



Designation: D86 – 23a^{ε1}

Standard Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure¹

This standard is issued under the fixed designation D86; 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.

^{ε1} NOTE—Editorially updated Section 7 in February 2024.

1. Scope*

1.1 This test method covers the atmospheric distillation of petroleum products and liquid fuels using a laboratory batch distillation unit to determine quantitatively the boiling range characteristics of such products as light and middle distillates, automotive spark-ignition engine fuels with or without oxygenates (see [Note 1](#)), aviation gasolines, aviation turbine fuels, diesel fuels, biodiesel blends up to 30 % volume, marine fuels, special petroleum spirits, naphthas, white spirits, kerosines, and Grades 1 and 2 burner fuels.

NOTE 1—An interlaboratory study was conducted in 2008 involving 11 different laboratories submitting 15 data sets and 15 different samples of ethanol-fuel blends containing 25 % volume, 50 % volume, and 75 % volume ethanol. The results indicate that the repeatability limits of these samples are comparable or within the published repeatability of the method (with the exception of FBP of 75 % ethanol-fuel blends). On this basis, it can be concluded that Test Method D86 is applicable to ethanol-fuel blends such as Ed75 and Ed85 (Specification [D5798](#)) or other ethanol-fuel blends with greater than 10 % volume ethanol. See ASTM RR:D02-1694 for supporting data.²

1.2 The test method is designed for the analysis of distillate fuels; it is not applicable to products containing appreciable quantities of residual material.

1.3 This test method covers both manual and automated instruments.

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

1.5 **WARNING**—Mercury has been designated by many regulatory agencies as a hazardous substance that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. Use Caution when handling mercury and mercury-containing products. See the applicable product Safety Data Sheet (SDS) for additional information. The potential exists that selling mercury or mercury-containing products, or both, is prohibited by local or national law. Users must determine legality of sales in their location.

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.*

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 All standards are subject to revision, and parties to agreement on this test method are to apply the most recent edition of the standards indicated below, unless otherwise specified, such as in contractual agreements or regulatory rules where earlier versions of the method(s) identified may be required.

2.2 ASTM Standards:³

[D97 Test Method for Pour Point of Petroleum Products](#)
[D323 Test Method for Vapor Pressure of Petroleum Products \(Reid Method\)](#)
[D4057 Practice for Manual Sampling of Petroleum and Petroleum Products](#)

¹ This test method is 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.

In the IP, the equivalent test method is published under the designation IP 123. It is under the jurisdiction of the Standardization Committee.

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² Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1694. Contact ASTM Customer Service at service@astm.org.

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.

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

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants
D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products
D4953 Test Method for Vapor Pressure of Gasoline and Gasoline-Oxygenate Blends (Dry Method)
D5190 Test Method for Vapor Pressure of Petroleum Products (Automatic Method) (Withdrawn 2012)⁴
D5191 Test Method for Vapor Pressure of Petroleum Products and Liquid Fuels (Mini Method)
D5798 Specification for Ethanol Fuel Blends for Flexible-Fuel Automotive Spark-Ignition Engines
D5842 Practice for Sampling and Handling of Fuels for Volatility Measurement
D5949 Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method)
D5950 Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)
D5985 Test Method for Pour Point of Petroleum Products (Rotational Method)
D6299 Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance
D6300 Practice for Determination of Precision and Bias Data for Use in Test Methods for Petroleum Products, Liquid Fuels, and Lubricants
D6708 Practice for Statistical Assessment and Improvement of Expected Agreement Between Two Test Methods that Purport to Measure the Same Property of a Material
E1 Specification for ASTM Liquid-in-Glass Thermometers
E77 Test Method for Inspection and Verification of Thermometers
E1272 Specification for Laboratory Glass Graduated Cylinders
E1405 Specification for Laboratory Glass Distillation Flasks
2.3 Energy Institute Standards:⁵
IP 69 Determination of Vapour Pressure—Reid Method
IP 123 Petroleum Products—Determination of Distillation Characteristics
IP 394 Determination of Air Saturated Vapour Pressure
IP Standard Methods for Analysis and Testing of Petroleum and Related Products 1996—Appendix A
2.4 ISO Standards:⁶
ISO Guide 34
ISO 17034 General requirements for the competence of reference material producers

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, refer to Terminology **D4175**.

3.1.2 *check standard*, *n*—in *QC testing*, material having an accepted reference value used to determine the accuracy of a measurement system.

3.1.3 *decomposition*, *n*—of a hydrocarbon, the pyrolysis or cracking of a molecule yielding smaller molecules with lower boiling points than the original molecule.

3.1.4 *decomposition point*, *n*—in *distillation*, the corrected temperature reading that coincides with the first indications of thermal decomposition of the specimen.

3.1.5 *dry point*, *n*—in *distillation*, the corrected temperature reading at the instant the last drop of liquid evaporates from the lowest point in the flask.

3.1.6 *dynamic holdup*, *n*—in *D86 distillation*, the amount of material present in the neck of the flask, in the sidearm of the flask, and in the condenser tube during the distillation.

3.1.7 *emergent stem effect*, *n*—the offset in temperature reading caused by the use of total immersion mercury-in-glass thermometers in the partial immersion mode.

3.1.7.1 *Discussion*—In the partial immersion mode, a portion of the mercury thread, that is, the emergent portion, is at a lower temperature than the immersed portion, resulting in a shrinkage of the mercury thread and a lower temperature reading.

3.1.8 *end point (EP) or final boiling point (FBP)*, *n*—the maximum corrected thermometer reading obtained during the test.

3.1.8.1 *Discussion*—This usually occurs after the evaporation of all liquid from the bottom of the flask. The term maximum temperature is a frequently used synonym.

3.1.9 *front end loss*, *n*—loss due to evaporation during transfer from receiving cylinder to distillation flask, vapor loss during the distillation, and uncondensed vapor in the flask at the end of the distillation.

3.1.10 *initial boiling point (IBP)*, *n*—in *D86 distillation*, the corrected temperature reading at the instant the first drop of condensate falls from the lower end of the condenser tube.

3.1.11 *percent evaporated*, *n*—in *distillation*, the sum of the percent recovered and the percent loss.

3.1.11.1 *percent loss*, *n*—in *distillation*, one hundred minus the percent total recovery.

3.1.11.2 *corrected loss*, *n*—percent loss corrected for barometric pressure.

3.1.12 *percent recovered*, *n*—in *distillation*, the volume of condensate collected relative to the sample charge.

3.1.12.1 *percent recovery*, *n*—in *distillation*, maximum percent recovered relative to the sample charge.

3.1.12.2 *corrected percent recovery*, *n*—in *distillation*, the percent recovery, adjusted for the corrected percent loss.

3.1.12.3 *percent total recovery*, *n*—in *distillation*, the combined percent recovery and percent residue.

3.1.13 *percent residue*, *n*—in *distillation*, the volume of residue relative to the sample charge.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

⁵ Available from Energy Institute, 61 New Cavendish St., London, WIG 7AR, U.K., <http://www.energyinst.org.uk>.

⁶ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.