

Ultrasonics - Transducers - Definitions and measurement methods regarding focusing for the transmitted fields

EESTI STANDARDI EESSÕNA**NATIONAL FOREWORD**

See Eesti standard EVS-EN IEC 61828:2021 sisaldab Euroopa standardi EN IEC 61828:2021 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 61828:2021 consists of the English text of the European standard EN IEC 61828:2021.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 05.02.2021.	Date of Availability of the European standard is 05.02.2021.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 17.140.50

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:
Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

Ultrasonics - Transducers - Definitions and measurement
methods regarding focusing for the transmitted fields
(IEC 61828:2020)

Ultrasons - Transducteurs - Définitions et méthodes de
mesure pour la focalisation des champs transmis
(IEC 61828:2020)

Ultraschall - Fokussierende Wandler - Definitionen und
Messverfahren mit Bezug auf die Fokussierung für die
erzeugten Felder
(IEC 61828:2020)

This European Standard was approved by CENELEC on 2021-01-19. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

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



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 87/746/FDIS, future edition 2 of IEC 61828, prepared by IEC/TC 87 "Ultrasonics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61828:2021.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2021-10-19 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2024-01-19 document have to be withdrawn

This document supersedes EN 61828:2001 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61828:2020 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 62127-1:2007	NOTE	Harmonized as EN 62127-1:2007 (not modified)
IEC 60601-2-62:2013	NOTE	Harmonized as EN 60601-2-62:2015 (not modified)
IEC/TS 61949:2007	NOTE	Harmonized as CLC/TS 61949:2008 (not modified)

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Ultrasonics – Transducers – Definitions and measurement methods
regarding focussing for the transmitted fields**

**Ultrasons – Transducteurs – Définitions et méthodes de mesure
pour la focalisation des champs transmis**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Ultrasonics – Transducers – Definitions and measurement methods
regarding focusing for the transmitted fields**

**Ultrasons – Transducteurs – Définitions et méthodes de mesure
pour la focalisation des champs transmis**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 17.140.50

ISBN 978-2-8322-9019-4

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references	9
3 Terms and definitions	10
4 Symbols	41
5 Independent measurement of total acoustic output power	44
6 Acoustic field measurement: equipment.....	44
6.1 Hydrophone	44
6.1.1 General	44
6.1.2 Sensitivity of a hydrophone.....	44
6.1.3 Directional response of a hydrophone.....	45
6.1.4 Effective hydrophone radius	45
6.1.5 Choice of the size of a hydrophone active element	45
6.1.6 Hydrophone pressure limits	46
6.1.7 Hydrophone intensity limits.....	46
6.1.8 Hydrophone cable length and amplifiers	47
6.2 Requirements for positioning and water baths.....	47
6.2.1 General	47
6.2.2 Positioning systems	47
6.2.3 Water bath.....	48
6.3 Requirements for data acquisition and analysis systems.....	49
6.4 Requirements and recommendations for ultrasonic equipment being characterized	50
7 Measurement procedure	50
7.1 General.....	50
7.2 Preparation and alignment	50
7.2.1 General drive and field conditions.....	50
7.2.2 Initial adjustment to driving voltage.....	51
7.2.3 Preparation of source transducer.....	52
7.2.4 Aligning an ultrasonic transducer and hydrophone	52
7.2.5 Finding the beam axis.....	53
7.2.6 Measurements to determine field level conditions	55
7.2.7 Determining if transducer is focusing	56
7.2.8 Measuring other beamwidth parameters of a focusing transducer	57
7.2.9 Measuring the beam area parameters.....	58
7.2.10 Measuring additional beam maximum based parameters	59
7.2.11 Alternative: calculation of focal parameters using numerical projection	60
7.2.12 Plane wave transmitted fields	61
7.2.13 Steered plane waves	61
7.2.14 Measurements of high intensity therapeutic ultrasound fields.....	61
7.2.15 Calculation of I_{sa}	62
7.2.16 Further evaluation for sidelobes and pre-focal maxima	63
7.3 Considerations for scanning transducers and transducers with multiple sources.....	65
7.3.1 Automatic scanning transducers	65

