SIST

SLOVENSKI STANDARD
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Neporuġitveno preskuġanje ï Industrijska raļ unalniġka radiografija s hranjenjem na fosfornih ploġļ ah ï 2. del: Sploġna naļ ela za preskuġanje kovinskih materialov z uporabo rentgenskih ġarkov in ġarkov gama

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

Zerstörungsfreie Prüfung - Industrielle Computer-Radiographie mit Phosphor-Speicherfolien - Teil 2: Grundlagen für die Prüfung von metallischen Werkstoffen mit Röntgen- und Gammastrahlen

Essais non destructifs - Radiographie industrielle numérisée avec plaques-images au phosphore - Partie 2 : Principes généraux de l'essai radiographique, a l'aide de rayons X et gamma, des matériaux métalliques

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This European Standard was approved by CEN on 1 July 2005.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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 Central Secretariat has the same status as the official versions.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This European Standard (EN 14784-2:2005) 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of an identical text or by endorsement, at the latest by February 2006, and conflicting national standards shall be withdrawn at the latest by February 2006.

EN 14784 comprises a series of European Standards for industrial computed radiography with storage phosphor imaging plates which is made up of the following:

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

EN 14784-2 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

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

1 Scope

This European 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 (EN 444 and ISO 5579). The basic set-up of radiation source, detector and the corresponding geometry shall be applied in agreement with EN 444 and ISO 5579 and the corresponding product standards as e.g. EN 1435 for welding and EN 12681 for foundry. It does not lay down acceptance criteria of the imperfections.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 462-1, *Non-destructive testing — Image quality of radiographs — Part 1: Image quality Indicators (wire type) — Determination of image quality value.*

EN 462-2, *Non-destructive testing — Image quality of radiographs — Part 2: Image quality indicators (step/hole type) — Determination of image quality value.*

EN 462-3, *Non-destructive testing — Image quality of radiographs — Part 3: Image quality classes for ferrous metals.*

EN 462-4, *Non-destructive testing — Image quality of radiographs — Part 4: Experimental evaluation of image quality values and image quality tables.*

EN 462-5, *Non-destructive testing — Image quality of radiographs — Part 5: Image quality indicators (duplex wire type), determination of image unsharpness value.*

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

3 Terms and definitions

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

3.1
storage phosphor imaging plate systems
complete system of a storage phosphor imaging plate (IP) and a corresponding read out unit (scanner or reader), which converts the information of the IP into a digital image

3.2
nominal thickness
t
nominal thickness of the material in the region under examination. Manufacturing tolerances do not have to be taken into account

3.3
penetrated thickness
w
thickness of material in the direction of the radiation beam calculated on basis of the nominal thickness.

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

3.4
object-to-detector distance
b
distance between the radiation side of the test object and the detector surface measured along the central axis of the radiation beam

3.5
source size
d
size of the source of radiation

3.6
source-to-detector distance (SDD)
distance between the source of radiation and the detector measured in the direction of the beam

3.7
source-to-object distance
f
distance between the source of radiation and the source side of the test object measured along the central axis of the radiation beam

4 Personnel qualification

The examination should be carried out by qualified and capable personnel. In order to prove this qualification, it is recommended to certify the personnel in accordance with EN 473 or ISO 9712.

5 Classification of computed radiographic techniques

Computed radiographic techniques are subdivided into two classes:

— Class A: basic technique;

— Class B: improved technique.

Class B technique will be used when class A may be insufficiently sensitive.

Better techniques, compared with class B, are possible and may be agreed between the contracting parties by specification of all appropriate test parameters.

The choice of radiographic technique shall be agreed between the parties concerned.

Due to image parameters such as SNR, un-sharpness and sensitivity to scattered radiation and hardening differences exist between film radiographs and computed radiographs.

Nevertheless, the perception of flaws using film radiography or computed radiography is comparable by using class A and class B techniques, respectively. The perceptibility shall be proven by the use of IQIs according to EN 462-1, EN 462-2 and EN 462-5.

If it is not possible for technical reasons to meet one of the conditions specified for the class B, such as the type of radiation source or the source-to-object distance f, it may be agreed between the contracting parties that the condition selected may be that specified for class A. The loss of sensitivity shall be compensated for, by doubling the required minimum exposure time with the goal to increase the minimum SNR by a factor of 1.4 (additional to the SNR required from the plate-scanner classes given by Tables 2 to 3). Because of the resulting improved sensitivity compared to class A, the test sections may be regarded as examined within class B.

NOTE This applies only to those IP-scanner systems whose SNR is not limited by the in-homogeneity of the phosphor layer or the scanner dynamic at the required minimum exposure time (see clause 7.9).

6 General

6.1 Protection against ionising radiation

WARNING — Exposure of any part of the human body to X-rays or gamma-rays can be highly injurious to health. Wherever X-ray equipment or radioactive sources are in use, appropriate legal requirements must be applied.

Local or national or international safety precautions when using ionizing radiation shall be strictly applied.

6.2 Surface preparation and stage of manufacture

In general, surface preparation is not necessary, but where surface imperfections or coatings might cause difficulty in detecting defects, the surface shall be ground smooth or the coatings shall be removed.

Unless otherwise specified computed radiography shall be carried out after the final stage of manufacture, e.g. after grinding or heat treatment.

6.3 Identification of radiographs

Symbols shall be affixed to each section of the object being radiographed. The images of these symbols shall appear in the radiograph outside the region of interest where possible and shall ensure unequivocal identification of the section.

6.4 Marking

Permanent markings on the object to be examined shall be made in order to locate accurately the position of each radiograph.

Where the natures of the material and/or its service conditions do not permit permanent marking, the location may be recorded by means of accurate sketches or photographs.

