

TECHNICAL REPORT

**Nuclear medicine instrumentation – Routine tests –
Part 2: Scintillation cameras and single photon emission computed tomography
imaging**

IEC TR 61948-2:2019
<https://standards.iteh.ai/catalog/standards/sist/19c9617a-2f73-48b1-b10e-2dcf288f5c90/iec-tr-61948-2-2019>



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2019 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.

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 It also gives information on projects, replaced and withdrawn publications.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.

[IEC TR 61948-2:2019](https://standards.iteh.ai/catalog/standards/sist/9c9617a-2f73-48b1-b10e-2dcf288f5c90/iec-tr-61948-2-2019)

<https://standards.iteh.ai/catalog/standards/sist/9c9617a-2f73-48b1-b10e-2dcf288f5c90/iec-tr-61948-2-2019>

TECHNICAL REPORT

**Nuclear medicine instrumentation – Routine tests –
Part 2: Scintillation cameras and single photon emission computed tomography
imaging**

STANDARD PREVIEW
(standards.iteh.ai)
<https://standards.iteh.ai/catalog/standards/sist/19c9617a-2f73-48b1-b10e-2dcf288f5c90/iec-tr-61948-2-2019>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 11.040.50

ISBN 978-2-8322-7239-8

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	3
1 Scope.....	5
2 Normative references	5
3 Terms and definitions	5
4 Test methods.....	10
4.1 General.....	10
4.2 Planar imaging.....	10
4.2.1 ENERGY WINDOW setting	10
4.2.2 Background	10
4.2.3 Constancy of sensitivity	10
4.2.4 Non-uniformity	10
4.2.5 PIXEL size	11
4.2.6 Resolution/linearity	11
4.3 SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT).....	11
4.3.1 CENTRE OF ROTATION (COR)	11
4.3.2 Tomographic non-uniformity	13
4.3.3 SPECT/CT co-registration	13
4.4 Wholebody imaging.....	13
4.5 Frequency of ROUTINE TESTS	14
Bibliography.....	15
Index of defined terms	16
https://standards.iteh.ai/catalog/standards/sist/19c9617a-2f73-48b1-b10e-2dc12885c90/iec-tr-61948-2-2019	
Figure 1 – Cylindrical phantom.....	7
Figure 2 – Geometry of PROJECTIONS	12
Table 1 – Frequency of ROUTINE TESTS	14

ITEH STANDARD PREVIEW
(standards.iteh.ai)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

NUCLEAR MEDICINE INSTRUMENTATION – ROUTINE TESTS –**Part 2: Scintillation cameras and single photon
emission computed tomography imaging**

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.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a Technical Report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 61948-2, which is a Technical Report, has been prepared by subcommittee 62C: Equipment for radiotherapy, nuclear medicine and radiation dosimetry, of IEC technical committee 62: Electrical equipment in medical practice.

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

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

- a) adaptation to apply to the present technology;
- b) updating of the test methods to comply with the recent state of the art.

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

Draft TR	Report on voting
62C/714/DTR	62C/733/RVDTR

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

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

In this document, the following print types are used:

- requirements, compliance with which can be tested, and definitions: roman type;
- notes, explanations, advice, introductions, general statements, exceptions and references: smaller roman type;
- *test specifications: italic type;*
- TERMS DEFINED IN CLAUSE 3 OF THIS DOCUMENT: SMALL CAPITALS.

The requirements are followed by specifications for the relevant tests.

A list of all parts in the IEC 61948 series, published under the general title *Nuclear medicine instrumentation – Routine tests*, can be found on the IEC website.

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

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

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

NUCLEAR MEDICINE INSTRUMENTATION – ROUTINE TESTS –

Part 2: Scintillation cameras and single photon emission computed tomography imaging

1 Scope

This part of IEC 61948, which is a Technical Report, is valid for single photon scintillation cameras with parallel hole collimators used in planar scintigraphy and tomography. It is also valid for the SPECT portion of SPECT/CT systems with parallel hole collimators, including the co-registration between the SPECT and CT subsystems. The objective is to specify ROUTINE TESTS for QUALITY CONTROL. Methods for the ACCEPTANCE TEST are described in IEC 61675-2.

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 TR 60788:2004, *Medical electrical equipment – Glossary of defined terms*

IEC 61675-2:2015, *Radionuclide imaging devices – Characteristics and test conditions – Part 2: Gamma cameras for planar, wholebody, and SPECT imaging*

<https://standards.iteh.ai/catalog/standards/sist/9c9617a-2f73-48b1-b10e-1c4c94e22017>

IEC TR 61948-1:2016, *Nuclear medicine instrumentation – Routine tests – Part 1: Gamma radiation counting systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60788, IEC 61675-2, and IEC TR 61948-1 and the following 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>

NOTE Defined terms are printed in small capital letters.

