



Designation: D2887 – 23

Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography¹

This standard is issued under the fixed designation D2887; 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.

1. Scope*

1.1 This test method covers the determination of the boiling range distribution of petroleum products. The test method is applicable to petroleum products and fractions having a final boiling point of 538 °C (1000 °F) or lower at atmospheric pressure as measured by this test method. This test method is limited to samples having a *boiling range* greater than 55.5 °C (100 °F), and having a vapor pressure sufficiently low to permit sampling at ambient temperature.

NOTE 1—Since a *boiling range* is the difference between two temperatures, only the constant of 1.8 °F/°C is used in the conversion of the temperature range from one system of units to another.

1.1.1 *Procedure A (Sections 6 – 14)*—Allows a larger selection of columns and analysis conditions such as packed and capillary columns as well as a Thermal Conductivity Detector in addition to the Flame Ionization Detector. Analysis times range from 14 min to 60 min.

1.1.2 *Procedure B (Sections 15 – 23)*—Is restricted to only 3 capillary columns and requires no sample dilution. In addition, Procedure B is used not only for the sample types described in Procedure A but also for the analysis of samples containing biodiesel mixtures B5, B10, and B20. The analysis time, when using Procedure B (Accelerated D2887), is reduced to about 8 min.

1.2 This test method is not to be used for the analysis of gasoline samples or gasoline components. These types of samples must be analyzed by Test Method D7096.

1.3 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.

1.4 *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 appro-*

priate 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

- D86 Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure
- D1160 Test Method for Distillation of Petroleum Products at Reduced Pressure
- D2892 Test Method for Distillation of Crude Petroleum (15-Theoretical Plate Column)
- D4057 Practice for Manual Sampling of Petroleum and Petroleum Products
- D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants
- D4626 Practice for Calculation of Gas Chromatographic Response Factors
- 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
- D7096 Test Method for Determination of the Boiling Range Distribution of Gasoline by Wide-Bore Capillary Gas Chromatography
- D7169 Test Method for Boiling Point Distribution of

¹ This test method is under the jurisdiction of Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.04.0H on Chromatographic Distribution Methods.

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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.

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

Samples with Residues Such as Crude Oils and Atmospheric and Vacuum Residues by High Temperature Gas Chromatography

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E260 Practice for Packed Column Gas Chromatography

E355 Practice for Gas Chromatography Terms and Relationships

E516 Practice for Testing Thermal Conductivity Detectors Used in Gas Chromatography

E594 Practice for Testing Flame Ionization Detectors Used in Gas or Supercritical Fluid Chromatography

3. Terminology

3.1 Definitions—This test method makes reference to many common gas chromatographic procedures, terms, and relationships. Detailed definitions of these can be found in Practices **E260**, **E355**, and **E594**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 area slice, n —the area, resulting from the integration of the chromatographic detector signal, within a specified retention time interval. In area slice mode (see **6.3.2**), peak detection parameters are bypassed and the detector signal integral is recorded as area slices of consecutive, fixed duration time intervals.

3.2.2 corrected area slice, n —an area slice corrected for baseline offset, by subtraction of the exactly corresponding area slice in a previously recorded blank (non-sample) analysis.

3.2.3 cumulative corrected area, n —the accumulated sum of corrected area slices from the beginning of the analysis through a given retention time, ignoring any non-sample area (for example, solvent).

3.2.4 final boiling point (FBP), n —the temperature (corresponding to the retention time) at which a cumulative corrected area count equal to 99.5 % of the total sample area under the chromatogram is obtained.

3.2.5 initial boiling point (IBP), n —the temperature (corresponding to the retention time) at which a cumulative corrected area count equal to 0.5 % of the total sample area under the chromatogram is obtained.

3.2.6 slice rate, n —the time interval used to integrate the continuous (analog) chromatographic detector response during an analysis. The slice rate is expressed in hertz (for example, integrations or slices per second).

3.2.7 slice time, n —the time associated with the end of each contiguous area slice. The slice time is equal to the slice number divided by the slice rate.

3.2.8 total sample area, n —the cumulative corrected area, from the initial area point to the final area point, where the chromatographic signal is considered to have returned to baseline after complete sample elution.

3.3 Abbreviations:

3.3.1 A common abbreviation of hydrocarbon compounds is to designate the number of carbon atoms in the compound. A prefix is used to indicate the carbon chain form, while a

subscripted suffix denotes the number of carbon atoms (for example, normal decane = $n\text{-C}_{10}$; isotetradecane = $i\text{-C}_{14}$).

4. Summary of Test Method

4.1 The boiling range distribution determination by distillation is simulated by the use of gas chromatography. A nonpolar packed or open tubular (capillary) gas chromatographic column is used to elute the hydrocarbon components of the sample in order of increasing boiling point. The column temperature is raised at a reproducible linear rate and the area under the chromatogram is recorded throughout the analysis. Boiling points are assigned to the time axis from a calibration curve obtained under the same chromatographic conditions by analyzing a known mixture of hydrocarbons covering the boiling range expected in the sample. From these data, the boiling range distribution can be obtained.

4.2 Procedure A and Procedure B yield essentially the same results. See Sections **14** and **23**, and the accompanying research reports.

5. Significance and Use

5.1 The boiling range distribution of petroleum fractions provides an insight into the composition of feedstocks and products related to petroleum refining processes. The gas chromatographic simulation of this determination can be used to replace conventional distillation methods for control of refining operations. This test method can be used for product specification testing with the mutual agreement of interested parties.

5.2 Boiling range distributions obtained by this test method are essentially equivalent to those obtained by true boiling point (TBP) distillation (see Test Method **D2892**). They are not equivalent to results from low efficiency distillations such as those obtained with Test Method **D86** or **D1160**.

5.3 Procedure B was tested with biodiesel mixtures and reports the Boiling Point Distribution of FAME esters of vegetable and animal origin mixed with ultra low sulfur diesel.

Procedure A

6. Apparatus

6.1 Chromatograph—The gas chromatograph used must have the following performance characteristics:

6.1.1 Detector—Either a flame ionization or a thermal conductivity detector may be used. The detector must have sufficient sensitivity to detect 1.0 % dodecane with a peak height of at least 10 % of full scale on the recorder under conditions prescribed in this test method and without loss of resolution as defined in **9.3.1**. When operating at this sensitivity level, detector stability must be such that a baseline drift of not more than 1 % of full scale per hour is obtained. The detector must be capable of operating continuously at a temperature equivalent to the maximum column temperature employed. Connection of the column to the detector must be such that no temperature below the column temperature exists.

NOTE 2—It is not desirable to operate a thermal conductivity detector at a temperature higher than the maximum column temperature employed.