BRITISH STANDARD

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Part 2 : 1997

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Specification for

The verification of sound level meters

Part 2. Shortened procedure for type 2 sound level meters

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Committees responsible for this British Standard

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British Association of Otolaryngologists
British Hearing Aid Industry Association
British Medical Association
British Society of Audiology
British Telecommunications plc
Confederation of British Industry
Department of Health
Department of Trade and Industry (National Physical Laboratory)
Health and Safety Executive
Institute of Acoustics
Institute of Sound and Vibration Research
Institution of Electrical Engineers
Medical Research Council
Ministry of Defence
Royal Aeronautical Society
Royal National Institute for Deaf People
Society of Environmental Engineers
University of Exeter

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Summary of pages

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Foreword

This British Standard has been prepared by Technical Committee EPL/29. The tests in this Part of BS 7580 are based largely upon those in BS 7580 : Part 1 : 1997 (BS 7580 : 1992 together with Amendment No. 1 : 1997). BS 7580 Part 1 : 1997 specifies a range of tests, based on BS EN 60651 : 1994 (which replaced BS 5969 : 1981) and BS EN 60804 : 1994 (formerly BS 6698 : 1986) to verify the accuracy of all types of sound level meters at regular intervals. Type 2 sound level meters are suitable for general field applications and it is considered appropriate that this type of meter be subjected to a shortened test procedure, as specified in this Part of BS 7580.

The draft international standard IEC 61672 *Sound level meters*, when published as a BS EN standard, will replace BS EN 60651 : 1994 and BS EN 60804 : 1994. IEC 61672 specifies wider tolerances to include measurement uncertainties which were not included in BS EN 60651 and BS EN 60804.

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Specification

1 Scope

This Part of BS 7580 specifies a procedure for a limited periodic verification test of Type 2 sound level meters, and includes test methods and the information to be shown on the certificate. This procedure is intended to verify the correct operation of a limited range of features of the sound level meter. This Part of BS 7580 specifies requirements for both the calibration laboratory and the user.

This Part of BS 7580 is applicable to Type 2 sound level meters originally manufactured in accordance with BS EN 60651 and BS EN 60804, and is based largely on the tests in Part 1. It is applicable to models of sound level meter that have successfully undergone a full pattern evaluation test to BS EN 60651 : 1994 and/or BS EN 60804 : 1994 as appropriate, or to individual sound level meters that have successfully undergone a full verification in accordance with BS 7580 : Part 1. The sound level meter is supplied for test together with a sound calibrator.

2 Normative references

This Part of BS 7580 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this Part of BS 7580 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

3 Definitions

For the purposes of this standard the definitions given in BS 7580 : Part 1 : 1997 apply.

4 Periodicity of verification

4.1 General

Intervals between verification to this Part of BS 7580 shall be determined by the particular application(s) of the sound level meter.

NOTE. The appropriate standards or guidelines should be consulted for information on the periodicity of testing required.

4.2 Verification after repair

Verification shall be performed on a sound level meter after repair and before further use, if it has undergone a repair which is likely to have affected its performance.

NOTE. Repairs necessitated by the failure of electronic components or transducers are likely to affect the performance of the sound level meter, whereas replacement of switches or battery leads is unlikely to have an effect.

5 Verification procedure

5.1 General

The calibrations of the equipment used for the verification of the sound level meter and the calibration of the sound calibrator shall be traceable to national standards.

NOTE 1. In the UK acoustical calibration laboratories are NAMAS (National Accreditation of Measurement and Sampling) accredited through the United Kingdom Accreditation Service (UKAS); the relevant national metrology institute is the National Physical Laboratory (NPL).

Where the user requires testing of additional facilities covered in BS 7580 : Part 1, the test methods from BS 7580 : Part 1 shall be used. This shall be noted on the certificate.

The tolerances given in this standard and in BS EN 60651 : 1994, BS EN 60804 : 1994 and BS EN 60942 : 1998 (which superseded BS 7189 : 1989) do not take into account any measurement uncertainty of the laboratory performing the verification. The measured values obtained during a verification shall not be extended by any measurement uncertainty when assessing whether an instrument conforms to this standard. Conformity is demonstrated when all measured values are within the specified tolerances.

NOTE 2. It is recommended that the calibration certificate states, if appropriate, that verification does not accommodate measurement uncertainty.

