SLOVENSKI STANDARD
SIST EN 12679:2019

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Nadomešča:
SIST EN 12679:2000

Neporušitvene preiskave - Radiografsko preskušanje - Ugotavljanje velikosti industrijskih radiografskih gama izvorov

Non-destructive testing - Radiographic testing - Determination of the size of industrial radiographic gamma sources

Zerstörungsfreie Prüfung - Durchstrahlungsprüfung - Bestimmung der Strahlergrößen von industriell genutzten Radio-Nukliden

Essais non destructifs - Contrôle radiographique - Détermination de la dimension des sources de radiographie industrielle gamma

Ta slovenski standard je istoveten z: **EN 12679:2018**

ICS:

19.100	Neporušitveno preskušanje	Non-destructive testing

SIST EN 12679:2019 **en,fr,de**

EUROPEAN STANDARD

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English Version

Non-destructive testing - Radiographic testing - Determination of the size of industrial radiographic gamma sources

Essais non destructifs - Contrôle radiographique - Détermination de la dimension des sources de radiographie industrielle gamma

Zerstörungsfreie Prüfung - Durchstrahlungsprüfung - Bestimmung der Strahlergrößen von industriell genutzten Radio-Nukliden

This European Standard was approved by CEN on 18 July 2018.

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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 CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 12679:2018) has been prepared by Technical Committee CEN/TC 138 “Non-destructive testing”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2019, and conflicting national standards shall be withdrawn at the latest by April 2019.

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

This document supersedes EN 12679:1999.

In the framework of its scope, Technical Committee CEN/TC 138 entrusted CEN/TC 138/WG 1 “Radiographic testing” with preparing the following standard:

EN 12679, *Non-destructive testing — Radiographic testing — Determination of the size of industrial radiographic gamma sources*.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document specifies the determination of the size of gamma radiographic sources of 0,5 mm or greater, made from the radionuclides Iridium 192, Ytterbium 169, Selenium 75 or Cobalt 60, by a method of radiography with X-rays. The source size of a gamma radiography source is an important factor which affects the image quality of gamma ray images.

The source size is determined with an accuracy of ± 10 % but typically not better than ± 0,1 mm.

The source size is provided by the manufacturer as the mechanical dimension of the source insert. A measurement may be required if the manufacturing process is validated or monitored after implementation of the source into the holder.

This document can be used for other radionuclides after validation.

The standard test method ASTM E1114 provides further information on the measurement of the Ir-192 source size, the characterization of the source shape, and its correct assembly and packaging.

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.

EN ISO 19232-5, *Non-destructive testing — Image quality of radiographs — Part 5: Determination of the image unsharpness value using duplex wire-type image quality indicators (ISO 19232-5)*

ISO 16371-1, *Non-destructive testing — Industrial computed radiography with storage phosphor imaging plates — Part 1: Classification of systems*

ASTM E2002 - 15, *Standard Practice for Determining Total Image Unsharpness and Basic Spatial Resolution in Radiography and Radioscopy*

ASTM E2597M - 14, *Standard Practice for Manufacturing Characterization of Digital Detector Arrays*

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
source size
d
maximum dimension of the source of radiation

3.2
signal-to-noise ratio
SNR
ratio of mean value of the linearized grey values to the standard deviation of the linearized grey values (noise) in a given region of interest in a digital image

3.3
normalized signal-to-noise ratio
SNR_N
signal-to-noise ratio, SNR, normalized by the basic spatial resolution, SR_b^{image}, as measured directly in the digital image and calculated from the measured SNR:

$$SNR_N = SNR_{masured} \cdot \frac{88,6\mu m}{SR_b}$$

3.4
basic spatial resolution of a detector
$SR_b^{detector}$
smallest degree of visible detail within a digital image, determined from the smallest number of the duplex wire pair, with the duplex wire IQI located on the detector (Magnification = 1), from the smallest number of the duplex wire pair with less than 20% modulation depth in a linearized profile, and which corresponds to ½ of the image unsharpness

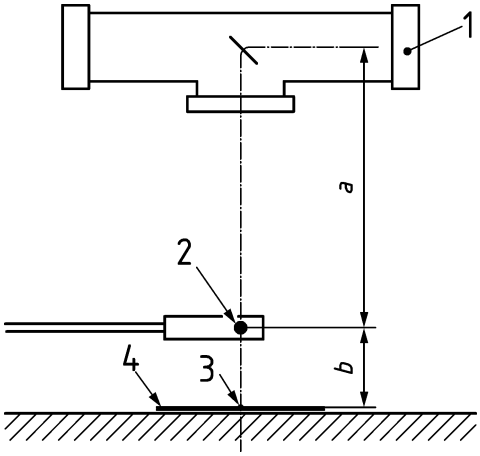
3.5
basic spatial resolution of a digital image
SR_b^{image}
smallest degree of visible detail within a digital image, determined from the smallest number of the duplex wire pair, with the duplex wire IQI located in the object plane (Magnification > 1), from the smallest number of the duplex wire pair with less than 20% modulation depth in a linearized profile, and which corresponds to ½ of the image unsharpness

4 Test procedure

4.1 Test alignment

The X-ray tube shall be placed at a minimum focus-detector-distance of 700 mm. The film system class should be C3 or better.

