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Responsible committee: CH/62/3 Equipment for radiotherapy, nuclear medicine and radiation dosimetry

Interested committees:

Title: BS EN 61675-2 Radionuclide imaging devices - Characteristics and test conditions

Part 2: Gamma cameras for planar, wholebody, and SPECT imaging

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



62C/871/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 61675-2 ED3

DATE OF CIRCULATION:

2023-05-05

CLOSING DATE FOR COMMENTS:

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SUPERSEDES DOCUMENTS:

62C/870/RR

IEC SC 62C : EQUIPMENT FOR RADIOTHERAPY, NUCLEAR MEDICINE AND RADIATION DOSIMETRY

SECRETARIAT:

Germany

SECRETARY:

Ms Regina Geierhofer

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☒ QUALITY ASSURANCE

☐ SAFETY

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TITLE:

Radionuclide imaging devices - Characteristics and test conditions - Part 2: Gamma cameras for planar, wholebody, and SPECT imaging

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**RADIONUCLIDE IMAGING DEVICES –
CHARACTERISTICS AND TEST CONDITIONS –****Part 2: Gamma cameras for planar, wholebody, and SPECT imaging****FOREWORD**

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IEC 61675-2 has been prepared by subcommittee 62C: Equipment for radiotherapy, nuclear medicine and radiation dosimetry, of IEC technical committee 62: Medical equipment, software, and systems. It is an International Standard.

This third edition cancels and replaces the second edition published in 2015. It combines IEC 60789:1992, IEC 61675-2:1998, IEC 61675-2:1998/AMD1:2004, and IEC 61675-3:1998. It has been modified to address systems based on pixelated semi-conductor detectors. Tests for wholebody SPECT performance and quantitative SPECT image accuracy have been added. It has been reformatted, updated, and partly aligned with NEMA NU 1-2018. Due to the lack of market share of SPECT-systems operated in coincidence mode all such tests have been removed. This edition constitutes a technical revision.

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

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

150
151 Full information on the voting for its approval can be found in the report on voting indicated in
152 the above table.

153 The language used for the development of this International Standard is English.

154 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
155 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement,
156 available at www.iec.ch/members_experts/refdocs. The main document types developed by
157 IEC are described in greater detail at www.iec.ch/publications.

158 In this standard, the following print types are used:

159 – TERMS DEFINED IN CLAUSE 3 OF THIS STANDARD OR LISTED IN THE INDEX OF DEFINED TERMS:
160 SMALL CAPITALS.

161 The requirements are followed by specifications for the relevant tests.

162 The committee has decided that the contents of this document will remain unchanged until the
163 stability date indicated on the IEC website under webstore.iec.ch in the data related to the
164 specific document. At this date, the document will be

- 165 • reconfirmed,
- 166 • withdrawn,
- 167 • replaced by a revised edition, or
- 168 • amended.

169

170

INTRODUCTION

171 The test methods specified in this part of IEC 61675 have been selected to reflect as much as
172 possible the clinical use of GAMMA CAMERAS for planar imaging, PLANAR WHOLEBODY IMAGING
173 EQUIPMENT, and SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT). It is intended that
174 the test methods are carried out by manufacturers thereby enabling them to describe the
175 characteristics of the systems on a common basis.

176

RADIONUCLIDE IMAGING DEVICES – CHARACTERISTICS AND TEST CONDITIONS –

Part 2: Gamma cameras for planar, wholebody, and SPECT imaging

1 Scope

This part of IEC 61675 specifies terminology and test methods for describing the characteristics of GAMMA CAMERAS equipped with PARALLEL HOLE COLLIMATORS that are capable of planar imaging. Additional tests are specified for those GAMMA CAMERAS that are capable of SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT) or planar wholebody imaging (PLANAR WHOLEBODY IMAGING EQUIPMENT) or SPECT wholebody imaging. SPECT systems may also be equipped with a CT system for hybrid imaging.

These GAMMA CAMERAS consist of a gantry, single or multiple DETECTOR HEADS, and a computer for data acquisition, processing, storage, and display. The DETECTOR HEADS may contain single or multiple scintillation crystals or solid state detectors.

