



Standard Test Method for Measurement of Focal Spots of Industrial X-Ray Tubes by Pinhole Imaging¹

This standard is issued under the fixed designation E1165; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 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 its two dimensional intensity distribution as seen from the detector plane.

1.2 This test method provides instructions for determining the effective size (dimensions) of standard 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.

1.3 This standard specifies a method for the measurement of focal spot dimensions from 50 μm up to several mm of X-ray sources up to 1000 kV tube voltage. Smaller focal spots should be measured using EN 12543-5 using the projection of an edge.

1.4 This test method may also be used to determine the presence or extent of focal spot damage or deterioration that may have occurred due to tube age, tube overloading, and the like. This would entail the production of a focal spot radiograph (with the pinhole method) and an evaluation of the resultant image for pitting, cracking, and the like.

1.5 Values stated in SI units are to be regarded as the standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

[E1000 Guide for Radioscopy](#)

¹ This test method is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.01 on Radiology (X and Gamma) Method.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[E1255 Practice for Radioscopy](#)

[E2002 Practice for Determining Total Image Unsharpness in Radiology](#)

[E2033 Practice for Computed Radiology \(Photostimulable Luminescence Method\)](#)

[E2698 Practice for Radiological Examination Using Digital Detector Arrays](#)

2.2 *European Standards:*³

[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 12543-5 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](#)

2.3 *Papers:*

Klaus Bavendiek, Uwe Heike, Uwe Zscherpel, Uwe Ewert And Adrian Riedo, “New measurement methods of focal spot size and shape of X-ray tubes in digital radiological applications in comparison to current standards,” WC-NDT 2012, Durban, South Africa

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *actual focal spot*—the X-ray producing area of the target as viewed from a position perpendicular to the target surface (see [Fig. 1](#)).

3.1.2 *effective focal spot*—the X-ray producing area of the target as viewed from a position perpendicular to the tube axis in the center of the X-ray beam (see [Fig. 1](#)).

3.1.3 *effective size of focal spot*—focal spot size measured in accordance with this standard.

4. Summary of Test Method

4.1 This method is based on a projection image of the focal spot using a pinhole camera. This image shows the intensity distribution of the focal spot. From this image the effective size of the focal spot is computed. A double integration of a profile

³ Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, <http://www.cen.eu>.