Designation: D 56 – 05

An American National Standard

Standard Test Method for Flash Point by Tag Closed Cup Tester[1]

This standard is issued under the fixed designation D 56; 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.

This standard has been approved for use by agencies of the Department of Defense.

INTRODUCTION

To ensure an acceptable precision, this dynamic flash point test method employs a prescribed rate of temperature rise for the material under test. The rate of heating may not in all cases give the precision quoted in the test method because of the low thermal conductivity of certain materials. To improve the prediction of flammability, Test Method D 3941, which utilizes a slower heating rate, was developed. Test Method D 3941 provides conditions closer to equilibrium where the vapor above the liquid and the liquid are at about the same temperature. If a specification requires Test Method D 56, do not change to Test Method D 3941 or other test method without permission from the specifier.

Flash point values are a function of the apparatus design, the condition of the apparatus used, and the operational procedure carried out. Flash point can therefore only be defined in terms of a standard test method, and no general valid correlation can be guaranteed between results obtained by different test methods, or with test apparatus different from that specified.

1. Scope*

1.1 This test method covers the determination of the flash point, by tag manual and automated closed testers, of liquids with a viscosity below 5.5 mm^2/s (cSt) at 40°C (104°F), or below 9.5 mm^2/s (cSt) at 25°C (77°F), and a flash point below 93°C (200°F).

1.1.1 For the closed-cup flash point of liquids with the following properties: a viscosity of 5.5 mm^2/s (cSt) or more at 40°C (104°F); a viscosity of 9.5 mm^2/s (cSt) or more at 25°C (77°F); a flash point of 93°C (200°F) or higher; a tendency to form a surface film under test conditions; or containing suspended solids, Test Method D 93 can be used.

1.1.2 For cut-back asphalts refer to Test Methods D 1310 and D 3143.

NOTE 1—The U.S. Department of Transportation (RSTA)[2] and U.S. Department of Labor (OSHA) have established that liquids with a flash point under 37.8°C (100°F) are flammable as determined by this test method for those liquids that have a viscosity less than 5.5 mm^2/s (cSt) at 40°C (104°F) or 9.5 mm^2/s (cSt) or less at 25°C (77°F), or do not contain suspended solids or do not have a tendency to form a surface film while under test. Other flash point classifications have been established by these departments for liquids using this test method.

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

1.3 Related standards are Test Methods D 93, D 1310, D 3828, D 3278, and D 3941.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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.* For specific hazard statements see 8.2, 8.3, 9.5, 12.5, and refer to Material Safety Data Sheets.

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.08 on Volatility.

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[2] For information on United States Department of Transportation regulations, see Codes of United States Regulation 49 CFR Chapter 1 and for information on United States Department of Labor regulations, see Code of United States Regulation 29 CFR Chapter XVII. Each of these items are revised annually and may be procured from the Superintendent of Documents, Government Printing Office, Washington, DC 20402.

***A Summary of Changes section appears at the end of this standard.**

2. Referenced Documents

2.1 *ASTM Standards:* [3]

D 93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester

D 1310 Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus

D 3143 Test Method for Flash Point of Cutback Asphalt with Tag Open-Cup Apparatus

D 3278 Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus

D 3828 Test Methods for Flash Point by Small Scale Closed Cup Tester

D 3941 Test Method for Flash Point by the Equilibrium Method with a Closed-Cup Apparatus

D 4057 Practice for Manual Sampling for Petroleum and Petroleum Products

D 6299 Practice for Applying Statistical Quality Assurance Techniques to Evaluate Analytical Measurement System Performance

D 6300 Practice for Determination of Precision and Bias Data for Use in Test Methods for Petroleum Products and Lubricants

E 1 Specification for ASTM Liquid-in-Glass Thermometers

E 502 Test Method for Selection and Use of ASTM Standards for the Determination of Flash Point of Chemicals by Closed Cup Methods

2.2 *Federal Test Method Standards:*[4]

Method 1101, Federal Test Method Standard No. 791b

Method 4291, Federal Test Method Standard No. 141A

2.3 *ISO Standards:*[5]

Guide 34 General Requirements for the Competence of Reference Material Producers

Guide 35 Certification of Reference Materials—General and Statistical Principles

3. Terminology

3.1 *Definitions:*

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

3.1.1.1 *Discussion*—The specimen is deemed to have flashed when a flame appears and instantaneously propagates itself over the entire surface of the fluid.