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 61675-1:2022, *Radionuclide imaging devices – Characteristics and test conditions – Part 1: Positron emission tomographs*

IEC 63073-1:2020, *Dedicated radionuclide imaging devices – Characteristics and test conditions – Part 1: Cardiac SPECT*

3 Terms and definitions

For the purposes of this document the terms and definitions given in IEC TR 60788:2004, IEC 63071-1:2020 and IEC 61675-1:2022 (some of which are repeated here for convenience), and the following terms and definitions apply.

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

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

3.1

ADDRESS PILE UP

<GAMMA CAMERA> false address calculation of an artificial event which passes the ENERGY WINDOW, but is formed from two or more events by the PILE UP EFFECT

3.2

AXIAL FIELD OF VIEW

dimensions of a slice through the TOMOGRAPHIC VOLUME parallel to and including the SYSTEM AXIS

219 Note 1 to entry: In practice it is specified only by its axial dimension given by the distance between the centres of
220 the outermost defined IMAGE PLANES plus the average of the measured AXIAL SLICE WIDTH measured as EQUIVALENT
221 WIDTH (EW).

222 3.3

223 AXIAL RESOLUTION

224 for tomographs with sufficiently fine axial sampling fulfilling the sampling theorem, SPATIAL
225 RESOLUTION along a line parallel to the SYSTEM AXIS

226 3.4

227 BAD PIXEL

228 detector pixel within the DETECTOR FIELD OF VIEW of the detector that has been physically or
229 electronically turned off such that gamma rays which interact in that pixel are not recorded by
230 the camera

231 [SOURCE: IEC 63073-1:2020, 3.2]

232 3.5

233 CENTRE OF ROTATION

234 COR

235 origin of that coordinate system, which describes the PROJECTIONS of a transverse slice with
236 respect to their orientation in space

237 Note 1 to entry: The CENTRE OF ROTATION of a transverse slice is given by the intersection of the SYSTEM AXIS with
238 the mid-plane of the corresponding OBJECT SLICE.

239 Note 2 to entry: The second note to entry concerns the French text only.

240 3.6

241 COLLIMATOR AXIS

242 straight line which passes through the geometrical centre of the exit field and entrance field of
243 the COLLIMATOR

