Designation: E 1260 – 95

Standard Test Method for Determining Liquid Drop Size Characteristics in a Spray Using Optical Nonimaging Light-Scattering Instruments[1]

This standard is issued under the fixed designation E 1260; 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.

In most cases it will not be possible to examine more than a partial region of the entire spray produced by the nozzle, so some judgment will be required of the operator in choosing a representative location.

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 sprayproducing 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 E 799, 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:*

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods[2]

E 456 Terminology Relating to Quality and Statistics[2]

E 799 Practice for Determining Data Criteria and Processing for Liquid Drop Size Analysis[2]

E 1088 Definition of Terms Relating to Atomizing Devices[2]

E 1296 Terminology Relating to Liquid Particle Statistics[2]

E 1620 Terminology Relating to Liquid Particles and Atomization[2]

2.2 *NFPA Standards:*

NFPA 30 Flammable and Combustible Liquids Code[3]

NFPA 33 Spray Application Using Flammable and Combustible Materials[3]

3. Terminology

3.1 For terminology pertaining to this test method, refer to

[1] This test method is under the jurisdiction of ASTM Committee E-29 on Particle Size Measurement and is the direct responsibility of Subcommittee E29.04 on Liquid Particle Measurement.

Current edition approved July 15, 1995. Published September 1995. Originally published as E 1260 – 88. Last previous edition E 1260 – 88.

[2] *Annual Book of ASTM Standards*, Vol 14.02.

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

Terminology E 456, Practice E 799, Definitions E 1088, and Terminology E 1296.

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 nonintrusive means whereby a beam of light passes through a local region, which is judged to be 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 such as mean drop size and dispersion. 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 and will give information on mean drop sizes and measures of dispersion of size. 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 water instead of a hydrocarbon liquid to simulate 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*, having transparent walls or windows which allow the light beam to pass through the spray. 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 permanently installed in a suitable location, and the devices to be tested shall be brought to the testing site for operation.

7.2.1 Where the spray is larger or is produced in a large structure the apparatus shall be designed to be portable and as far as possible nonintrusive.

7.2.2 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 may 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 Brief description of the operational principles of the instrument, oriented towards a trained technical operator.

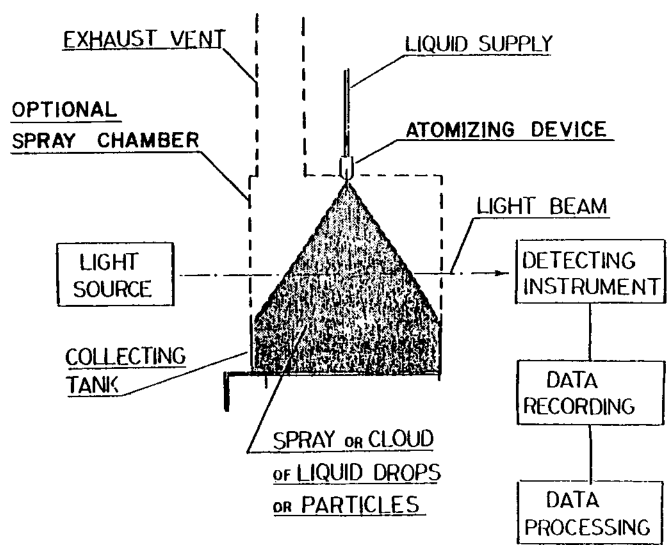

FIG. 1 Diagram of Test Arrangement