SLOVENSKI STANDARD
SIST EN 61027:2002

01-september-2002

Instruments for the measurement of aural acoustic impedance/admittance (IEC 61027:1991)

Instruments for the measurement of aural acoustic impedance/admittance

Geräte für die Messung der akustischen Impedanz/Admittanz des Ohres

Impédancemètres ou admittancemètres utilisés en audiologie

Ta slovenski standard je istoveten z: EN 61027:1993

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17.140.50 Elektroakustika Electroacoustics

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EUROPEAN STANDARD

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EUROPÄISCHE NORM

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Descriptors: Electromedical devices, audiology, measurement, instruments for the measurement, impedance, probe, equipment specifications, calibration

ENGLISH VERSION

Instruments for the measurement of aural acoustic impedance/admittance
(IEC 1027:1991)

Impédancemètres ou admittancemètres utilisés en audiologie
(CEI 1027:1991)

Geräte für die Messung der akustischen Impedanz/Admittanz des Ohres
(IEC 1027:1991)

This European Standard was approved by CENELEC on 1992-12-09. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

FOREWORD

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 1027:1991 could be accepted without textual changes, has shown that no common modifications were necessary for the acceptance as European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as EN 61027 on 9 December 1992.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1993-12-01
- latest date of withdrawal of conflicting national standards (dow) 1993-12-01

Annexes designated "normative" are part of the body of the standard. In this standard, annex ZA is normative.

ENDORSEMENT NOTICE

The text of the International Standard IEC 1027:1991 was approved by CENELEC as a European Standard without any modification.

ANNEX ZA (normative)

OTHER INTERNATIONAL PUBLICATIONS QUOTED IN THIS STANDARD WITH THE REFERENCES OF THE RELEVANT EUROPEAN PUBLICATIONS

When the international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

IEC Publication	Date	Title	EN/HD	Date
126	1973	IEC reference coupler for the measurement of hearing aids using earphones coupled to the ear by means of ear inserts	HD 305 S1	1977
601-1	1977*	Medical electrical equipment Part 1: General requirements	HD 395.1 S2 + A1	1988 1993
645-1	19xx	Audiometers - Part 1: Pure-tone audiometers	-	-
711	1981	Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts	HD 443 S1	1983

Other publication

ISO 389:1985 - Acoustics - Standard reference zero for the calibration of pure tone air conduction audiometers
Addendum 01:1983
Addendum 02:1986

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* IEC 601-1:1988 was harmonized as EN 60601-1:1990

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

INSTRUMENTS FOR THE MEASUREMENT OF AURAL ACOUSTIC IMPEDANCE/ADMITTANCE

FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as posssible, be clearly indicated in the latter.

PREFACE

This standard has been prepared by IEC Technical Committee No. 29: Electroacoustics.

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

Six Months' Rule	Report on Voting	Two Months' Procedure	Report on Voting
29C(CO)56	29(CO)143	29(CO)144	29(CO)155

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

The following publications are quoted in this standard:

Publications Nos.
126 (1973): IEC reference coupler for the measurement of hearing aids using earphones coupled to the ear by means of ear inserts.
601-1 (1977): Medical electrical equipment, Part 1: General requirements.
645-1 (19xx): Audiometers, Part 1: Pure tone audiometers.
711 (1981): Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts.

Other publication quoted:

ISO Standard 389 (1985): Acoustics — Standard reference zero for the calibration of pure tone air conduction audiometers.
Addendum 01: 1983.
Addendum 02: 1986

INSTRUMENTS FOR THE MEASUREMENT OF AURAL ACOUSTIC IMPEDANCE/ADMITTANCE

Introduction

Developments in the field of diagnostic hearing measurement have resulted in a number of instruments designed to evaluate the acoustic impedance/admittance of the human ear by means of acoustic probe signals having different frequencies and temporal characteristics. The practical use of such instruments concerns to a large extent the changes in acoustic impedance/admittance caused either by varying the air pressure in the external acoustic meatus or by activating the middle ear muscle reflex.

1 Scope

This standard covers instruments designed primarily for the measurement of modulus of acoustic impedance/admittance in the human external acoustic meatus using a probe tone of 226 Hz. It is recognized that other probe signals may also be used. The standard defines the characteristics to be specified by the manufacturer, lays down performance specifications for four types of instrument and specifies the facilities to be provided on three of these types. Methods of test to be used for approval testing rather than routine calibration are also specified.