3.1.1.2 *Discussion*—When the ignition source is a test flame, the application of the test flame may cause a blue halo or an enlarged flame prior to the actual flash point. This is not a flash and should be ignored.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *dynamic (non-equilibrium)*—in this type of flash point apparatus, the condition of the vapor above the specimen and the specimen are not at the same temperature at the time that the ignition source is applied.

3.2.1.1 *Discussion*—This is primarily caused by the heating of the specimen at the constant prescribed rate with the vapor temperature lagging behind the specimen temperature. The resultant flash point temperature is generally within the reproducibility of the test method.

3.2.2 *equilibrium*—in that type of flash point apparatus or test method, the vapor above the specimen and the specimen are at the same temperature at the time the ignition source is applied.

3.2.2.1 *Discussion*—This condition may not be fully achieved in practice, since the temperature is not uniform throughout the specimen and the test cover and shutter are generally cooler.

4. Summary of Test Method

4.1 The specimen is placed in the cup of the tester and, with the lid closed, heated at a slow constant rate. An ignition source is directed into the cup at regular intervals. The flash point is taken as the lowest temperature at which application of the ignition source causes the vapor above the specimen to ignite.

5. Significance and Use

5.1 Flash point measures the tendency of the specimen to form a flammable mixture with air under controlled laboratory conditions. It is only one of a number of properties that shall be considered in assessing the overall flammability hazard of a material.

5.2 Flash point is used in shipping and safety regulations to define flammable and combustible materials. One should consult the particular regulation involved for precise definitions of these classes.

5.3 Flash point can indicate the possible presence of highly volatile and flammable materials in a relatively nonvolatile or nonflammable material. For example, an abnormally low flash point on a sample of kerosene can indicate gasoline contamination.

6. Apparatus (Manual Instrument)

6.1 *Tag Closed Tester*—The apparatus is shown in Fig. 1 and described in detail in Annex A1.

6.2 *Shield*—A shield 460 mm (18 in.) square and 610 mm (24 in.) high, open in front, is recommended.

6.3 *Temperature Measuring Device*—A liquid-in-glass thermometer, as prescribed in Table 1, or an electronic temperature measuring device such as a resistance device or thermocouple. The device shall exhibit the same temperature response as the liquid-in-glass thermometer.

NOTE 2—Whenever thermometers complying with ASTM requirements are not available, thermometers complying with the requirements for The Institute of Petroleum thermometer IP 15C PM-Low can be used.

7. Sampling

7.1 Erroneously high flash points will be obtained when precautions are not taken to avoid the loss of volatile material.

[3] 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.

[4] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

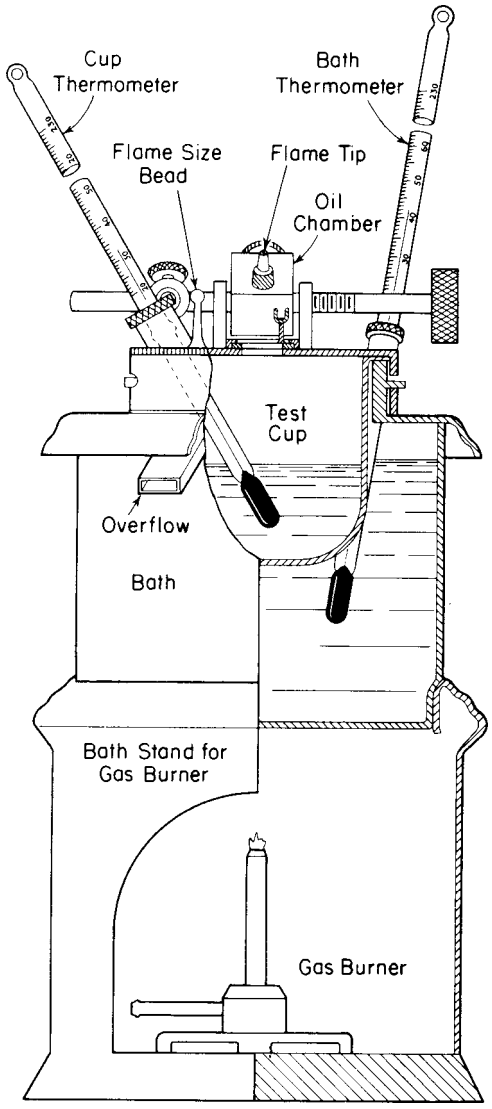

FIG. 1 Tag Closed Flash Tester (Manual)

