



Standard Test Method for Using Calorimeters for Total Dose Measurements in Pulsed Linear Accelerator or Flash X-ray Machines¹

This standard is issued under the fixed designation F526; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers a calorimetric measurement of the total absorbed dose delivered in a single pulse of electrons from an electron linear accelerator or a flash X-ray machine (FXR, e-beam mode) used as an ionizing source in radiation-effects testing. The test method is designed for use with pulses of electrons in the energy range from 10 to 50 MeV and is only valid for cases in which both the calorimeter and the test specimen to be irradiated are “thin” compared to the range of these electrons in the materials of which they are constructed.

1.2 The procedure described can be used in those cases in which (1) the dose delivered in a single pulse is 5 Gy(matl)² [500 rd (matl)] or greater, or (2) multiple pulses of a lower dose can be delivered in a short time compared to the thermal time constant of the calorimeter. The units for the total absorbed dose delivered to a material require the specification of the material and the notation “matl” refers to the active material of the calorimeter. The minimum dose per pulse that can be acceptably monitored depends on the variables of the particular test, including pulse rate, pulse uniformity, and the thermal time constant of the calorimeter.

1.3 A determination of the total dose is made directly for the material of which the calorimeter block is made. The total dose in other materials can be calculated from this measured value by formulas presented in this test method. The need for such calculations and the choice of materials for which calculations are to be made shall be subject to agreement by the parties to the test.

1.4 The values stated in SI units are to be regarded as the standard. The values in parenthesis are provided for information only.

1.5 This standard does not purport to address 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:³

E170 Terminology Relating to Radiation Measurements and Dosimetry

E230 Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples

E1894 Guide for Selecting Dosimetry Systems for Application in Pulsed X-Ray Sources

3. Terminology

3.1 Definitions:

3.1.1 *device under test (DUT)*—the device that is under the current test.

3.1.2 *Seebeck EMF*—the electromagnetic force (EMF) generated by the Seebeck effect when two wires composed of dissimilar metals are joined at both ends and the ends are held at different temperatures. A voltage can be measured across the terminals when current flows through the wires.

3.1.3 *temperature coefficient of resistance*—the resistance change in a material per degree of temperature change $d\Omega/(\Omega \cdot d\theta)$, where Ω denotes the resistance and θ denotes the temperature. This quantity has units of inverse temperature and, for small changes about a reference temperature in a conductor, this quantity is often modeled as a linear relationship with temperature.

3.1.4 *thermal time constant of a calorimeter*—the time for the temperature excursion of the calorimeter resulting from a radiation pulse to drop to $1/e$ of its initial maximum value.

3.1.5 *TSP*—twisted shielded pair, a shielded case of a twisted pair cable in which two conductors are twisted together

¹ This test method 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.

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² In 1975 the General Conference on Weights and Measures adopted the unit gray (symbol—Gy) for absorbed dose; 1 Gy = 100 rad.

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.