5.2 Submission for verification

The sound level meter shall be submitted for verification together with its instruction manual, if required by the calibration laboratory, and the associated sound calibrator. The instruction manual shall contain all the information required by **5.2** of BS 7580 : Part 1 : 1997. In addition, information shall be supplied on the pressure to free-field correction at the frequency of the sound calibrator for the combination of microphone/sound level meter and sound calibrator submitted.

The user shall specify the span of sound levels and range settings over which the sound level meter is to be tested and whether verification is required for sound level L_{eq} or both. The level span shall be at least 40 dB, unless this is greater than the range of the sound level meter in which case it shall cover the full range of sound levels available. The level span shall include the sound pressure level of the sound calibrator submitted with the sound level meter. The specified level span shall not include any sound levels outside the manufacturer's specifications given in the instruction manual.

The sound level meter shall meet the pattern evaluation or verification criteria given in clause **1**.

NOTE. The tolerances in this Part of BS 7580 are applied following the initial adjustment of the sound level meter using the sound calibrator supplied, and hence refer to the particular combination of sound level meter and sound calibrator. It is possible that in some cases this may mean that the meter fails to comply with the specifications, for example if the sound calibrator generates a different level to the reference level specified by the manufacturer and/or the reference range of the sound level meter is not within the user specified level span.

5.3 Preliminary inspection

Prior to any measurements, the sound level meter, microphone, and sound calibrator shall be visually inspected, including direct viewing of the microphone diaphragm where possible, and all controls operated to ensure that they are in working order. It shall be established that the power supply is within the operating limits specified by the manufacturer.

5.4 Sound calibrator measurements

The sound calibrator supplied shall have been calibrated within the previous year, using equipment whose calibrations are traceable to national standards, and shall be supplied with a certificate.

The certificate shall state the sound pressure level and frequency generated by the sound calibrator when it is coupled to an appropriate model of microphone, such that manufacturer's corrections are available to convert this level for free-field use with the model of microphone fitted to the sound level meter.

5.5 Setting-up

The sensitivity of the sound level meter shall be checked using the sound calibrator specified in **5.2** and, if necessary, adjusted according to the sound level meter manufacturer's instructions and the sound pressure level data for the sound calibrator obtained in **5.4**.

5.6 Test procedure

5.6.1 *General*

Tests in **5.6** shall be performed either acoustically or by application of an electrical signal, in which case the manufacturer's stated method of applying an electrical signal to the sound level meter shall be followed.

NOTE 1. **4.7** of BS EN 60651 : 1994 and **4.8** of BS EN 60804 : 1994 require the manufacturer to provide the means to substitute an electrical signal for the microphone for the purpose of performing tests on the sound level meter without the microphone. The actual method of substitution will vary depending on the construction and component parts of the sound level meter. The three most important situations are as follows.

a) Where the sound level meter is fitted with a detachable condenser or piezoelectric microphone, the microphone should be replaced by an equivalent capacitance within a tolerance of $\pm$20 %, unless a closer tolerance is specified by the manufacturer, in series with a low-impedance electrical signal source.

b) Where the preamplifier is an integral part of the microphone, the method of substitution specified by the manufacturer should be used, and corrections used to take account of preamplifier performance.

c) Where access to the point of application of the electrical signal is restricted, for example when it is inside the case of the sound level meter, the manufacturer's instructions should be followed on how to gain access to this point.

NOTE 2. These tests should, if possible, be performed with the sound level meter set to frequency-weighting A.

5.6.2 *Linearity*

The linearity of the sound level meter shall be tested using a continuous sinusoidal signal at a frequency in the range 1000 Hz to 4000 Hz. If available, integrating meters shall be set to indicate sound pressure level for this test. Where possible, the reference point for the test shall be a measurement made at the level of the sound calibrator supplied, on the level range used for the initial adjustment of the sound level meter described in **5.5**; otherwise the reference point shall be within 0.5 dB of the level generated by the sound calibrator.

Measurements shall be made over the user specified level span at intervals of not greater than 10 dB starting from the reference point, and shall include a measurement within 5 dB of the upper limit and 5 dB of the lower limit of the user specified level span, with the range settings specified by the user. In addition, for all the specified range settings where the indicator range is fully contained within the user specified level span, a measurement shall be made within 5 dB of the upper limit and 5 dB of the lower limit of the indicator range. At least one measurement shall be made on each measurement range setting specified by the user.

The level span over which the linearity is tested, together with the measurement range(s) used shall be stated on the certificate.

