



Designation: E1260 – 03

Standard Test Method for Determining Liquid Drop Size Characteristics in a Spray Using Optical Nonimaging Light-Scattering Instruments¹

This standard is issued under the fixed designation E1260; 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.

INTRODUCTION

This standard is one of several describing a different class of test methods for determining liquid drop size characteristics in a spray. These test methods can be broadly distinguished as “optical” or “non-optical.” In the optical category there are test methods that essentially make images (such as photographs) of drops that can be measured either manually or automatically, and test methods that do not make images but use optical phenomena exhibited by single drops or ensembles of drops which can be recorded and used to calculate either individual drop sizes or the distribution of drop sizes in an ensemble. This test method deals with the latter class, and hence, is described as “nonimaging.” The various optical phenomena involved are commonly described as “light-scattering.” Using any of these test methods, the spray is observed for a period of time during which a large number of drops is examined, and the data are treated so as to derive drop-size statistics for the sample investigated.

1. Scope

1.1 The purpose of this test method is to obtain data which characterize the sizes of liquid particles or drops such as are produced by a spray nozzle or similar device under specified conditions using a specified liquid. The drops will generally be in the size range from 5- μm to the order of 1 000- μm diameter; they will occur in sprays which may be as small as a few cubic centimetres or as large as several cubic metres. Typically the number density of the particles can vary significantly from one point to another.

1.2 This test method is intended primarily for use in standardizing measurements of the performance of spray-producing devices. It is limited to those techniques and instruments that operate by passing a beam of light through the spray and analyzing the light scattered by the droplets to derive size information. Such techniques do not produce images of individual drops, and therefore, are known as “optical (nonimaging) instruments.”

1.3 The measurements made, when referred to the entire spray being sampled, may be flux sensitive or spatial, as defined in Practice E799, depending on the techniques used with a particular instrument.

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 ASTM Standards:²

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E456 Terminology Relating to Quality and Statistics

E799 Practice for Determining Data Criteria and Processing for Liquid Drop Size Analysis

E1088 Definition of Terms Relating to Atomizing Devices

E1296 Terminology Relating to Liquid Particle Statistics

E1620 Terminology Relating to Liquid Particles and Atomization

2.2 NFPA Standards:

NFPA 30 Flammable and Combustible Liquids Code³

NFPA 33 Spray Application Using Flammable and Combustible Materials³

3. Terminology

3.1 For terminology pertaining to this test method, refer to Terminology E456, Practice E799, Definitions E1088, and Terminology E1296.

¹ This test method is under the jurisdiction of ASTM Committee E29 on Particle and Spray Characterization and is the direct responsibility of Subcommittee E29.02 on Non-Sieving Methods.

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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.

³ Available from the National Fire Protection Association, Battery-March Park, Quincy, MA 02269.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *spray*—the term “spray” in this test method includes all ensembles, arrays, or clouds composed of liquid particles or drops whether produced artificially or naturally. Although it is usual to consider a spray as implying significant motion of the drops relative to the atmosphere there are situations in which the relative velocity is or becomes sufficiently low to be negligible. In this case, a “spray” is indistinguishable from a “cloud” which implies a static ensemble of drops.

4. Summary of Test Method

4.1 The spray is examined by a means whereby a beam of light passes through local regions, which make a representative sample, and one of the forms of light-scattering phenomena that occur is detected by the instrument. The data are recorded, usually by data-processing equipment, and are transformed mathematically into statistics characterizing the size distribution. These operations may be performed manually or automatically and the instrument may provide a visual display or a printed report.

5. Significance and Use

5.1 The purpose of this test method is to provide data on liquid drop-size characteristics for sprays, as indicated by optical nonimaging light-scattering instruments. The results obtained generally will be statistical in nature. The number of variables concerned in the production of liquid spray, together with the variety of optical, electronic, and sampling systems used in different instruments, may contribute to variations in the test results. Care must be exercised, therefore, when attempting to compare data from samples obtained by different means.

