Designation: D8254 – 19

# Standard Test Method for Flash and Fire Points of Asphalt by Cleveland Open Cup Tester[1]

This standard is issued under the fixed designation D8254; 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 flash point and fire point test method is a dynamic method and depends on definite rates of temperature increases to control the precision of the test method. Its primary use is for viscous materials having flash point of 79 °C (174 °F) and above. It is also used to determine fire point, which is a temperature above the flash point, at which the test specimen will support combustion for a minimum of 5 s. Do not confuse this test method with Test Method D4206, which is a sustained burning test, open cup type, at a specific temperature of 49 °C (120 °F).

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 describes the determination of the flash point and fire point of asphalt by a manual Cleveland open cup apparatus or an automated Cleveland open cup apparatus.

NOTE 1—Apparatus is the same as described in Test Method D92 with the addition of the materials for the skin prevention technique.

1.2 This test method is applicable to asphalts that can form a skin, and those that do not form a skin during heat treatment.

1.3 This test method is applicable to products with flash points above 79 °C (174 °F) and below 400 °C (752 °F), except fuel oils.

1.4 The precision has been determined over the temperature range of 300 °C to 370 °C (572 °F to 698 °F).

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *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.* For specific warning statements, see 6.4, 7.1, 11.1, 11.2.3, and 11.3.4.

1.7 *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]

D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester

D140 Practice for Sampling Asphalt Materials

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products

D4206 Test Method for Sustained Burning of Liquid Mixtures Using the Small Scale Open-Cup Apparatus

E1 Specification for ASTM Liquid-in-Glass Thermometers

E300 Practice for Sampling Industrial Chemicals

[1] This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.47 on Miscellaneous Asphalt Tests.

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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.

2.2 *Energy Institute Standard:*[3]
Specifications for IP Standard Thermometers

2.3 *ISO Standards:*[4]
ISO 17034 General requirements for the competence of reference material producers
ISO Guide 35 Reference materials—Guidance for characterization and assessment of homogeneity and stability

## 3. Terminology

3.1 *Definitions:*

3.1.1 *dynamic, adj—in petroleum products—in petroleum product flash point test methods,* the condition where the vapor above the test specimen and the test specimen are not in temperature equilibrium at the time that the ignition source is applied.

3.1.1.1 *Discussion*—This is primarily caused by the heating of the test specimen at the constant prescribed rate with the vapor temperature lagging behind the test specimen temperature.

3.1.2 *fire 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 and sustain burning for a minimum of 5 s under specified conditions of test.

3.1.3 *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 Method

4.1 Approximately 50 mL of test specimen is filled into a test cup which has been previously prepared for running the skin-prevention procedure. The temperature of the test specimen is increased rapidly at first and then at a slower constant rate as the flash point is approached. At specified intervals, a test flame is passed across the cup. The flash point is the lowest liquid temperature at which application of the test flame causes the vapors of the test specimen of the sample to ignite. To determine the fire point, the test is continued until the application of the test flame causes the test specimen to ignite and sustain burning for a minimum of 5 s.

## 5. Significance and Use

5.1 The flash point is one measure of the tendency of the test specimen to form a flammable mixture with air under controlled laboratory conditions. It is only one of a number of properties that should 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. Consult the particular regulation involved for precise definitions of these classifications.

5.3 Flash point can indicate the possible presence of highly volatile and flammable materials in a relatively nonvolatile or nonflammable material.

5.4 Skin prevention technique involves assembling a restraining ring over a centrally-holed qualitative filter paper that is laid at the bottom of the COC (Cleveland open cup) test cup, prior to introduction of the sample specimen into the cup. This allows a column of the hot sample specimen to move up constantly, through the hole, to the surface of the test specimen so that the surface is maintained in the hot condition to prevent skin formation. (See 9.6).

5.5 Skin-forming asphalts may not be limited to those which are air blown/oxidized, polymerized or non-homogeneous materials that, although infrequently, exhibit some unique behavior and characteristics, as far as manifestation of flash point is concerned. At the flash point stage, this behavior may involve flame propagation across the surface or just a flame appearing at one or more points on the surface.