All deviations shall be calculated relative to the reference point and shall be within $\pm$1.0 dB within the primary indicator range and within $\pm$1.5 dB outside the primary indicator range. For L_{eq} indication the tolerance is $\pm$1.0 dB over the entire range.

NOTE 1. For integrating sound level meters sufficient time should be allowed for the indication to settle.

NOTE 2. For sound level meters where range changing is accomplished other than by switching attenuators, for example where the microphone polarizing voltage is changed, manufacturer's information may be required in addition to these tests to establish conformance of the sound level meter to these linearity requirements.

5.6.3 *Frequency weighting*

Frequency weighting A shall be tested at frequencies of 125 Hz, 1000 Hz and 4000 Hz, using an appropriate measurement range of the sound level meter and the 1000 Hz signal as reference. Any corrections necessary for the frequency response of the microphone and, where appropriate, of the sound level meter case and the windshield shall be made to the meter indications. The response of the weighting network shall be as specified in tables IV and V of BS EN 60651 : 1994.

NOTE. It is recommended that tests are performed at a constant A-weighted sound pressure level in the range 73 dB to 125 dB.

In addition, a measurement at 1000 Hz shall be made on all other weighting networks. The indications shall agree with that obtained when the sound level meter was set to A-weighting within $\pm$1.5 dB.

5.6.4 *R.M.S. accuracy*

This test shall be performed on sound level meters manufactured in accordance with BS EN 60651. The r.m.s. accuracy shall be tested for a crest factor of 3 by comparing the indication for a sequence of tone bursts with that for a continuous sinusoidal signal.

The test shall be carried out with the sound level meter set to time weighting S if available, otherwise the meter shall be set to time weighting F.

The frequency of the continuous signal shall be 2000 Hz, at an amplitude that produces an indication 2 dB below the upper limit of the user specified level span or 2 dB below the upper limit of the primary indicator range, whichever is the lower. The tone burst signal shall consist of 11 cycles of a sine wave of frequency 2000 Hz, starting and ending at zero crossing, with a repetition frequency of 40 Hz, and having an r.m.s. level which is identical to that of the continuous sine wave signal. The indication for the tone burst signal compared with that for the continuous signal shall be within a tolerance of $\pm$1.0 dB.

NOTE. The r.m.s. level of each burst in the tone burst signal is 6.6 dB higher than the r.m.s. level of the continuous signal.

5.6.5 *Time averaging*

With the integrating sound level meter set to L_{eq} and to frequency weighting A, time averaging shall be tested by comparing the indication for a continuous sinusoidal signal with that for a sequence of tone bursts having the same equivalent continuous level.

A continuous signal at a frequency of 4000 Hz and at an amplitude 30 dB below the upper limit of the linearity range shall be applied to the sound level meter. The measurement range selected shall be included in those range settings specified by the user, and shall be such that the signal level is within the user specified level span. If the upper limit of the user specified level span is more than 30 dB below the upper limit of the linearity range on the most sensitive user specified measurement range, the signal amplitude shall correspond to the upper limit of the user specified level span, and the measurement shall be performed on the most sensitive of the range settings specified by the user.

A sequence of 10 ms tone bursts of the same frequency, burst duty factor $1/10^3$, and calculated equivalent continuous level identical to that for the continuous signal, shall then be applied (see table III of BS EN 60804 : 1994). Using an integration time of at least 120 s, the indication on the meter shall be the same for the tone burst signal as for the continuous signal within a tolerance of $\pm$1.5 dB.

NOTE. The manufacturer may require that the sound level meter be set to a specific time weighting to meet the requirements on time averaging in BS EN 60804.

5.6.6 *Overload indication*

If present, it shall be verified that the overload indicator operates when an appropriate high level acoustic or electrical signal is applied.

5.7 Acoustic tests

5.7.1 *General*

The acoustic tests described in **5.7.2**, **5.7.3**, and **5.7.4** shall be performed with the sound level meter set to measure sound pressure level unless the verification is required for L_{eq} only, in which case the L_{eq} setting shall be used.

5.7.2 *Calibration at 1000 Hz*

A continuous acoustic signal of frequency 1000 Hz at a sound pressure level in the range 73 dB to 125 dB shall be applied to the microphone of the sound level meter, using an appropriate range setting within the user specified span. The sensitivity of the sound level meter shall be adjusted if necessary so that it reads correctly at this frequency. The range setting used shall be stated on the certificate.

