



Standard Practice for Application of CaF₂(Mn) Thermoluminescence Dosimeters in Mixed Neutron-Photon Environments¹

This standard is issued under the fixed designation E2450; 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 practice describes a procedure for correcting a CaF₂(Mn) thermoluminescence dosimeter (TLD) reading for its response to neutrons during the irradiation. The neutron response may be subtracted from the total TLD response to give the gamma-ray response. In fields with a large neutron contribution to the total response, this procedure may result in large uncertainties.

1.2 More precise experimental techniques may be applied if the uncertainty derived from this practice is larger than the level that the user can accept. These more precise techniques are not discussed here. The references in Section 8 describe some of these techniques.

1.3 This practice does not discuss effects on the TLD reading from neutron interactions with the material surrounding the TLD and used to ensure a charged particle equilibrium. These effects will depend on the isotopic composition of the surrounding material and its thickness, and on the incident neutron spectrum (1).²

1.4 The values stated in SI units are to be regarded as standard.

2. Referenced Documents

2.1 ASTM Standards:³

E170 Terminology Relating to Radiation Measurements and Dosimetry

E666 Practice for Calculating Absorbed Dose From Gamma or X Radiation

E668 Practice for Application of Thermoluminescence-Dosimetry (TLD) Systems for Determining Absorbed

Dose in Radiation-Hardness Testing of Electronic Devices
E720 Guide for Selection and Use of Neutron Sensors for Determining Neutron Spectra Employed in Radiation-Hardness Testing of Electronics

E721 Guide for Determining Neutron Energy Spectra from Neutron Sensors for Radiation-Hardness Testing of Electronics

E722 Practice for Characterizing Neutron Fluence Spectra in Terms of an Equivalent Monoenergetic Neutron Fluence for Radiation-Hardness Testing of Electronics

E1854 Practice for Ensuring Test Consistency in Neutron-Induced Displacement Damage of Electronic Parts

F1190 Guide for Neutron Irradiation of Unbiased Electronic Components

3. Terminology

3.1 Definitions:

3.1.1 *absorbed dose*—see Terminology **E170**.

3.1.2 *exposure*—see Terminology **E170**.

3.1.3 *kerma*—see Terminology **E170**.

3.1.4 *linear energy transfer (LET)*—the energy loss per unit distance as a charged particle passes through a material.

3.1.4.1 *Discussion*—Electrons resulting from gamma-ray interactions in a material generally have a low LET. Heavy charged particles resulting from neutron interactions with a material generally have a high LET.

3.1.5 *neutron sensitivity $m(E)$* —the ratio of the detector reading, that is, the effective neutron dose, to the neutron fluence. Thus,

$$m(E) = \frac{M(E)}{\Phi(E)} \quad (1)$$

where:

$\Phi(E)$ = the neutron fluence, and

$M(E)$ = the apparent dose (light output) in the TLD caused by neutrons of energy E .

4. Significance and Use

4.1 Electronic devices are typically tested for survivability to gamma radiation in pure gamma-ray fields. Testing electronic device response against neutrons is more complex since there is invariably a gamma-ray component in addition to the

¹ This practice is under the jurisdiction of ASTM Committee **E10** on Nuclear Technology and Applications and is the direct responsibility of Subcommittee **E10.07** on Radiation Dosimetry for Radiation Effects on Materials and Devices.

Current edition approved June 1, 2016. Published July 2016. Originally approved in 2005. Last previous edition approved in 2011 as E2450 – 11. DOI: 10.1520/E2450-16.

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.