MEASUREMENT OF THE PERFORMANCE OF SOUND LEVEL METERS USING IEC 61672-3:2006

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1. INTRODUCTION

1.1 IEC 61672

IEC 61672-1:2002[1] provides specifications for sound level meters (SLMs) and was recommended for use in Canada by the Canadian Standards Association in CSA Z107.10[2] in 2006. IEC 61672-1:2002 generally specifies tighter tolerance limits than previous standards, and requires that measurement uncertainties are taken into account when testing conformance[3].

IEC 61672-3:2006[4] provides the first internationally agreed methods for measuring the performance of individual SLMs. Because of the limited extent of the measurements, even if the results of the measurements are successful, no general conclusion about the conformance of the SLM to the specifications of IEC 61672-1 can be made unless evidence of pattern approval of the model of SLM is publicly available. Pattern approval tests are specified in IEC 61672-2[5] but are in practice only performed in countries where legal requirements exist for testing a model of SLM before it may be sold.

1.2 Measurements required by IEC 61672-3

A calibrated sound calibrator is applied in order to determine the overall sensitivity at a reference level (for example, 94 dB) at a single frequency (usually 1 kHz).

The indicated sound level with no input signal is noted; this corresponds to the level of self-generated noise in the SLM.

The difference in the response to a steady 1 kHz sinusoidal signal when switching between different time weightings and frequency weightings is measured.

One frequency weighting response relative to 1 kHz is determined using acoustical signals at 125 Hz and either 4 kHz or 8 kHz. This provides a simple test of the performance of the microphone.

Frequency weightings A, C and Z (if available) relative to 1 kHz are determined for the frequency range from 63 Hz to 8 kHz or 16 kHz (depending on performance class) by applying sinusoidal electrical signals and adjusting the results for the acoustical influence of the microphone, case and any accessories.

The level of an applied 8 kHz sinusoidal signal is varied over the entire linear operating range. The differences between the indicated sound levels and the anticipated levels are determined. The level linearity errors caused by switching the SLM to other level ranges are also measured.

The response of the SLM to toneburst signals of durations as short as 0.25 ms is measured, and compared with the theoretical ideal response. Accurate toneburst response is crucial for measurement of sounds of short duration.

The indicated peak C sound level in response to single cycle and half cycle sinusoidal electrical signals is measured and compared with the theoretical ideal response.

For SLMs capable of displaying time-average sound level only, the levels of positive and negative half-cycle input signals that first give overload indications are compared. The SLM should respond equally to signals of positive and negative polarity. The indicator should latch on until reset.

2. APPLICATION TO OLDER INSTRUMENTS

While Part 3 of IEC 61672 was intended for use in testing sound level meters that are designed to meet the requirements of Part 1, the measurement methods are also useful for determining the performance of older SLMs. NRC-INMS does not perform conformance tests of acoustical instruments, but does provide a measurement service for its clients that closely follows the methods of Part 3.

Five SLMs that were manufactured prior to 2002 were measured using the methods of Part 3. Measurements of frequency weighting at some additional frequencies using acoustical and electrical input signals were also attempted, but the results are not considered here; measurements of frequency weighting A at the lowest frequencies are not always possible because of the limited extent of the linear operating range of the SLM.

All the instruments were well-maintained examples of relatively expensive instruments from well-known manufacturers. Instruction manuals were available; most contained adjustment data and typical microphone frequency responses. Some sensible selection of levels and settings at which the measurements were performed was required. Because the SLMs were designed to conform to the specifications of previous standards and because the individual examples are not necessarily representative of their models, the instruments are identified here only by their year of manufacture and claimed performance Type.

3. RESULTS

The majority of the SLMs performed adequately for the majority of the measurements. A summary of the results is shown in Table 1.

The results most often exceed the tolerance limits of IEC 61672 for the toneburst response measurements. The 1997 Type 2 SLM performed poorly in response to any toneburst of duration less than 200 ms. The response of the 1980 Type 1 SLM in response to a 200 ms toneburst when using the S time weighting was just outside the IEC 61672 tolerance limits, but the SLM performed adequately for shorter toneburst durations and when using the F time weighting. The 1977 Type 1 SLM performed poorly in three of the five toneburst response measurements.

The level linearity error of the 1980 Type 1 SLM exceeded the IEC 61672 tolerance limits only when attempting to indicate the reference SPL on its most-sensitive (lowest) level range. The same SLM gave a level difference in the overload indication test of about four times the tolerance limit of IEC 61672.

4. CONCLUSIONS

Existing sound level meters did not necessarily become obsolete on the publication of IEC 61672-1 in 2002. However, it is quite possible that models of SLMs that have not been successfully pattern evaluated according to IEC 61672-2 could perform poorly by current standards, especially in response to signals of short duration.

Measurement using the methods of IEC 61672-3 provides the best basis for determining confidence in the performance of an individual SLM. IEC 61672-3 should be recommended for use in Canada with appropriate guidance on its use with respect to older SLMs. Measurement standards in Canada should be updated where appropriate to require at least that the performance of an individual SLM has been measured according to the methods specified in IEC 61672-3.

REFERENCES

[1]IEC 61672-1 Ed. 1, Electroacoustics – sound level meters – Part 1: Specifications (2002)

[2]CSA Z107.10-06 Guide for the use of acoustical Standards in Canada (2006)

[3]G. S. K. Wong, L. Wu, and P. Hanes, “The current status of international standards for sound level meters” Canadian Acoustics, 30(3), 110-111 (2002)

[4]IEC 61672-3 Ed. 1, Electroacoustics – sound level meters – Part 3: Periodic tests (2006)

[5]IEC 61672-2 Ed. 1, Electroacoustics – sound level meters – Part 2: Pattern evaluation tests (2003)

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Table 1. Summary of results. ✓ indicates that the results do not exceed the tolerance limits of IEC 61672; ✕ indicates that the results exceeds the tolerance limits of IEC 61672; ··· indicates that the SLM does not provide this capability.

Measurement / Sound level meter	1997 Type 2	1996 Type 1	1984 Type 1	1980 Type 1	1977 Type 1
Time & frequency weightings at 1 kHz	✓	✓	✓	✓	✓
Frequency weighting – acoustical input	✓	✓	✓	✓	✓
Frequency weighting – electrical input	✓	✓	✓	✓	✓
Level linearity – reference level range	✓	✓	✓	✓	✓
Level linearity – including range control	✓	✓	✓	✕	✓
Toneburst response	✕	✓	✓	✕	✕
Peak C sound level	···	✓	✓	✓	✓
Overload indication	···	✓	✓	✕	···