



Designation: D3278 – 21

Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus¹

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 (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 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 mm²/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

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:²

- [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](#)

¹ 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.

Current edition approved June 15, 2021. Published August 2021. Originally approved in 1973. Last previous edition approved in 2020 as D3278 – 20. DOI: 10.1520/D3278-21.

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.

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*:³

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 $\pm$ 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.

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