



Designation: D3278 – 21

# Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus<sup>1</sup>

This standard is issued under the fixed designation D3278; 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 ( $\epsilon$ ) 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 test a sample at a specific temperature, where the specimen being tested and the air-vapor mixture above it are close to thermal equilibrium.

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 determining whether a material does or does not flash at a specified temperature (flash/no flash Method A) or for determining the lowest finite temperature at which a material does flash (Method B), when using a small scale closed-cup apparatus. The test methods are applicable to paints, enamels, lacquers, varnishes, solvents, and related products having a flash point between 0 °C and 110 °C (32 °F and 230 °F) and viscosity lower than 15 000 mm<sup>2</sup>/s (cSt) at 25 °C (77 °F).

NOTE 1—Tests at higher or lower temperatures are possible however the precision has not been determined.

NOTE 2—More viscous materials can be tested in accordance with Annex A4.

NOTE 3—Organic peroxides can be tested in accordance with Annex A5, which describes the applicable safety precautions.

NOTE 4—The U.S. Department of Labor (OSHA, Hazard Communications), the U.S. Department of Transportation (RSPA), and the U.S. Environmental Protection Agency (EPA) have specified Test Methods D3278 as one of several acceptable methods for the determination of flash point of liquids in their regulations.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.3 This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame

<sup>1</sup> These test methods are under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and are the direct responsibility of Subcommittee D01.21 on Chemical Analysis of Paints and Paint Materials.

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under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products, or assemblies under actual fire conditions.

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.*

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:<sup>2</sup>

- D56 Test Method for Flash Point by Tag Closed Cup Tester
- D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- D3828 Test Methods for Flash Point by Small Scale Closed Cup Tester
- D3925 Practice for Sampling Liquid Paints and Related Pigmented Coatings
- D6299 Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

**D7236** Test Method for Flash Point by Small Scale Closed Cup Tester (Ramp Method)

**D8174** Test Method for Finite Flash Point Determination of Liquid Wastes by Small-Scale Closed Cup Tester

**E1137/E1137M** Specification for Industrial Platinum Resistance Thermometers

2.2 *ISO Standards*:<sup>3</sup>

**ISO 1513** Paints and varnishes — Examination and preparation of test samples for testing

**ISO 3679** Determination of flash no-flash and flash point—Rapid equilibrium closed cup method

**ISO 15528** Paints, varnishes and raw materials for paints and varnishes — Sampling

**ISO 17034** General requirements for the competence of reference material producers

**ISO 17043** Conformity assessment – General requirements for proficiency testing

**ISO 60751** Industrial platinum resistance thermometers and platinum temperature sensors

**Guide 35** Certification of Reference Materials—General and Statistical Principles

### 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 2 mL test specimen is introduced, by a syringe (6.5), into the test cup of the selected apparatus that is set and maintained at the specified test temperature. After one minute, 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 iteratively.

4.2.1 A 2 mL test specimen is introduced into the test cup of the selected apparatus that is maintained at the expected flash point. After one minute, 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 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.

4.2.3 The procedure is then repeated at 0.5 °C intervals until the flash point is determined to the nearest 0.5 °C.

4.2.4 A second determination is made in accordance with 4.2.3 and the average of the two determinations recorded as the flash point.

### 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 by governmental regulatory agencies to define flammable and combustible materials and to 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 impurities or contaminants in a given liquid, such as the presence of residual solvents in solvent-refined drying oils.

5.4 These equilibrium flash point test methods use a smaller specimen (2 mL) and a shorter test time (1 min) than traditional non-equilibrium test methods such as Test Method D56 and Test Methods D93.

5.5 Test Methods D3828, Test Method D8174, and ISO 3679 are similar test methods and use the same apparatus.

### 6. Apparatus

#### 6.1 Test Cup and Cover Assembly:

6.1.1 The essential dimensions and requirements of the apparatus are shown in Fig. A1.1 and described in Annex A1.

6.1.2 The temperature range is from 0 °C to 110 °C.

6.1.2.1 Versions of the apparatus can cover a wider temperature range.

6.1.3 Some apparatuses can automate temperature control down to sub-ambient temperatures, timing and dipping, including hot wire ignition, automatically detecting a valid flash point and measuring barometric pressure.