5.6 This test method shall be used to measure and describe the properties of materials, products, or assemblies in response to heat and a test flame under controlled laboratory conditions and shall 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 method may be used as elements of a fire risk assessment that takes into account all of the factors that are pertinent to an assessment of the fire hazard for a particular end use.

5.7 The fire point is one measure of the tendency of the test specimen to support combustion.

## 6. Apparatus

6.1 *Cleveland Open Cup Apparatus (manual)*—This apparatus consists of the test cup, heating plate, test flame applicator, heater, and supports described in detail in the Annex A1. The assembled manual apparatus, heating plate, and cup are illustrated in Figs. 1-3, respectively. Dimensions are listed with the figures.

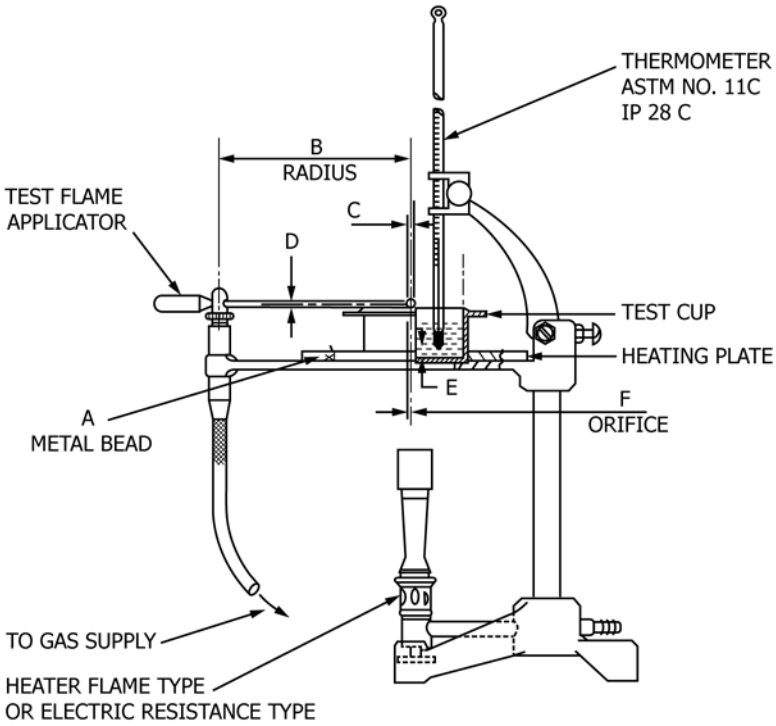
6.2 *Cleveland Open Cup Apparatus (automated)*—This apparatus is an automated flash point instrument that shall perform the test in accordance with the procedure, 11.3. The apparatus shall use the test cup with the dimensions as described in Annex A1 and the application of the test flame shall be as described in Annex A1.

6.3 *Temperature Measuring Device*—A thermometer having the range as shown below and conforming to the requirements prescribed in Specification E1 or in the Specifications for IP Standard Thermometers, or an electronic temperature measuring device, such as a resistance thermometer or thermocouple. The device shall exhibit the same temperature response as the liquid in glass thermometers.

| Temperature Range | Thermometer Number ASTM IP |
|---|---|
| –6 °C to +400 °C | 11C 28C |

[3] Available from Energy Institute, 61 New Cavendish St., London, W1G 7AR, U.K., http://www.energyinst.org.

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

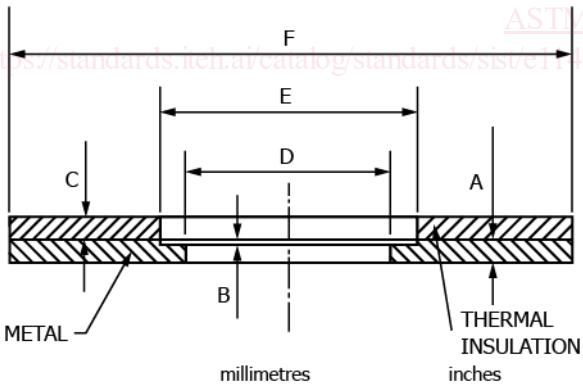



| | millimetres | | inches | |
|---|---|---|---|---|
| | min | max | min | max |
| A—Diameter | 3.2 | 4.8 | 0.126 | 0.189 |
| B—Radius | 152 | nominal | 6 | nominal |
| C—Diameter | 1.6 | nominal | 0.063 | nominal |
| D | | 2 | | 0.078 |
| E | 5.9 | 6.9 | 0.23 | 0.27 |
| F—Diameter | 0.8 | nominal | 0.031 | nominal |



