SLOVENSKI STANDARD

SIST EN 12543-5:2000

01-oktober-2000

Neporuġitveno preskuġanje - Znaļ ilnosti goriġļ ne povrġine v industrijskih rentgenskih sistemih za Neporuġitveno preskuġanje - 5. del: Meritve efektivne velikosti goriġļ ne povrġine za mini in mikro goriġļ ne rentgenske aparate

Non-destructive testing - Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 5: Measurement of the effective focal spot size of mini and micro focus X-ray tubes

Zerstörungsfreie Prüfung - Charakterisierung von Brennflecken in Industrie-Röntgenanlagen für die zerstörungsfreie Prüfung - Teil 5: Messung der effektiven Brennfleckgröße von Mini- und Mikrofokus-Röntgenröhren

Essais non destructifs - Caractéristiques des foyers émissifs des tubes radiogenes industriels utilisés dans les essais non destructifs - Partie 5: Mesure de la dimension du foyer émissif de tubes radiogenes a mini et micro foyer

Ta slovenski standard je istoveten z: **EN 12543-5:1999**

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Essais non destructifs - Caractéristiques des foyers émissifs des tubes radiogènes industriels utilisés dans les essais non destructifs - Partie 5: Mesure de la dimension du foyer émissif de tubes radiogènes à mini et micro foyer

Zerstörungsfreie Prüfung - Charakterisierung von Brennflecken in Industrie-Röntgenanlagen für die zerstörungsfreie Prüfung - Teil 5: Messung der effektiven Brennfleckgröße von Mini- und Mikrofokus-Röntgenröhren

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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 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

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Foreword

This European Standard 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of an identical text or by endorsement, at the latest by March 2000, and conflicting national standards shall be withdrawn at the latest by March 2000.

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

In the framework of its scope, Technical Committee CEN/TC 138 entrusted CEN/TC 138/WG 1 "Ionizing Radiation" with preparing the following standard:

EN 12543-5, *Non-destructive testing - Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 5: Measurement of the effective focal spot size of mini and micro focus X-ray tubes.*

EN 12543-5 is a part of series of European Standards with the same number; the other parts are the following:

EN 12543-1, *Non-destructive testing - Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 1: Scanning method.*

EN 12543-2, *Non-destructive testing - Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 2: Pinhole camera radiographic method.*

EN 12543-3, *Non-destructive testing - Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 3: Slit camera radiographic method.*

EN 12543-4, *Non-destructive testing - Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 4: Edge method.*

Introduction

In order to cover the different requirements for focal spot size measurement, five different methods are described in EN 12543-1 to EN 12543-5.

The scanning method (EN 12543-1) is dedicated to those applications where quantitative values for the intensity distribution and spot sizes are needed, i. e. calibration and image processing purposes.

The radiographic methods (EN 12543-2 and EN 12543-3) describe the traditional techniques and are dedicated for certification purposes and for field application up to 200 kV.

Where no pinhole or slit cameras are available in the field, the edge method (EN 12543-4) may be applied. It represents a very simple method for field application.

In order to cover also the micro focus systems, a specific method is presented in EN 12543-5.

1 Scope

This European standard specifies a method for the measurement of focal spot dimensions within the range of 5 µm to 300 µm of X-ray systems up to and including 225 kV tube voltage, by means of radiographs of sharp edges.

The image quality and the resolution of X-ray images highly depend on the characteristics of the focal spot. The imaging qualities of the focal spot are based on the two dimensional intensity distribution in the object plane.

For certification purposes the radiographic technique is used.

NOTE The same procedure can be used at higher kilovoltages by agreement but the accuracy of the measurement may be poorer.

2 Normative References

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 584-1, *Non-destructive testing - Industrial radiographic film - Part 1: Classification of film systems for industrial radiography.*

3 Terms and definitions

For the purposes of this standard, the following definition applies:

Focal spot: the X-ray emitting area on the anode of the X-ray tube, as seen from the measuring device [EN 12543-1].