2 Object

The purpose of this standard is to ensure that measurements made under comparable test conditions with different instruments complying with the standard will be consistent. The standard is not intended to restrict development or incorporation of new features, nor to discourage innovative approaches.

3 Definitions

For the purpose of this standard the following definitions shall apply.

NOTE — The units in this standard conform to the International System of Units (SI). However, for audiological measurements test results have traditionally often been reported in other units. To provide information on the conversion from such units to SI units, annex A has been compiled.

3.1 **aural impedance/admittance:** Throughout this standard the term aural impedance/admittance will be employed as a general term covering all aspects of aural acoustic impedance/admittance, except where reference is made to specific derivatives.

3.2 **acoustic impedance:** At a given surface, the complex ratio of sound pressure averaged over the surface to volume velocity through it. The symbol is Z_a and the unit is the pascal second per metre to the third power (Pa · s/m^3). The quantity usually measured is the modulus.

3.3 **acoustic resistance:** The real component of complex acoustic impedance. The symbol is R_a and the unit is the pascal second per metre to the third power (Pa · s/m^3).

3.4 **acoustic reactance:** The imaginary component of complex acoustic impedance. The symbol is X_a and the unit is the pascal second per metre to the third power (Pa · s/m^3).

3.5 **acoustic admittance:** At a given surface, the reciprocal of acoustic impedance at the same surface. The symbol is Y_a and the unit is the metre to the third power per pascal second (m^3/Pa · s). Thus, the acoustic admittance at a given surface is the complex ratio of the volume velocity through the surface to the sound pressure averaged over the surface. The quantity usually measured is the modulus.

3.6 **acoustic conductance:** The real component of complex acoustic admittance. The symbol is G_a and the unit is the metre to the third power per pascal second ($m^3/Pa \cdot s$).

3.7 **acoustic susceptance:** The imaginary component of complex acoustic admittance. The symbol is B_a and the unit is the metre to the third power per pascal second ($m^3/Pa \cdot s$).

3.8 **acoustic inertance:** The ratio of the driving sound pressure to the resulting rate of change in volume velocity. The symbol is M_a and the unit is the pascal second to the second power per metre to the third power ($Pa \cdot s^2/m^3$).

3.9 **acoustic compliance:** The ratio of volume displacement to sound pressure. The symbol is C_a and the unit is the metre to the third power per pascal (m^3/Pa).

3.10 **equivalent volume:** The volume of an air-filled hard-walled cylindrical cavity that offers the equivalent acoustic impedance/admittance. The volume is given by the formula:

$$V_e = \gamma \cdot p_s \cdot C_a = \varrho \cdot c^2 \cdot C_a$$

where

V_e is the equivalent volume in m^3;

γ is the ratio of specific heat for air at constant pressure to that at constant volume (approximately 1,40);

p_s is the barometric air pressure in Pa;

ϱ is the ambient density of air in kg/m^3, at the temperature and pressure of the measurement;

c is the speed of sound in m/s at the temperature and pressure of the measurement;

C_a is the acoustic compliance in m^3/Pa.

NOTES

1 It has been practice to refer to aural impedance/admittance at the probe tone frequency of 226 Hz as an equivalent volume of air.

2 For a probe tone frequency of 226 Hz, the equivalent volume of air is equal to its physical volume provided the latter does not exceed 5 cm^3.

3.11 **relative pressure in the external acoustic meatus:** The difference between the pressure in the external acoustic meatus and the ambient barometric pressure in daPa.

NOTE — Traditionally, for audiological measurements, air pressure has been reported with respect to the height of a column of water it can support. The unit has been mm H_2O. The appropriate SI unit is the decapascal. For comparison with traditional measurements, the decapascal (daPa) is recommended in this standard. (1 daPa = 1,02 mm H_2O.)

3.12 **probe:** A coupling device that is inserted into the external acoustic meatus to connect the instrument to the ear.

3.13 **probe cuff:** A device used to provide a seal between the probe and the external acoustic meatus.

3.14 **probe signal:** An acoustic signal that is emitted into the external auditory meatus by means of a probe. The signal is used to measure acoustic impedance/admittance.

3.15 **probe ear:** The ear into which the probe is inserted.

3.16 **measurement plane:** A plane located at the frontal surface of the probe perpendicular to the volume velocity vector.

3.17 **tympanometry:** The measurement of changes of aural impedance/admittance as a function of air pressure in the external acoustic meatus.

NOTE — The measured acoustic impedance/admittance values may depend on rate and direction of change of air pressure as well as time spent with a certain constant air pressure in the external acoustic meatus.