



## Standard Test Method for Conradson Carbon Residue of Petroleum Products<sup>1</sup>

This standard is issued under the fixed designation D189; 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.*

### 1. Scope ~~Scope~~\*

1.1 This test method covers the determination of the amount of carbon residue (**Note 1**) left after evaporation and pyrolysis of an oil, and is intended to provide some indication of relative coke-forming propensities. This test method is generally applicable to relatively nonvolatile petroleum products which partially decompose on distillation at atmospheric pressure. Petroleum products containing ash-forming constituents as determined by Test Method **D482** or IP Method 4 will have an erroneously high carbon residue, depending upon the amount of ash formed (**Note 2** and **Note 4**).

**NOTE 1**—The term *carbon residue* is used throughout this test method to designate the carbonaceous residue formed after evaporation and pyrolysis of a petroleum product under the conditions specified in this test method. The residue is not composed entirely of carbon, but is a coke which can be further changed by pyrolysis. The term *carbon residue* is continued in this test method only in deference to its wide common usage.

**NOTE 2**—Values obtained by this test method are not numerically the same as those obtained by Test Method **D524**. Approximate correlations have been derived (see **Fig. X1.1**), but need not apply to all materials which can be tested because the carbon residue test is applied to a wide variety of petroleum products.

**NOTE 3**—The test results are equivalent to Test Method **D4530**, (see **Fig. X1.2**).

**NOTE 4**—In diesel fuel, the presence of alkyl nitrates such as amyl nitrate, hexyl nitrate, or octyl nitrate causes a higher residue value than observed in untreated fuel, which can lead to erroneous conclusions as to the coke forming propensity of the fuel. The presence of alkyl nitrate in the fuel can be detected by Test Method **D4046**.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 **WARNING**—Mercury has been designated by many regulatory agencies as a hazardous ~~material~~ substance that can cause ~~central nervous system, kidney and liver damage, serious medical issues~~. Mercury, or its vapor, ~~may has been demonstrated to be~~ hazardous to health and corrosive to materials. ~~Caution should be taken—Use caution~~ when handling mercury and ~~mercury containing—mercury-containing~~ products. See the applicable product ~~Material Safety Data Sheet (MSDS) for details and EPA's~~

<sup>1</sup> 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 **D02.06** on Analysis of Liquid Fuels and Lubricants.

Current edition approved ~~Dec. 1, 2019~~ **May 1, 2024**. Published ~~December 2019~~ **May 2024**. Originally approved in 1924. Last previous edition approved in ~~2014~~ **2019** as **D189 – 06 (2014) (2019)**. DOI: ~~10.1520/D0189-06R19~~ **10.1520/D0189-24**.

In the IP, this test method is under the jurisdiction of the Standardization Committee and is issued under the fixed designation IP 13. The final number indicates the year of last revision. This test method was adopted as a joint ASTM–IP standard in 1964.

This procedure is a modification of the original Conradson method and apparatus for Carbon Test and Ash Residue in Petroleum Lubricating Oils. See *Proceedings*, Eighth International Congress of Applied Chemistry, New York, Vol 1, p. 131, September 1912; also *Journal of Industrial and Engineering Chemistry*, IECHA, Vol 4, No. 11, December 1912.

In 1965, a new Fig. 2 on reproducibility and repeatability combining ASTM and IP precision data replaced old Fig. 2 and **Note 4**.

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

website—<http://www.epa.gov/mercury/faq.htm>—for additional information. Users should be aware (SDS) for additional information. The potential exists that selling mercury and/or mercury containing products into your state or country may be prohibited by law or mercury-containing products, or both, is prohibited by local or national law. Users must determine legality of sales in their location.

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>

D482 Test Method for Ash from Petroleum Products

D524 Test Method for Ramsbottom Carbon Residue of Petroleum Products

D4046 Test Method for Alkyl Nitrate in Diesel Fuels by Spectrophotometry (Withdrawn 2019)<sup>3</sup>

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products

D4530 Test Method for Determination of Carbon Residue (Micro Method)

E1 Specification for ASTM Liquid-in-Glass Thermometers

E133 Specification for Distillation Equipment

## 3. Terminology

### 3.1 Definitions:

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

3.1.2 *carbon residue, n*—the residue formed by evaporation and thermal degradation of a carbon containing material.

#### 3.1.2.1 Discussion—

The residue is not composed entirely of carbon but is a coke that can be further changed by carbon pyrolysis. The term carbon residue is retained in deference to its wide common usage.

## 4. Summary of Test Method

4.1 A weighed quantity of sample is placed in a crucible and subjected to destructive distillation. The residue undergoes cracking and coking reactions during a fixed period of severe heating. At the end of the specified heating period, the test crucible containing the carbonaceous residue is cooled in a desiccator and weighed. The residue remaining is calculated as a percentage of the original sample, and reported as Conradson carbon residue.

## 5. Significance and Use

5.1 The carbon residue value of burner fuel serves as a rough approximation of the tendency of the fuel to form deposits in vaporizing pot-type and sleeve-type burners. Similarly, provided alkyl nitrates are absent (or if present, provided the test is performed on the base fuel without additive) the carbon residue of diesel fuel correlates approximately with combustion chamber deposits.

5.2 The carbon residue value of motor oil, while at one time regarded as indicative of the amount of carbonaceous deposits a motor oil would form in the combustion chamber of an engine, is now considered to be of doubtful significance due to the presence of additives in many oils. For example, an ash-forming detergent additive may increase the carbon residue value of an oil yet will generally reduce its tendency to form deposits.

<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.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).