EUHA Guideline

The practice of calibrating test boxes

Guideline 04-03

EUHA
Europäische Union der
Hörgeräteakustiker e.V.

Audiology Expert Group

Beate Gromke (Chairwoman), EUHA, Leipzig
Martin Blecker, EUHA, Hanover
Harald Bonsel, EUHA, Reinheim
Dr.-Ing. Josef Chalupper, advanced bionics, Hanover
Tillmann Harries B.Sc., Academy of Hearing Aid Acoustics, Lübeck
Dan Hilgert-Becker, Becker Hörakustik, Koblenz
Prof. Dr. Inga Holube, Jade University of Applied Sciences, Oldenburg
Dr. Hendrik Husstedt, German Hearing Aid Institute, Lübeck
Julia Kahl, geb. Steinhauer, Academy of Hearing Aid Acoustics, Lübeck
Prof. Dr. Jürgen Kießling, Justus Liebig University, Gießen
Thorsten Knoop, GN Otometrics, Münster
Dr. Steffen Kreikemeier, Aalen University of Applied Sciences
Thomas Lenck, Academy of Hearing Aid Acoustics, Lübeck
Dipl.-Ing. Reimer Rohweder, German Hearing Aid Institute, Lübeck
Katharina Roth, Academy of Hearing Aid Acoustics, Lübeck
Torsten Saile B.Sc., Das Ohr - Hörgeräte und mehr GmbH, Tuttlingen
Alexandra Winkler M.Sc., Jade University of Applied Sciences, Oldenburg

Published by Europäische Union der Hörakustiker e.V.
Neubrunnenstraße 3, 55122 Mainz, Germany

Phone +49 (0)6131 28 30-0
Fax +49 (0)6131 28 30-30
E-mail: info@euha.org
Website: www.euha.org

Contents

The practice of calibrating test boxes

1. Introduction/Aims

The use of test boxes only makes sense if these instruments offer consistent measuring accuracy and reliability. Although the equipment is not subject to obligatory calibration, it should be calibrated at least once a year. Moreover, calibration should be checked and, if required, adjusted whenever the regular (weekly) routine check of the test box (cf. the corresponding recommendations) shows any deviation. Calibration and/or testing may be performed by

- the manufacturer or distributor of the equipment
- a calibration service provider
- or the hearing care professional

Below we shall outline how the hearing care professional can check calibration himself/herself, using one of two options: a working standard, or a reference hearing aid. Depending on the measuring software used and access rights, the hearing care professional may be able to change test box calibration.

2. Calibration based on a working standard

The optimum choice is calibration based on a working standard. Such working standard is provided by the sound calibrator, an example of which is shown in fig. 1. The device emits a tone with fixed frequency and level, e.g. a frequency of 1000 Hz at 94 dB SPL.

Fig. 1: Sound calibrator

Before testing the measuring microphone (also called coupler microphone) using the sound calibrator, the coupler is removed from the measuring microphone and the sound calibrator is attached. The output level of the measuring microphone must be equivalent to the nominal value of the calibrator, i.e. 94 dB SPL. Errors of up to 1 dB are permissible.

In a second step, the reference microphone is checked. The coupler still remains removed from the measuring microphone. The measuring microphone and the reference microphone are set up in the test box at a distance of 5 mm ± 3 mm from each other at the point where the hearing aid is usually placed (cf. fig. 2). The direction of sound propagation from the loudspeaker is perpendicular to the plane in which the two microphones are located, which means that none of the two microphones must interfere with the sound incidence from the speaker. When sound is presented from above or from below (cf. fig. 2 a, b, c, e), the measuring microphone and the reference microphone should be set up at a 90-degree angle to one another. When sound is presented from the side (cf. fig. 2 d, f), the measuring and reference microphones should be aligned, i.e. positioned at a 0-degree angle. The loudspeaker emits a 1000-Hz sinusoid at 80 dB SPL. In comparison mode (also called pressure method), the reference microphone adjusts the loudspeaker level to the nominal value. The output level at the measuring microphone must correspond to the nominal value of 80 dB. Again, errors of up to 1 dB are permissible.