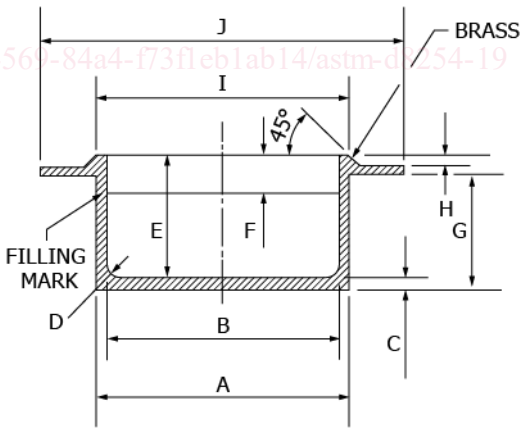
**FIG. 1 Cleveland Open Cup Apparatus**






| | millimetres | | inches | |
|---|---|---|---|---|
| | min | max | min | max |
| A | 6 | 7 | 0.236 | 0.276 |
| B | 0.5 | 1.0 | 0.020 | 0.039 |
| C | 6 | 7 | 0.236 | 0.276 |
| D—Diameter | 55 | 56 | 2.165 | 2.205 |
| E—Diameter | 69.5 | 70.5 | 2.736 | 2.776 |
| F—Diameter | 146 | 159 | 5.748 | 6.260 |

**FIG. 2 Heating Plate**




| | millimetres | | inches | |
|---|---|---|---|---|
| | min | max | min | max |
| A | 67.5 | 69 | 2.658 | 2.717 |
| B | 63 | 64 | 2.480 | 2.520 |
| C | 2.8 | 3.5 | 0.110 | 0.138 |
| D—Radius | 4 | nominal | 0.157 | nominal |
| E | 32.5 | 34 | 1.280 | 1.339 |
| F | 9 | 10 | 0.354 | 0.394 |
| G | 31 | 32.5 | 1.221 | 1.280 |
| H | 2.8 | 3.5 | 0.110 | 0.138 |
| I | 67 | 70 | 2.638 | 2.756 |
| J | 97 | 100 | 3.819 | 3.937 |

**FIG. 3 Cleveland Open Cup**

6.4 *Test Flame*—Natural gas (methane) flame and bottled gas (butane, propane) flame have been found acceptable for use as the ignition source. The gas flame device is described in

detail in Annex A1. (**Warning—**Gas pressure supplied to the apparatus must not be allowed to exceed 3 kPa (12 in.) of water pressure.)

6.5 *Hotplate or Oven,* capable of/suitable for liquefying asphalt samples.

## 7. Reagents and Materials

7.1 *Cleaning Solvents*—Use suitable technical grade solvent capable of cleaning out the test specimen from the test cup and drying the test cup. Some commonly used solvents are toluene and acetone. (**Warning—**Toluene, acetone, and many solvents are flammable. Health hazard. Dispose of solvents and waste material in accordance with local regulations.)

7.2 *Materials Required for Application of Skin-prevention Technique:*

7.2.1 *Filter paper,* qualitative, No. 417 or equivalent, 75 mm ± 1.01 mm (3.0 in. ± 0.04 in.) in diameter.

7.2.2 *Restraining Ring,* made from metal wire, nominal dimensions: 210 mm (8.3 in.) long by 2.0 mm (0.08 in.) thick, with the following configuration: circular, 62 mm to 63 mm (2.4 in. to 2.5 in.) outside diameter, with its 15 mm (0.6 in.) straight, open ends folded inwards such that they are 15 mm (0.6 in.) apart and parallel to each other.

