SLOVENSKI STANDARD

SIST EN 61161:2008

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Nadomeģļa:

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Ultrazvok - Moļnostne meritve - Ravnoteģje sevalnih jakosti in tehniļne zahteve (IEC 61161:2006)

Ultrasonics - Power measurement - Radiation force balances and performance requirements (IEC 61161:2006)

Ultraschall - Leistungsmessung - Schallfeldkraft-Waagen und Anforderungen an ihre Funktionseigenschaften (IEC 61161:2006)

Ultrasons - Mesurage de puissance - Balances de forces de rayonnement et exigences de fonctionnement (IEC 61161:2006)

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17.140.50

SIST EN 61161:2008 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61161

April 2007

ICS 17.140.50

Supersedes EN 61161:1994 + A1:1998

English version

Ultrasonics - Power measurement - Radiation force balances and performance requirements

(IEC 61161:2006)

Ultrasons -
Mesurage de puissance -
Balances de forces de rayonnement
et exigences de fonctionnement
(CEI 61161:2006)

Ultraschall -
Leistungsmessung -
Schallfeldkraft-Waagen
und Anforderungen an ihre
Funktionseigenschaften
(IEC 61161:2006)

This European Standard was approved by CENELEC on 2007-03-01. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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

Ref. No. EN 61161:2007 E

Foreword

The text of document 87/325/CDV, future edition 2 of IEC 61161, prepared by IEC TC 87, Ultrasonics, was submitted to the IEC-CENELEC parallel Unique Acceptance Procedure and was approved by CENELEC as EN 61161 on 2007-03-01.

This European Standard supersedes EN 61161:1994 + A1:1998.

The main significant changes are:

– the main body of the standard has been restricted to normative statements;

– informative statements on corresponding aspects of ultrasonic power measurement and radiation force balances have been collected in Annex A;

– Annexes A, D, E and F are new;

– more radiation force balance arrangements are dealt with. The new material relates particularly to power measurement of ultrasonic physiotherapy devices.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2007-12-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2010-03-01

The following print types are used:

– requirements: roman type;

– notes: small roman type;

– words in **bold** in the text are defined in Clause 3.

The numbers in square brackets refer to the Bibliography (after the annexes).

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61161:2006 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60601-2-5	NOTE	Harmonized as EN 60601-2-5:2000 (not modified).
IEC 61157	NOTE	Harmonized as EN 61157:1994 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

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

Publication	Year	Title	EN/HD	Year
IEC 60050-801	-[1)]	International Electrotechnical Vocabulary (IEV) - Chapter 801: Acoustics and electroacoustics	-	-
IEC 60854	1986	Methods of measuring the performance of ultrasonic pulse-echo diagnostic equipment	-	-
IEC 60866	1987	Characteristics and calibration of hydrophones for operation in the frequency range 0,5 MHz to 15 MHz	-	-
IEC 61101	1991	The absolute calibration of hydrophones using the planar scanning technique in the frequency range 0,5 MHz to 15 MHz	EN 61101	1993
IEC 61102	1991	Measurement and characterisation of ultrasonic fields using hydrophones in the frequency range 0,5 MHz to 15 MHz	EN 61102	1993
IEC 61689	1996	Ultrasonics - Physiotherapy systems - Performance requirements and methods of measurement in the frequency range 0,5 MHz to 5 MHz	EN 61689	1996
IEC 61846	1998	Ultrasonics - Pressure pulse lithotripters - Characteristics of fields	EN 61846	1998

[1)] Undated reference.

