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Practice for use of an alanine-EPR dosimetry system

*Pratique pour l'utilisation d'un système dosimétrique à l'alanine
utilisant la résonance paramagnétique électronique*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

ASTM International is one of the world's largest voluntary standards development organizations with global participation from affected stakeholders. ASTM technical committees follow rigorous due process balloting procedures.

A pilot project between ISO and ASTM International has been formed to develop and maintain a group of ISO/ASTM radiation processing dosimetry standards. Under this pilot project, ASTM Committee E61, Radiation Processing, is responsible for the development and maintenance of these dosimetry standards with unrestricted participation and input from appropriate ISO member bodies.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. Neither ISO nor ASTM International shall be held responsible for identifying any or all such patent rights.

International Standard ISO/ASTM 51607 was developed by ASTM Committee E61, Radiation Processing, through Subcommittee E61.02, Dosimetry Systems, and by Technical Committee ISO/TC 85, Nuclear energy, nuclear technologies and radiological protection.

This third edition of ISO/ASTM 51607 cancels and replaces ISO/ASTM 51607:2004(E)



Standard Practice for Use of an Alanine-EPR Dosimetry System¹

This standard is issued under the fixed designation ISO/ASTM 51607; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision.

1. Scope

1.1 This practice covers dosimeter materials, instrumentation, and procedures for using the alanine-EPR dosimetry system for measuring the absorbed dose in the photon and electron radiation processing of materials. The system is based on electron paramagnetic resonance (EPR) spectroscopy of free radicals derived from the amino acid alanine.²

1.2 The alanine dosimeter is classified as a type I dosimeter as it is affected by individual influence quantities in a well-defined way that can be expressed in terms of independent correction factors (see ASTM Practice E2628). The alanine dosimeter may be used in either a reference standard dosimetry system or in a routine dosimetry system.

1.3 This document is one of a set of standards that provides recommendations for properly implementing dosimetry in radiation processing, and describes a means of achieving compliance with the requirements of ASTM E2628 “Practice for Dosimetry in Radiation Processing” for alanine dosimetry system. It should be read in conjunction with ASTM E2628.

1.4 This practice covers alanine-EPR dosimetry systems for dose measurements under the following conditions:

1.4.1 The absorbed dose range is between 1 and 1.5×10^5 Gy.

1.4.2 The absorbed dose rate is up to 10^2 Gy s⁻¹ for continuous radiation fields and up to 3×10^{10} Gy s⁻¹ for pulsed radiation fields **(1-4)**.³

1.4.3 The radiation energy for photons and electrons is between 0.1 and 30 MeV **(1, 2, 5-8)**.

1.4.4 The irradiation temperature is between -78 °C and +70 °C **(2, 9-12)**.

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:⁴

E170 Terminology Relating to Radiation Measurements and Dosimetry

E2628 Practice for Dosimetry in Radiation Processing

E2701 Guide for Performance Characterization of Dosimeters and Dosimetry Systems for Use in Radiation Processing

2.2 ISO/ASTM Standards:⁴

51261 Practice for Calibration of Routine Dosimetry Systems for Radiation Processing

51707 Guide for Estimating Uncertainties in Dosimetry for Radiation Processing

2.3 ICRU Reports:⁵

ICRU Report 85a Fundamental Quantities and Units for Ionizing Radiation

ICRU Report 80 Dosimetry Systems for Use in Radiation Processing

2.4 Joint Committee for Guides in Metrology (JCGM) Reports:

JCGM 100:2008, GUM 1995, with minor corrections, Evaluation of measurement data – Guide to the Expression of Uncertainty in Measurement⁶

JCGM 100:2008, VIM, International vocabulary of metrology – Basis and general concepts and associated terms⁷

3. Terminology

3.1 Definitions:

3.1.1 *alanine dosimeter*—specified quantity and physical form of the radiation-sensitive material alanine and any added inert substance such as a binder.

3.1.2 *alanine-EPR dosimetry system*—system used for determining absorbed dose, consisting of alanine dosimeters, an EPR spectrometer and its associated reference materials, and procedures for the system’s use.

¹ This practice is under the jurisdiction of ASTM Committee E61 on Radiation Processing and is the direct responsibility of Subcommittee E61.02 on Dosimetry Systems, and is also under the jurisdiction of ISO/TC 85/WG 3.

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² The term “electron spin resonance” (ESR) is used interchangeably with electron paramagnetic resonance (EPR).

³ The boldface numbers in parentheses refer to the bibliography at the end of this standard.

⁴ For referenced ASTM and ISO/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.

⁵ Available from International Commission on Radiation Units and Measurements, 7910 Woodmont Ave., Suite 800, Bethesda, MD 20814, U.S.A.

⁶ Document produced by Working Group 1 of the Joint Committee for Guides in Metrology (JCGM/WG 1). Available free of charge at the BIPM website (<http://www.bipm.org>).

⁷ Document produced by Working Group 2 of the Joint Committee for Guides in Metrology (JCGM/WG 2). Available free of charge at the BIPM website (<http://www.bipm.org>).