SLOVENSKI STANDARD
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Radionuclide imaging devices - Characteristics and test conditions - Part 1: Positron emission tomographs (IEC 61675-1:1998)

Radionuclide imaging devices - Characteristics and test conditions -- Part 1: Positron emission tomographs

Bildgebende Systeme in der Nuklearmedizin - Merkmale und Prüfbedingungen -- Teil 1: Positronen-Emissions-Tomographen

Dispositifs d'imagerie par radionucléides - Caractéristiques et conditons d'essai -- Partie 1: Tomographes à émisssion de positrons

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EUROPEAN STANDARD

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Radionuclide imaging devices Characteristics and test conditions Part 1: Positron emission tomographs

(IEC 61675-1:1998)

Dispositifs d'imagerie par radionucléides
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de positrons
(CEI 61675-1:1998)

Bildgebende Systeme in der
Nuklearmedizin - Merkmale
und Prüfbedingungen
Teil 1: Positronen-Emissions-
Tomographie
(IEC 61675-1:1998)

This European Standard was approved by CENELEC on 1998-01-01. 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.

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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 text of document 62C/205/FDIS, future edition 1 of IEC 61675-1, prepared by SC 62C, Equipment for radiotherapy, nuclear medicine and radiation dosimetry, of IEC TC 62, Electrical equipment in medical practice, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61675-1 on 1998-01-01.

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) 1998-11-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1998-11-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annex A is informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61675-1:1998 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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 60788	1984	Medical radiology - Terminology	HD 501 S1	1988

INTERNATIONAL STANDARD

IEC 61675-1

First edition
1998-02

Radionuclide imaging devices – Characteristics and test conditions –

Part 1: Positron emission tomographs

Dispositifs d'imagerie par radionucléides – Caractéristiques et conditions d'essai –

Partie 1: Tomographes à émission de positrons

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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RADIONUCLIDE IMAGING DEVICES – CHARACTERISTICS AND TEST CONDITIONS –

Part 1: Positron emission tomographs

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61675-1 has been prepared by subcommittee 62C: Equipment for radiotherapy, nuclear medicine and radiation dosimetry, of IEC technical committee 62: Electrical equipment in medical practice.

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

FDIS	Report on voting
62C/205/FDIS	62C/214/RVD

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

In this standard, the following print types are used:

– TERMS DEFINED IN CLAUSE 2 OF THIS STANDARD OR LISTED IN ANNEX A: SMALL CAPITALS.

The requirements are followed by specifications for the relevant tests.

Annex A is for information only.

A bilingual version of this standard may be issued at a later date.

RADIONUCLIDE IMAGING DEVICES – CHARACTERISTICS AND TEST CONDITIONS –

Part 1: Positron emission tomographs

1 General

1.1 Scope and object

This part of IEC 61675 specifies terminology and test methods for declaring the characteristics of POSITRON EMISSION TOMOGRAPHS. POSITRON EMISSION TOMOGRAPHS detect the ANNIHILATION RADIATION of positron emitting RADIONUCLIDES by COINCIDENCE DETECTION.

The test methods specified in this part of IEC 61675 have been selected to reflect as much as possible the clinical use of POSITRON EMISSION TOMOGRAPHS. It is intended that the test methods be carried out by manufacturers, thereby enabling them to declare the characteristics of POSITRON EMISSION TOMOGRAPHS. So, the specifications given in the ACCOMPANYING DOCUMENTS shall be in accordance with this standard. This standard does not imply which tests will be performed by the manufacturer on an individual tomograph.

No test has been specified to characterize the uniformity of reconstructed images, because all methods known so far will mostly reflect the noise in the image.

1.2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of IEC 61675. At the time of publication, the edition indicated was valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 61675 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60788:1984, *Medical radiology – Terminology*

2 Terminology and definitions

For the purpose of this part of IEC 61675, the definitions given in IEC 60788 (see annex A) and the following definitions apply.

Defined terms are printed in small capitals.

2.1 TOMOGRAPHY (see annex A)

2.1.1
TRANSVERSE TOMOGRAPHY
in TRANSVERSE TOMOGRAPHY the three-dimensional object is sliced by physical methods, for example collimation, into a stack of OBJECT SLICES, which are considered as being two-dimensional and independent from each other. The transverse IMAGE PLANES are perpendicular to the SYSTEM AXIS.

2.1.2
EMISSION COMPUTED TOMOGRAPHY (ECT)
imaging method for the representation of the spatial distribution of incorporated RADIONUCLIDES in selected two-dimensional slices through the object

2.1.2.1
PROJECTION
transformation of a three-dimensional object into its two-dimensional image or of a two-dimensional object into its one-dimensional image, by integrating the physical property which determines the image along the direction of the PROJECTION BEAM

NOTE – This process is mathematically described by line integrals in the direction of projection (along the LINE OF RESPONSE) and called Radon-transform.

2.1.2.2
PROJECTION BEAM
determines the smallest possible volume in which the physical property which determines the image is integrated during the measurement process. Its shape is limited by SPATIAL RESOLUTION in all three dimensions.

NOTE – The PROJECTION BEAM mostly has the shape of a long thin cylinder or cone. In POSITRON EMISSION TOMOGRAPHY, it is the sensitive volume between two detector elements operated in coincidence.

2.1.2.3
PROJECTION ANGLE
angle at which the PROJECTION is measured or acquired

2.1.2.4
SINOGRAM
two-dimensional display of all one-dimensional PROJECTIONS of an OBJECT SLICE, as a function of the PROJECTION ANGLE. The PROJECTION ANGLE is displayed on the ordinate, the linear PROJECTION coordinate is displayed on the abscissa.

