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# Standard Test Method for Selection and Use of ASTM Standards for the Determination of Flash Point of Chemicals by Closed Cup Methods[1]

This standard is issued under the fixed designation E502; 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 covers the determination of the flash point of liquid and solid chemical compounds flashing from below – 10 to 370°C (16 to 700°F). The procedures and apparatus in Test Methods D56, D93, D3278, D3828, and D3941 are to be used. Modification to these procedures are specified for tests on solids and viscous liquids. The significance of the results obtained is discussed along with possible sources of error and factors that might cause interference.

1.2 Suggestions for adapting this procedure to mixtures of chemicals are included (see Appendix X2).

1.3 This test method should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials or assemblies under actual fire conditions. However, results of this test method may be used as elements of a fire risk assessment that take into account all of the factors that are pertinent to an assessment of the fire hazard of a particular end use.

1.4 **Warning—**Mercury has been designated by EPA and many state agencies as a hazardous material that can cause central nervous system, kidney and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA's website – http://www.epa.gov/mercury/faq.htm - for additional information. Users should be aware that selling mercury and/or mercury containing products into your state may be prohibited by state law.

1.5 *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.* See also Section 8.

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D56 Test Method for Flash Point by Tag Closed Cup Tester
D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester
D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
D270 Methods of Sampling Petroleum and Petroleum Products (Withdrawn 1984)[3]
D1310 Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus
D3278 Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
D3827 Test Method for Estimation of Solubility of Gases in Petroleum and Other Organic Liquids
D3828 Test Methods for Flash Point by Small Scale Closed Cup Tester
D3934 Test Method for Flash/No Flash Test—Equilibrium Method by a Closed-Cup Apparatus
D3941 Test Method for Flash Point by the Equilibrium Method With a Closed-Cup Apparatus
E681 Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)
E1232 Test Method for Temperature Limit of Flammability of Chemicals

## 3. Terminology

3.1 *Definitions:*

3.1.1 *flash point*—the lowest temperature, corrected to a pressure of 760 mm Hg (101.3 kPa) (1013 mbar) at which application of an ignition source causes the vapors of a specimen to ignite under specified conditions of test.

[1] This test method is under jurisdiction of ASTM Committee E27 on Hazard Potential of Chemicals and is the direct responsibility of Subcommittee E27.04 on Flammability and Ignitability of Chemicals.

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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] The last approved version of this historical standard is referenced on www.astm.org.

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## 4. Summary of Test Method

4.1 The specimen is placed in a closed cup and in the small scale method equilibrated at a test temperature, in the Pensky-Martens Method heated at a controlled rate with stirring, and in the Tag Method also heated at a controlled rate but without stirring. A small flame is directed into the vapor space of each cup at specified intervals, with simultaneous interruption of stirring in the Pensky-Martens Method, to determine whether a flash occurs or not. In Test Method D3941, the specimen is heated at a slower rate than in the other controlled heating methods, maintaining a small temperature differential between bath and specimen.

## 5. Significance and Use

5.1 The flash point measures the response of the sample to heat and flame under controlled laboratory conditions. It is only one of a number of properties that must be considered in assessing the overall flammability hazard of a material.

5.2 As a result of physical factors inherent in the apparatus and procedure, the closed cup flash point does not necessarily represent the minimum temperature at which a material can evolve flammable vapors, and the absence of a flash point does not guarantee nonflammability (see Appendix X1 and Appendix X2).

5.3 Flash point is used in shipping and safety regulations to define flammable and combustible materials. Test Methods D56, D93, and D3278 are specified as test methods for determining the flash point of these materials.

5.4 If the process or handling conditions dictate the usage of a flammable material at temperatures ranging upward from 5 to 10°C below the closed-cup flash point, then a flammable vapor might be present above the liquid. In such cases, it may be more appropriate to use the temperature limit of flammability (as determined by Test Method E1232) instead of flash point.

5.5 Small scale methods involving equilibrium procedures and only one flame pass per specimen are preferred.

## 6. Interferences

6.1 Incorrect flash points can be obtained when testing chemicals corrosive to the materials of construction of the cup. (For example, certain amines and acid chlorides react with the standard aluminum small scale cup causing erroneously low flash points, perhaps due to hydrogen formation.) Cups employing alternative materials of construction, electroplating or plastic coating can provide corrosion resistance. Results in non-standard cups, particularly in non-equilibrium tests, may differ slightly from those obtained in this test method.

## 7. Apparatus

7.1 *Tag Closed-Cup Tester,* including thermometers, shall be as shown in Test Methods D56 and D3941.

7.2 *Penksy-Martens Closed-Cup Tester,* including thermometers, shall be as shown in Test Methods D93.

7.3 *Small scale Closed Tester,* including thermometers, shall be as shown in Test Methods D3278 or D3828.

NOTE 1—Some automatic flash point testers may save testing time and permit the use of small samples. If automatic testers are used, the user must be certain that all instructions for calibration and operation are followed to ensure that the results are equivalent to those obtained on the ASTM standard equipment. For regulation purposes or in cases of dispute, the flash point as determined on the manual tester shall be the accepted value.

NOTE 2—ASTM thermometers 33C or 33F may be used in the Tag Tester instead of those specified in Test Method D56 when conducting tests at temperatures below – 10°C (14°F). Slight stem corrections may be necessary and care should be taken to avoid freezing the mercury in the thermometer by cooling below – 40°C (–40°F).

7.4 *Shield*, as described in Test Method D3941 or Test Method D1310.

## 8. Hazards

8.1 *Toxicity of Chemical and Combustion Products:*

8.1.1 Isolate or control operations on toxic or corrosive materials to prevent exposure to any personnel.

8.1.2 Since flash point tests are conducted in still air, the use of forced circulation for removal of toxic or nuisance fumes or combustion products is restricted. However, a laboratory fume hood equipped with an exhaust damper that can be completely closed provides an ideal location for maintaining draft-free conditions and provides the ability to readily exhaust dangerous vapors and combustion products when necessary.

8.1.3 Use respiratory and splash protective devices as appropriate with toxic or corrosive materials. In most cases, approved cartridge respirators are adequate respiratory protection for the concentrations normally encountered in flash-point testing. Certain toxic or unusual materials, however, may require an air-supplied respirator and extreme cases may require complete protective coverage such as an air-supplied plastic suit. (Two examples of the latter type of material are dimethyl sulfate and pure mercaptans.) Tests on these highly toxic or obnoxious materials may also be conducted in completely isolated, closed systems, such as glove boxes. In this case, procedures should ensure an uncontaminated air system in the box, and should prevent a buildup of vapors from the material under test.

8.2 *Dry Ice Use:*

8.2.1 Exercise care in the use of dry ice for sample and apparatus cooling. Avoid contact with dry ice to prevent frostbite. Glass bottles or vials of chemicals should not be placed directly in dry ice or dry ice baths because of the possibility of breakage due to thermal shock.

8.3 *Tests of Explosives and Propellants:*

8.3.1 Flash tests should not be conducted on potential or known explosive or propellant materials without complete prior knowledge that burning will not result in propagation to an explosive decomposition. Properly barricaded or remotely operated automatic testers should be used if precise flash points are needed.

8.4 *Pyrophoric Materials:*

8.4.1 Flash point apparatus is not applicable for the evaluation of pyrophoric materials and should not be used for this purpose.

## 9. Preparation of Sample

9.1 Obtain samples representative of the batch under test. Methods D270 can be used as a reference on sampling techniques. With mixtures and with samples containing

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