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Edition 2.0 2014-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electroacoustics – Simulators of human head and ear – Part 3: Acoustic coupler for the calibration of supra-aural earphones used in audiometry

Électroacoustique – Simulateurs de tête et d'oreille humaines – Partie 3: Coupleur acoustique pour l'étalonnage des écouteurs supra-auraux utilisés en audiométrie

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ELECTROACOUSTICS – SIMULATORS OF HUMAN HEAD AND EAR –

Part 3: Acoustic coupler for the calibration of supra-aural earphones used in audiometry

FOREWORD

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International Standard IEC 60318-3 has been prepared by IEC technical committee 29: Electroacoustics.

This second edition cancels and replaces the first edition published in 1998 and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) adjustment of terms and wording to the other parts of IEC 60318,
b) introduction of maximum permitted uncertainties,
c) revised requirements for static pressure equalization.

The text of this standard is based on the following documents:

CDV	Report on voting
29/796/CDV	29/811A/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 60318 series, published under the general title *Electroacoustics – Simulators of human head and ear* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

ELECTROACOUSTICS – SIMULATORS OF HUMAN HEAD AND EAR –

Part 3: Acoustic coupler for the calibration of supra-aural earphones used in audiometry

1 Scope

This part of IEC 60318 specifies an acoustic coupler for the measurement of supra-aural audiometric earphones in the frequency range from 125 Hz to 8 000 Hz.

The sound pressure developed by an earphone is not, in general, the same in the coupler as in a person's ear. However, the acoustic coupler can be used as an objective and reproducible means of measuring the output of supra-aural earphones. It can be used for specifying reference equivalent threshold sound pressure levels (RETSPL) for the calibration of audiometers.

2 Normative references

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

IEC 61094-1, *Measurement microphones – Part 1: Specifications for laboratory standard microphones*

ISO/IEC Guide 98-3, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

For the purpose of this document, the following definition applies:

3.1
acoustic coupler
device for measuring the acoustic output of sound sources where the sound pressure is measured by a calibrated microphone coupled to the source by a cavity of predetermined shape and volume which does not necessarily approximate the acoustical impedance of the normal human ear

4 Construction

4.1 General

The coupler consists essentially of a cylindrical cavity whose acoustic transfer impedance is determined by the volume of air in the cavity and its dimensions (see 4.2). A microphone with a diaphragm having high acoustic impedance is located in the base of the cylindrical cavity.

The coupler shall be made of a material that has no negative influences on its performance. For example it should be acoustically hard and dimensionally stable. The general construction of the coupler and mounting of the microphone shall aim to reduce the response to vibration of any earphone or to sound outside the cavity.

In the following, the specified tolerance shall be reduced by an amount equal to the actual expanded measurement uncertainty of the test laboratory before deciding if a device conforms to this specification.

4.2 Cavity dimensions

The critical dimensions (see Figure 1) of the coupler are those that determine the shape and volume of the cavity terminated by the microphone, the static pressure equalization mechanism, the upper edge (lip) and the 45° angle.

The effective acoustic volume of the coupler shall be 5 780 mm^3 ± 130 mm^3.

The diameter d_1 shall be 23,825 mm ± 0,080 mm.

Diameter d_2 shall be 18,55 mm ± 0,16 mm.

The height l_2 shall be 1,950 mm ± 0,065 mm.

The angle β defining the slope of the external part of the coupler shall be 45° ± 5,5°.

The height h of the coupler shall be calculated according to the following formula:

$$h = \frac{V_1 - V_{eq} - V_2}{\frac{1}{4}\pi d_1^2} \quad (1)$$

where

V_1 is the effective acoustic volume;

