SLOVENSKI STANDARD
oSIST prEN ISO 16371-2:2016

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Neporušitveno preskušanje - Industrijska računalniška radiografija s hranjenjem na fosfornih ploščah - 2. del: Splošna načela za preskušanje kovinskih materialov z uporabo rentgenskih žarkov in žarkov gama (ISO/DIS 16371-2:2016)

Non-destructive testing - Industrial computed radiography with storage phosphor imaging plates - Part 2: General principles for testing of metallic materials using X-rays and gamma rays (ISO/DIS 16371-2:2016)

Zerstörungsfreie Prüfung - Industrielle Computer-Radiographie mit Phosphor-Speicherfolien - Teil 2: Grundlagen für die Prüfung metallischer Werkstoffe mit Röntgen- und Gammastrahlen (ISO/DIS 16371-2:2016)

Essais non destructifs - Radiographie industrielle numérisée avec plaques-images au phosphore - Partie 2: Principes généraux de l'essai radiographique des matériaux métalliques au moyen de rayons X et gamma (ISO/DIS 16371-2:2016)

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Non-destructive testing — Industrial computed radiography with storage phosphor imaging plates —

Part 2:
General principles for testing of metallic materials using X-rays and gamma rays

Essais non destructifs — Radiographie industrielle numérisée avec plaques-images au phosphore —

Partie 2: Principes généraux de l'essai radiographique des matériaux métalliques au moyen de rayons X et gamma

ICS: 19.100

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the European Committee for Standardization (CEN), and processed under the **CEN lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel three month enquiry.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 documents 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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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/XXX

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

ISO XXXX consists of the following parts. [Add information as necessary.]

Part 1: *Classification of systems*

Part 2: *General principles for testing of metallic materials using X-rays and gamma rays*

Non-destructive testing — Industrial computed radiography with storage phosphor imaging plates — Part 2: General principles for testing of metallic materials using X-rays and gamma rays

1 Scope

This International Standard specifies fundamental techniques of computed radiography with the aim of enabling satisfactory and repeatable results to be obtained economically. The techniques are based on the fundamental theory of the subject and tests measurements. This document specifies the general rules for industrial computed X- and gamma radiography for flaw detection purposes, using storage phosphor imaging plates (IP). It is based on the general principles for radiographic examination of metallic materials on the basis of films (ISO 5579). The basic set-up of radiation source, detector and the corresponding geometry shall be applied in agreement with ISO 5579 and the corresponding product standards as e.g. ISO 17636 for welding and EN 12681 for foundry. It does not lay down acceptance criteria of the imperfections. CR systems provide a digital grey value image which can be viewed and evaluated on basis of a computer only. This practice describes the recommended procedure for detector selection and radiographic practice. Selection of computer, software, monitor, printer and viewing conditions are important but not in the main focus of this standard.

The procedure specified by this standard, provides the minimum requirements and practice which permits to expose and acquire digital radiographs with equivalent sensitivity for detection of imperfections as film radiography and as specified in ISO 5579. Some application standards, as e.g. EN 16407 may require different and less stringent practice conditions.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12543 (all parts), *Non-destructive testing — Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing*

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

EN 12681, *Foundry — Radiographic examination*

EN 16407(all parts), *Non-destructive testing — Radiographic inspection of corrosion and deposits in pipes by X- and gamma rays*

EN 14784-1:2005, *Non-destructive testing — Industrial computed radiography with storage phosphor imaging plates — Part 1: Classification of systems*

ISO 5579, *Non-destructive testing — Radiographic examination of metallic materials by X- and gamma-rays — Basic rules*

ISO 5580, *Specification for minimum requirements for industrial radiographic illuminators for non-destructive testing*

ISO 9712, *Non-destructive testing — Qualification and certification of personnel*

ISO 19232–1, *Non-destructive testing — Image quality of radiographs — Part 1: Image quality indicators (wire type) - Determination of image quality value*

ISO 19232–2, *Non-destructive testing — Image quality of radiographs — Part 2: Image quality indicators (step/hole type) - Determination of image quality value*

ISO 19232–3, *Non-destructive testing — Image quality of radiographs — Part 3: Image quality classes for ferrous metals*

ISO 19232–4, *Non-destructive testing — Image quality of radiographs — Part 4: Experimental evaluation of image quality values and image quality tables*

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

ISO 17636-2, *Non-destructive testing of welds — Radiographic testing — Part 2: X- and gamma-ray techniques with CR systems*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
computed radiography
CR
storage phosphor imaging plate system
complete system comprising a storage phosphor imaging plate (IP) and a corresponding read-out unit (scanner or reader), which converts the information from the IP into a digital image

3.2
storage phosphor imaging plate
IP
photostimulable luminescent material capable of storing a latent radiographic image of a material being examined and, upon stimulation by a source of red light of appropriate wavelength, generates luminescence proportional to radiation absorbed

Note 1 to entry: When performing computed radiography, an IP is used in lieu of a film. When establishing techniques related to source size or focal geometries, the IP is referred to as a detector, i.e. source-to-detector distance (SDD).