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.

6.4 *Syringe (optional)*—General purpose for use with very viscous samples, to dispense 2 mL to 4 mL specimens (see Annex A4).

6.5 *Glass Syringe*, 2 mL ± 0.1 mL capacity at 25 °C (77 °F), to provide a means of taking a uniform specimen. Check the capacity by discharging water into a weighing bottle and weighing. Adjust plunger if necessary. A disposable syringe of equal precision may be used.

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

## 7. Reagents and Materials

7.1 *Cleaning Solvent*—Use only non-corrosive solvents capable of cleaning the test cup and lid assembly. Two commonly used solvents are toluene and acetone. (**Warning**—Toluene, acetone, and many other solvents are flammable and a health hazard. Dispose of solvents and waste material in accordance with local regulations.)

7.2 *Butane, Propane, and Natural Gas*—Optional for use as a pilot and ignition source. (**Warning**—Butane, propane, and natural gases are flammable and a health hazard.)

7.3 *Verification Fluids*—See [Annex A2](#).

## 8. Sampling

8.1 Obtain at least a 25 mL sample from a bulk test site in accordance with Practice [D3925](#), ISO 1513, or ISO 15528, or a comparable sampling practice.

8.2 Store samples in clean, tightly sealed containers, suitable for the type of liquid being sampled, at normal room temperature (for example 20 °C to 25 °C (68 °F to 77 °F)) or colder.

8.3 Do not store samples for an extended period of time in gas permeable containers, such as those made of plastic, because volatile material can diffuse through the walls of the container. Samples in leaky containers are suspect and not a source of valid results.

8.4 Erroneously high flash points can be obtained when precautions are not taken to avoid loss of volatile materials. Do not open containers unnecessarily. Do not make a transfer unless the sample temperature is at least 10 °C below the expected flash point. Where possible, perform the flash point as the first test on the sample.

8.5 Decant any free water in the sample container.

8.6 Cool or adjust the temperature of the sample and its container to at least 10 °C below the expected flash point before opening to remove the test specimen. If an aliquot of the original sample is to be stored prior to testing, ensure that the container is filled to between 85 % and 95 % of its capacity.

8.7 If sufficiently fluid, mix samples by gently shaking by hand prior to removal of the test specimen, taking care to minimize the loss of volatile components. If the sample is too viscous at ambient temperature, gently warm the sample in its container to a temperature not warmer than 10 °C below the test temperature, such that the sample can be mixed by gentle shaking.

NOTE 5—Results of flash point tests can be affected if the sample volume falls below 50 % of the container's capacity.

8.8 If the sample is highly viscous and not sufficiently fluid to be drawn into the 2 mL syringe and be introduced into the test cup through the filler orifice, follow the procedure given in [Annex A4](#).

## 9. Preparation of Apparatus

9.1 Place the apparatus on a level, stable surface. Unless tests are made in a draft-free area, surround the tester on three sides with a draft shield (see [6.3](#)) for protection. Do not rely on

tests made in a laboratory draft hood unless the extracted air and vapors can be withdrawn without causing air currents over the test cup during the ignition source application period.

9.2 Read the manufacturer's instructions on the care and servicing of the instrument and for the correct operation of any controls.

9.3 Prepare the apparatus for operation in accordance with the manufacturers' instructions for calibrating, checking and operating the equipment, especially the operation of the ignition source. (**Warning**—An incorrectly set test flame size or setting of an electric ignitor can significantly affect the test result.)

9.4 Clean the test cup, cover, and its accessories with an appropriate solvent ([7.1](#)) to remove any traces of gum or residue from the previous test. See [Appendix X1](#) for detailed cleaning instructions.