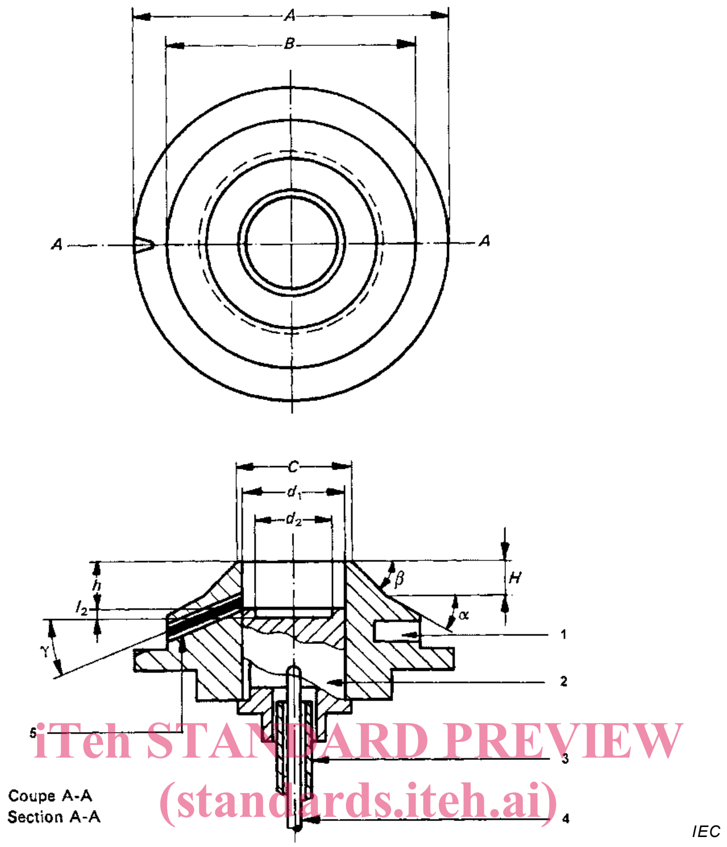
V_{eq} is the equivalent acoustic volume of the microphone;

V_2 is the volume of the front cavity of the microphone, given by

$$V_2 = \frac{1}{4}\pi d_2^2 \cdot l_2 \quad (2)$$

It is recommended that a value of h be selected from Table 1, according to the value of the equivalent acoustic volume of the microphone.

NOTE 1 It is recognized that certain combinations of coupler cavity and microphone could cause problems if the tolerance of the coupler diameter is exploited towards the smallest allowed diameter and at the same time, the tolerance of the microphone diameter is exploited towards the largest allowed diameter. Practical experience however, has proven that those problems are very unlikely to occur.



Dimension	Specification mm
A	73
B	57,2
C	25,27
d_1	**23,825**
d_2	**18,55**
l_2	**1,95**
h	**See 4.2, Equation.(1), Table 1**
H	7,5
Angle	**In degrees**
α	25
ß	**45**
Y	25
The dimensions printed in bold are the critical dimensions that determine the shape and volume of the cavity terminated by the microphone, the capillary leak, the upper edge (lip) and the 45° angle, see 4.2	

Key

1 hole for thermometer

2 microphone

3 ground shield

4 contact pin

5 venting mechanism, see 4.3.

Figure 1 – Dimensions of acoustic coupler

Table 1 – Height of the coupler as a function of the acoustic volume of the microphone

Equivalent acoustic volume of the microphone mm^3	Height of the coupler mm
$0 < V_{eq} \leq 50$	11,72 ± 0,15
$50 < V_{eq} \leq 100$	11,62 ± 0,15
$100 < V_{eq} \leq 150$	11,50 ± 0,15
$150 < V_{eq} \leq 200$	11,39 ± 0,15

NOTE 2 If the coupler described in this standard is constructed with a fixed value of $h + l_2$ = 13,41 mm regardless of the equivalent volume of the microphone, then the coupler will be identical with the NBS 9A coupler, see [1][1]. The nominal effective acoustic volume of the type 9A coupler is:

$$V_1 = V_{eq} + 5\,640 \text{ mm}^3$$

4.3 Static pressure equalization

Any change in the static pressure within the cavity caused by assembly of the earphone to the coupler and microphone shall decay toward the static ambient pressure with a time constant of less than 1,5 s. If this necessitates the introduction of a controlled leak in the coupler, it shall have the following characteristics.

a) It shall not alter the cavity volume by more than 20 mm^3;

b) It shall attenuate external sound reaching the cavity, with the entrance of the cavity blocked, by at least 16 dB at 100 Hz, increasing by 6 dB per octave for increasing frequency.

NOTE Equalization can be realized, for example, by a capillary tube with a diameter of 0,6 mm ± 0,05 mm containing a wire with a diameter of 0,4 mm ± 0,05 mm.

