

British Standard Methods of test for

Petroleum and its products

Part 13. Conradson carbon residue of petroleum products

(Identical with IP 13/82 (87))

Méthodes d'essai du pétrole et des produits pétroliers

Partie 13. Résidu de carbone des produits pétroliers — Méthode Conradson

Verfahren zur Prüfung von Erdöl und Erdölprodukten

Teil 13. Koksrückstands nach Conradson bei Erdölprodukten

Foreword

BS 2000 comprises a series of test methods for petroleum and its products that have been published previously by the Institute of Petroleum (IP) and have been accorded the status of British Standards. Each method should be read in conjunction with BS 2000 : Part 0 'General introduction', which gives details of the BSI/IP agreement for publication of the series, provides general information on safety precautions, sampling and other matters, and lists the methods scheduled for publication as Parts of BS 2000. When BS 2000 : Part 0 was first published in 1982, it included a list of more than 60 methods intended for publication in the first group of Parts of BS 2000; it is envisaged that Part 0 will be revised from time to time to take account of the publication of additional methods.

The numbering of the other Parts follows that of the corresponding methods published in 'IP Standards for petroleum and its products, Part 1 Methods for analysis and testing', which in 1987 has been retitled by the IP as 'Standard methods for analysis and testing of petroleum and related products'. BS 2000 : Part 13 is thus identical with IP 13/82(87). In the present revision, in which the IP designation is unchanged, the following changes have been introduced:

- (a) a safety warning has been added as 1.2;
- (b) additional information is given in note 3 relating to the presence of alkyl nitrates;
- (c) asbestos is no longer specified for the insulator in 4.4 and 4.6;
- (d) precision data has been revised to give values obtained in a more recent test programme;
- (e) a correlation with the ASTM micro carbon residue test is included in B.2.

It is intended to issue further revisions when necessary in line with changes that may be made in subsequent editions of this IP method. The related method published by the International Organization for Standardization (ISO) is ISO 6615 - 1983.

This Part of BS 2000 supersedes BS 2000 : Part 13 : 1983 which is withdrawn.

Caution. Attention is drawn to the safety precautions in Part 0 of this British Standard and also to the specific hazard indicated in 1.2. It is strongly recommended that asbestos should not be used to meet the requirements of 4.4, 4.6, 8.2 and A1(d) for heat resisting material and a flask support board.

NOTE. The titles of the publications referred to in this Part of this British Standard are listed on the inside back cover.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

WITHDRAWN

Method (identical with IP 13/82 (87)¹)**1. SCOPE**

1.1 This method describes a procedure for 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. The method is generally applicable to relatively non-volatile petroleum products which partially decompose on distillation at atmospheric pressure. Petroleum products containing ash-forming constituents as determined by method ASTM D482-IP 4, Test for Ash from Petroleum Oils,² will have an erroneously high carbon residue, depending upon the amount of ash formed [Notes 2 and 3].

1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

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

NOTE 2: Values obtained by this method are not numerically the same as those obtained by ASTM D524-IP 14, Test for Ramsbottom Carbon Residue of Petroleum Products, nor have satisfactory correlations been found between the results by the two methods for all materials which may be tested, because the carbon residue test is applied to a wide variety of petroleum products. In general, Ramsbottom Carbon Residue is the preferred method for samples that are mobile below 90°C. The Conradson Carbon Residue is finding use to characterize heavy residue fuels, coker feed stocks, etc., which cannot readily be loaded into a Ramsbottom coker bulb, and when it is desirable to examine or further test the residue.

NOTE 3: Also in diesel fuel the presence of alkyl nitrates such as amyl nitrate, hexyl nitrate or octyl nitrate causes a higher carbon residue value than observed in untreated fuel which may lead to erroneous conclusions as to the coke-forming propensity of the fuel. The presence of alkyl nitrate in the fuel may be detected by ASTM D4046-81³. – Alkyl Nitrate in Diesel Fuels by Spectrophotometry.

2. SUMMARY OF METHOD

2.1. 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.

3. SIGNIFICANCE

3.1. 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, the test is performed on the base fuel without additive) the carbon residue of diesel fuel correlates approximately with combustion chamber deposits.

3.2. 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.

3.3. The carbon residue value of gas oil is useful as a guide in the manufacture of gas from gas oil, while carbon residue values of crude oil residuums, cylinder and bright stocks are useful in the manufacture of lubricants.

4. APPARATUS

The apparatus (see Fig. 1) shall consist of the following:

4.1. *Porcelain Crucible* – Porcelain crucible, wide form, glazed throughout, or a silica crucible; 29 to 31 ml capacity, 46 to 49 mm in rim diameter.

NOTE to 1.1. BS 4450, the dual-numbered version of EN 7, is technically equivalent to IP 4.

NOTES to note 2.

1. BS 4551, the dual-numbered version of ISO 4262, is technically equivalent to IP 14.

2. Some information concerning correlation of results between the Conradson and Ramsbottom carbon residue methods is given in appendix II.

NOTE to note 3. There is no British Standard relating to ASTM D4046. This reference is given for information only.

¹ Under the standardization procedure of ASTM, this method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants.