4 Test method

4.1 Principle and equipment

This method is based on indirect measurement of the focal spot size by measuring the geometric unsharpness. For this purpose sharp edges are imaged either on a film or by means of a radioscopic device using a relatively high geometric magnification.

The following equipment is required for the measurement if using a film:

– a test object as described below,

– films, min. 10 cm x 10 cm without screens,

– film cassettes made of low absorbing material (e.g. polyehtylene),

– a film holder,

– a film processing unit,

– a microdensitometer capable of reading densities of $D \geq 3{,}0$ and having an input diaphragm d_i of 10 µm or smaller.

The following equipment is required for the measurement if using a radioscopic device:

– a test object as described below,

– a radioscopic device, e. g. any image intensifier with TV equipment,

– an image processing device with the capability of producing linear intensity profiles within the radioscopic image in two directions perpendicular to each other, and with the capability to measure distances.

The test object shall be either a cross wire or a ball consisting of highly absorbing material (e.g. tungsten, tungsten alloy or platinum) having a diameter between 0,9 mm and 1,1 mm which has an accuracy of ± 0,01 mm.

In case of using wires they shall cross each other of an angle of 90° ± 3°. The wires shall be mounted across a circular aperture in a stable frame, in such a manner that the crossing point is located in the center of the aperture.

In case of using the ball it shall be mounted on a thin polyethylene support or placed into a thin polyethylene envelope.

The mounting frame shall be of a size that enables the test object to be positioned very close to the window of the X-ray tube.

Scattering shall be avoided as far as possible.

Any use of additional X-ray prefiltering shall be avoided.

In case of using a film system the following shall be ensured:

The film system shall meet the requirements of film system class C2 according to EN 584-1 and shall be packed in low absorption polyethylene cassettes using no screens.

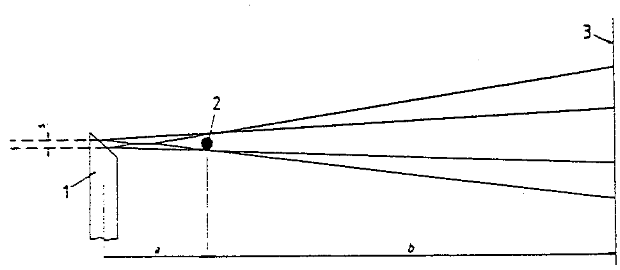
4.2 Selections of distances and exposure time

The distance between test object and detector shall enable projective magnification between X 20 and X 100 (see figure 1), where smaller focal spots require larger magnifications in the given range.

The minimum distance between the test object and the focal spot shall be at least five times the wire or ball diameter.

In case of using a cross wire, its plane shall be parallel within ± 3° to both the tube axis and the detector plane.

In case of using a film, the exposure time shall result in a background density of the radiograph film of D = 2,5 ± 0,3. If no shutter is used the exposure time shall exceed 30 s.



Projection magnification
$M = (a + b)/a$

Key

1 X-ray tube anode
2 test object
3 film plane

Figure 1 – Positioning of test object

5 Measurement and determination of the focal spot size

5.1 Measurement

Line scans shall be produced of the image in length and width direction.

If using radiography, this shall be done with a suitable microdensitometer with an aperture of about 10 µm.

If using radioscopy, the measurement shall be done using an image processor.

From these scans the diameters D_l and D_w of the test object in width and length direction shall be measured at 50 % of the total image contrast (points B and C), see figure 2.

The geometrical magnification is

$$M_{l,w} = D_{l,w} / D_{real} \qquad (1)$$

where D_{real} is the real diameter.

In case of the cross wire both wires have to be measured because of their different magnifications.

Then, according to figure 2, the points A and D are obtained at 90 % of the contrast. From the projection the focal spot sizes l and w are calculated using equation (2) and equation (3):

$$l = (\overline{EF} + \overline{GH}) / M_l \qquad (2)$$

$$w = (\overline{EF} + \overline{GH}) / M_w \qquad (3)$$