NORME INTERNATIONALE

INTERNATIONAL STANDARD

CEI
IEC
61161

Deuxième édition
Second edition
2006-12

Ultrasons – Mesurage de puissance – Balances de forces de rayonnement et exigences de fonctionnement

Ultrasonics – Power measurement – Radiation force balances and performance requirements

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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For price, see current catalogue

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ULTRASONICS – POWER MEASUREMENT – RADIATION FORCE BALANCES AND PERFORMANCE REQUIREMENTS

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61161 has been prepared by IEC technical committee 87: Ultrasonics

This second edition of IEC 61161 cancels and replaces the first edition published in 1992, and its Amendment 1 (1998). It constitutes a technical revision. The main significant changes are:

– the main body of the Standard has been restricted to normative statements;
– informative statements on corresponding aspects of ultrasonic power measurement and radiation force balances have been collected in Annex A;
– Annexes A, D, E and F are new;
– more radiation force balance arrangements are dealt with. The new material relates particularly to power measurement of ultrasonic physiotherapy devices.

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

Enquiry draft	Report on voting
87/325/CDV	87/358/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.

NOTE The following print types are used:

- Requirements: roman type
- Notes: in small roman type
- Words in **bold** in the text are defined in Clause 3.
- The numbers in square brackets refer to the Bibliography (after the annexes).

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

INTRODUCTION

A number of measuring methods exist for the determination of the total emitted power of ultrasonic transducers ([1], [2], [3], see also Annex C). The purpose of this International Standard is to establish standard methods of measurement of ultrasonic power in liquids in the lower megahertz frequency range based on the measurement of the radiation force using a gravimetric balance. The great advantage of radiation force measurements is that a value for the total radiated power is obtained without the need to integrate field data over the cross-section of the radiated sound beam. This standard identifies the sources of errors and describes a systematic step-by-step procedure to assess overall measurement uncertainty as well as the precautions that should be undertaken, and uncertainties that should be taken into account, while performing power measurements

Basic safety requirements for ultrasonic physiotherapy devices are identified in IEC 60601-2-5 and make reference to IEC 61689, which specifies the need for acoustic power measurements with an uncertainty better than ± 15 %. Considering the usual degradation of accuracy in the practical application of this standard, reference measurement methods need to be established with uncertainties better than ± 7 %. Ultrasonic diagnostic device declaration requirements, including acoustic power, are specified in other IEC standards, as for example in IEC 61157.

The measurement of acoustic power accurately, precisely and repeatably using a radiation force balance as defined in this standard is influenced by a number of practical problems. As a guide to the user, additional information is provided in Annex A using the same section and clause numbering as the main body.

ULTRASONICS – POWER MEASUREMENT – RADIATION FORCE BALANCES AND PERFORMANCE REQUIREMENTS

1 Scope

This International Standard

- specifies a method of determining the total emitted acoustic power of ultrasonic transducers based on the use of a radiation force balance;
- establishes general principles for the use of radiation force balances in which an obstacle (target) intercepts the sound field to be measured;
- establishes limitations of the radiation force method related to cavitation and temperature rise;
- establishes quantitative limitations of the radiation force method in relation to diverging and focused beams;
- provides information on assessment of overall measurement uncertainties.

This International Standard is applicable to:

- the measurement of ultrasonic power up to 1 W based on the use of a radiation force balance in the frequency range from 0,5 MHz to 25 MHz;
- the measurement of ultrasonic power up to 20 W based on the use of a radiation force balance in the frequency range 0,75 MHz to 5 MHz;
- the measurement of total ultrasonic power of transducers, preferably with well-collimated beams;
- the use of radiation force balances of the gravimetric type or force feedback type.

NOTE The titles of all publications refered to in this Standard are listed in the Bibliography.

2 Normative references

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

IEC 60050, *International Electrotechnical Vocabulary (IEV) – Chapter 801: Acoustics and Electroacoustics, Chapter 802: Ultrasonics*

IEC 60854:1986, *Methods of measuring the performance of ultrasonic pulse-echo diagnostic equipment*

IEC 60866:1987, *Characteristics and calibration of hydrophones for operation in the frequency range 0,5 MHz to 15 MHz*

IEC 61101:1991, *The absolute calibration of hydrophones using the planar scanning technique in the frequency range 0,5 MHz to 15 MHz*

IEC 61102:1991, *Measurement and characterisation of ultrasonic fields using hydrophones in the frequency range 0,5 MHz to 15 MHz*

IEC 61689:1996, *Ultrasonics – Physiotherapy systems – Performance requirements and methods of measurement in the frequency range 0,5 MHz to 5 MHz*

IEC 61846:1998, *Ultrasonics – Pressure pulse lithotripters – Characteristics of fields*

3 Terms and definitions

For the purposes of this document, the following terms and definitions as well as the definitions of IEC 60050-801 and IEC 60050-802 apply.