7.4	Spatial impulse response and beamplots	65
7.4.1	General	65
7.4.2	Point target.....	66
7.4.3	Beamplots and beam contour plots	66
7.5	Plane wave compounding	66
Annex A (informative) Background for the transmission/ Characteristics of focusing transducers.....		67
A.1	General.....	67
A.2	Field of piston source.....	68
A.3	Focusing with a lens	68
A.4	Focusing with a concave transducer	71
A.5	Geometric focusing gains.....	73
A.6	Beamwidth estimation	74
Annex B (informative) Rationale for focusing and nonfocusing definitions		79
B.1	Overview.....	79
B.1.1	Background information	79
B.1.2	General	79
B.1.3	Focusing transducers	79
B.1.4	Focusing methods	80
B.1.5	Known and unknown focusing transducers.....	81
B.1.6	Focusing and beamwidth	81
B.1.7	Focusing parameter definitions	82
B.1.8	Applications of focusing definitions	82
B.1.9	Relation of present definitions to physiotherapy transducers (treatment heads)	82
B.1.10	Relation of present definitions to therapeutic transducers	82
B.2	System and measurement requirements	83
B.2.1	General	83
B.2.2	Transmitted pressure waveforms	83
B.2.3	Transmitted fields	83
B.2.4	The scan plane and the steering of beams.....	83
B.2.5	Pulse echo field measurements	84
Annex C (informative) Methods for determining the beam axis for well-behaved beams		94
C.1	Comparisons of beam axis search methods	94
C.2	Beamwidth midpoint method	95
Annex D (informative) Methods for determining the beam axis for beams that are not well behaved.....		97
Annex E (informative) Uncertainties		99
E.1	General.....	99
E.2	Overall (expanded) uncertainty	99
E.3	Common sources of uncertainty	99
Annex F (informative) Transducer and hydrophone positioning systems.....		101
Annex G (informative) Planar scanning of a hydrophone to determine acoustic output power		102
G.1	Overview.....	102
G.2	General principle	102
G.3	Hydrophone scanning methodology.....	103
G.3.1	General methodology.....	103
G.3.2	Particular considerations for implementation for HITU fields	104

G.4	Corrections and sources of measurement uncertainty	104
G.4.1	Uncertainty in the hydrophone calibration	104
G.4.2	Planar scanning	104
G.4.3	Attenuation factor of water: unfocusing transducers	104
G.4.4	Attenuation factor of water: focusing transducers	105
G.4.5	Received hydrophone signal	105
G.4.6	Integration	105
G.4.7	Finite size of the hydrophone	106
G.4.8	Partial extent of integration	106
G.4.9	Non-linear propagation	106
G.4.10	Directional response	106
G.4.11	Noise	107
G.4.12	Intensity approximated by derived intensity	107
Annex H (informative)	Properties of water	108
H.1	General	108
H.2	Attenuation coefficient for propagation in water	109
Bibliography		110
Figure A.1	– Beam contour plot: contours at –6 dB, –12 dB, and –20 dB for a 5 MHz transducer with a radius of curvature of $D = 50$ mm centred at location 0,0 (bottom centre of graph)	76
Figure A.2	– Types of geometric focusing	76
Figure A.3	– Transducer options	77
Figure A.4	– Parameters for describing a focusing transducer of known geometry	78
Figure A.5	– Path difference parameters for describing a focusing transducer of known geometry	78
Figure B.1	– Electronic focusing along z by transmit beamforming in the scan plane xz	84
Figure B.2	– Field parameters for a nonfocusing transducer of known geometry. For example, for a circularly symmetric geometry, transducers have a diameter $2a$ and a beam axis along z	85
Figure B.3	– Phased array geometry and construction for electronic focusing in the azimuth plane and mechanical lens focusing in the elevation plane	85
Figure B.4	– Field parameters for a focusing transducer of known geometry	86
Figure B.5	– Definitions for pressure-based field measurements for an unknown transducer geometry	86
Figure B.6	– Beamwidth focus for transducers of known and unknown geometry	87
Figure B.7	– Beam maximum parameters	88
Figure B.8	– Pressure focus for a transducer of known geometry (design case)	88
Figure B.9	– Pressure focus for a transducer of unknown geometry (measurement case)	89
Figure B.10	– Beam area parameters	89
Figure B.11	– Beam axis parameters: pulse-pressure-squared-integral level relative to the beam maximum in decibels (dB) plotted against axial distance	90
Figure B.12	– Beamplot parameters	91
Figure B.13	– Schematic diagram of the different planes and lines in an ultrasonic field for a rectangular transducer	92
Figure B.14	– Schematic diagram of the different planes and lines in an ultrasonic field for a circular transducer	93

