Designation: D3828 – 16a (Reapproved 2021)

Standard Test Methods for Flash Point by Small Scale Closed Cup Tester[1]

This standard is issued under the fixed designation D3828; 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 U.S. Department of Defense.

INTRODUCTION

These small scale flash point methods are generally used for testing a sample at a specific temperature where the specimen being tested and the air–vapor mixture above it are close to thermal equilibrium. Test Method D3941 covers other flash point equipment operated at a specific temperature.

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 These test methods cover procedures for flash point tests, within the range of –30 °C to 300 °C, of petroleum products and biodiesel liquid fuels, using a small scale closed cup tester. The procedures may be used to determine, whether a product will or will not flash at a specified temperature (flash/no flash Method A) or the flash point of a sample (Method B). When used in conjunction with an electronic thermal flash detector, these test methods are also suitable for flash point tests on biodiesels such as fatty acid methyl esters (FAME).

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

1.3 *This standard 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, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.*

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Warning statements appear throughout. See also the Material Safety Data Sheets for the product being tested.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D3941 Test Method for Flash Point by the Equilibrium Method With a Closed-Cup Apparatus

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products

D6299 Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance

D6708 Practice for Statistical Assessment and Improvement of Expected Agreement Between Two Test Methods that Purport to Measure the Same Property of a Material

E300 Practice for Sampling Industrial Chemicals

[1] These test methods are under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.08 on Volatility.

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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.

E1137/E1137M Specification for Industrial Platinum Resistance Thermometers

2.2 *ISO Standards:*[3]

Guide 34 General requirements for the competence of reference material producers

Guide 35 Reference materials—General and statistical principles for certification

EN ISO 3679 Determination of Flash Point—Rapid Equilibrium Closed Cup Method

EN ISO 3680 Determination of Flash/No Flash—Rapid Equilibrium Closed Cup Method

ISO 60751 Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors

2.3 *Energy Institute Standards:*[4]

IP 523 Determination of Flash Point—Rapid Equilibrium Closed Cup Method

IP 524 Determination of Flash/No Flash—Rapid Equilibrium Closed Cup Method

3. Terminology

3.1 *Definitions:*

3.1.1 *equilibrium, n—in flash point test methods*, the condition where the vapor above the test specimen, and the test specimen are at the same temperature at the time the ignition source is applied.

3.1.1.1 *Discussion*—This condition may not be fully achieved in practice, since the temperature may not be uniform throughout the test specimen, and the test cover and shutter on the apparatus can be cooler or warmer.

3.1.2 *flash point, n—in flash point test methods*, the lowest temperature of the test specimen, adjusted to account for variations in atmospheric pressure from 101.3 kPa, at which application of an ignition source causes the vapors of the test specimen to ignite under specified conditions of test.

4. Summary of Test Methods

4.1 *Method A—Flash/No Flash Test*—A test specimen is introduced, by a syringe, into the test cup of the selected apparatus that is set and maintained at the specified temperature. After a specific time an ignition source is applied and a determination made as to whether or not a flash occurred.

4.2 *Method B—Finite (or Actual) Flash Point*—This method essentially repeats Method A a number of times, and by changing the test temperature and test specimen a number of times, determines the flash point.

4.2.1 A test specimen is introduced into the test cup of the selected apparatus that is maintained at the expected flash point. After a specified time an ignition source is applied and a determination made whether or not a flash occurred.

4.2.2 The test specimen is removed from the test cup; the test cup and cover are cleaned, and the test temperature adjusted 5 °C (9 °F) lower or higher depending on whether or not a flash occurred previously. A fresh test specimen is introduced and tested. This procedure is repeated until the flash point is established within 5 °C (9 °F).

4.2.3 The procedure is then repeated at 1 °C (2 °F) intervals until the flash point is determined to the nearest 1 °C (2 °F).

4.2.4 If improved accuracy is desired the procedure is repeated at 0.5 °C (1 °F) intervals until the flash point is determined to the nearest 0.5 °C (1 °F).

4.3 *Test Time and Specimen Volume:*

4.3.1 For all products, except biodiesel; for test temperatures up to and including 100 °C (212 °F), the test time is 1 min and the specimen volume is 2 mL.

4.3.2 For all products, except biodiesel; for test temperatures over 100 °C (212 °F), the test time is 2 min and the specimen volume is 4 mL.

4.3.3 For biodiesel; for all test temperatures, the test time is 1 min and the specimen volume is 2 mL.

5. Significance and Use

5.1 Flash point measures the response of the test specimen to heat and ignition source 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 Flash point is used in shipping and safety regulations to define *flammable* and *combustible* materials and classify them. 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.

5.4 These test methods use a smaller sample (2 mL to 4 mL) and a shorter test time (1 min to 2 min) than traditional test methods.

5.5 Method A, IP 524 and EN ISO 3680 are similar methods for flash no-flash tests. Method B, IP 523 and EN ISO 3679 are similar methods for flash point determination.

6. Apparatus

6.1 *Test Cup and Cover Assembly*—The essential dimensions and requirements of the apparatus are shown in Fig. A1.1 and Table A1.1 of Annex A1. The apparatus and accessories are described in detail in Annex A1. The temperature range is from –30 °C to 300 °C. Some versions of the apparatus may not cover the full temperature range.

6.2 *Barometer,* accurate to 0.5 kPa. Barometers that have been pre-corrected for use at weather stations or airports are not suitable.

6.3 *Draft Shield*—A shield located at the back and on two sides of the instrument, for use in circumstances where protection from drafts does not exist.

7. Reagents and Materials

7.1 *Cleaning Solvent*—Use only non-corrosive solvents capable of cleaning the test cup and cover. Two commonly used solvents are toluene and acetone. (**Warning—**Toluene, acetone

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from Energy Institute, 61 New Cavendish St., London, WIG 7AR, U.K., http://www.energyinst.org.uk.