2.1.2.5
OBJECT SLICE
slice in the object. The physical property of this slice, that determines the measured information, is displayed in the tomographic image.

2.1.2.6
IMAGE PLANE
a plane assigned to a plane in the OBJECT SLICE

NOTE – Usually the IMAGE PLANE is the midplane of the corresponding OBJECT SLICE.

2.1.2.7
SYSTEM AXIS
axis of symmetry, characterized by geometrical and physical properties of the arrangement of the system

NOTE – For a circular POSITRON EMISSION TOMOGRAPH, the SYSTEM AXIS is the axis through the centre of the detector ring. For tomographs with rotating detectors it is the axis of rotation.

2.1.2.8
TOMOGRAPHIC VOLUME
juxtaposition of all volume elements which contribute to the measured PROJECTIONS for all PROJECTION ANGLES

2.1.2.8.1
TRANSVERSE FIELD OF VIEW
dimensions of a slice through the TOMOGRAPHIC VOLUME, perpendicular to the SYSTEM AXIS. For a circular TRANSVERSE FIELD OF VIEW, it is described by its diameter

NOTE – For non-cylindrical TOMOGRAPHIC VOLUMES the TRANSVERSE FIELD OF VIEW may depend on the axial position of the slice.

2.1.2.8.2
AXIAL FIELD OF VIEW
dimensions of a slice through the TOMOGRAPHIC VOLUME, parallel to and including the SYSTEM AXIS. In practice, it is specified only by its axial dimension, given by the distance between the centre of the outmost defined IMAGE PLANEs plus the average of the measured AXIAL SLICE WIDTH

2.1.2.8.3
TOTAL FIELD OF VIEW
dimensions (three-dimensional) of the TOMOGRAPHIC VOLUME

2.1.3
POSITRON EMISSION TOMOGRAPHY (PET)
EMISSION COMPUTED TOMOGRAPHY utilizing the ANNIHILATION RADIATION of positron emitting RADIONUCLIDES by COINCIDENCE DETECTION

2.1.3.1
POSITRON EMISSION TOMOGRAPH
tomographic device, which detects the ANNIHILATION RADIATION of positron emitting RADIONUCLIDES by COINCIDENCE DETECTION

2.1.3.2
ANNIHILATION RADIATION
ionizing radiation that is produced when a particle and its antiparticle interact and cease to exist

2.1.3.3
COINCIDENCE DETECTION
a method which checks whether two opposing detectors have detected one photon each simultaneously. By this method the two photons are concatenated into one event.

NOTE – The COINCIDENCE DETECTION between two opposing detector elements serves as an electronic collimation to define the corresponding PROJECTION BEAM or LINE OF RESPONSE (LOR), respectively.

2.1.3.4
COINCIDENCE WINDOW
time interval during which two detected photons are considered being simultaneous

2.1.3.5
LINE OF RESPONSE (LOR)
the axis of the PROJECTION BEAM

NOTE – In PET, it is the line connecting the centres of two opposing detector elements operated in coincidence.

2.1.3.6
TOTAL COINCIDENCES
sum of all coincidences detected

2.1.3.6.1
TRUE COINCIDENCE
result of COINCIDENCE DETECTION of two gamma events originating from the same positron annihilation

2.1.3.6.2
SCATTERED TRUE COINCIDENCE
TRUE COINCIDENCE where at least one participating photon was scattered before the COINCIDENCE DETECTION

2.1.3.6.3
UNSCATTERED TRUE COINCIDENCE
the difference between TRUE COINCIDENCES and SCATTERED TRUE COINCIDENCES

2.1.3.6.4
RANDOM COINCIDENCE
result of COINCIDENCE DETECTION in which both participating photons emerge from different positron annihilations

2.1.3.7
SINGLES RATE
COUNT RATE measured without COINCIDENCE DETECTION, but with energy discrimination

2.1.4 Reconstruction

2.1.4.1
TWO-DIMENSIONAL RECONSTRUCTION
in TWO-DIMENSIONAL RECONSTRUCTION, the data are rebinned prior to reconstruction into SINOGRAMS, which are the PROJECTION data of transverse slices, which are considered being independent of each other and being perpendicular to the SYSTEM AXIS. So, each event will be assigned, in the axial direction, to that transverse slice passing the midpoint of the corresponding LINE OF RESPONSE. Any deviation from perpendicularity to the SYSTEM AXIS is neglected. The data are then reconstructed by two-dimensional methods, i.e. each slice is reconstructed from its associated SINOGRAM, independent of the rest of the data set.

NOTE – This is the standard method of reconstruction for POSITRON EMISSION TOMOGRAPHS using small axial acceptance angles, i.e. utilizing septa. For POSITRON EMISSION TOMOGRAPHS using large axial acceptance angles, i.e. without septa, this method is also called 'single slice rebinning'.

2.1.4.2
THREE-DIMENSIONAL RECONSTRUCTION
in THREE-DIMENSIONAL RECONSTRUCTION, the LINES OF RESPONSE are not restricted to being perpendicular to the SYSTEM AXIS. So, a LINE OF RESPONSE may pass several transverse slices. Consequently, transverse slices cannot be reconstructed independent of each other. Each slice has to be reconstructed utilizing the full three-dimensional data set.

2.2
IMAGE MATRIX
arrangement of MATRIX ELEMENTS in a preferentially cartesian coordinate system

2.2.1
MATRIX ELEMENT
smallest unit of an IMAGE MATRIX, which is assigned in location and size to a certain volume element of the object (VOXEL)

2.2.1.1
PIXEL
matrix element in a two-dimensional IMAGE MATRIX

2.2.1.2
TRIXEL
matrix element in a three-dimensional IMAGE MATRIX