated sound levels, shall be recorded.

15.2 The level of the input signal shall first be adjusted to display an indication of the reference sound pressure level on the reference range.

15.3 On the least-sensitive level range the level of the input signal shall be adjusted to display an indication 2 dB below the upper limit of the range specified in the instruction manual. Additionally, on all ranges the level of the input signal shall be adjusted to display an indication 2 dB above the lower limit of the range specified in the instruction manual, except where the lower limit of the range is less than 16 dB above the level of the self-generated noise as measured for frequency weighting A in 10.1, or less than 16 dB above the minimum indication of the sound level meter. In this case, measurements shall be performed for indications 16 dB above the level of the self-generated noise or above the minimum indication of the sound level meter, whichever is higher. When the self-generated noise is measured on several ranges, where available the value measured for the range under test shall be used to determine the test point. For other ranges where the self-generated noise is not measured in 10.1, the highest measured level of A-weighted self-generated noise shall be used to determine the test point.

15.4 Level linearity errors on ranges other than the reference level range, extended by the actual expanded uncertainties of measurement, shall not exceed the tolerance limits given in 5.5.5 of IEC 61672-1:2002 (BS EN 61672-1 : 2003).

16 Toneburst response

16.1 The response of the sound level meter to short-duration signals shall be tested on the reference level range with 4 kHz tonebursts that start and stop at zero crossings and are extracted from steady 4 kHz sinusoidal electrical input signals. The sound level meter shall be set for frequency-weighting A.

16.2 For the toneburst signals, indications of the sound level meter to be recorded are: maximum F-time-weighted sound level, maximum S-time-weighted sound level and sound exposure level, as applicable. If the capability to measure sound exposure level is not provided, then time-average sound level and an averaging time that includes the toneburst shall be measured, if available, and the sound exposure level calculated according to Equation (4) in IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

16.3 When maximum F-time-weighted sound levels of tonebursts are measured, the level of the steady 4kHz signals from which the tonebursts are extracted shall be measured with the F-time weighting. Similarly, the S-time-weighted level of the steady signal shall be measured when maximum S-time-weighted sound levels of tonebursts are measured. When sound exposure levels of the tonebursts are measured, the time-average sound level of the steady signal shall be measured. If the capability to measure a time-average sound level is not provided, then the sound exposure level of the steady signal for any convenient integration time shall be measured, if available, and the corresponding time-average sound level calculated according to Equation (5b) in IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

16.4 The level of the steady input signal shall be adjusted to display an F-time-weighted, S-time-weighted, or time-average sound level, as appropriate, that is 3 dB less than the upper limit stated in the instruction manual for the linear operating range at 4 kHz on the reference level range.

16.5 For tests with the F-time-weighting, the indication of the maximum F-time-weighted sound level in response to tonebursts having durations of 200 ms, 2 ms and 0,25 ms shall be recorded.

16.6 For tests with the S-time-weighting, the indication of the maximum S-time-weighted sound level in response to tonebursts having durations of 200 ms and 2 ms shall be recorded.

16.7 For measurements of sound exposure level (or time-average sound level and averaging time), the indications in response to tonebursts having durations of 200 ms, 2 ms and 0,25 ms shall be recorded.

16.8 The deviations of the measured toneburst responses from the corresponding reference toneburst responses given in Table 3 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), extended by the actual expanded uncertainties of measurement, shall not exceed the applicable tolerance limits given in Table 3 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

17 Peak C sound level

17.1 Indications of peak C sound level shall be tested on the reference level range. The test signals are a single complete cycle of an 8 kHz sinusoid starting and stopping at zero crossings, and positive and negative half cycles of a 500 Hz sinusoid that also start and stop at zero crossings.

17.2 The level of the steady sinusoidal 8 kHz electrical input signal, from which the single complete cycle is extracted, shall be adjusted to yield an indication of C-weighted, F-time-weighted sound level, or C-weighted, time-average sound level, that is 4 dB less than the upper limit stated in the instruction manual for the peak level range on the reference level range. The indications of steady sound level shall be recorded.