This acoustic calibration shall be performed using one of the following methods.

a) By calibration in a plane progressive sound field. The sound shall be incident on the microphone of the sound level meter in the reference direction and the indication of the sound level meter shall be compared with the true sound level, measured using a reference microphone substituted at the same position in the sound field.

b) By application of a sound calibrator with a calibration traceable to national standards. In this case corrections shall be applied for the difference between the free-field and pressure responses of the sound level meter, appropriate to the configuration in which it is used.

5.7.3 *Low frequency test*

If the test described in **5.6.3** is performed acoustically, the following test may be omitted.

The sound level meter shall be tested using a continuous acoustic signal at a frequency of 125 Hz. The indication, relative to the indication in response to the 1000 Hz signal applied in **5.7.2**, shall be as specified in tables IV and V of BS EN 60651 : 1994, with the reference frequency defined as 1000 Hz.

This acoustic test shall be performed using the method specified in **5.7.2**a) or that in **5.7.2**b) or by a method using a simulated acoustic input from an electrostatic actuator. In the latter case, a correction shall be applied for the difference between the free-field and actuator response of the sound level meter appropriate to the configuration in which it is used.

If this test is performed using a test signal applied at a different level from the level of the 1000 Hz signal used in **5.7.2**, corrections shall be applied for any non-linearity or differences in range control settings.

NOTE. It is recommended that the indication of the sound level meter is in the range 60 dB to 125 dB.

5.7.4 ***High frequency test***

If the test described in **5.6.3** is performed acoustically, the following test may be omitted.

The sound level meter shall be tested using a continuous acoustic signal at a frequency of 4000 Hz or 8000 Hz. The indication, relative to the indication in response to the 1000 Hz signal applied in **5.7.2**, shall be as specified in tables IV and V of BS EN 60651 : 1994, with the reference frequency defined as 1000 Hz.

This acoustic test shall be performed using the method specified in **5.7.2**a) or that in **5.7.2**b) or by a method using a simulated acoustic input from an electrostatic actuator. In the latter case, a correction shall be applied for the difference between the free-field and actuator response of the sound level meter appropriate to the configuration in which it is used.

If this test is performed using a test signal applied at a different level from the level of the 1000 Hz signal used in **5.7.2**, corrections shall be applied for any non-linearity or differences in range control settings.

NOTE. It is recommended that the indication of the sound level meter is in the range 73 dB to 125 dB.

5.7.5 ***Response to associated sound calibrator***

After completion of the tests, the sound calibrator supplied shall be re-applied to the sound level meter and the indication recorded for the sound pressure level setting and/or the L_{eq} setting, as required. The measurement range setting used shall be stated on the certificate. The indication recorded, corrected where appropriate for ambient environmental conditions, shall be used henceforth to set-up the sound level meter for field use.

6 Information to be provided

A certificate shall be issued giving the following information:

a) details of the laboratory performing the tests;

b) the name of the manufacturer, the model number and the serial number of the sound level meter;

c) the name of the manufacturer, the model number and the serial number of the microphone, if detachable;

d) the name of the manufacturer, the model number and the serial number of the preamplifier, if separate;

e) identification of any connecting cables and/or any other accessories;

f) the name of the manufacturer, the model number and the serial number of the associated sound calibrator, together with details of any adaptors used;

g) the user specified level span and measurement range setting(s) over which the meter has been tested;

h) the sound pressure level of the sound calibrator and the measurement range setting used in **5.5**;

i) the method of acoustic calibration employed for the test specified in **5.7.2** including the sound pressure level and the measurement range setting used;

j) the indication(s) of the sound level meter in response to the sound calibrator, obtained in the test specified in **5.7.5** and the measurement range setting used;

k) details of any further parameters tested and reference to the relevant subclauses of BS 7580 : Part 1 : 1997;

l) a statement that the sound level meter has been tested in accordance with BS 7580 : Part 2 : 1997 and, if applicable, that it conforms to BS 7580 : Part 2 : 1997; and

m) the date of the measurements.

List of references (see clause 2)

Normative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 7580	*Specification for the verification of sound level meters*
BS 7580 : Part 1 : 1997[1)]	*Comprehensive procedure*
BS EN 60651 : 1994[2)]	*Specification for sound level meters*
BS EN 60804 : 1994[3)]	*Specification for integrating-averaging sound level meters*

[1)] BS 7580 : 1992 renumbered.
[2)] BS EN 60651 : 1994 superseded BS 5969 : 1981.
[3)] BS 6698 : 1986 renumbered.

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