244 3.7

245 COLLIMATOR FRONT FACE

246 surface of the COLLIMATOR which is closest to the object being imaged

247 3.8

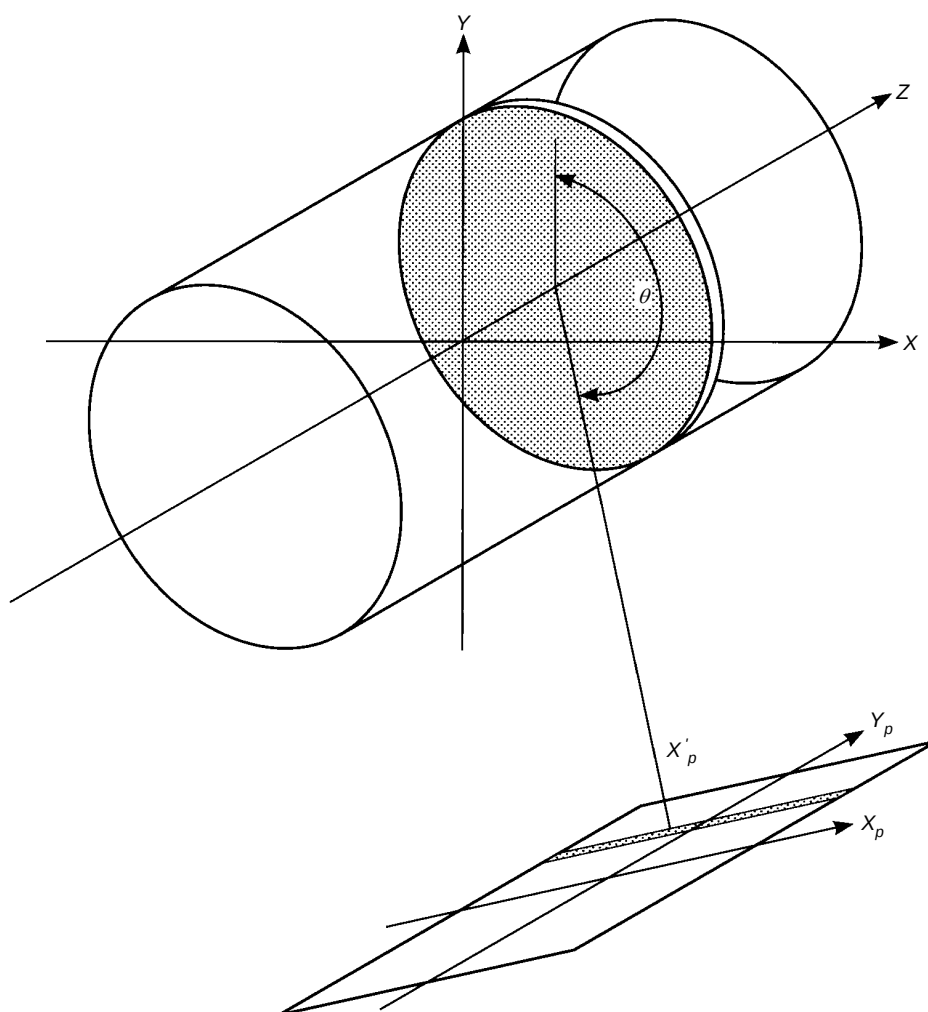
248 COORDINATE SYSTEM OF PROJECTION

249 Cartesian system of the IMAGE MATRIX of each two-dimensional PROJECTION with axes X_p and
250 Y_p

251 Note 1 to entry: Axes X_p and Y_p are defined by the axes of the IMAGE MATRIX.

252 Note 2 to entry: The Y_p axis and the PROJECTION of the SYSTEM AXIS onto the COLLIMATOR FRONT FACE have to be
253 in parallel.

254 Note 3 to entry: The origin of the COORDINATE SYSTEM OF PROJECTION may be the centre of the IMAGE MATRIX (see
255 Figure 1).



IEC 151/98

Figure 1 – Geometry of PROJECTIONS

3.9

COUNT LOSS

difference between measured COUNT RATE and TRUE COUNT RATE, which is caused by the finite RESOLVING TIME of the instrument

[SOURCE: IEC 61675-1:2022, 3.8.1]

3.10

COUNT RATE

number of counts per unit of time

[SOURCE: IEC 61675-1:2022, 3.8.2]

3.11

COUNT RATE CHARACTERISTIC

function giving the relationship between observed COUNT RATE and TRUE COUNT RATE

274 [SOURCE: IEC TR 60788:2004, rm-34-21]

275 **3.12**

276 **DETECTOR FIELD OF VIEW**

277 **FOV**

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

280 Note 1 to entry: The note to entry regarding the abbreviation concerns the French text only.

281 **3.13**

282 **DETECTOR HEAD TILT**

283 deviation of the COLLIMATOR AXIS from orthogonality with the SYSTEM AXIS

284 **3.14**

285 **DETECTOR POSITIONING TIME**

286 fraction of the total time spent on an acquisition which is not used in collecting data

287 **3.15**

288 **DETECTOR PIXEL**

289 smallest discrete unit of a pixelated DETECTOR HEAD that is able to provide distinct energy,
290 spatial, and timing information about detected photons

291 **3.16**

292 **EMISSION COMPUTED TOMOGRAPHY**

293 **ECT**

294 imaging method for the representation of the spatial distribution of RADIONUCLIDES in selected
295 two-dimensional slices through the object

296 **3.17**

297 **ENERGY WINDOW**

298 range defining the energy of the signals accepted by the device for further processing

299 **3.18**

300 **EQUIVALENT WIDTH**

301 **EW**

302 width of that rectangle having the same area and the same height as the response function,
303 e.g., the POINT SPREAD FUNCTION

304 [SOURCE: IEC TR 60788:2004, rm-34-45]

305 **3.19**

306 **FIXED COORDINATE SYSTEM**

307 Cartesian system with axes X, Y, and Z

308 Note 1 to entry: Z being the SYSTEM AXIS.

309 Note 2 to entry: The origin of the FIXED COORDINATE SYSTEM is defined by the centre of the TOMOGRAPHIC VOLUME
310 (see Figure 1).