The film or the digital detector shall be placed perpendicular to the axis of the central X-ray beam. The gamma source shall be placed on the axis between the X-ray source and the film or digital detector. The gamma source to film or the gamma source to digital detector distance b shall be 10 % to 20 % of the X-ray source to film distance or X-ray source to digital detector distance, a + b, see Figure 1.



$$magnifying\ factor\ v = \frac{d'}{d} = \frac{a+b}{a}$$

Key

1 X-ray tube
2 gamma source: size d
3 image of gamma source: projected size d'
4 image detector

Figure 1 — Test alignment

4.2 Test practice

The gamma source shall be brought into the test position and shall not be moved during the measurement. The X-rays should be switched on immediately after the arrival of the gamma source in the exposure position and switched off again simultaneously with the gamma source leaving the exposure position. The source movement time should be minimized to reduce fogging in the radiograph. A reference object with well-defined dimensions (e.g. a steel or tungsten cylinder) shall be positioned in the vicinity of the gamma source for calibration purposes. Alternatively the known tube diameter of the source guide tube can be used for measurement of the magnification in the gamma source projection (Figure 2). The measured source size in the radiograph shall be corrected by the magnification.

5 Requirements to digital equipment

5.1 Digital Detectors

Digital detectors, which are either imaging plates or digital detector arrays (DDA), may be used for film replacement. The digital detector shall possess a pixel pitch which is at least 40 times smaller than the nominal source size to measure and shall not exceed 50 µm. The basic spatial image resolution (SR_b^{image}) shall be smaller than 1/20 of the nominal source size. The basic spatial resolution in the image shall be measured in accordance with the procedure of practice EN ISO 19232-5 or ASTM E2002 in a reference image or taken from manufacturer's statements normalized to the magnification. In the area of the free beam a detector $SNR_N > 100$ shall be achieved. The measurement procedure of the SNR_N shall be in accordance with the procedure of practice ASTM E2597M for DDAs or ISO 16371-1 for CR.

5.2 Test parameters for digital radiography

If the source is in a guide tube, the known tube diameter should be used preferably for calibration of the image pixel size in the gamma source plane (Figure 2). Calibration and analysis of source dimensions shall be performed using the corresponding functions (6.2) of the image processing software. Image integration or averaging for noise reduction of DDAs is recommended.

6 Measurement and determination of source size *d*

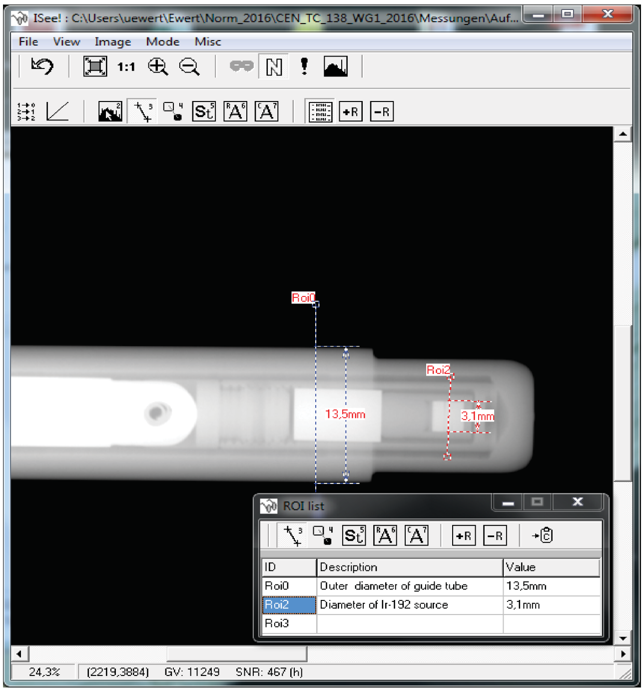
6.1 Measurement with film

The film radiograph shall be examined visually on a film illuminator using a magnifying lens with a built-in measurement scale (graticule) with divisions of 0,1 mm for source sizes > 1mm or of 0,05 mm for source sizes ≤ 0,5 mm and an optical magnification between 5 and 10. The magnifying factor ν according to Figure 1 shall be taken into account for calculation of the actual dimension d from the measured values at film or digitized film. The image of the radiation source shall have sufficient contrast sensitivity to be easily measured.

6.2 Measurement with digital detectors

Digital images shall be evaluated by an image processing software with contrast, brightness (window levelling), profile, pixel size calibration and zoom function. The digital images shall be magnified at the monitor to a degree that allows the image viewing with at least one pixel of the image at one pixel of the monitor.

Digital images show the gamma source with a certain magnifying factor. It shall be normalized by the magnifying factor for measurement of the source size. The measurement shall consider a known dimension as e.g. the diameter of a reference object (e.g. a steel or tungsten cylinder) or the known sample guide tube diameter to determine the overall magnifying factor and the real dimensions of the source. The measurement of the source size shall be performed with a profile function as shown in Figure 2 to achieve sufficient accuracy.



a) Digital Image of an Ir-192 source and profile positions at source guide tube and source

b) Photograph of measurement assembly with 420 kV tube, SDD = 1 m