9.5 Measure and record the barometric pressure ([6.2](#)) before commencing a test.

9.6 An optional electronic thermal flash detector may be used for all product types. It is essential where the ignition of the vapors of the test specimen is not visible or when the apparatus is automated.

9.7 For sub-ambient test temperatures see [Annex A3](#), unless the apparatus has integral test cup cooling facilities.

## 10. Verification of Apparatus

10.1 Verify that the temperature measuring device is in accordance with [A1.2.2](#) and [Annex A6](#).

10.2 Verify the performance of the apparatus at least once per year by determining the flash point of a certified reference material (CRM): suitable materials are listed in [Annex A2](#). Use a CRM that is reasonably close to the expected temperature range of the samples to be tested. The material shall be tested according to Method B, Section [12](#), and the detected flash point obtained in [12.1.11](#) and [12.1.12](#) shall be corrected for barometric pressure (see Section [13](#)). The mean of the two determined flash points shall be within the limits stated in [Table A2.1](#) for the identified CRM or within the limits calculated for an unlisted CRM (see [A2.1.1](#)).

10.3 Once the performance of the apparatus has been verified, the flash point of secondary working standards (SWS) can then be utilized for more frequent performance checks (see [Annex A2](#)).

10.4 When the flash point obtained is not within the limits stated in [10.2](#) or [10.3](#), 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 cover ([A1.2.1](#)), the action of the shutter, the size or intensity of the ignition source, the position of the ignition source ([A1.3](#)), the operation of the flash detector (if fitted), and correct reading of the temperature measuring device. After any adjustment, repeat the test in [10.2](#) or [10.3](#) using a fresh test specimen, with special attention to the procedural details prescribed in the test method.

## TEST METHOD A—FLASH/NO FLASH

### 11. Procedure

11.1 For specification purposes carry out a flash/no flash test at a temperature (actual) that allows for a correction due to the ambient atmospheric pressure at the time of the test. Use the following equations to convert a specification flash point test requirement to the actual test temperature required for the test and then round to the nearest 0.5 °C.

$$\text{Actual test temperature(}^\circ\text{C)} = S_c - 0.25(101.3 - A) \quad (1)$$

$$\text{Actual test temperature(}^\circ\text{C)} = S_c - 0.033(760 - B) \quad (2)$$

where:

$S_c$  = Specification, or uncorrected target test temperature, °C,

$A$  = Ambient barometric pressure, kPa, and

$B$  = Ambient barometric pressure, mm Hg.

**Warning**—Eq 1 and Eq 2 are only to be used when testing at a prescribed specification or target temperature is required.

11.1.1 Follow the manufacturer's instructions to set the test temperature and the test time.

11.1.2 When the test cup is at the test temperature, fill the syringe (6.5) with the sample to be tested; transfer the syringe to the filling orifice, taking care not to lose any sample; discharge the 2 mL test specimen into the test cup by fully depressing the syringe plunger; remove the syringe.

11.1.2.1 If the sample is too viscous to be syringed through the orifice, see Annex A4.

11.1.3 Start the 60 s test timer; light the pilot light and adjust the test flame (if used) to conform to the 4 mm ( $\frac{5}{32}$  in.) gauge.

11.1.4 When the end of the test time is indicated, apply the ignition source by slowly and uniformly opening the shutter and closing it completely over a period of 2 s to 3 s. Watch closely for a flash at the test cup openings.

11.1.5 The test specimen is deemed to have flashed when a large flame appears and instantaneously propagates itself over the surface of the test specimen (see 3.1.2). Occasionally, particularly near the actual flash point, application of the ignition source can cause a blue halo or an enlarged flame; this is not a flash and should be ignored.

11.1.6 Record the test result as flash (or no flash), allowing for any known thermometer correction and the test temperature.

11.1.7 Turn off the pilot and test flames (if used). Remove the test specimen and clean the test cup and cover (see Appendix X1). It may be necessary to allow the test cup temperature to fall to a safe level before cleaning.

