



Standard Guide for Procedure for Measuring Ionizing Radiation-Induced Attenuation in Silica-Based Optical Fibers and Cables for Use in Remote Fiber-Optic Spectroscopy and Broadband Systems¹

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1. Scope

1.1 This guide covers a method for measuring the real time, in situ radiation-induced spectral attenuation of multimode, step index, silica optical fibers transmitting unpolarized light. This procedure specifically addresses steady-state ionizing radiation (that is, alpha, beta, gamma, protons, etc.) with appropriate changes in dosimetry, and shielding considerations, depending upon the irradiation source.

1.2 This test procedure is not intended to test the balance of the optical and non-optical components of an optical fiber-based system, but may be modified to test other components in a continuous irradiation environment.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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 Test or inspection requirements include the following references:

2.2 *Military Standard:*²

MIL-STD-2196-(SH) Glossary of Fiber Optic Terms

¹ This guide is under the jurisdiction of ASTM Committee E13 on Molecular Spectroscopy and Separation Science and is the direct responsibility of Subcommittee E13.09 on Fiber Optics, Waveguides, and Optical Sensors.

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² Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS. Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

2.3 *EIA Standards:*³

EIA-455-57 Optical Fiber End Preparation and Examination

EIA-455-64 Procedure for Measuring Radiation-Induced Attenuation in Optical Fibers and Cables

EIA-455-78A-90 Spectral Attenuation Cutback Measurement for Single-Mode Optical Fibers

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to MIL-STD-2196 for the definition of terms used in this guide.

4. Significance and Use

4.1 Ionizing environments will affect the performance of optical fibers/cables being used to transmit spectroscopic information from a remote location. Determination of the type and magnitude of the spectral attenuation or interferences, or both, produced by the ionizing radiation in the fiber is necessary for evaluating the performance of an optical fiber sensor system.

4.2 The results of the test can be utilized as a selection criteria for optical fibers used in optical fiber spectroscopic sensor systems.

NOTE 1—The attenuation of optical fibers generally increases when exposed to ionizing radiation. This is due primarily to the trapping of radiolytic electrons and holes at defect sites in the optical materials, that is, the formation of color centers. The depopulation of these color centers by thermal and/or optical (photobleaching) processes, or both, causes recovery, usually resulting in a decrease in radiation-induced attenuation. Recovery of the attenuation after irradiation depends on many variables, including the temperature of the test sample, the composition of the sample, the spectrum and type of radiation employed, the total dose applied to the test sample, the light level used to measure the attenuation, and the operating spectrum. Under some continuous conditions, recovery is never complete.

³ Available from Electronic Industries Alliance (EIA), 2500 Wilson Blvd., Arlington, VA 22201, <http://www.eaus.org/eia>.