311 Note 3 to entry: The SYSTEM AXIS is orthogonal to all transverse slices.

312 **3.20**

313 **IMAGE MATRIX**

314 arrangement of MATRIX ELEMENTS in a preferentially Cartesian coordinate system

315 **3.21**

316 **IMAGE PLANE**

317 plane assigned to a plane in the OBJECT SLICE

318 Note 1 to entry: Usually the IMAGE PLANE is the mid-plane of the corresponding OBJECT SLICE.

319 **3.22**

320 **INTRINSIC ENERGY RESOLUTION**

321 FULL WIDTH AT HALF MAXIMUM of the full energy absorption peak in the INTRINSIC ENERGY
322 SPECTRUM for a specified RADIONUCLIDE

323 **3.23**

324 **INTRINSIC ENERGY SPECTRUM**

325 measured histogram of pulse heights for the DETECTOR HEAD without COLLIMATOR

326 Note 1 to entry: The pulse height should be expressed as corresponding energy.

327 **3.24**

328 **INTRINSIC NON-UNIFORMITY OF RESPONSE**

329 NON-UNIFORMITY OF RESPONSE of the DETECTOR HEAD without COLLIMATOR

330 **3.25**

331 **INTRINSIC SPATIAL NON-LINEARITY**

332 SPATIAL NON-LINEARITY of the DETECTOR HEAD without COLLIMATOR

333 **3.26**

334 **INTRINSIC SPATIAL RESOLUTION**

335 <GAMMA CAMERA> SPATIAL RESOLUTION in air for a specified RADIONUCLIDE measured without
336 the COLLIMATOR

337 **3.27**

338 **LINE SOURCE**

339 straight RADIOACTIVE SOURCE approximating a δ -function in two dimensions and being constant
340 (uniform) in the third dimension

341 **3.28**

342 **LOW-ENERGY-TAIL RATIO**

343 ratio of the counts measured in an energy window of width $2 \cdot E_{FWHM}$ centred at energy E_{peak} -
344 $2 \cdot E_{FWHM}$ divided by the counts measured in an energy window of width $2 \cdot E_{FWHM}$ centred at an
345 energy of E_{peak} , where E_{peak} is the peak energy of the RADIOISOTOPE being measured and
346 E_{FWHM} is the energy resolution of the detector

347 [SOURCE: IEC 63073-1:2020, 3.12]

348 **3.29**

349 **MATRIX ELEMENT**

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

352 **3.30**

353 **MULTIPLE WINDOW SPATIAL REGISTRATION**

354 measured position of a source as a function of the ENERGY WINDOW setting

355 **3.31**

356 **NORMALIZED VOLUME SENSITIVITY**

357 VOLUME SENSITIVITY divided by the AXIAL FIELD OF VIEW of the tomograph or the phantom
358 length, whichever is the smaller

359 **3.32**

360 **OBJECT SLICE**

361 slice in the object

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

364 **3.33**

365 **OFFSET**

366 deviation of the position of the PROJECTION of the COR (X'_p) from $X_p = 0$ (see Figure 1)

367 **3.34**

368 **PARALLEL HOLE COLLIMATOR**

369 COLLIMATOR with a number of apertures, the axes of which are parallel

370 **3.35**

371 **PILE UP EFFECT**

372 false measurement of the pulse amplitude, due to the absorption of two or more gamma rays,
373 reaching the same radiation detector within the RESOLVING TIME

374 **3.36**

375 **PIXEL**

376 MATRIX ELEMENT in a two-dimensional IMAGE MATRIX

377 **3.37**

378 **PLANAR WHOLEBODY IMAGING EQUIPMENT**

379 <GAMMA CAMERA> GAMMA CAMERA, with one or two DETECTOR HEAD(S), in which the image of an
380 extended object is formed by moving the DETECTOR HEAD(S) or the object in the axial direction
381 relative to each other

