



## Standard Test Method for Conducting Aqueous Direct Photolysis Tests<sup>1</sup>

This standard is issued under the fixed designation E 896; 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 test method describes procedures for obtaining information on direct photolysis rates, quantum yields, and phototransformation products of materials in an aqueous environment. Laboratory testing procedures designed to provide estimates of environmental rates of photolysis are described.

1.2 A three-tiered approach is described. The testing procedures are designed to provide basic and easily obtainable information in the first tier. More detailed and costly experiments are proposed in the second and third tiers. This approach is thought to be more scientific and cost-effective than one which provides for no sequential assessment. It is not within the scope of this test method to provide decision points to move from one tier to the next. The degree of testing should be decided as part of an overall exposure assessment in which the importance of photolysis is weighed with respect to other transformation routes.

1.3 These procedures are designed to be applicable to all types of materials. However, tests on formulations and commercial products that are complex mixtures of materials with diverse physical and chemical properties may require isolation of individual compounds prior to testing to eliminate indirect photochemical reactions. With slight modification, these procedures should meet the needs of most investigators.

1.4 In developing this test method an attempt was made to balance the needs and costs against the scientific considerations and reliability of results. Major considerations were: (1) that the procedures generate precise, accurate, and environmentally relevant data, and (2) that the procedural requirements be as flexible as possible without destroying this integrity of the data and the ability to compare interlaboratory results.

1.5 Since all details are not covered in this test method, successful execution of the described tests will require some training or experience in the area of photolysis. Familiarity with the material in the references is essential. Detailed

descriptions on conducting similar test procedures have been published by the U.S. Environmental Protection Agency (**1**, **2**).<sup>2</sup>

1.6 *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.* For specific hazard statements, see Section 6.

### 2. Referenced Documents

2.1 *ASTM Standards:*<sup>3</sup>

**D 1193** Specification for Reagent Water

**E 131** Terminology Relating to Molecular Spectroscopy

### 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *Beer-Lambert law*—the law that states that the absorbance of a homogeneous sample is directly proportional to the concentration of the absorbing material and to the thickness of the sample in the optical path.

3.1.2 *direct photolysis*—direct absorption of light by a molecule followed by a reaction that converts the parent molecule into one or more products. These transformations depend on adsorption of energy (photons) in the ultraviolet-visible spectrum. The rate of transformation depends upon the absorption of photons, light intensity (photon flux), and quantum yield.

3.1.3 *first-order rate equation*—an equation that describes a reaction rate that is linearly dependent on the concentration. The half-life of the reaction is independent of the concentration. The photolysis rate equation shown in **3.1.10** is a first-order equation.

3.1.4 *Grotthus-Draper law* (first law of photochemistry)—the law that states that only light absorbed by a molecule is responsible for a reaction.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E47 on Biological Effects and Environmental Fate and is the direct responsibility of Subcommittee E47.04 on Environmental Fate of Chemical Substances.

Current edition approved August 1, 2005. Published August 2005. Originally approved in 1982. Last previous edition approved in 1997 as E 896 – 87(1997).

<sup>2</sup> The boldface numbers in parentheses refer to the list of references at the end of this test method.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.