3.3
structure noise of imaging plate
structure noise of IP
fixed pattern noise measured due to IP structure which is inherent from inhomogeneities in the sensitive layer (graininess) and surface of an imaging plate

Note 1 to entry: After scanning of the exposed imaging plate, the inhomogeneities appear as overlaid fixed pattern noise in the digital image.

Note 2 to entry: This noise limits the maximum achievable image quality of digital CR images and can be compared with the graininess in film images.

3.4
grey value
GV
numeric value of a pixel in a digital image

Note 1 to entry: This is typically interchangeable with the terms pixel value, detector response, analogue-to-digital unit, and detector signal.

3.5
linearized grey value
GV
numeric value of a pixel which is directly proportional to the detector exposure dose, having a value of zero if the detector was not exposed

Note 1 to entry: This is typically interchangeable with the terms linearized pixel value, and linearized detector signal.

3.6
basic spatial resolution of CR system
$\mathbf{SR_b^{detector}}$
corresponds to half of the measured detector unsharpness in a digital image and corresponds to the effective pixel size and indicates the smallest geometrical detail, which can be resolved with a CR system at magnification equal to one

Note 1 to entry: For this measurement, the duplex wire IQI is placed directly on the CR system array or imaging plate.

Note 2 to entry: The measurement of unsharpness is described in ISO 19232-5, see also ASTM E2736[13] and ASTM E1000.[8]

3.7
basic spatial resolution of a digital image
$\mathbf{SR_b^{image}}$
corresponds to half of the measured image unsharpness in a digital image and corresponds to the effective pixel size and indicates the smallest geometrical detail, which can be resolved in a digital image

Note 1 to entry: For this measurement, the duplex wire IQI is placed directly on the object (source side).

Note 2 to entry: The measurement of unsharpness is described in ISO 19232-5, see also ASTM E2736,[13] and ASTM E1000.[8]

3.8
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

3.9
normalized signal-to-noise ratio
SNR_N
signal-to-noise ratio, SNR, normalized by the basic spatial resolution, SR_b, as measured directly in the digital image and/or calculated from the measured SNR, $SNR_{measured}$, by

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

3.10
contrast-to-noise ratio
CNR
ratio of the difference of the mean signal levels between two image areas to the averaged standard deviation of the signal levels

Note 1 to entry: The contrast-to-noise ratio describes a component of image quality and depends approximately on the product of radiographic attenuation coefficient and SNR. In addition to adequate CNR, it is also necessary for a digital radiograph to possess adequate unsharpness or basic spatial resolution to resolve desired features of interest.

3.11
normalized contrast-to-noise ratio
CNR_N
contrast-to-noise ratio, CNR, normalized by the basic spatial resolution, SR_b, as measured directly in the digital image and/or calculated from the measured CNR, by

$$CNR_N = CNR \times \frac{88{,}6\ \mu m}{SR_b}$$

3.12
aliasing
artefacts that appear in an image when the spatial frequency of the input is higher than the output is capable of reproducing

Note 1 to entry: Aliasing often appears as jagged or stepped sections in a line or as moiré patterns.

3.13
nominal thickness
t
thickness of the material in the region under examination. Manufacturing tolerances do not have to be taken into account.

3.14
penetrated thickness
w
thickness of material in the direction of the radiation beam calculated on basis of the nominal thickness of all penetrated walls.

For multiple wall techniques the penetrated thickness is calculated from the nominal thickness of all penetrated walls.

3.15
source size
d
size of the radiation source or focal spot size.

Note 1 to entry: See EN 12543 and EN 12679.

3.16
object-to-detector distance
b
largest (maximum) distance between the radiation side of the radiographed part of the test object and the sensitive layer of the detector along the central axis of the radiation beam

3.17
source-to-detector distance
SDD
distance between the source of radiation and the detector, measured in the direction of the beam

Note 1 to entry: SDD = $f + b$

where

f source-to-object distance

b object-to-detector distance

3.18 source-to-object distance
f
distance between the source of radiation and the source side of the test object, most distant from the detector, measured along the central beam

3.19
geometric magnification
v
ratio of source-to-detector distance SDD to source-to-object distance, *f*

4 Symbols and abbreviated terms

For the purposes of this standard, the symbols given in Table 1 apply.

Table 1 — Symbols and abbreviated terms

Symbol	Term
b	object-to-detector distance
d	source size, focal spot size
f	source-to-object distance
SNR	signal-to-noise ratio
SNR_N	normalized signal-to-noise ratio
t	nominal thickness
u_G	geometric unsharpness
u_i	inherent unsharpness of the detector system, excluding any geometric unsharpness, measured from the digital image with a duplex wire IQI adjacent to the detector