382 **3.38**

383 **POINT SOURCE**

384 RADIOACTIVE SOURCE approximating a δ -function in all three dimensions

385 **3.39**

386 **POINT SPREAD FUNCTION**

387 **PSF**

388 scintigraphic image of a POINT SOURCE

389 **3.40**

390 **PROJECTION**

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

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

396 **3.41**

397 **PROJECTION ANGLE**

398 angle at which the PROJECTION is measured or acquired

399 Note 1 to entry: See Figure 1.

400 **3.42**

401 **PROJECTION BEAM**

402 determines the smallest possible volume in which the physical property which determines the
403 image is integrated during the measurement process

404 Note 1 to entry: Its shape is limited by the SPATIAL RESOLUTION in all three dimensions and may vary with photon
405 energy and COLLIMATOR design.

406 Note 2 to entry: In SPECT the PROJECTION BEAM usually has the shape of a long thin diverging cone.

3.43**RADIAL RESOLUTION**

TRANSVERSE RESOLUTION along a line passing through the position of the source and the SYSTEM AXIS

[SOURCE: IEC 61675-1:2022, 3.4.1.1]

3.44**RADIOACTIVE SOURCE**

quantity of radioactive material having both an ACTIVITY and a specific ACTIVITY above specific levels

[SOURCE: IEC TR 60788:2004, rm-20-02]

3.45**RADIUS OF ROTATION**

distance between the SYSTEM AXIS and the COLLIMATOR FRONT FACE

3.46**SCATTER FRACTION****SF**

<GAMMA CAMERA> ratio between the number of scattered photons and the sum of scattered plus unscattered photons for a given experimental set-up which includes a specific ENERGY WINDOW size and position and a specific scattering medium

3.47**SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY****SPECT**

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

Note 1 to entry: The note to entry regarding the abbreviation concerns the French version only.

3.48**SINOGRAM**

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 61675-1:2022, 3.1.1.4]

3.49**SLICE SENSITIVITY**

ratio of COUNT RATE as measured on the SINOGRAM to the ACTIVITY concentration in the phantom

Note 1 to entry: In SPECT the measured counts are not numerically corrected for scatter by subtracting the SCATTER FRACTION.

[SOURCE: IEC 61675-1:2022, 3.6, modified – The note to entry has been changed]

3.50**SPATIAL NON-LINEARITY**

deviations of the image of a straight LINE SOURCE from a straight line

3.51**SPATIAL RESOLUTION**

<nuclear medicine> ability to concentrate the count density distribution in the image of a POINT SOURCE to a point

[SOURCE: IEC 61675-1:2022, 3.4]

3.52**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.

[SOURCE: IEC 61675-1:2022, 3.1.1.7, modified – The note to entry has been changed]

