



Standard Test Method for Nondestructive Assay of Plutonium, Tritium and ^{241}Am by Calorimetric Assay¹

This standard is issued under the fixed designation C 1458; 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 (NDA) of plutonium, tritium, and ^{241}Am using heat flow calorimetry. For plutonium the range of applicability corresponds to < 1 g to > 2000 g quantities while for tritium the range extends from 0.001 g to > 10 g. This test method can be applied to materials in a wide range of container sizes up to 50 L. It has been used routinely to assay items whose thermal power ranges from 0.001 W to 135 W.

1.2 This test method requires knowledge of the relative abundances of the plutonium isotopes and the $^{241}\text{Am}/\text{Pu}$ mass ratio to determine the total plutonium mass.

1.3 This test method provides a direct measure of tritium content.

1.4 This test method provides a measure of ^{241}Am either as a single isotope or mixed with plutonium.

1.5 *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:

C 697 Test Methods for Chemical, Mass Spectrometry, and Spectrochemical Analysis of Nuclear-Grade Plutonium Dioxide Powder and Pellets²

C 859 Terminology Relating to Nuclear Materials²

C 1009 Guide for Establishing a Quality Assurance Program for Analytical Chemistry Laboratories Within the Nuclear Industry²

C 1030 Test Method for Determination of Plutonium Isotopic Composition by Gamma-Ray Spectrometry²

2.2 ANSI Standards:³

ANSI N15.22 Plutonium—Bearing Solids—Calibration

Techniques for Calorimetric Assay

ANSI N15.54 Radiometric Calorimeters—Measurement Control Program

3. Terminology

3.1 *Definitions*—Terms shall be defined in accordance with Terminology C 859 except for the following:

3.1.1 *baseline*—the calorimeter output signal with no heat-generating item in the calorimeter sample chamber.

3.1.2 *basepower*—a constant thermal power applied in a calorimeter through an electrical resistance heater with no heat-generating item in the sample chamber.

3.1.3 *calorimeter*—a device to measure heat or rate-of-heat generation.

3.1.4 *calorimetric assay*—determination of the mass of radioactive material through the measurement of its thermal power by calorimetry and the use of nuclear decay constants and, if necessary, additional isotopic measurements.

3.1.5 *effective specific power*—the rate of energy emission per unit mass of plutonium at the time of measurement.

3.1.6 *equilibrium*—the point at which the temperature of the calorimeter measurement cell and the item being measured stops changing.

3.1.7 *heat distribution error*—the bias arising from the location of the heat source within the calorimeter chamber.

3.1.8 *heat-flow calorimeter*—a calorimeter so constructed that the heat generated in the calorimeter flows past a temperature sensing element, through a thermal resistance, to a constant temperature heat sink.

3.1.9 *passive mode*—a mode of calorimeter operation where no external power is applied to the calorimeter except the current needed to excite the Wheatstone Bridge circuit.

3.1.10 *sensitivity*—the change in calorimeter response per Watt of thermal power (usually in units of micro Volts per Watt) for a heat flow calorimeter.

3.1.11 *servo control*—a mode of calorimeter operation where a constant applied thermal power is maintained in a calorimeter measurement chamber through the use of an electric resistance heater in a closed loop control system.

3.1.12 *specific power*—the rate of energy emission by ionizing radiation per unit mass of an isotope, such as ^{241}Am or tritium.

¹ This test method is under the jurisdiction of ASTM Committee C-26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.10 on Nondestructive Analysis.

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² *Annual Book of ASTM Standards*, Vol 12.01.

³ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.