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Standard Guide for Specifying Dynamic Characteristics of Optical Radiation Transmitting Fiber Waveguides[1]

This standard is issued under the fixed designation E1653; 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 key parameters that determine the dynamic performance of an optical radiation transmitting fiber waveguide (see Note 1). For the purpose of this guide, optical radiation is electromagnetic radiation of wavelengths from about 200 nm to about 5000 nm (correspondingly, frequencies of 50 000 cm^{-1} to 2000 cm^{-1}, and photon energies of 6 eV to 0.25 eV).

NOTE 1—Typical designations of radiation transmitting fiber waveguides include optical waveguide, fiber-optic, fiber-optic waveguide, and fiber-optic radiation guide.

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

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E131 Terminology Relating to Molecular Spectroscopy

3. Terminology

3.1 *Definition of Terms and Symbols*—For definitions of terms and symbols, refer to Terminology E131.

4. Significance and Use

4.1 Many characteristics of a fiber-optic waveguide affect the dynamic performance. Quantitative values of certain key parameters (characteristics) need to be known, *a priori*, in order to predict or evaluate the dynamic performance of a waveguide for specific conditions of use. This guide identifies these key parameters and provides information on their significance and how they affect performance. However, this guide does not describe how the needed quantitative information is to be obtained. Manufacturers of fiber-optic waveguides can use this guide for characterizing their products suitably for users who are concerned with dynamic performance. Users of fiber-optic waveguides can use this guide to determine that their waveguides are adequately characterized for their intended application.

5. Key Dynamic Characteristics

5.1 Dynamic characteristics and dynamic performance, for the purposes of this guide, have to do with the time- or frequency-domain response of a fiber-optic waveguide to pulsed or sinusoidally modulated optical radiation. Fig. 1 and Fig. 2 show hypothetical outputs of an optical fiber to pulsed and sinusoidally modulated radiation inputs. (Either the time- or the frequency-domain can be used to characterize the temporal features of a fiber-optic waveguide, because the two are related through the Fourier transform.) It is this response, as it is affected by launch condition, input radiant flux, wavelength, bend radii, temperature, and spatial position across the face of a fiber-optic waveguide, that is the concern of this guide.

5.2 *Ideal Fiber-Optic*—Features that would be possessed by an ideal fiber-optic waveguide provide a basis for discussing the key parameters that determine the dynamic aspects of a fiber-optic waveguide. An ideal fiber-optic radiation guide would have the following features.

5.2.1 A large numerical aperture, such that noncollimated or poorly collimated radiation sources (for example, arc lamps) could be coupled to it effectively.

5.2.2 Wide transmissive (spectral) bandwidth, within the range from 200 nm to 5000 nm, so that experiments requiring ultraviolet (UV), visible, and IR radiation may be performed with the minimum change in radiation guides.

[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] 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.