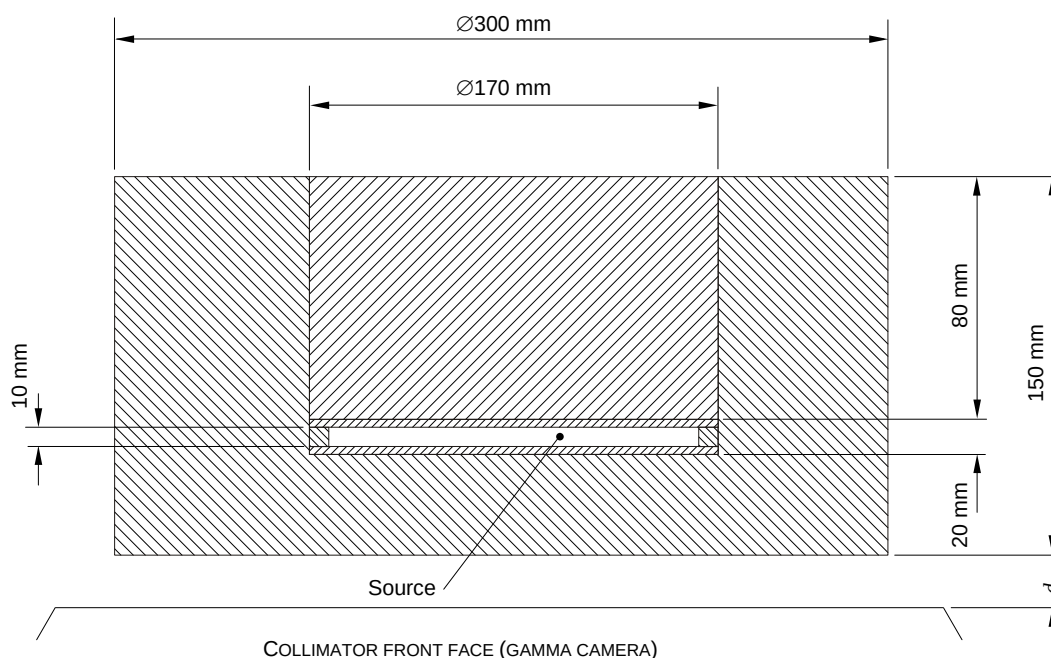
3.53**SYSTEM NON-UNIFORMITY OF RESPONSE**

NON-UNIFORMITY OF RESPONSE of the DETECTOR HEAD with COLLIMATOR

3.54**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

Note 1 to entry: See also Figure 2.



Material: polymethylmethacrylate

IEC 1707/05

Figure 2 – Cylindrical phantom

3.55**SYSTEM SPATIAL RESOLUTION**

<GAMMA CAMERA> SPATIAL RESOLUTION in a scattering medium for a specified COLLIMATOR, or a specified RADIONUCLIDE, and at a specified distance from the COLLIMATOR FRONT FACE

3.56**TANGENTIAL RESOLUTION**

TRANSVERSE RESOLUTION in the direction orthogonal to the direction of RADIAL RESOLUTION

[SOURCE: IEC 61675-1:2022, 3.4.1.2]

3.57**TOMOGRAPHIC VOLUME**

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

Note 1 to entry: For a rotating GAMMA CAMERA with a circular field of view the TOMOGRAPHIC VOLUME is a sphere provided that the RADIUS OF ROTATION is larger than the radius of the field of view. For a rectangular field of view, the TOMOGRAPHIC VOLUME is a cylinder.

[SOURCE: IEC 61675-1:2022, 3.1.1.8, modified – A note to entry has been added.]

3.58**TRANSVERSE POINT SPREAD FUNCTION**

reconstructed two-dimensional POINT SPREAD FUNCTION in a tomographic IMAGE PLANE

Note 1 to entry: In TOMOGRAPHY, the TRANSVERSE POINT SPREAD FUNCTION can also be obtained from a LINE SOURCE located parallel to the SYSTEM AXIS.

[SOURCE: IEC 61675-1:2022, 3.3.3]

3.59**TRANSVERSE RESOLUTION**

SPATIAL RESOLUTION in a reconstructed plane perpendicular to the SYSTEM AXIS

[SOURCE: IEC 61675-1:2022, 3.4.1]

3.60**VOLUME SENSITIVITY**

sum of the individual SLICE SENSITIVITIES

[SOURCE: IEC 61675-1:2022, 3.7]

3.61**VOXEL**

volume element in the object which is assigned to a MATRIX ELEMENT in a two- or three-dimensional IMAGE MATRIX

Note 1 to entry: The dimensions of the VOXEL are determined by the dimensions of the corresponding MATRIX ELEMENT via the appropriate scale factors and by the systems SPATIAL RESOLUTION in all three dimensions.

[SOURCE: IEC 61675-1:2022, 3.2.3]

4 Test methods**4.1 General**

All measurements shall be performed with the PULSE AMPLITUDE ANALYSER WINDOW set as specified in Table 1. Additional measurements with other settings as specified by the

manufacturer can be performed. Before the measurements are performed, the tomographic system shall be adjusted by the procedure normally used by the manufacturer for an installed unit and shall not be adjusted specially for the measurement of specific parameters. If any test cannot be carried out exactly as specified in this document, the reason for the deviation and the exact conditions under which the test was performed shall be stated clearly.