TABLE 1 Thermometers

For tests	Below 4°C (40°F)	At 4 to 49°C (40 to 120°F)	Above 49°C (120°F)
Use ASTM Thermometer[A]	57C or (57F)	9C or (9F) 57C or (57F)	9C or (9F)

[A] Complete specifications for these thermometers are given in Specification E 1.

Containers should not be opened unnecessarily to prevent loss of volatile material and possible introduction of moisture. Transfers should not be made unless the sample temperature is at least 10°C (18°F) below the expected flash point. When possible, flash point shall be the first test performed on a sample and the sample must be stored at low temperature.

7.2 Do not store samples in gas-permeable containers since volatile materials may diffuse through the walls of the enclosure. Samples in leaky containers are suspect and not a source of valid results.

7.3 At least 50 mL of sample is required for each test. Refer to sampling information in Practice D 4057.

8. Preparation of Apparatus (Manual)

8.1 Support the manual apparatus on a level steady surface, such as a table. Unless tests are made in a draft-free room or compartment, surround the tester on three sides by the shield for protection from drafts. Tests are not to be made in a laboratory draft hood or near ventilators.

8.2 Natural gas and bottled gas flame and electric ignitors have been found acceptable for use as the ignition source. (**Warning—**Gas pressure supplied to the apparatus must not be allowed to exceed 3 kPa (12 in.) of water pressure.)

8.3 For flash points below 13°C (55°F) or above 60°C (140°F), use as a bath liquid a 1 + 1 mixture of water and ethylene glycol (**Warning—**Ethylene Glycol—Poison. Harmful or fatal if swallowed. Vapor harmful. Avoid contact with skin.) For flash points between 13°C (55°F) and 60°C (140°F), either water or a water-glycol mixture can be used as bath liquid. The temperature of the liquid in the bath shall be at least 10°C (18°F) below the expected flash point at the time of introduction of the sample into the test cup. Do not cool bath liquid by direct contact with dry ice (solid carbon dioxide).

NOTE 3—Due to possible difficulty in maintaining the prescribed rate of temperature rise and due to the formation of ice on the lid, results by this test method for samples having flash points below 0°C (32°F) may be unreliable. Trouble due to ice formation on the slide can be minimized by carefully lubricating the slide shutter with high-vacuum silicone lubricant.

8.4 Verify the performance of the manual apparatus (or in 11.2.3, the automated apparatus) at least once per year by determining the flash point of a certified reference material (CRM), such as those listed in Annex A2, which is reasonably close to the expected temperature range of the samples to be tested. The material shall be tested according to the procedure of this test method and the observed flash point obtained in 9.5 shall be corrected for barometric pressure (see Section 13). The flash point obtained shall be within the limits stated in Table A2.1 for the identified CRM or within the limits calculated for an unlisted CRM (see Annex A2).

8.5 Once the performance of the apparatus has been verified, the flash point of secondary working standards (SWSs) can be determined along with their control limits. These secondary materials can then be utilized for more frequent performance checks (see Annex A2).

8.6 When the flash point obtained is not within the limits stated in 8.4 or 8.5, check the condition and operation of the apparatus to ensure conformity with the details listed in Annex A1, especially with regard to tightness of the lid (see A1.1.3), the action of the shutter, the position of the ignition source (see A1.1.3.3), and the angle and position of the temperature measuring device (see A1.1.3.4). After any adjustment, repeat the test in 8.4 using fresh test specimen, with special attention to the procedural details prescribed in the test method.

9. Procedure (Manual)

9.1 Using a graduated cylinder and taking care to avoid wetting the cup above the final liquid level, measure 50 ± 0.5 mL of the sample into the cup, both the sample and graduated cylinder being precooled, when necessary, so that the specimen temperature at the time of measurement will be 27 ± 5°C (80