3.1

ACCEPTANCE TEST

test carried out after new EQUIPMENT has been installed, or major modifications have been made to existing EQUIPMENT, in order to verify compliance with contractual specifications

Note 1 to entry: During or immediately after ACCEPTANCE TEST, REFERENCE DATA are collected to be used as a standard for comparison with future ROUTINE TESTS.

[SOURCE: IEC TR 60788:2004, rm-70-01, modified – The note to entry has been added.]

3.2

QUALITY CONTROL

<nuclear medicine> part of the quality assurance including tests of instruments with appropriate test methods

Note 1 to entry: Includes both ACCEPTANCE TEST and ROUTINE TEST.

[SOURCE: IEC TR 61948-1:2016, 3.5]

3.3

ROUTINE TEST

test of a piece of equipment or its components, which is repeated at specified intervals, to establish and document changes from the initial status described by REFERENCE DATA

Note 1 to entry: A ROUTINE TEST could be carried out by the user with simple test methods and equipment.

[SOURCE: IEC TR 61948-1:2016, 3.8]

3.4

REFERENCE DATA

set of data measured immediately after ACCEPTANCE TEST, using test methods designed for ROUTINE TEST

[SOURCE: IEC TR 61948-1:2016, 3.7]

3.5

DETECTOR HEAD

radiation detector, collimator and radiation shield

[SOURCE: IEC TR 60788:2004, rm-34-09, modified – The definition has been rephrased.]

3.6

DETECTOR HEAD TILT

deviation of the COLLIMATOR AXIS from orthogonality with the SYSTEM AXIS

[SOURCE: IEC 61675-2:2015, 3.12]

3.7

DETECTOR FIELD OF VIEW

FOV

region of the detector within which events are included in the display image, and for which all performance specifications are provided

[SOURCE: IEC 61675-2:2015, 3.11, modified – The note to entry has been deleted.]

3.8

SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY

SPECT

EMISSION COMPUTED TOMOGRAPHY utilizing single photon detection of gamma-ray emitting RADIONUCLIDES

[SOURCE: IEC 61675-2:2015, 3.44, modified – The note to entry has been deleted.]

3.9**NON-UNIFORMITY OF RESPONSE**

in a RADIONUCLIDE imaging device, difference in count rate between small areas of specified dimensions within the DETECTOR FIELD OF VIEW when a uniform plane source parallel to the detector face and of dimensions larger than its entrance field is used

[SOURCE: IEC TR 60788:2004, rm-34-26]

3.10**INTRINSIC NON-UNIFORMITY OF RESPONSE**

NON-UNIFORMITY OF RESPONSE of the DETECTOR HEAD without COLLIMATOR

[SOURCE: IEC 61675-2:2015, 3.22]

3.11**SYSTEM NON-UNIFORMITY OF RESPONSE**

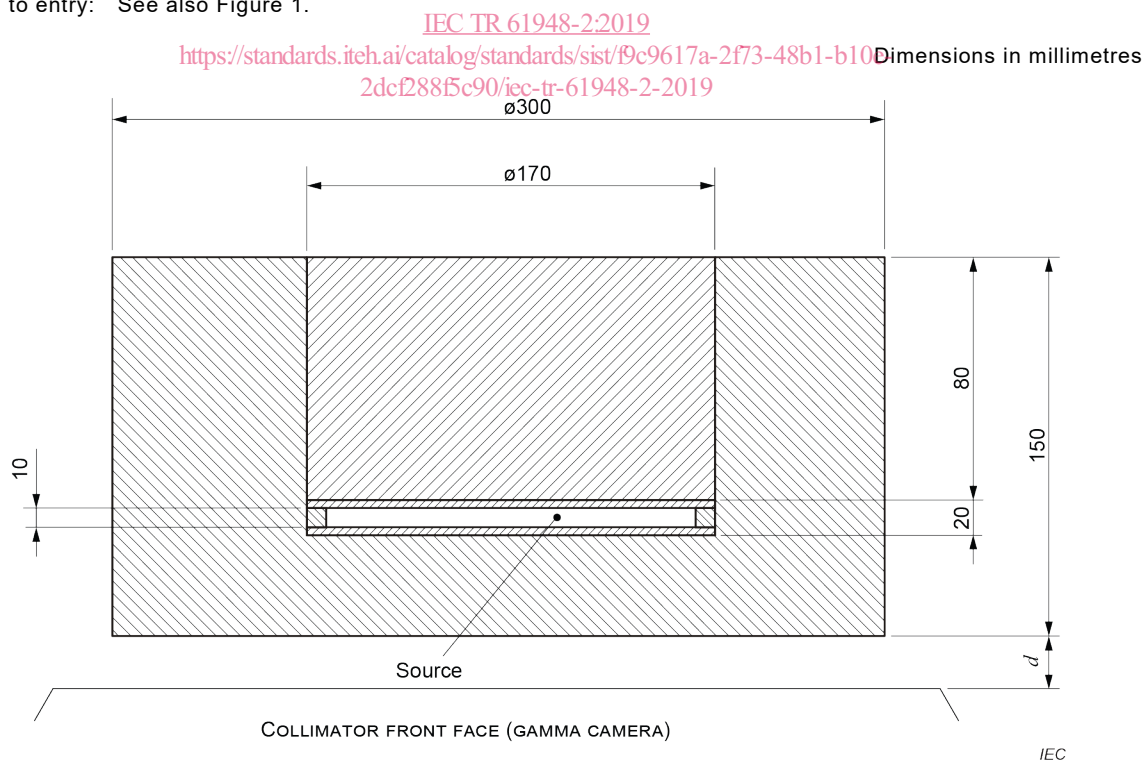
NON-UNIFORMITY OF RESPONSE of the DETECTOR HEAD with COLLIMATOR