Table 1 – RADIONUCLIDES and ENERGY WINDOWS to be used for performance measurements

RADIONUCLIDE	ENERGY WINDOW keV
^{99m} Tc	141 (± 10 %)
¹³¹ I	364 (± 10 %)
⁶⁷ Ga	93, 184, 300 (± 10 %)
⁵⁷ Co	122 (± 10 %)
NOTE Because the characteristics of a GAMMA CAMERA may change noticeably between 122 keV (⁵⁷ Co) and 141 keV (^{99m} Tc), the former is not included as a suitable RADIONUCLIDE. However, it may be useful in some circumstances, e.g., for quality control.	

Unless otherwise specified, each DETECTOR HEAD in the system shall be characterized by a full data set.

Unless otherwise specified, SPECT characterization shall be provided for an acquisition covering the minimal rotation required to obtain a complete set of data (e.g., 120° for a three-headed system). If the tomograph is specified to operate in a non-circular orbiting mode influencing the performance parameters, test results for the non-circular orbiting mode shall be reported in addition. For SPECT characterization, all corrections that are used for clinical acquisitions are applied unless explicitly stated otherwise.

Unless otherwise specified, measurements shall be carried out at COUNT RATES not exceeding 40 000 counts per second.

4.2 Planar imaging

4.2.1 SYSTEM SENSITIVITY

4.2.1.1 General

SYSTEM SENSITIVITY is a parameter that characterizes the effectiveness of a system to identify the radiation emitted from a RADIOACTIVE SOURCE, i.e., the rate at which events are detected in the presence of a RADIOACTIVE SOURCE with low ACTIVITY where COUNT LOSSES are negligible. The measured COUNT RATE for a given ACTIVITY and RADIONUCLIDE depends on many factors, including the detector material, its size and thickness, the size and shape of the RADIOACTIVE SOURCE including its absorption and scatter properties, and instrument's dead time, energy thresholds and COLLIMATOR.

4.2.1.2 Purpose

The purpose of this measurement is to determine the detected rate of events per unit of ACTIVITY for a standard volume source of given dimensions and a specified COLLIMATOR.

4.2.1.3 Method

The SYSTEM SENSITIVITY test places a known amount of ACTIVITY of a specified RADIONUCLIDE within the DETECTOR FIELD OF VIEW of the GAMMA CAMERA and observes the resulting COUNT RATE. From these values the SYSTEM SENSITIVITY is calculated. The test is critically dependent

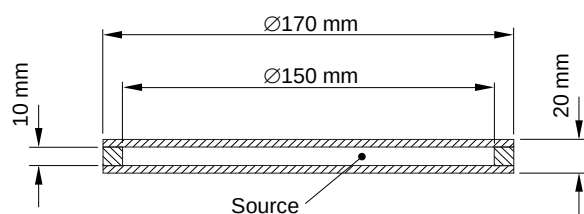
upon accurate assays of ACTIVITY as measured in a dose calibrator or well counter. A calibrated dose calibrator or well counter is used.

4.2.1.4 RADIONUCLIDE

The RADIONUCLIDE used for this measurement shall be appropriate for the COLLIMATOR energy specification and chosen from Table 1.

4.2.1.5 RADIOACTIVE SOURCE distribution

The cylindrical phantom of polymethylmethacrylate as specified in Figure 2 shall be used. The source cuvette shown in Figure 3 shall be filled with the appropriate RADIONUCLIDE and shall be placed in the cylindrical hole with the dimensions shown in Figure 2; the remainder of the hole shall then be filled by the cylindrical insert, the dimensions of which are also shown in Figure 2. The phantom, including the source, shall then be placed on the COLLIMATOR FRONT FACE (distance $d = 0$) and centred on the COLLIMATOR AXIS.



