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Guide for use of radiation-sensitive indicators

Guide pour l'utilisation d'indicateurs sensibles aux rayonnements

Reference number
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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.

International Standard ISO 15564 was prepared by the American Society for Testing and Materials (ASTM) Subcommittee E10.01 (as E 1539-93) and was adopted, under a special "fast-track procedure", by Technical Committee ISO/TC 85, *Nuclear energy*, in parallel with its approval by the ISO member bodies.

A new ISO/TC 85 Working Group WG 3, *High-level dosimetry for radiation processing*, was formed to review the voting comments from the ISO "Fast-track procedure" and to maintain these standards. The USA holds the convenership of this working group.

International Standard ISO 15564 is one of 20 standards developed and published by ASTM. The 20 fast-tracked standards and their associated ASTM designations are listed below:

ISO Designation	ASTM Designation	Title
15554	E 1204-93	*Practice for dosimetry in gamma irradiation facilities for food processing*
15555	E 1205-93	*Practice for use of a ceric-cerous sulfate dosimetry system*
15556	E 1261-94	*Guide for selection and calibration of dosimetry systems for radiation processing*
15557	E 1275-93	*Practice for use of a radiochromic film dosimetry system*
15558	E 1276-96	*Practice for use of a polymethylmethacrylate dosimetry system*
15559	E 1310-94	*Practice for use of a radiochromic optical waveguide dosimetry system*
15560	E 1400-95a	*Practice for characterization and performance of a high-dose radiation dosimetry calibration laboratory*
15561	E 1401-96	*Practice for use of a dichromate dosimetry system*

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15562	E 1431-91	*Practice for dosimetry in electron and bremsstrahlung irradiation facilities for food processing*
15563	E 1538-93	*Practice for use of the ethanol-chlorobenzene dosimetry system*
15564	E 1539-93	*Guide for use of radiation-sensitive indicators*
15565	E 1540-93	*Practice for use of a radiochromic liquid dosimetry system*
15566	E 1607-94	*Practice for use of the alanine-EPR dosimetry system*
15567	E 1608-94	*Practice for dosimetry in an X-ray (bremsstrahlung) facility for radiation processing*
15568	E 1631-96	*Practice for use of calorimetric dosimetry systems for electron beam dose measurements and dosimeter calibrations*
15569	E 1649-94	*Practice for dosimetry in an electron-beam facility for radiation processing at energies between 300 keV and 25 MeV*
15570	E 1650-94	*Practice for use of cellulose acetate dosimetry system*
15571	E 1702-95	*Practice for dosimetry in a gamma irradiation facility for radiation processing*
15572	E 1707-95	*Guide for estimating uncertainties in dosimetry for radiation processing*
15573	E 1818-96	*Practice for dosimetry in an electron-beam facility for radiation processing at energies between 80 keV and 300 keV*

Designation: E 1539 – 93

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If not listed in the current combined index, will appear in the next edition.

Standard Guide for Use of Radiation–Sensitive Indicators[1]

This standard is issued under the fixed designation E 1539; 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 guide covers the use of radiation-sensitive indicators in radiation processing. These indicators may be labels, papers, or inks which undergo a color change or become colored when exposed to ionizing radiation.[2]

1.2 The purpose of these indicators is to determine visually whether or not a product has been irradiated, rather than to measure different dose levels.

1.3 Such materials are not dosimeters and should not be used as a substitute for proper dosimetry. Information about dosimetry systems for ionizing radiation is provided in other ASTM documents (see Guide E 1261).

1.4 *This standard does not purport to address all of the safety problems, 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:*

E 170 Terminology Relating to Radiation Measurements and Dosimetry[3]

E 1261 Guide for the Selection and Application of Dosimetry Systems for Radiation Processing of Food[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *dosimetry system*—system used for determining absorbed dose, consisting of dosimeters, measuring instrumentation, the calibration curve, reference standards, and procedures for the system's use.

3.1.2 *irradiation unit*—one or more containers of product, collectively transported through the irradiator as a whole, for example, box, tote, pallet, carrier. This term is not relevant to bulk-flow processing.

3.1.3 *radiation–sensitive indicators*—materials such as coated or impregnated adhesive-backed substrates, inks, or coatings which may be affixed to or printed on the irradiation units and which undergo a visual change when exposed to ionizing radiation.

3.2 Other appropriate terms may be found in Terminology E 170.

4. Significance and Use

4.1 Radiation-sensitive indicators may be used to show that products have been exposed to a radiation source. They should be used only to provide a qualitative indication of radiation exposure and can be used to distinguish processed irradiation units from unprocessed irradiation units.

NOTE 1—The use of such materials does not eliminate the need for other process-control procedures, such as quantitative dosimetry or the physical separation of irradiated from nonirradiated products.

5. Selection of Indicators

5.1 Radiation-sensitive indicators should be selected that are convenient to use, will remain attached to the product, and can withstand the stresses of the irradiation process.

5.2 Indicators should be selected that have a response appropriate for the ranges of dose, dose rate, radiation energy, and environmental conditions experienced by the product.[2]

5.3 The suitability of such materials shall be determined under the conditions of use from the time of purchase until their use or expiration of their shelf life.

5.4 Indicators used for electron beam processing should be thin enough to avoid significant change of the dose distribution within the product.

6. Applications

6.1 In the event of interruption of the irradiation process, radiation sensitive indicators may help to locate the specific zone of process interruption, thereby minimizing the loss of improperly treated irradiation units.

6.2 These indicators may be used for monitoring multiple-sided irradiation processes. In the case of such a process where the absorbed dose at the far side of the product is sufficient to affect the indicator, then an unexposed indicator could be affixed to the side of the product that will face the radiation source before the first exposure and between each subsequent exposure.

NOTE 2—There are other means of monitoring multiple-sided product irradiation, such as the use of bar code labels and automatic turnover mechanisms.

7. Limitations of Use

7.1 Radiation-sensitive indicators may have nonlinear response characteristics and environmental susceptibilities that make them unsuitable for accurate dose measurement.

7.2 Exposure to environmental conditions such as heat, ultraviolet radiation, and gases produced by the irradiation process may cause undesirable changes to some of these indicator materials. The user should be aware of and follow

[1] This guide is under the jurisdiction of ASTM Committee E-10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.01 on Dosimetry for Radiation Processing.

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[2] Abdel-Rahim, F., Miller, A., and McLaughlin, W. L., "Response of Radiation Monitoring Labels to Gamma Rays and Electrons," *Radiation Physics and Chemistry*, Vol 25, Nos. 4–6, 1985, pp. 767–775.

[3] *Annual Book of ASTM Standards*, Vol 12.02.

any special handling and storage procedures that would minimize such effects.

7.3 Some irradiation or storage conditions may result in false positive or negative observations. For these reasons, indicators should not be used as a criterion for product release. Also, external environmental influences may make the interpretation of the indicators meaningless outside the irradiation facility unless appropriate controls are used.

8. Keywords

8.1 electron beam; gamma radiation; ionizing radiation; irradiation; label dosimeter; radiation indicator; radiation processing; radiation-sensitive indicator

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