7.2.3 *Single-hole punch or equivalent,* capable of making a 6.0 mm ± 1.0 mm (0.24 in. ± 0.04 in.) diameter hole in the center of the filter paper.

## 8. Sampling

8.1 Obtain a sample in accordance with the instructions given in Practices D140, D4057, D4177, or E300.

8.2 At least 50 mL of sample is required for each test. Refer to Practice D4057.

8.3 Erroneously high flash points may be obtained if precautions are not taken to avoid the loss of volatile material. Do not open containers unnecessarily; this will prevent loss of volatile material and possible introduction of moisture. Do not make a transfer of the sample unless the sample temperature is at least 56 °C (101 °F) below the expected flash point. When possible, flash point should be the first test performed on a sample and the sample should be stored at low temperature.

NOTE 2—Typical sample storage temperature is 18 °C to 25 °C (64 °F to 77 °F).

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

8.5 Light hydrocarbons may be present in the form of gases, such as propane or butane, and may not be detected by testing because of losses during sampling and filling of the test cup. This is especially evident on heavy residuums or asphalts from solvent extraction processes.

8.6 Samples of very viscous materials can be warmed until they are reasonably fluid before they are tested. However, no sample shall be heated more than is absolutely necessary. It shall never be heated above a temperature of 56 °C (101 °F) below its expected flash point. When the sample has been heated above this temperature, allow the sample to cool until it is at least 56 °C (101 °F) below the expected flash point before transferring.

NOTE 3—Typically, the sample containers for these types of samples will remain closed during the warming process.

NOTE 4—If the sample is suspected of containing volatile contaminants, the treatment described in 8.6 should be omitted.

## 9. Preparation of Apparatus

9.1 Support the manual or automated apparatus on a level, steady surface, such as a table.

9.2 Tests are to be performed in a draft-free room or compartment.

NOTE 5—A draft shield is recommended to prevent drafts from disturbing the vapors above the test cup. This shield should cover at least three sides of the test cup vicinity. Some apparatus may already include a built-in draft shield.

9.3 Wash the test cup with the cleaning solvent to remove any test specimen or traces of gum or residue remaining from a previous test. If any deposits of carbon are present, they should be removed with a material such as a very fine grade of steel wool. Ensure that the test cup is completely clean and dry before using again. If necessary, flush the test cup with cold water and dry for a few minutes over an open flame or a hot plate to remove the last traces of solvent and water. Cool the test cup to at least 56 °C (101 °F) below the expected flash point before using.

9.4 Support the temperature measuring device in a vertical position with the bottom of the device located 6.4 mm ± 0.5 mm (¼ in. ± 1⁄50 in.) up from the bottom of the inside of the test cup and located at a point halfway between the center and the side of the test cup on a diameter perpendicular to the arc (or line) of the sweep of the test flame and on the side opposite to the test flame applicator mounting position. It is permissible for electronic temperature measuring devices to be mounted in a non-vertical position provided that performance is in accordance with the requirements given in 6.3.

NOTE 6—The immersion line engraved on the ASTM or IP thermometer will be 2 mm ± 0.5 mm (5⁄64 in. ± 1⁄50 in.) below the level of the rim of the cup when the thermometer is properly positioned.

NOTE 7—Some automated apparatus are capable of positioning the temperature measuring device automatically. Refer to the manufacturer's instructions for proper installation and adjustment.

9.5 Prepare the manual apparatus or the automated apparatus for operation according to the manufacturer's instructions for calibrating, checking, and operating the equipment.

9.6 *Skin Prevention Technique*—Punch a 6.0 mm (0.24 in.) diameter hole in the center of the 7.5 cm (3.0 in.) diameter qualitative filter paper. Curl up the sides of the filter paper 6.0 mm (0.24 in.) all around, and place it in the base of the test cup, with the skirt facing upwards. Place the restraining ring snugly over the curved portion of the filter paper in the base of the cup.

NOTE 8—Restraining ring prevents the filter paper from rising upwards during the test.

## 10. Calibration and Standardization

10.1 Adjust the automated flash point detection system, when used, according to the manufacturer's instructions.