## TEST METHOD B—FINITE FLASH POINT DETERMINATION

### 12. Procedure

12.1 This procedure repeats the procedure of Method A a number of times. Each test uses a fresh test specimen and a different temperature. The changes of temperature allow the determination of two temperatures 5 °C apart and then two temperatures 0.5 °C apart for which the final lower temperature

did not result in a flash while the higher temperature resulted in a flash (the flash point).

12.1.1 Select the expected flash point of the sample as the initial test temperature.

12.1.1.1 If the expected flash point of the sample is unknown, Appendix X2 may be used to obtain an approximate flash point.

12.1.2 Follow the manufacturer's instructions to set the test temperature and the one minute test time.

12.1.3 When the test cup is at the test temperature, fill the syringe (6.5) with the sample to be tested; transfer the syringe to the filling orifice, taking care not to lose any sample; discharge the 2 mL test specimen into the test cup by fully depressing the syringe plunger; remove the syringe.

12.1.3.1 If the sample is too viscous to be syringed through the orifice, see Annex A4.

12.1.4 Start the 60 s test timer; light the pilot light and adjust the test flame (if used) to conform to the 4 mm ( $\frac{5}{32}$  in.) gauge.

12.1.5 When the end of the test time is indicated, apply the ignition source by slowly and uniformly opening the shutter and closing it completely over a period of 2 s to 3 s. Watch closely for a flash at the test cup openings.

12.1.6 The test specimen is deemed to have flashed when a large flame appears and instantaneously propagates itself over the surface of the test specimen (see 3.1.2). Occasionally, particularly near the actual flash point, application of the ignition source can cause a blue halo or an enlarged flame; this is not a flash and should be ignored.

12.1.7 Note the test result as flash (or no flash) and the test temperature.

12.1.8 If a flash is detected, repeat the procedure given in 12.1.3 to 12.1.7 testing a fresh specimen at a temperature 5 °C lower each time until no flash is detected.

12.1.8.1 Proceed to 12.1.10.

12.1.9 When no flash was detected, repeat the procedure given in 12.1.3 to 12.1.7 testing a fresh specimen at a temperature 5 °C higher each time until a flash is detected.

12.1.10 Having established a flash within two temperatures 5 °C apart, repeat the procedure testing a fresh specimen at 0.5 °C intervals from the lower of the two temperatures until a flash is detected.

12.1.11 Record the temperature of the test when this detected flash point occurs, allowing for any known thermometer correction.

12.1.12 Repeat 12.1.10 and 12.1.11 to obtain and record a second detected flash point for the sample.

12.1.13 Turn off the pilot and test flames, if used. When the cup temperature falls to a safe level, remove the test specimen and clean the cup and cover (see Appendix X1).

### 13. Calculations

13.1 *Method A*—No further calculations are required if the effects of barometric pressure were corrected for in Eq 1 or Eq 2 in 11.1.

13.1.1 If the effects of barometric pressure were not corrected before the flash/no flash test, Eq 3 or Eq 4 shall be used to calculate the corrected test temperature.

$$\text{Corrected test temperature} (^{\circ}\text{C}) = C + 0.25(101.3 - A) \quad (3)$$

$$\text{Corrected test temperature} (^{\circ}\text{C}) = C + 0.033(760 - B) \quad (4)$$

where:

$C$  = Actual test temperature,  $^{\circ}\text{C}$ ,

$A$  = Ambient barometric pressure, kPa, and

$B$  = Ambient barometric pressure, mm Hg.

13.2 *Method B*—If the ambient barometric pressure (9.5) differs from 101.3 kPa (760 mm Hg), correct the flash point temperatures of the two recorded detected flash points as follows:

$$\text{Corrected temperature} (^{\circ}\text{C}) = C + 0.25(101.3 - A) \quad (5)$$

$$\text{Corrected temperature} (^{\circ}\text{C}) = C + 0.033(760 - B) \quad (6)$$

where:

$C$  = Detected flash point,  $^{\circ}\text{C}$ ,

$A$  = Ambient barometric pressure, kPa, and

$B$  = Ambient barometric pressure, mm Hg.