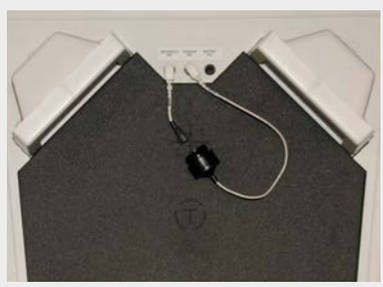
a) ACAM 5

b) Affinity

c) Aurical (before 2012)

d) Aurical (from 2012)

e) Unity 2



f) Verifit

g) Verifit 2

Fig. 2: Positioning of reference and measuring microphones in different test boxes

3. Calibration using a reference hearing aid

If no sound calibrator is available, one can perform the test procedure using a reference hearing aid that meets the following requirements:

- The reference hearing aid should provide a test mode that can be set to the broadest possible frequency bandwidth and highest possible gain across the whole frequency range. Dynamic compression (AGC) is set to the lowest effect possible (linear amplification) and any adaptive parameters that might affect the measurement with sinusoids (e.g. noise suppression, feedback cancellation) are switched off. The microphone mode is set to omnidirectional. This test mode is also known as full-on gain (FOG) setting.
- The frequency-specific output sound pressure level of the reference hearing aid for 90 dB input SPL, also referred to as OSPL90, should be known; errors of up to ± 0.7 dB are permissible, however, the lower the value, the better (± 0.1 dB is feasible). The OSPL90 can either be taken from the technical data sheet, or, for more accuracy, may be provided by the hearing aid manufacturer. Alternatively, the manufacturer of the measuring equipment may be contacted for the OSPL90 reference curve as measured using the reference hearing aid in a calibrated test box.
- The battery status of the reference hearing aid should be checked before performing the measurement. In case gain loss is above 0.7 dB/100 mV, measurements should be carried out using a voltage adapter.

The following procedure is recommended for checking calibration using the reference hearing aid:

- The reference hearing aid is set to the FOG test mode.
- The coupler is reconnected to the measuring microphone and the reference hearing aid is hooked up.
- The measuring microphone with coupler and reference hearing aid is set up in the test box together with the reference microphone. The distance between the reference microphone and the microphone of the reference hearing aid (hearing aid microphone) is to be 5 mm ± 3 mm. The hearing aid microphone should be facing the loudspeaker, while the reference microphone is to be placed at a 90-degree angle to that direction (cf. fig. 3). None of the two microphones must interfere with the sound incidence from the loudspeaker.
- A 1000-Hz sinusoid is presented to the reference hearing aid at 90 dB SPL. The output sound pressure level at the measuring microphone must correspond to the OSPL90 reference value at 1000 Hz. Errors of up to ± 2 dB are permissible.

- In addition, one may record the complete OSPL90 response characteristic (at least for frequencies ranging between 200 Hz and 5 kHz), and compare it against the OSPL90 nominal curve for the reference hearing aid. Errors of up to ± 2 dB are again permissible.
- Subsequently, by analogy with the second step in checking calibration using a sound calibrator, the reference hearing aid is checked: the coupler and the reference microphone are removed from the measuring microphone. The measuring microphone and the reference microphone are set up in the test box at a distance of 5 mm ± 3 mm from each other at the point where the hearing aid is usually placed (cf. fig. 2). The direction of sound propagation from the loudspeaker is perpendicular to the plane in which the two microphones are located, which means that none of the two microphones must interfere with the sound incidence from the speaker. The speaker emits a 1000-Hz sinusoid at 80 dB SPL, if possible. In comparison mode (pressure method), the reference microphone adjusts the loudspeaker level to the nominal value. The output level at the measuring microphone must correspond to the nominal value of 80 dB. Again, errors of up to 1 dB are permissible.

Fig. 3: Positioning of reference hearing aid and reference microphone in the test box

The procedure involving the reference hearing aid works almost as well as calibration based on a sound calibrator, the reason being that at 90 dB input SPL, the hearing aid has usually entered saturation. This means that deviations in input level have no effect on the OSPL90. However, in between calibration checks, the reference hearing aid should be handled with care and stored in an adequate place as dirt and shock may affect the reference values.