



BSI Standards Publication

# **Non-destructive testing — Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing**

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Part 2: Pinhole camera radiographic method

## National foreword

This British Standard is the UK implementation of EN 12543-2:2021. It supersedes BS EN 12543-2:2008, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee WEE/46/5, Radiographic Testing.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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ICS 19.100

Supersedes EN 12543-2:2008

English Version

## Non-destructive testing - Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 2: Pinhole camera radiographic method

Essais non destructifs - Caractéristiques des  
foyers émissifs des tubes radiogènes industriels  
utilisés dans les essais non destructifs - Partie  
2 : Méthode radiographique par sténopé

Zerstörungsfreie Prüfung - Charakterisierung  
von Brennflecken in Industrie-Röntgenanlagen  
für die zerstörungsfreie Prüfung - Teil 2:  
Radiographisches Lochkamera-Verfahren

This European Standard was approved by CEN on 1 March 2021.

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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 CEN-CENELEC Management Centre has the same status as the official versions.

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## European foreword

This document (EN 12543-2:2021) 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of an identical text or by endorsement, at the latest by October 2021, and conflicting national standards shall be withdrawn at the latest by October 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 12543-2:2008.

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

- The document has been technically and editorially revised;
- The scope of application was extended up to 1000 kV for digital detectors;
- Table 1 has been extended to include pin holes of 10 micron diameter;
- In Annex A, Focal Spot Classes have been introduced for simple X-ray tube classification;
- Chapter 5 introduces a new measurement procedure “Integrated Line Profile”;
- Table A.1 and Table A2 provide a new classification and result of focal spot measurement.

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

## Introduction

In order to cover the large range of effective focal spot sizes, different methods are described in EN 12543-1, EN 12543-2, EN 12543-3, EN 12543-4 and EN 12543-5.

The pinhole method (EN 12543-2) is intended for effective focal spot sizes above 0,1 mm and mainly used for sealed standard and mini focus tubes.

The edge method of EN 12543-4 is intended for field applications when the users have to observe the effective focal spot on a regular basis and the pinhole method is non-practical.

The edge measurement method of EN 12543-5 is intended for measurement of effective focal spot sizes between 5  $\mu\text{m}$  and 300  $\mu\text{m}$  and mainly for the use with  $\mu$ -Focus tubes (up to 100  $\mu\text{m}$ ) and mini focus tubes with spot sizes of 100  $\mu\text{m}$  to 300  $\mu\text{m}$ .

In the overlapping ranges, the different standard parts provide comparable values within  $\pm 20\%$  tolerance.

ASTM E1165 describes the same pinhole procedure.

## 1 Scope

This document specifies a method for the measurement of effective focal spot dimensions above 0,1 mm of X-ray systems up to and including 1000 kV tube voltage by means of the pinhole camera method with digital evaluation. The tube voltage applied for this measurement is restricted to 200 kV for visual film evaluation and may be selected higher than 200 kV if digital detectors are used.

The imaging quality and the resolution of X-ray images depend highly on the characteristics of the effective focal spot, in particular the size and the two dimensional intensity distribution as seen from the detector plane. This method compared to the others in the EN 12543 series allows to obtain an image of the focal spot and to see the state of it (e.g. cratering of the anode).

This test method provides instructions for determining the effective size (dimensions) of standard (macro focal spots) and mini focal spots of industrial X-ray tubes. This determination is based on the measurement of an image of a focal spot that has been radiographically recorded with a "pinhole" technique and evaluated with a digital method.

For the characterization of commercial X-ray tube types (i.e. for advertising or trade) it is advised that the specific FS (Focal spot) values of [Annex A](#) are used.

## 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.

EN ISO 19232-5, *Non-destructive testing - Image quality of radiographs - Part 5: Determination of the image unsharpness and basic spatial resolution value using duplex wire-type image quality indicators (ISO 19232-5)*

## 3 Terms and definitions

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

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

### 3.1

#### **actual focal spot**

X-ray emitting area of the anode as viewed from a position perpendicular to the anode surface

Note 1 to entry: The actual focal spot is also called thermal focal spot in other literature.

Note 2 to entry: See [Figure 3](#), Key 7.

### 3.2

#### **effective focal spot**

X-rays emitting area of the anode as viewed from the image plane of the detector

Note 1 to entry: The effective focal spot is also called optical focal spot in other literature.

Note 2 to entry: See [Figure 3](#), Key 4.

### 3.3

#### **effective focal spot size**

focal spot size measured in accordance with this document