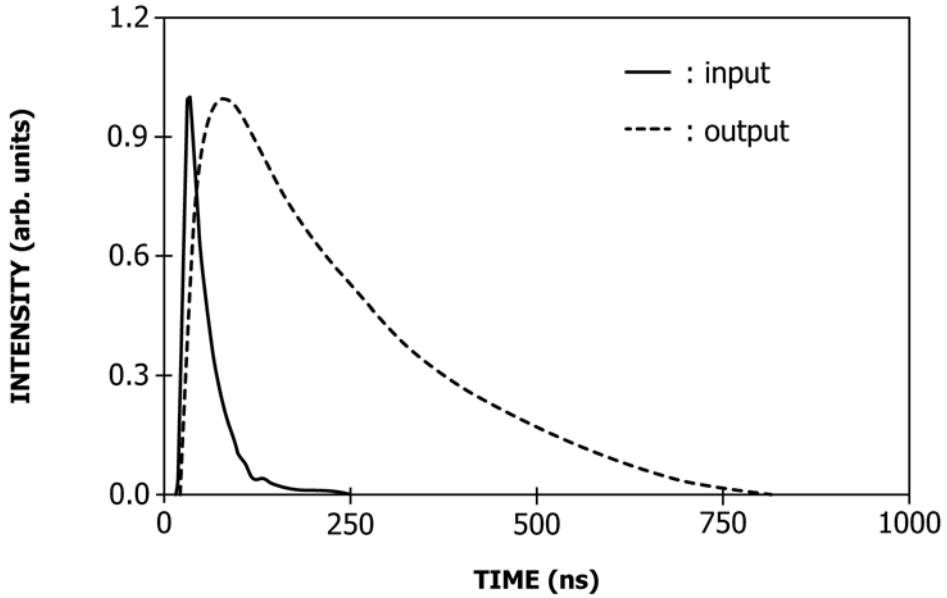

FIG. 1 Output of an Optical Fiber to a Radiation Input Pulse

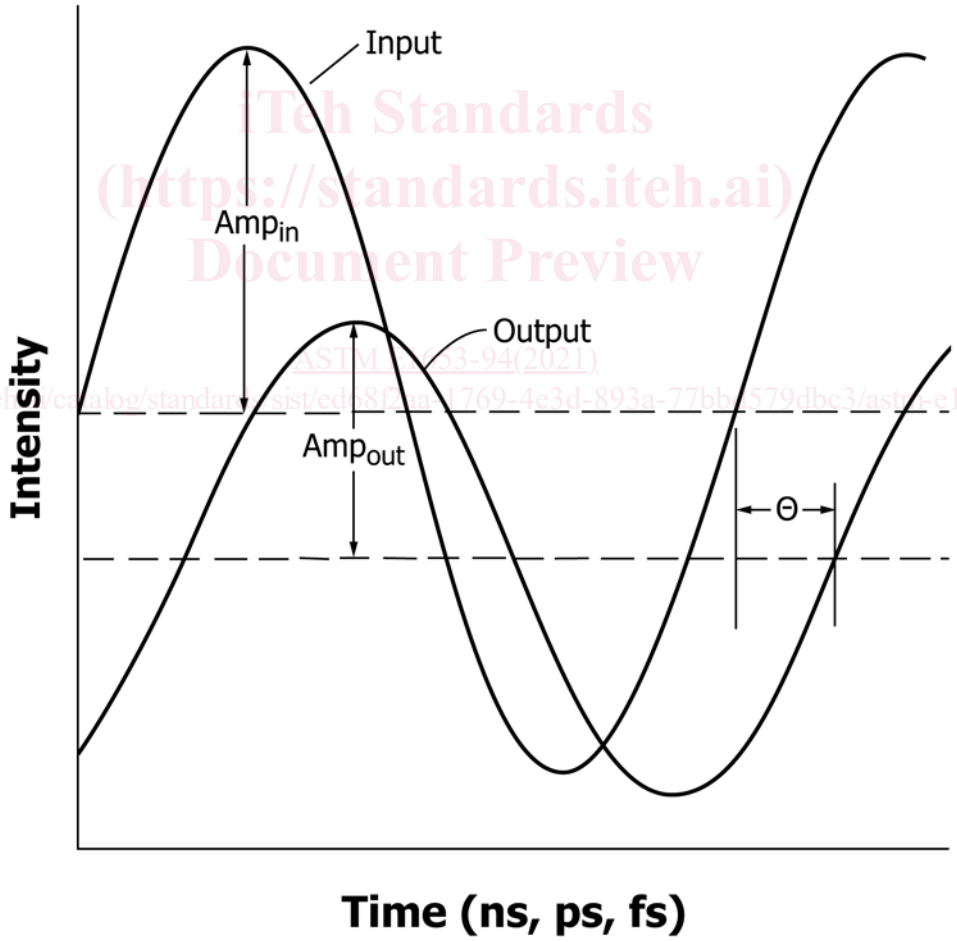

FIG. 2 Output of an Optical Fiber to a Sinusoidal Waveform Radiation Input