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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

ISO/TC **135**/SC **5**

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee CEN/TC 138, *Non-destructive testing* (as EN 12679:2018) and was adopted (without modification other than that (those) given below) by Technical Committee ISO/TC 135, *Non-destructive testing*, Subcommittee SC 5, *Radiographic testing.*

The main changes are as follows:

— revised definitions 3.1, 3.3 and 3.4;

— deleted definition 3.5;

— added formula (1) defining the geometrical magnification factor;

— updated figures;

— editorial corrections.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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

1 Scope

This document specifies a test procedure for determination of the size of industrial radiographic gamma sources of 0,5 mm or greater, made from the radionuclides Iridium 192, Ytterbium 169, Selenium 75 or Cobalt 60, by a radiography method with X-rays. The source size of a gamma radiation 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 can 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.

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

ASTM E 2002 - 22, *Standard Practice for Determining Total Image Unsharpness and Basic Spatial Resolution in Radiography and Radioscopy*

ASTM E 2597/2597M - 22, *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 terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
source size
d
maximum dimension of the gamma radiation source

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 (3.2) as measured directly in the digital image and normalized by the basic spatial detector resolution, SR_b^{detector}

$$SNR_N = SNR \cdot \frac{c}{SR_b^{\text{detector}}}$$

where

c is a constant (0,088 6 mm);

SR_b^{detector} is the basic spatial detector resolution, in mm.

3.4
basic spatial detector resolution
SR_b^{detector}
smallest degree of visible detail within a digital image, determined, with the duplex wire Image Quality Indicator *(*IQI) according to ISO 19232-5 or ASTM E 2002 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, which corresponds to ½ of the inherent detector unsharpness

4 Test procedure

4.1 Test alignment

The X-ray tube shall be placed at a minimum focus-detector-distance of 700 mm for focal spot sizes below 1 mm. The film system class should be at least C3.

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 detector distance *b* shall be 10 % to 20 % of the X- ray source to detector distance, a + b, see Figure 1.

A geometrical magnification factor v is introduced in Formula (1):

$$v = \frac{d'}{d} = \frac{a+b}{a} \quad (1)$$

where

d is the diameter of the gamma radiation source, in mm;

d' is the project size d', in mm;

a is the X-ray source to gamma radiation source distance, in mm;

b is the distance between gamma radiation source and image detector, in mm.