[SOURCE: IEC 61675-2:2015, 3.50]

3.12**SYSTEM SENSITIVITY**

<GAMMA CAMERA> with a specified COLLIMATOR and ENERGY WINDOW, the ratio of the COUNT RATE of the DETECTOR HEAD to the ACTIVITY of a plane source of specific dimensions and containing a specified RADIONUCLIDE placed perpendicular to and centred on the COLLIMATOR AXIS under specified conditions (standards.iteh.ai)

Note 1 to entry: See also Figure 1.



Material: polymethylmetacrylate

Figure 1 – Cylindrical phantom

[SOURCE: IEC 61675-2:2015, 3.51]

3.13**IMAGE MATRIX**

arrangement of MATRIX ELEMENTS in a preferentially Cartesian coordinate system

[SOURCE: IEC 61675-2:2015, 3.18]

3.14**OFFSET**

deviation of the position of the PROJECTION of the COR (X'_p) from $X_p = 0$

[SOURCE: IEC 61675-2:2015, 3.30, modified – The reference to Figure 1 has been deleted in the definition.]

3.15**SINOGRAM**

the two dimensional display of all one-dimensional PROJECTIONS of an OBJECT SLICE, as a function of the PROJECTION ANGLE

Note 1 to entry: The PROJECTION ANGLE is displayed on the ordinate. The linear PROJECTION coordinate is displayed on the abscissa

[SOURCE: IEC 61675-2:2015, 3.45]

3.16**RADIONUCLIDE**

radioactive nuclide

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SOURCE: IEC TR 60788:2004, rm-11-22]

[IEC TR 61948-2:2019](#)

3.17**ACTIVITY**

A

quantitative indication of the radioactivity of an amount of RADIONUCLIDE in a particular energy state at a given time

<https://standards.iteh.ai/catalog/standards/sist/19c9617a-2f73-48b1-b10e-2dcf288f5c90/iec-tr-61948-2-2019>

Note 1 to entry: ACTIVITY is determined as the quotient of dN by dt , where dN is the expectation value of the number of spontaneous nuclear transitions from that energy state in the time interval dt :

$$A = \frac{dN}{dt}$$

The unit of ACTIVITY is the reciprocal second (s^{-1}). The special name of the unit of ACTIVITY is the becquerel (Bq), 1 Bq being equal to one transition per second. The earlier unit of ACTIVITY was the curie (Ci), 1 Ci being equal to $3,7 \times 10^{10}$ transitions per second.

[SOURCE: IEC TR 60788:2004, rm-13-18]

3.18**COLLIMATOR AXIS**

straight line which passes through the geometrical centre of the exit and entrance fields of the collimator

[SOURCE: IEC 61675-2:2015, 3.5]

3.19**MATRIX ELEMENT**

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

[SOURCE: IEC 61675-2:2015, 3.26]

3.20

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 1 to entry: This process is mathematically described by line integrals in the direction of PROJECTION and called the Radon-transform.

[SOURCE: IEC 61675-2:2015, 3.37]

3.21

OBJECT SLICE

slice in the object

Note 1 to entry: The physical property of this slice that determines the measured information is displayed in the tomographic image

[SOURCE: IEC 61675-2:2015, 3.29]

3.22

PROJECTION ANGLE

angle at which the PROJECTION is measured or acquired

[SOURCE: IEC 61675-2:2015, 3.38, modified – The note to entry has been deleted.]

3.23

POINT SOURCE

radioactive source approximating a δ -function in all three dimensions

IEC TR 61948-2:2019

<https://standards.iteh.ai/catalog/standards/sist/9c9617a-2f73-48b1-b10e-2dcf2885c90/iec-tr-61948-2-2019>

[SOURCE: IEC 61675-2:2015, 3.35]

3.24

SYSTEM AXIS

axis of symmetry characterized by geometrical and physical properties of the arrangement of the system

Note 1 to entry: The SYSTEM AXIS of a gamma camera with rotating detectors is the axis of rotation.

Note 2 to entry: 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.

[SOURCE: IEC 61675-2:2015, 3.49, modified – Note 2 to entry has been added.]

3.25

RADIUS OF ROTATION

distance between the SYSTEM AXIS and the collimator front face

[SOURCE: IEC 61675-2:2015, 3.42]