NOTE 6—The above formula has been proven for barometric pressures down to 82.0 kPa<sup>4</sup> and is strictly correct only up to 104.7 kPa.

## 14. Report

14.1 *Method A (flash/no flash)*, report flash or no flash, and the specification temperature used, rounded to the nearest 0.5  $^{\circ}\text{C}$ , and that Method A was used.

14.2 *Method B (Flash point determination)*, report the mean of the two corrected flash points to the nearest 0.5  $^{\circ}\text{C}$  as the flash point, provided the difference between the values is not  $>1^{\circ}\text{C}$ .

14.2.1 If the difference is greater, then report this deviation and use the lowest value of the duplicate results or repeat the determinations.

14.3 Report the identification of the material tested, the test date, and any deviation, by agreement or not, from the procedures specified.

## 15. Precision and Bias<sup>5</sup>

15.1 *Precision*—The precision of Test Method B was developed from an ILS in 1972. Five laboratories made two

<sup>4</sup> Supporting data have been filed at the Energy Institute, 61 New Cavendish Street, London W1G 7AR, UK <http://www.energyinst.org> and may be obtained by requesting Research Report IP 523.

<sup>5</sup> Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D01-1000. Contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). These data are also reported in the *Journal of Paint Technology*, Vol 45, No. 581, p. 44.

determinations on two different days on four solvents, three resins, and two paints, covering the flash point range of 6  $^{\circ}\text{C}$  (43  $^{\circ}\text{F}$ ) to 84  $^{\circ}\text{C}$  (183  $^{\circ}\text{F}$ ). A gas flame was used as the ignition source.

15.1.1 No statement is made about either the precision or bias of Test Method A flash/no flash, since the result merely states whether there is conformance to the criteria for success specified in the procedure.

15.1.2 *Repeatability*—The difference between two independent results obtained by the same operator in a given laboratory applying the same test method with the same apparatus under constant operating conditions on identical test material within short intervals of time would exceed the following value with an approximate probability of 5 % (one case in 20 in the long run) in the normal and correct operation of the test method.

15.1.2.1 For viscosities  $<5.5 \text{ mm}^2/\text{s}$  at 40.0  $^{\circ}\text{C}$  or  $<45 \text{ SUS}$  at 37.8  $^{\circ}\text{C}$  : 1.6  $^{\circ}\text{C}$ .

15.1.2.2 For viscosities  $\geq 5.5 \text{ mm}^2/\text{s}$  at 40.0  $^{\circ}\text{C}$  or  $\geq 45 \text{ SUS}$  at 37.8  $^{\circ}\text{C}$  : 3.1  $^{\circ}\text{C}$ .

15.1.3 *Reproducibility*—The difference between two single and independent results obtained by different operators applying the same test method in different laboratories using different apparatuses on identical test material would exceed the following value with an approximate probability of 5 % (one case in 20 in the long run) in the normal and correct operation of the test method.

15.1.3.1 For viscosities  $<5.5 \text{ mm}^2/\text{s}$  at 40.0  $^{\circ}\text{C}$  or  $<45 \text{ SUS}$  at 37.8  $^{\circ}\text{C}$  : 3.4  $^{\circ}\text{C}$ .

15.1.3.2 For viscosities  $\geq 5.5 \text{ mm}^2/\text{s}$  at 40.0  $^{\circ}\text{C}$  or  $\geq 45 \text{ SUS}$  at 37.8  $^{\circ}\text{C}$  : 5.3  $^{\circ}\text{C}$ .

15.2 *Bias*—The procedure in Test Method B for measuring flash point has no bias since the flash point can be defined only in terms of this test method.