3.1
acoustic streaming
bulk fluid motion initiated by a sound field

3.2
free field
sound field in a homogeneous isotropic medium whose boundaries exert a negligible effect on the sound waves

[IEV 801-23-28, modified]

3.3
output power
time-average ultrasonic power emitted by an **ultrasonic transducer** into an approximately **free field** under specified conditions in a specified medium, preferably water

Symbol: *P*
Unit: watt, W

3.4
radiation force
acoustic radiation force
time-average force acting on a body in a sound field and caused by the sound field, excluding the component due to acoustic streaming; or, more generally: time-average force (excluding the component due to acoustic streaming) in a sound field, appearing at the boundary surface between two media of different acoustic properties

Symbol: *F*
Unit: Newton, N

3.5
radiation pressure
acoustic radiation pressure
radiation force per unit area

NOTE This term is widely used in the literature. However, strictly speaking, the radiation force per unit area is a tensor quantity [4] and it should be referred to as the acoustic radiation stress tensor when a strict scientific terminology is to be used. The integral quantity "acoustic radiation force" is generally preferred in this International Standard. Whenever at some places the term "acoustic radiation pressure" appears, it is to be understood as the negative value of the normal radiation stress in the direction of the field axis.

Unit: Pascal, Pa

3.6
target
device specially designed to intercept substantially all of the ultrasonic field and to serve as the object which is acted upon by the **radiation force**

3.7
ultrasonic transducer
device capable of converting electrical energy to mechanical energy within the ultrasonic frequency range and/or reciprocally of converting mechanical energy to electrical energy

3.8
radiation conductance
ratio of the acoustic **output power** and the squared RMS transducer input voltage. It is used to characterize the electrical to acoustical transfer of **ultrasonic transducers**

Symbol: *G*
Unit: siemens, S

4 List of symbols

a radius of a source **ultrasonic transducer**

c speed of sound (usually in water)

d geometrical focal length of a focused **ultrasonic transducer**

F **radiation force** on a **target** in the direction of the incident ultrasonic wave

g acceleration due to gravity

G **radiation conductance**

k circular wavenumber ($2\pi/\lambda$)

P **output power** of an **ultrasonic transducer**

s normalized distance from an **ultrasonic transducer** ($s = z\ \lambda\ /\ a^2$)

z distance between a **target** and an **ultrasonic transducer**

α amplitude attenuation coefficient of plane waves in a medium (usually water)

γ focus (half-)angle of a focused **ultrasonic transducer** (arc sin *a/d*)

θ angle between the direction of the incident ultrasonic wave and the normal to a reflecting surface of a **target**

λ ultrasonic wavelength

ρ (mass) density of the sound-propagating medium (usually water).

NOTE The direction of the incident wave mentioned above under *F* and θ is understood to be the direction of the field axis, i.e., it is understood in a global sense rather than in a local sense.

5 Requirements for radiation force balances

5.1 General

The **radiation force** balance shall consist of a **target** which is connected to a balance. The ultrasonic beam shall be directed vertically upwards or downwards or horizontally on the **target** and the **radiation force** exerted by the ultrasonic beam shall be measured by the balance. The ultrasonic power shall be determined from the difference between the force measured with and without ultrasonic radiation, in accordance with the formulae given in Annex B. Calibration can be carried out by means of small precision weights of known mass.

NOTE Different possible radiation force measurement set-ups are presented in Figures F.1 to F.7. Each measurement set-up has its own merits, which are also summarised in Annex F.