Material: polymethylmethacrylate

IEC 1706/05

Figure 3 – Cuvette

NOTE Measurements of SYSTEM SENSITIVITY without scatter, using the source cuvette of Figure 3 placed at a distance of 10 cm from the COLLIMATOR FRONT FACE, may be carried out in addition to this test.

4.2.1.6 Data collection

With an ENERGY WINDOW setting as specified in Table 1, at least 200 000 counts shall be acquired, and the data acquisition time recorded to calculate the COUNT RATE C_s for all events collected in the image.

For pixelated detectors, BAD PIXEL correction should not be applied. If BAD PIXEL correction cannot be deactivated, then this is noted in the report.

4.2.1.7 Data processing

The ACTIVITY in the phantom shall be corrected for decay to determine the average ACTIVITY, A_{ave} , during the data acquisition time interval, T_{acq} , by the following equation

$$A_{ave} = \frac{A_{cal}}{\ln 2} \frac{T_{1/2}}{T_{acq}} \exp \left[\frac{T_{cal} - T_0}{T_{1/2}} \ln 2 \right] \left[1 - \exp \left(- \frac{T_{acq}}{T_{1/2}} \ln 2 \right) \right] \quad (1)$$

where

A_{cal} is the ACTIVITY measured at time T_{cal} ;

T_0 is the acquisition start time;

$T_{1/2}$ is the RADIOACTIVE HALF-LIFE of the RADIONUCLIDE.

4.2.1.8 Data analysis

The SYSTEM SENSITIVITY S for the COLLIMATOR used shall then be found by

$$S = \frac{C_s}{A_{ave}} \quad (2)$$

and shall be expressed in counts · s⁻¹ · MBq⁻¹.

4.2.1.9 Report

Report the SYSTEM SENSITIVITY together with the COLLIMATOR and the RADIONUCLIDE used.

4.2.2 SPATIAL RESOLUTION**4.2.2.1 General**

SPATIAL RESOLUTION determines the ability of an imaging system to reproduce the spatial distribution of a RADIONUCLIDE in an object. The measurement is performed by imaging LINE SOURCES in air without COLLIMATOR (INTRINSIC SPATIAL RESOLUTION) and with COLLIMATOR using scattering material (SYSTEM SPATIAL RESOLUTION), respectively. The measurement of SYSTEM SPATIAL RESOLUTION including scatter is more representative of the clinical situation when measuring a patient, whereas the INTRINSIC SPATIAL RESOLUTION characterizes the DETECTOR HEAD performance without the COLLIMATOR.

4.2.2.2 Purpose

The purpose of this measurement is to describe the ability of the camera to characterize small objects.

4.2.2.3 Method

For all systems, the SPATIAL RESOLUTION shall be measured in IMAGE PLANES parallel to the COLLIMATOR FRONT FACE by characterizing the width of the LINE SPREAD FUNCTIONS using LINE SOURCES. The width of the LINE SPREAD FUNCTION is measured by the FULL WIDTH AT HALF MAXIMUM (FWHM). In order to accurately measure the width of the LINE SPREAD FUNCTION, its FWHM shall span at least ten PIXELS in the test image. Some GAMMA CAMERAS, for example GAMMA CAMERAS with detectors composed of multiple crystals, may not be able to achieve ten PIXELS in the FWHM in the test image. In this case the matrix used for the test shall be specified and interpolation shall be used and stated.

4.2.2.4 RADIONUCLIDE

For the measurement of SYSTEM SPATIAL RESOLUTION, the RADIONUCLIDE for the measurement shall be chosen from Table 1 according to the COLLIMATOR used. For the measurement of INTRINSIC SPATIAL RESOLUTION, the RADIONUCLIDE shall be ^{99m}Tc.

4.2.2.5 RADIOACTIVE SOURCE distribution

For the measurement of SYSTEM SPATIAL RESOLUTION, a LINE SOURCE shall be prepared by placing a solution containing the selected RADIONUCLIDE in a tube with an inner diameter of 1 mm and length at least equal to the longer detector axis.

For the measurement of INTRINSIC SPATIAL RESOLUTION, a multiple slit transmission phantom shall be used as shown in Figure 4.