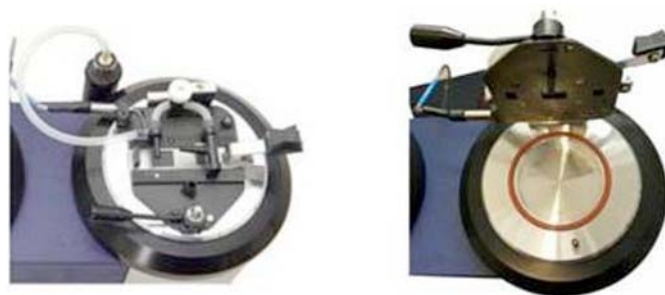
15.3 A study to determine the precision for materials with a viscosity greater than 15 000 cSt has not been made.

15.4 The precision for liquid peroxides has not been determined, but the precision of liquid peroxides should be similar to that of other liquids.

## 16. Keywords

16.1 flash/no flash; flash point; organic peroxides; organic solvents; small scale closed-cup apparatus





Lid Closed

Lid Open

FIG. A1.2 Typical Lid and Shutter Assembly

heated section horizontally and intersect the underside of the cover. Follow the manufacturer’s instructions for ensuring the correct operation of the ignitor. In the event of a dispute, the gas ignition source shall be considered the referee test.

A1.4 *Audible Signal*—Indicates for the operator to dip the ignition source into the cup.

A1.5 *Flash Detector (optional)*—A low mass thermocouple device for the detection of the flash point.

A1.6 *Timing Device*—An electronic timer.

A1.7 *Temperature Measuring Device*—A liquid in glass thermometer or an electronic temperature measuring device in accordance with Annex A6.

A1.8 *Electric Ignitor Screen*—A metal screen to optically screen the ignitor from the operator. Only required when an electric ignitor is used.

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## A2. VERIFICATION OF APPARATUS PERFORMANCE

A2.1 *Certified Reference Material (CRM)*—CRM is a stable product with a method-specific certified flash point established by a method-specific interlaboratory study following ISO 17034 and ISO Guide 35, or an equivalent national standard.

A2.1.1 Typical values of the flash point adjusted to account for the variation in atmospheric pressure from 101.3 kPa for some reference materials and their typical limits are given in Table A2.1 (see Note A2.1). Suppliers of CRMs shall provide certificates stating the method-specific flash point for each material of the current production batch. Calculation of the limits for these or other CRMs can be determined from the reproducibility value of Test Methods D3828 and then multiplied by 0.7. This value provides a nominal coverage of at least 90 % with 95 % confidence.

NOTE A2.1—Supporting data for the interlaboratory studies to generate

the flash points in Table A2.1 can be found in the research reports.<sup>4, 6</sup>

A2.2 *Secondary Working Standard (SWS)*—SWS is a stable, pure (99+ mole % purity) hydrocarbon or other material whose composition is known to remain appreciably stable and a mean flash point has been established (see A2.2.1 and A2.2.2).

A2.2.1 A material with a mean flash point derived from a programme such as a proficiency testing (PT) program in accordance with Practice D6299, ISO 17043, or similar national standard.

A2.2.2 One of the materials, using the values and tolerances listed in Table A2.1.

<sup>6</sup> Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:S15-1010. Contact ASTM Customer Service at service@astm.org.

TABLE A2.1 Typical Flash Point Values and Typical Tolerances (Acceptance Limits for a Single Result)

Substance (Purity ≥99 %)	Flash Point °C	Reproducibility (R) (D3828) °C	Tolerance Limits (0.7R) °C
2-Butanol <sup>A</sup>	20.7	3.3	±2.3
p-Xylene (1,4-dimethylbenzene) <sup>A</sup>	26.1	3.4	±2.4
n-Butanol <sup>A</sup>	36.5	3.7	±2.6
Decane <sup>B</sup>	49.7	4.1	±2.9
Undecane <sup>B</sup>	65.9	4.6	±3.2

<sup>A</sup> Mean values from interlaboratory test program, see Research Report IP 523/10.

<sup>B</sup> Mean values from interlaboratory test program, see Research Report RR:S15-1010. Contact ASTM Customer Service at service@astm.org.