17.3 The indication of peak C sound level in response to the complete-cycle 8 kHz signal shall be recorded. Application of the complete-cycle 8 kHz signal shall not cause indication of an overload condition.

17.4 The level of the steady sinusoidal 500 Hz electrical input signal, from which the positive and negative half cycles are extracted, shall be adjusted to yield an indication of C-weighted, F-time-weighted sound level, or C-weighted, time-average sound level, that is 4 dB less than the upper limit stated in the instruction manual for the peak level range on the reference level range. The indications of steady sound levels shall be recorded.

17.5 The indications of peak C sound level in response to the positive half-cycle 500 Hz signal and the negative half-cycle 500 Hz signal shall be recorded. Applications of the 500 Hz half cycle signals shall not cause indications of an overload condition.

17.6 The deviations of the measured differences between the indications of peak C sound level and the corresponding indications of the levels of the C-weighted steady signals from the design-goal differences given in Table 4 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), extended by the actual uncertainties of measurement, shall be within the applicable tolerance limits given in Table 4 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

18 Overload indication

18.1 This test of overload indication is only to be performed for sound level meters capable of displaying time-average sound level.

18.2 Overload indication shall be tested on the reference level range with the sound level meter set to display A-weighted time-average sound level. Positive and negative one-half cycle sinusoidal electrical signals at a frequency of 4 kHz shall be used. The one-half cycle signals shall be extracted from steady signals of the same signal level and shall begin and end at zero crossings.

18.3 The test shall begin at an indicated time-average level for the steady input signal which corresponds to 1 dB less than the upper limit specified for the linear operating range. The level of the positive one-half cycle input signal, 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 the negative one-half cycle signal. The levels of the one-half cycle 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 may be determined from the setting of an input attenuator.

18.4 The difference between the positive and negative one-half cycle input signals that first caused the displays of overload indication shall be extended by the actual expanded uncertainties of measurement. The extended difference shall be within the tolerance limits of 5.10.3 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).

18.5 It shall be verified that the overload indicator latches on as specified in 5.10.5 of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) when an overload condition occurs.

19 Documentation

After completion of the periodic tests of a sound level meter, the documentation shall contain at least the following information.

- a) The date(s) when the periodic tests were performed;
- b) A statement that procedures from Technical Guide NPL Acoustics 2004/1 were used to perform the periodic tests;
- c) A statement and reference as to the availability to the public of evidence, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter submitted for periodic testing successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003 (BS EN 61672-2 : 2003);
- d) The name and location of the laboratory performing the periodic tests;
- e) The name of the manufacturer or supplier, model designation, serial number, and performance class of the sound level meter and, if applicable, the version of the internal operating software loaded in the sound level meter;
- f) The name of the manufacturer or supplier, model designation and the serial number of the microphone, if detachable;
- g) The name of the manufacturer or supplier, model designation and any unique identification of the preamplifier, if separate;
- h) If the sound level meter is a multi-channel device, a designation of which channels were selected for testing;
- i) Details of the instruction manual relating to the sound level meter including, as applicable, the publication date and version number;
- j) The name of the manufacturer or supplier, model designation and serial number of the sound calibrator, together with details of any adaptors used;
- k) A statement of the calibration check frequency, reference sound pressure level and reference level range for the sound level meter;
- l) A description of the configuration of the sound level meter during the tests including any connecting cables that were provided to operate the sound level meter;
- m) The static air pressure, air temperature and relative humidity measured at the start and end of the testing.

NOTE. Where additional measurements of static air pressure, air temperature and relative humidity have been made the range of measured values may be quoted.

