



Designation: C1500 – 08 (Reapproved 2017)

Standard Test Method for Nondestructive Assay of Plutonium by Passive Neutron Multiplicity Counting¹

This standard is issued under the fixed designation C1500; 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 describes the nondestructive assay of plutonium in forms such as metal, oxide, scrap, residue, or waste using passive neutron multiplicity counting. This test method provides results that are usually more accurate than conventional neutron coincidence counting. The method can be applied to a large variety of plutonium items in various containers including cans, 208-L drums, or 1900-L Standard Waste Boxes. It has been used to assay items whose plutonium content ranges from 1 g to 1000s of g.

1.2 There are several electronics or mathematical approaches available for multiplicity analysis, including the multiplicity shift register, the Euratom Time Correlation Analyzer, and the List Mode Module, as described briefly in Ref. (1).²

1.3 This test method is primarily intended to address the assay of ²⁴⁰Pu-effective by moments-based multiplicity analysis using shift register electronics (1, 2, 3) and high efficiency neutron counters specifically designed for multiplicity analysis.

1.4 This test method requires knowledge of the relative abundances of the plutonium isotopes to determine the total plutonium mass (See Test Method C1030).

1.5 This test method may also be applied to modified neutron coincidence counters (4) which were not specifically designed as multiplicity counters (that is, HLNCC, AWCC, etc), with a corresponding degradation of results.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 *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 appro-*

priate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 *ASTM Standards:*³

C1030 Test Method for Determination of Plutonium Isotopic Composition by Gamma-Ray Spectrometry

C1207 Test Method for Nondestructive Assay of Plutonium in Scrap and Waste by Passive Neutron Coincidence Counting

C1458 Test Method for Nondestructive Assay of Plutonium, Tritium and ²⁴¹Am by Calorimetric Assay

C1490 Guide for the Selection, Training and Qualification of Nondestructive Assay (NDA) Personnel

C1592 Guide for Nondestructive Assay Measurements

C1673 Terminology of C26.10 Nondestructive Assay Methods

3. Terminology

3.1 *Definitions:*

3.1.1 Terms shall be defined in accordance with Terminology C1673 except for the following:

3.1.2 *gate fractions, n*—the fraction of the total coincidence events that occur within the coincidence gate.

3.1.2.1 *doubles gate fraction (f_d), n*—the fraction of the theoretical double coincidences that can be detected within the coincidence gate (see Eq 1).

3.1.2.2 *triples gate fraction (f_t), n*—the fraction of the theoretical triple coincidences that can be detected within the coincidence gate (see Eq 2).

3.1.3 *factorial moment of order, n*—this is a derived quantity calculated by summing the neutron multiplicity distribution weighted by $v!/(v - n)!$ where n is the order of the moment.

3.1.4 *induced fission neutron multiplicities (v_{i1}, v_{i2}, v_{i3}), n*—the factorial moments of the induced fission neutron multiplicity distribution. Typically multiplicity analysis will utilize

¹ This test method is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.10 on Non Destructive Assay.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ 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.