



Standard Test Method for Measurement of Beam Divergence and Alignment in Neutron Radiologic Beams¹

This standard is issued under the fixed designation E2861; 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 This test method covers the design, materials, manufacture, and use of a divergence and alignment indicator (DAI) for measuring the effective divergence of a thermal neutron beam used for neutron imaging as well as determining the alignment of the imaging plane relative (usually normal) to the centerline of the beam. This test method is applicable to thermal neutron imaging.

1.2 The values stated in SI units are to be regarded as the standard.

1.3 *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

E543 Specification for Agencies Performing Nondestructive Testing

E545 Test Method for Determining Image Quality in Direct Thermal Neutron Radiographic Examination

E748 Guide for Thermal Neutron Radiography of Materials

E803 Test Method for Determining the L/D Ratio of Neutron Radiography Beams

E1316 Terminology for Nondestructive Examinations

2.2 Other Documents:

ANSI Y14.5M Dimensioning and Tolerances³

¹ This test method is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.05 on Radiology (Neutron) Method.

Current edition approved June 1, 2016. Published June 2016. Originally approved in 2011. Last previous edition approved as E2861-11. DOI:10.1520/E2861-16.

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.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide other than those defined in this section, refer to Terminology E1316.

3.2 Definitions:

3.2.1 *neutron image*—record in two dimensions of the intensity of neutron radiation. Examples include radiographs, radioscopy images, computed radiography (CR) images, and track etch images produced from a neutron source.

3.2.2 *neutron imaging*—process of making a neutron image.

4. Summary of Test Method

4.1 The DAI allows the user to determine the alignment of the imaging plane with the beam centerline and the beam divergence for a thermal neutron beam. The user can determine if the imaging system is aligned, aligned only in one direction or completely misaligned and the angle of misalignment, as well as the divergence angle for the imaging system. The DAI is made using aluminum plate and rods, and incorporates cadmium wires for contrast. Circular symmetry is utilized to simplify manufacture. An important feature of the DAI is flexibility to adapt the “as-built” dimensions into the analysis. The DAI is placed with the five stand off posts against the film cassette or radioscopy imaging device in the physical center of the beam. The DAI is perpendicular to the selected beam radius when the center S1 and center S4 cadmium wire images overlap (see Figs. 1 and 2). The degree of misalignment can be measured by the cadmium wire image positions. After the DAI is aligned, analysis of the cadmium wire “+” image spacing yields the beam divergence.

5. Significance and Use

5.1 As discussed in Practice E748, traditional neutron radiography typically employs a high flux reactor source with a well defined collimation system to produce an image on film. The alignment of the imaging plane and the divergence angle are generally well defined and a small degree of misalignment or uncertainty in divergence angle makes little difference in the final image. These systems are well characterized by their physical dimension, the L/D ratio, and image quality indicators (Beam Purity Indicator and Sensitivity Indicator) described in Test Method E545. Neutron computed tomography is an

*A Summary of Changes section appears at the end of this standard