In the IP, this method is under the jurisdiction of the Standardization Committee.

This procedure is a modification of the original Conradson method and apparatus for Carbon Test and Ash Residue in Petroleum Lubricating Oils. *Proc. 8th Intern. Congr. Applied Chem.*, 1912, 1, 131; *J. Industr. Engng Chem.*, 1912, 4, 903.

² Annual Book of ASTM Standards, Vol 05.01.

³ Annual Book of ASTM Standards, Vol 05.03.

4.2. *Iron Crucible* – Skidmore iron crucible, flanged and ringed, 65 to 82 ml capacity, 53 to 57 mm inside and 60 to 67 mm outside diameter of flange, 37 to 39 mm in height supplied with a cover without delivery tubes and having the vertical opening closed. The horizontal opening of about 6.5 mm shall be kept clean. The outside diameter of the flat bottom shall be 30 to 32 mm.

4.3. *Iron Crucible* – Spun sheet-iron crucible, with cover; 78 to 82 mm in outside diameter at the top, 58 to 60 mm in height, and approximately 0.8 mm in thickness. Place at the bottom of this crucible, and level before each test, a layer of about 25 ml of dry sand, or enough to bring the Skidmore crucible, with cover on, nearly to the top of the sheet-iron crucible.

4.4. *Wire Support* – Triangle of bare nichrome wire of approximately No. 13 B & S gauge or equivalent having an opening small enough to support the bottom of the sheet-iron crucible at the same level as the bottom of the heat-resistant block or hollow sheet-metal box (Paragraph 4.6.).

NOTE to 4.4. CAUTION.
See foreword.

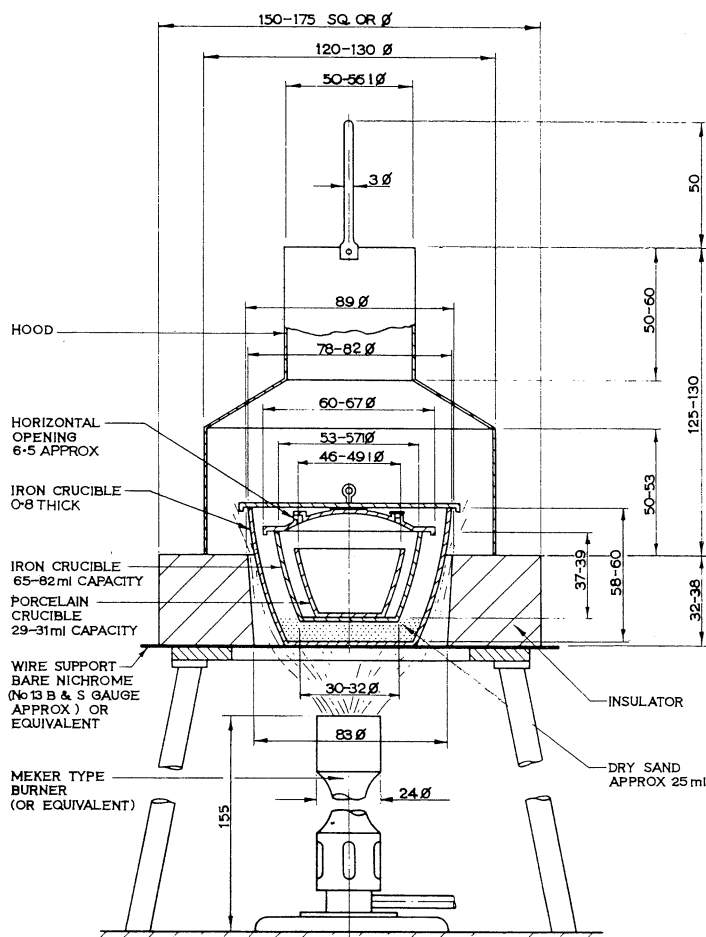


Fig. 1. Apparatus for determining carbon residue.

4.5. *Hood* – Circular sheet-iron hood, from 120 to 130 mm in diameter the height of the lower perpendicular side to be from 50 to 53 mm; provided at the top with a chimney 50 to 60 mm in height and 50 to 56 mm in inside diameter, which is attached to the lower part having the perpendicular sides by a cone-shaped member, bringing the total height of the complete hood to 125 to 130 mm. The hood may be made from a single piece of metal, provided it conforms to the foregoing dimensions. As a guide for the height of the flame above the chimney a bridge made of approximately 3 mm iron or nichrome wire, and having a height of 50 mm above the top of the chimney, shall be attached.

4.6. *Insulator* – Block of heat-resistant materials, refractory ring, or hollow sheet-metal box, 150 to 175 mm in diameter if round, or on a side if square, 32 to 38 mm in thickness, provided with a metal-lined, inverted cone-shaped opening through the centre, 83 mm in diameter at the bottom, and 89 mm diameter at the top. In the case of the refractory ring no metal lining is necessary, providing the ring is of hard, heat-resistant material.

4.7. *Burner* – Burner, Meker type, having an orifice of approx 24 mm in diameter.

NOTE to Fig. 1. All dimensions are in millimetres unless otherwise indicated.

NOTE to 4.6. CAUTION.
See foreword.