6.5 Overlap of phosphor imaging plates

When radiographing an area with two or more separate phosphor imaging plates (IP), the IPs shall overlap sufficiently to ensure that the complete region of interest is radiographed. This shall be verified by a high-density marker on the surface of the object that will appear on each image.

6.6 Image quality indicators

The quality of image shall be verified by use of IQIs, in accordance with the specific application of the following European Standards - EN 462-1 for the contrast resolution and EN 462-5 for measurement of un-sharpness. Therefore, two IQIs are always required on each image. The minimum IQI-values in dependence on wall thickness and geometry are defined by EN 462-3. This document may be applied to non-ferrous metals if appropriate IQIs are used. In specific application cases minimum IQI-values may be specified in accordance with EN 462-4. IQIs of the step-hole type (e.g. EN 462 2) should not be applied because the wire IQIs are more suitable to encourage the operator to compensate for limited sharpness with increased contrast. This compensation can be achieved either by reduction of the source voltage or by longer exposure time to increase the SNR of the computed radiograph.

7 Recommended techniques for making computed radiographs

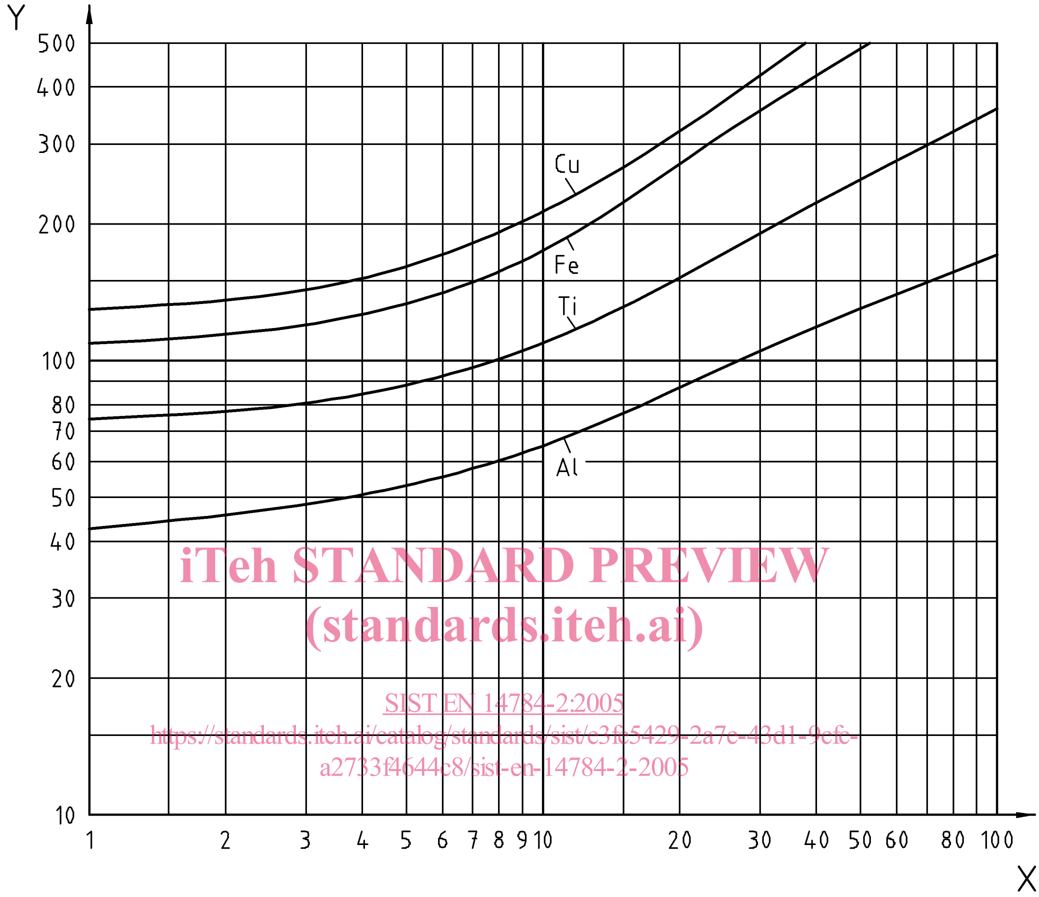
7.1 Test arrangements

Test arrangements shall be determined from the specific application standards for film radiography as e.g. EN 1435 and EN 12681.

7.2 Choice of X-ray tube voltage and radiation source

7.2.1 X-ray equipment

To maintain good flaw detection sensitivity, the X-ray tube voltage should be as low as possible. The maximum values of tube voltage versus thickness are given in Figure 1.



Key

X penetrated thickness *w*, in millimetres

Y X-ray voltage, in kilovolts

Figure 1 — Maximum X-ray voltage for X-ray devices up to 500 kV as function of penetrated wall thickness

7.2.2 Other radiation sources

The permitted penetrated thickness ranges for gamma ray sources and X-ray equipment above 1 MeV are given in Table 1.

By agreement of the contracting parties the value for Ir 192 may be reduced furthermore to 10 mm and for Se 75 to 5 mm penetrated wall thickness.

On thin specimens, gamma rays from Ir-192 and Co-60 will not produce computed radiographs having as good a defect detection sensitivity as X-rays used with appropriate technique parameters. However, because of the advantages of gamma ray sources in handling and accessibility, Table 1 gives a range of thickness for which each of these gamma ray sources may be used when the use of X-rays is not practicable.

For certain applications wider wall thickness ranges may be permitted if sufficient image quality can be achieved.

In cases where radiographs are produced using gamma rays, the travel time to position the source shall not exceed 10 % of the total exposure time.