Figure C.1 – x -axis scan at 9 cm depth for the first focal zone with beam centre	95
Figure C.2 – x -axis scan at 4,4 cm depth for the second focal zone	95
Figure D.1 – Asymmetric beam showing relative acoustic pressure versus sample number for the beamwidth midpoint method	98
Figure F.1 – Schematic diagram of the ultrasonic transducer and hydrophone degrees of freedom	101
Table C.1 – Standard deviations for x and y scans using three methods of determining the centre of the beam	94
Table C.2 – Decibel beamwidth levels for determining midpoints	96
Table H.1 – Speed of sound, c , and characteristic acoustic impedance, ρc , as a function of temperature, for propagation in water	108

This document is a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ULTRASONICS –TRANSDUCERS – DEFINITIONS AND MEASUREMENT METHODS REGARDING FOCUSING FOR THE TRANSMITTED FIELDS

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61828 has been prepared by IEC technical committee 87: Ultrasonics.

This second edition cancels and replaces the first edition published in 2001. This edition constitutes a technical revision.

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

- a) Clause 6 on Measurement procedures has been replaced by Clause 6: "Acoustic field measurement: equipment" and Clause 7: "Measurement procedure" and related definitions.
- b) Reorganization of definitions and measurement section to accommodate specific sets of measurements for focusing, nonlinearity, beam axis alignment, beam area, beam maximum, numerical projection, plane wave, high intensity therapeutic ultrasound, multiple sources, spatial impulse response and compound plane waves. Clause 3 has been moved to Annex B.
- c) The normative references have been updated and the Bibliography has been expanded from 8 to 40 references.

- d) Twelve figures have been updated and seven new figures (B.1, B.3, B.7, B.10, B.11, B.12, B.13, B.14) have been added to facilitate measurements and be consistent with measurement terminology.
- e) New measurements have been added for time delays, arrays, plane waves and spatial impulse response.
- f) Annex A has been expanded to provide general guidance on pulsed waves, system responses, focusing gains and minimum beamwidth estimation.
- g) New annexes have been added:
 - Annex B (informative) Rationale for focusing and nonfocusing definitions
 - Annex E (informative) Uncertainties;
 - Annex F (informative) Transducer and hydrophone positioning systems;
 - Annex G (informative) Planar scanning of a hydrophone to determine acoustic output power;
 - Annex H (informative) Properties of water;
 In addition, Annex A was reorganized and new Clauses A.1, A.5 and A.6 were added.
- h) Guidelines for remaining within the manufacturer's pressure and intensity hydrophone limits and the determination of the extent of nonlinearity in the field have been added.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
87/746/FDIS	87/749/RVD

Full information on the voting for the approval of this International 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 1 The following print types are used:

- Requirements: in roman type.
- Notes: small roman type.
- Words in **bold** in the text are defined in Clause 3.

NOTE 2 There are some inconsistencies in font type for symbols and formulae between some of the normative references and this document. They will be resolved in a future revision of the normative references.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Focusing transducers are essential in medical applications for obtaining high-resolution images, Doppler and flow data and for concentrating ultrasonic energy at desired sites for therapy. This document provides specific definitions appropriate for describing the focused field from a theoretical viewpoint for transducers with known characteristics intended by design. Other specific definitions included in this document, based on measurement methods, provide a means of determining **focusing** properties, if any, of a transducer of unknown field characteristics. The measurement method and definitions provide criteria for determining if the transducer is focusing, as well as a means of describing the **focusing** properties of the field. **Beam axis** alignment methods and field characterization measurements are given for both **focusing** and **nonfocusing** transducers.