6. Interferences

6.1 *Spray Nozzle*—Many spray nozzles are designed with internal liquid passages of small dimensions and it is important to ensure that these passages do not become blocked with foreign matter. Some nozzles have built-in filters or screens but in all cases it is advisable to fit a filter in the liquid supply line immediately upstream of the nozzle inlet to remove any solid particles that are considered likely to cause problems.

6.1.1 The use of one liquid to simulate another fuel may affect the performance of certain types of nozzle due to differences in density, viscosity, and surface tension. In addition, however, occasionally a problem may occur due to differences in wetting the surfaces, for example, a nozzle tested previously in fuel (or other hydrocarbon) may exhibit a poor quality spray when first tested with water and may require the use of a degreasing agent to remove traces of hydrocarbon from the surfaces containing the liquid.

6.1.2 It is very important to protect the edges of the discharge orifice of a spray nozzle from accidental damage prior to testing. This protection is best accomplished by the use of a cover over the discharge orifice of the nozzle during storage and installation on the test stand.

6.2 Care must be exercised to prevent the ingress of liquid drops into the instrument. The surfaces of lenses, mirrors, and

windows should be inspected at frequent intervals for cleanliness or damage and the manufacturer’s recommendations followed.

7. Apparatus

7.1 *Light Source*, (including lasers),

7.1.1 *Optical Means*, for producing a suitable beam that passes through a region of the spray,

7.1.2 *Detecting Means*, for recording light-scattering phenomena resulting from the liquid drops and means for transforming the observations into statistical estimates of drop size and dispersion characteristics, as shown in Fig. 1.

7.2 *Spray Chamber*, preferably without components that could affect the optical behavior of the incident/scattered light (or have known effect thereon). It is convenient to employ this when the spray or spray-producing device to be tested is small in size relative to the apparatus. Use of this chamber may be desirable to protect the optical and electronic components of the apparatus from damage by the liquid spray (see also Section 8). In this case the apparatus is preferably securely installed in a suitable location. The chamber should not affect the normal formation of the spray.

7.2.1 In cases where there are known or suspected steep drop concentration gradients or variations in the spray, for example, in hollow-cone spray patterns, means shall be provided for accurately locating the spraying device relative to the light beam source and sensor. Provision should also be made for selectively examining a number of different locations or regions in the spray.

7.3 Operating instructions shall be supplied by the manufacturer or contractor of the apparatus or instrument. The instructions shall contain:

7.3.1 Description of the operational principles of the instrument, oriented towards a trained technical operator. Reference to relevant published literature shall be included;

7.3.2 Recommendations for installation and use of the apparatus;

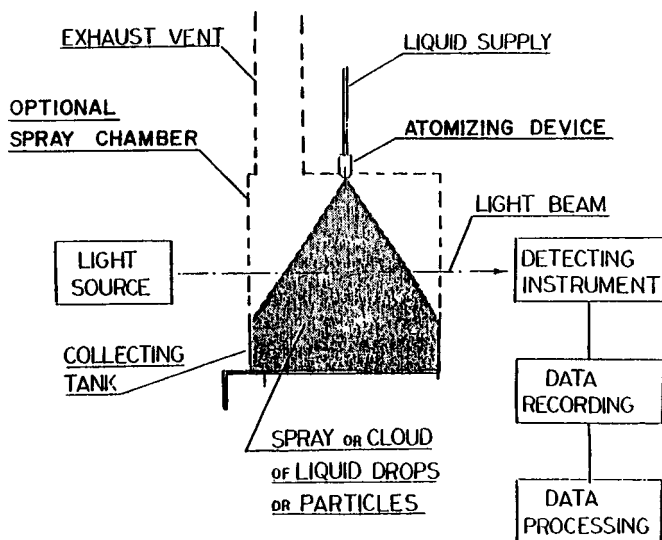


FIG. 1 Diagram of Test Arrangement