- n) From application of the calibrated sound calibrator, the initial and adjusted indications of the sound level meter at the calibration check frequency, and reference to the certificate for the sound calibrator, if applicable;
- o) The frequency-weighted levels of self-generated noise measured with the microphone replaced by the electrical input device;

p) Where an extension lead and/ or a windscreen is in use with the sound level meter, and no data on the effect of the windscreen or which excludes effects due to the case of the sound level meter, is published in the instruction manual or available from the manufacturer or supplier of the sound level meter to adjust the indications, as required in 11.2 and / or 12.5, a statement as follows:

'No adjustment data have been published in the instruction manual or made available by the manufacturer or supplier of the sound level meter to account for the average effects of reflections from the case of the sound level meter and diffraction of sound around the microphone and, if applicable, the influence of a windscreen (delete as appropriate), as required by sub-clause 11.2 and / or 12.5 (delete as appropriate) of this Technical Guide. The average effects of reflections from the case of the sound level meter and diffraction of sound around the microphone and, if applicable, for the influence of a windscreen (delete as appropriate) have therefore been assumed to be numerically zero for the purposes of this periodic test. If these adjustment data are not actually zero, there is a possibility that the frequency response of the sound level meter may not meet the requirements of IEC 61672 –1 : 2002 (BS EN 61672-1 : 2003).'

q) Where the uncertainties of measurement, required in 11.3, are not published in the instruction manual or available from the manufacturer or supplier of the sound level meter, a statement as follows:

'No information on the uncertainty of measurement, required by sub-clause 11.3 of this Technical Guide, of the adjustment data given in the instruction manual or obtained from the manufacturer or supplier of the sound level meter (delete as appropriate) was published in the instruction manual or made available by the manufacturer or supplier. The uncertainty of measurement of the adjustment data has therefore been assumed to be numerically zero for the purposes of this periodic test. If these uncertainties are not actually zero, there is a possibility that the frequency response of the sound level meter may not meet the requirements of IEC 61672 –1 : 2002 (BS EN 61672-1 : 2003).'

r) Where public evidence was available to show that pattern evaluation tests had been performed in accordance with IEC 61672-2 : 2003 (BS EN 61672-2 : 2003) to demonstrate that the model of sound level meter conformed to all applicable requirements of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) and the results of all periodic tests according to this technical guide were satisfactory, a statement as follows:

'The sound level meter submitted for testing has successfully completed the class X periodic tests of Technical Guide NPL Acoustics 2004/1, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2 : 2003 (BS EN 61672-2 : 2003), to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), the sound level meter submitted for testing conforms to the class X requirements of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).'

s) Where no public evidence was available to show that pattern evaluation tests had been performed in accordance with IEC 61672-2 : 2003 (BS EN 61672-2 : 2003) to demonstrate that the model of sound level meter conformed to all applicable requirements of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) and the results of all periodic tests according to this technical guide were satisfactory, a statement as follows:

'The sound level meter submitted for testing has successfully completed the class X periodic tests of Technical Guide NPL Acoustics 2004/1, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) because evidence

was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1 : 2002 (BS EN 61672-1 : 2003) and because the periodic tests of Technical Guide NPL Acoustics 2004/1 cover only a limited subset of the specifications in IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).'

t) When the results of the periodic tests for the sound level meter are not satisfactory for the designated performance class, a statement as follows:

'The sound level meter submitted for periodic testing did not successfully complete the class X tests of Technical Guide NPL Acoustics 2004/1. The sound level meter does not conform to the requirements of IEC 61672-1 : 2002 (BS EN 61672-1 : 2003).'

In addition, the documentation shall indicate which tests were not successfully completed and the reasons therefore.

NOTE Examples of reasons for tests that were not successfully completed might be 'Level linearity errors exceeded the appropriate tolerance limits' or 'Errors in indications of peak C sound levels exceeded the appropriate tolerance limits.'

For future reference, the calibration laboratory shall retain the measured data and a copy of the documentation for a reasonable period of time after completion of the periodic tests.