4.4 Calibrated pressure type microphone

The overall pressure sensitivity level of the microphone and associated measuring system (e.g. preamplifier) over the specified frequency range shall be known with a maximum measurement uncertainty not exceeding 0,2 dB for a level of confidence of 95 %.

The internal shape of the base of the coupler shall correspond to that of the laboratory standard (LS) configuration specified in IEC 61094-1.

NOTE A WS1P microphone conforming to IEC 61094-4 [2], without protective grid but with a coupler ring that converts the microphone to an LS1P configuration can be used. WS2P microphones conforming to IEC 61094-4 [2] can also be used, provided that the LS1 configuration and the stipulated volume are preserved, for example by using an adaptor.

The microphone used shall have a high acoustic impedance, the equivalent acoustic volume being less than 200 mm^3 at frequencies between 125 Hz and 8 000 Hz. The manufacturer of the microphone shall state the equivalent acoustic volume.

If it is necessary to use a microphone for which the diameter of the free part of the diaphragm is less than the diameter of the coupler cavity, the axes of the microphone and the cylindrical cavity shall coincide The microphone to be used shall be stated by the manufacturer.

There shall be an effective seal between the coupler and the microphone. However, any obstruction in the static pressure equalization device of the microphone shall be avoided.

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1 Numbers in square brackets refer to the Bibliography.

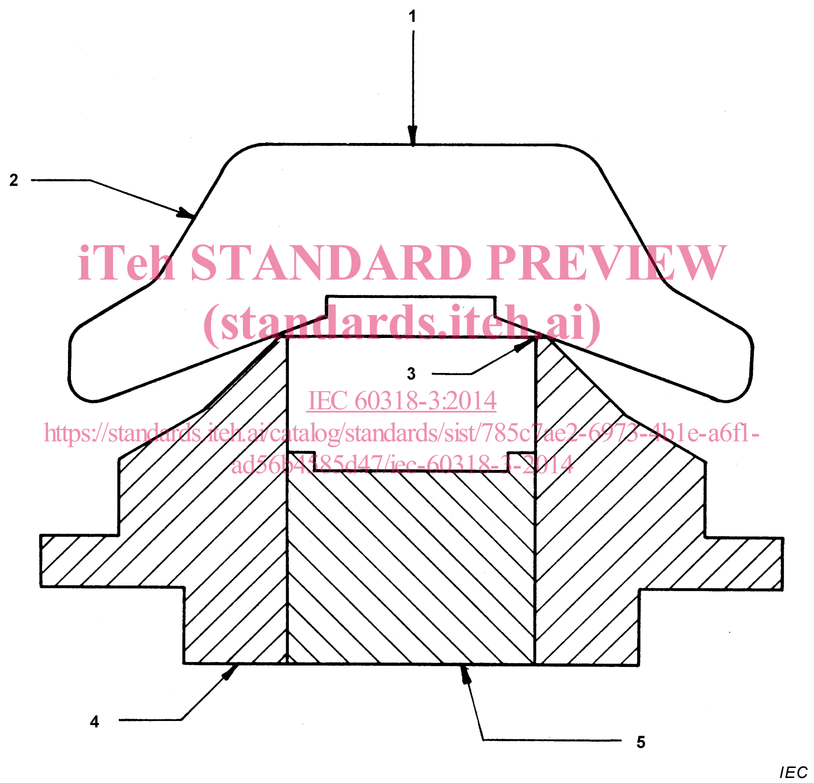
5 Coupling of earphone to acoustic coupler

The earphone to be calibrated shall be applied to the acoustic coupler without acoustic leakage with a force 4,5 N ± 0,5 N, not including the weight of the earphone itself (see Figure 2). If, for a specific earphone, a different coupling force is specified this shall be stated.

The earphone shall not rest on the sloping side of the acoustic coupler, but only on the upper edge (or lip, see Figure 2).

In the case of earphones with a hard earcap, a thin film of sealing material or thin soft rubber ring should be used on the lip in order to produce an effective seal between the earphone and the upper edge of the coupler.

NOTE With some earphones, a special adapter can be used for coupling the earphone to the coupler, e.g. see [3].



Key

1 coupling force between 4 N and 5 N
2 earphone
3 lip
4 coupler
5 microphone

Figure 2 – Coupling of earphone to coupler

6 Calibration

6.1 Reference environmental conditions

The reference environmental conditions are the following: