



Standard Test Method for Determining Thermal Neutron Reaction Rates and Thermal Neutron Fluence Rates by Radioactivation Techniques¹

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1. Scope

1.1 The purpose of this test method is to define a general procedure for determining an unknown thermal-neutron fluence rate by neutron activation techniques. It is not practicable to describe completely a technique applicable to the large number of experimental situations that require the measurement of a thermal-neutron fluence rate. Therefore, this method is presented so that the user may adapt to his particular situation the fundamental procedures of the following techniques.

1.1.1 Radiometric counting technique using pure cobalt, pure gold, pure indium, cobalt-aluminum, alloy, gold-aluminum alloy, or indium-aluminum alloy.

1.1.2 Standard comparison technique using pure gold, or gold-aluminum alloy, and

1.1.3 Secondary standard comparison techniques using pure indium, indium-aluminum alloy, pure dysprosium, or dysprosium-aluminum alloy.

1.2 The techniques presented are limited to measurements at room temperatures. However, special problems when making thermal-neutron fluence rate measurements in high-temperature environments are discussed in 9.2. For those circumstances where the use of cadmium as a thermal shield is undesirable because of potential spectrum perturbations or of temperatures above the melting point of cadmium, the method described in Test Method E481 can be used in some cases. Alternatively, gadolinium filters may be used instead of cadmium. For high temperature applications in which aluminum alloys are unsuitable, other alloys such as cobalt-nickel or cobalt-vanadium have been used.

1.3 This test method may be used to determine the equivalent 2200 m/s fluence rate. The accurate determination of the actual thermal neutron fluence rate requires knowledge of the neutron temperature, and determination of the neutron temperature is not within the scope of the standard.

1.4 The techniques presented are suitable only for neutron fields having a significant thermal neutron component, in which moderating materials are present, and for which the average scattering cross section is large compared to the average absorption cross section in the thermal neutron energy range.

1.5 Table 1 indicates the useful neutron-fluence ranges for each detector material.

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

E170 Terminology Relating to Radiation Measurements and Dosimetry

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E181 Test Methods for Detector Calibration and Analysis of Radionuclides

E261 Practice for Determining Neutron Fluence, Fluence Rate, and Spectra by Radioactivation Techniques

E481 Test Method for Measuring Neutron Fluence Rates by Radioactivation of Cobalt and Silver

3. Terminology

3.1 *cadmium ratio*—see Terminology E170.

3.2 *Calibration Techniques:*

3.2.1 *radiometric*—the radiometric technique uses foil properties, decay properties of the activation product, the detector efficiency, and cross section to derive the neutron fluence rate. When beta counting is used, it becomes problematic to determine the absolute detector efficiency, and calibration is usually performed by exposing the foil to a Standard or Secondary Standard field.

¹ This method is under the jurisdiction of ASTM Committee E10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.05 on Nuclear Radiation Metrology.

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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.