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## Practice for use of the ethanol- chlorobenzene dosimetry system

*Pratique de l'utilisation d'un système dosimétrique à l'éthanol  
chlorobenzène*



Reference number  
ISO/ASTM 51538:2009(E)

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ASTM International, 100 Barr Harbor Drive, PO Box C700,  
West Conshohocken, PA 19428-2959, USA  
Tel. +610 832 9634  
Fax +610 832 9635  
E-mail [khooper@astm.org](mailto:khooper@astm.org)  
Web [www.astm.org](http://www.astm.org)

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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 project between ISO and ASTM International has been formed to develop and maintain a group of ISO/ASTM radiation processing dosimetry standards. Under this project, ASTM Subcommittee E10.01, Radiation Processing: Dosimetry and Applications, 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 51538 was developed by ASTM Committee E10, Nuclear Technology and Applications, through Subcommittee E10.01, and by Technical Committee ISO/TC 85, Nuclear energy.

This second edition cancels and replaces the first edition (ISO/ASTM 51538:2002), which has been technically revised.



## Standard Practice for Use of the Ethanol-Chlorobenzene Dosimetry System<sup>1</sup>

This standard is issued under the fixed designation ISO/ASTM 51538; 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 the procedure for preparation, handling, testing, and use of the ethanol-chlorobenzene (ECB) dosimetry system to determine absorbed dose (in terms of absorbed dose to water) in materials irradiated by photons (gamma radiation or X-radiation/bremsstrahlung) or high energy electrons. The system consists of a dosimeter and appropriate analytical instrumentation. For simplicity, the system will be referred to as the ECB system. It is classified as a reference-standard dosimetry system and is also used as a routine dosimetry system (see ISO/ASTM Guide 51261).

1.2 This practice describes the mercurimetric titration analysis as a standard readout procedure for the ECB dosimeter when used as a reference standard dosimetry system. Other readout methods (spectrophotometric, oscillometric) that are applicable when the ECB system is used as a routine dosimetry system are described in Annex A1 and Annex A2.

1.3 This practice applies provided the following conditions are satisfied:

1.3.1 The absorbed dose range is between 10 Gy and 2 MGy for gamma radiation and between 10 Gy and 200 kGy for high current electron accelerators **(1,2)**.<sup>2</sup> (**Warning**—the boiling point of ethanol chlorobenzene solutions is approximately 80°C. Ampoules may explode if the temperature during irradiation exceeds the boiling point. This boiling point may be exceeded if an absorbed dose greater than 200 kGy is given in a short period of time.)

1.3.2 The absorbed-dose rate is less than  $10^6$  Gy s<sup>-1</sup> **(2)**.

1.3.3 For radionuclide gamma-ray sources, the initial photon energy is greater than 0.6 MeV. For bremsstrahlung photons, the energy of the electrons used to produce the bremsstrahlung photons is equal to or greater than 2 MeV. For electron beams, the initial electron energy is equal to or greater than 4 MeV **(3)** (see ICRU Reports 34 and 35).

NOTE 1—The same response relative to <sup>60</sup>Co gamma radiation was obtained in high-power bremsstrahlung irradiation produced by a 5 MeV electron accelerator **(4)**. The lower limits of energy given are appropriate for a cylindrical dosimeter ampoule of 12-mm diameter. Corrections for

dose gradients across an ampoule of that diameter or less are not required. The ECB system may be used at energies of incident electrons lower than 4 MeV by employing thinner (in the beam direction) dosimeters. The ECB system may also be used at X-ray energies as low as 120 kVp **(5)**. However, in this range of photon energies the effect caused by the ampoule wall is considerable.

1.3.4 The irradiation temperature of the dosimeter is within the range from -40°C to 80°C.

NOTE 2—The temperature dependence of dosimeter response is known only in this range (see 4.3). For use outside this range, the dosimetry system should be calibrated for the required range of irradiation temperatures.

1.4 The effects of size and shape of the dosimeter on the response of the dosimeter can adequately be taken into account by performing the appropriate calculations using cavity theory **(6)**.

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.* Specific warnings are given in 8.2 and 9.2.

### 2. Referenced documents

#### 2.1 ASTM Standards:<sup>3</sup>

- C 912 Practice for Designing a Process for Cleaning Technical Glasses
- D 1193 Specification for Reagent Water
- E 170 Terminology Relating to Radiation Measurements and Dosimetry
- E 275 Practice for Describing and Measuring Performance of Ultraviolet and Visible Spectrophotometers
- E 666 Practice for Calculating Absorbed Dose From Gamma or X Radiation
- E 668 Practice for Application of Thermoluminescence-Dosimetry (TLD) Systems for Determining Absorbed Dose in Radiation-Hardness Testing of Electronic Devices
- E 925 Practice for Monitoring the Calibration of Ultraviolet-Visible Spectrophotometers whose Spectral Slit Width does not Exceed 2 nm
- E 958 Practice for Measuring Practical Spectral Bandwidth of Ultraviolet-Visible Spectrophotometers
- 2.2 ISO/ASTM Standards:<sup>3</sup>
- 51261 Guide for Selection and Calibration of Dosimetry

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee E10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.01 on Radiation Processing: Dosimetry and Applications, and is also under the jurisdiction of ISO/TC 85/WG 3.

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<sup>2</sup> The boldface numbers in parentheses refer to the bibliography at the end of this practice.

<sup>3</sup> For referenced ASTM and ISO/ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