ULTRASONICS –TRANSDUCERS – DEFINITIONS AND MEASUREMENT METHODS REGARDING FOCUSING FOR THE TRANSMITTED FIELDS

1 Scope

This document

- provides definitions for the transmitted field characteristics of focusing and nonfocusing transducers for applications in medical ultrasound;
- relates these definitions to theoretical descriptions, design, and measurement of the transmitted fields of focusing transducers;
- gives measurement methods for obtaining defined field characteristics of focusing and nonfocusing transducers;
- specifies beam axis alignment methods appropriate for focusing and nonfocusing transducers.

This document relates to focusing ultrasonic transducers operating in the frequency range appropriate to medical ultrasound (0,5 MHz to 40 MHz) for both therapeutic and diagnostic applications. It shows how the characteristics of the transmitted field of transducers can be described from the point of view of design, as well as measured by someone with no prior knowledge of the construction details of a particular device. The transmitted ultrasound field for a specified excitation is measured by a hydrophone in either a standard test medium (for example, water) or in a given medium. This document applies only to media where the field behaviour is essentially like that in a fluid (i.e. where the influence of shear waves and elastic anisotropy is small), including soft tissues and tissue-mimicking gels. Any aspects of the field that affect their theoretical description or are important in design are also included. These definitions would have use in scientific communications, system design and description of the performance and safety of systems using these devices.

This document incorporates definitions from other related standards where possible, and supplies more specific terminology, both for defining focusing characteristics and for providing a basis for measurement of these characteristics.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 61689:2013, *Ultrasonics – Physiotherapy systems – Field specifications and methods of measurement in the frequency range 0,5 MHz to 5MHz*

IEC 62127-3:2007, *Ultrasonics – Hydrophones – Part 3: Properties of hydrophones for ultrasonic fields up to 40 MHz*

IEC 62127-3:2007/AMD1:2013

IEC TS 62556:2014, *Ultrasonics – Field characterization – Specification and measurement of field parameters for high intensity therapeutic ultrasound (HITU) transducers and systems*

IEC 61161, *Ultrasonics – Power measurement – Radiation force balances and performance requirements*

IEC 62555, *Ultrasonics – Power measurement – High intensity therapeutic ultrasound (HITU) transducers and systems*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

For the purposes of this document the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

acoustic pulse waveform

temporal waveform of the instantaneous acoustic pressure at a specified position in an acoustic field and displayed over a period sufficiently long to include all significant acoustic information in a single pulse, a single **tone-burst**, or one cycle of a **continuous wave**

Note 1 to entry: In some cases such as an amplitude-modulated pulse, the overall pulse train can appear as a group of nearly contiguous pulses with spacings much smaller than the overall pulse repetition time.

3.2

annular array

ultrasonic transducer element group having radiating elements in the same plane or curved surface and consisting of concentric elements which are electrically phased to control the characteristics of an acoustic beam

3.3

acoustic frequency

acoustic-working frequency

frequency of an acoustic signal based on the observation of the output of a **hydrophone** placed in an acoustic field at the position corresponding to the **spatial-peak temporal-peak acoustic pressure**

Note 1 to entry: The signal is analysed using either the **zero-crossing acoustic-working frequency** technique or a spectrum analysis method.

Note 2 to entry: In a number of cases the present definition is not very helpful or convenient, especially for **broadband transducers**. In that case a full description of the frequency spectrum should be given in order to enable any frequency-dependent correction to the signal.

Note 3 to entry: **Acoustic frequency** is expressed in hertz (Hz).

[SOURCE: IEC 62127-1:2007, 3.3]

3.3.1

zero-crossing acoustic-working frequency

number, n , of consecutive half-cycles (irrespective of polarity) divided by twice the time between the commencement of the first half-cycle and the end of the n -th half-cycle

Note 1 to entry: None of the n consecutive half-cycles should show evidence of phase change.

Note 2 to entry: This frequency is intended for continuous-wave systems only.

[SOURCE: IEC 62127-1:2007/AMD1:2013, 3.3.1, modified – NOTE 2 and NOTE 3 have been deleted.]