SLOVENSKI STANDARD
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Neporušitveno preskušanje zvarnih spojev - Radiografske preiskave - 2. del: Tehnike z rentgenskimi in gama žarki z uporabo digitalnih detektorjev (ISO/DIS 17636-2:2021)

Non-destructive testing of welds - Radiographic testing - Part 2: X- and gamma-ray techniques with digital detectors (ISO/DIS 17636-2:2021)

Zerstörungsfreie Prüfung von Schweißverbindungen - Durchstrahlungsprüfung - Teil 2: Röntgen- und Gammastrahlungstechniken mit digitalen Detektoren (ISO/DIS 17636-2:2021)

Contrôle non destructif des assemblages soudés - Contrôle par radiographie - Partie 2: Techniques par rayons X ou gamma à l'aide de détecteurs numériques (ISO/DIS 17636-2:2021)

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Non-destructive testing of welds — Radiographic testing —

Part 2:
X- and gamma-ray techniques with digital detectors

Contrôle non destructif des assemblages soudés — Contrôle par radiographie —

Partie 2: Techniques par rayons X ou gamma à l'aide de détecteurs numériques

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by the Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement)

This second edition cancels and replaces the first edition (ISO 17636-2:2013), which has been technically revised.

The main changes compared to the previous edition are as follows:

— The normative references have been updated;

— The figures in this document have been updated;

— “Evaluation of image quality” for digital radiography has been added as 6.8;

— The lower thickness limit for Se-75 applications has been deleted in 6.9 and the “agreement of contracting parties” has been deleted in 7.2.2;

— The permission of “class A” IQI visibility for “class B” testing with Se 75 in 6.9 for w < 10 mm has been added;

— The references to Figure 1 to Figure 19 have been added in all relevant clauses;

— A clarification for IQI usage for DWDI technique has been added in 6.8, 6.9 and 7.3.1;

— The permission to the reduce SNR_N, if the tube voltage is reduced to < 80% of the values as given in Figure 20 in 7.3.1, has been added;

— The usage of ASTM wires and other IQIs by agreement of contracting parties in 6.7.1 has been added;

— The compensation principle 2 (CP 2) was extended to 3 wire pairs without agreement of contracting parties in 7.3.2;

— The annex C "Determination of basic spatial resolution" has been revised and partly deleted with reference to ISO 19232-5;

— In annex D.2, a new note and recommendation on fading has been added;

— A new annex F "Considering the detector unsharpness for f_{min}" has been added;

— A new annex G "The maximum tube voltages of Figure 20" has been added;

— The document has been editorially revised.

A list of all parts in the ISO 17636 series can be found on the ISO website.

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.

Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html

Introduction

This document specifies fundamental techniques of radiography with the object of enabling satisfactory and repeatable results. The techniques are based on generally recognized practice and fundamental theory of the subject, inspection of fusion welded joints with digital radiographic detectors.

The procedure specified in this document provides the minimum requirements and practice which permits exposure and acquisition of digital radiographs with equivalent sensitivity for detection of imperfections as film radiography, specified in ISO 17636-1.

Non-destructive testing of welds – Radiographic testing – Part 2: X- and gamma-ray techniques with digital detectors

1 Scope

This document specifies fundamental techniques of digital radiography with the object of enabling satisfactory and repeatable results to be obtained economically. The techniques are based on generally recognized practice and fundamental theory of the subject.

This document applies to the digital radiographic examination of fusion welded joints in metallic materials. It applies to the joints of plates and pipes. Besides its conventional meaning, "pipe", as used in this document, covers other cylindrical bodies such as tubes, penstocks, boiler drums, and pressure vessels.

NOTE This document complies with most requirements of ISO 16371-2.[3]

This document specifies the requirements for digital radiographic X- and gamma-ray testing by either computed radiography (CR) or radiography with digital detector arrays (DDA) of the welded joints of metallic plates and tubes for the detection of imperfections.

Digital detectors provide a digital grey value (GV) image which can be viewed and evaluated using a computer. This document specifies the recommended procedure for detector selection and radiographic practice. Selection of computer, software, monitor, printer and viewing conditions are important, but are not the main focus of this document. The procedure specified in this document provides the minimum requirements for radiographic practice which permit exposure and acquisition of digital radiographs with equivalent sensitivity for detection of imperfections as film radiography, as specified in ISO 17636-1.

This document does not specify acceptance levels for any of the indications found on the digital radiographs. ISO 10675 provides information on acceptance levels.

If contracting parties apply lower test criteria, it is possible that the quality achieved is significantly lower than when this document is strictly applied.

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 5576, *Non-destructive testing — Industrial X-ray and gamma-ray radiology — Vocabulary*

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

ISO 16371-1:2011, *Non-destructive testing — Industrial computed radiography with storage phosphor imaging plates — Part 1: Classification of systems*

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 19232-4, *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*

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5576 and the following apply.

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

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

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

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
digital detector array system
DDA system
electronic device converting ionizing or penetrating radiation into a discrete array of analogue signals which are subsequently digitized and transferred to a computer for display as a digital image corresponding to the radiologic energy pattern imparted upon the input region of the device

3.4
structure noise of imaging plate
structure noise of IP
structure due to 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.

3.5
structure noise of digital detector array
structure noise of DDA
structure due to different properties of detector elements (pixels)

Note 1 to entry After read-out of the exposed uncorrected DDA image, the inhomogeneities of the DDA appear as overlaid fixed pattern noise in the digital image. Therefore, all DDAs require, after read-out, a software based image correction (software and guidelines are provided by the manufacturer). A suitable correction procedure reduces the structure noise.

Note 2 to entry The image correction is also called calibration in other documents.

3.6
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.

3.7
linearized grey value
GV_{lin}
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.

3.8
basic spatial resolution of a digital detector
$SR_b^{detector}$
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 digital detector at magnification equal to one

Note 1 to entry For this measurement, the duplex wire IQI is placed directly on the digital detector 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]

3.9
basic spatial resolution of a digital image
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]

3.10
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

3.11
normalized signal-to-noise ratio
SNR_N
signal-to-noise ratio, SNR, normalized by the basic spatial resolution SR_b, which can be SR_b^{image}, or $SR_b^{detector}$ and calculated from the measured SNR, $SNR_{measured}$, by

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

3.12
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.

3.13
normalized contrast-to-noise ratio
CNR_N
contrast-to-noise ratio, CNR, normalized by the basic spatial resolution, SR_b^{image}, as measured directly in the digital image with the duplex wire IQI on the object source side and calculated from the measured CNR, i. e.

$$CNR_N = CNR \cdot \frac{88{,}6\mu m}{SR_b{}^{image}}$$

3.14
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.

3.15
cluster kernel pixel
CKP
bad pixel which does not have five or more good neighbourhood pixels

Note 1 to entry See ASTM E2597[13] for details on bad pixels and CKP.

