BS 2000 :
Part 57 : 1995
ISO 3014 : 1993

Methods of test for

Petroleum and its products

Part 57. Petroleum products - Determination of the smoke point of kerosine

(Identical with IP 57/95)

BSi
British Standards

Foreword

This British Standard was published under the authority of the Materials and Chemicals Sector Board and comes into effect on 31 March 1995. It is identical with ISO 3014 : 1993, prepared by Technical Committee 28, Petroleum products and lubricants, of the International Organization for Standardization (ISO).

This British Standard supersedes BS 2000 : Part 57 : 1993, which is withdrawn.

BS 2000 comprises a series of test methods for petroleum and its products that are published by the Institute of Petroleum (IP) and have been accorded the status of a British Standard. Each method should be read in conjunction with the preliminary pages of 'IP Standard methods for analysis and testing of petroleum and related products' 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 published as Parts of BS 2000.

The numbering of the Parts of BS 2000 follows that of the corresponding methods published in 'IP Standard methods for analysis and testing of petroleum and related products'. Under the terms of the agreement between BSI and the Institute of Petroleum, the revised version of BS 2000 : Part 57 will be published by the IP (in 'Standard methods for analysis and testing of petroleum and related products' and as a separate publication). BS 2000 : Part 57 : 1995 is thus identical with IP 57/95.

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

The following BSI references relate to the work of this standard:
Committee reference PTI/13
Draft for comment 89/55650

IP 57/95 ISO 3014:1993 BS 2000 : Part 57 : 1995

Petroleum products — Determination of the smoke point of kerosine

WARNING — The use of this International 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 the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard describes a procedure for the determination of the smoke point of kerosine.

NOTE 1 The smoke point of kerosine is related to the hydrocarbon type composition, and provides an indication of relative smoke-producing properties in a diffusion flame.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3170:1988, *Petroleum liquids — Manual sampling.*

ISO 3171:1988 *Petroleum liquids — Automatic pipeline sampling.*

ISO 5272:1979, *Toluene for industrial use — Specifications.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 kerosine: Refined petroleum distillate, boiling between 140 °C and 300 °C, generally used in lighting and heating applications, and as a fuel for aviation gas turbines.

3.2 smoke point: The maximum height, in millimetres, of a smokeless flame of fuel burned in a wick-fed lamp of specified design.

4 Principle

The sample is burned in an enclosed wick-fed lamp that is calibrated daily against pure hydrocarbon blends of known smoke point. The maximum height of flame that can be achieved with the test fuel without smoking is determined to the nearest 0,5 mm.

5 Reagents and materials

5.1 Toluene, grade 1 as defined in ISO 5272.

5.2 2,2,4-trimethylpentane (isooctane), minimum purity 99,75 % (*m/m*).

5.3 Methanol (methyl alcohol), anhydrous.

5.4 Reference fuel blends, appropriate to the fuels under test, made up accurately from toluene (5.1) and 2,2,4-trimethylpentane (5.2), in accordance with the compositions given in table 1, by means of calibrated burettes or pipettes (6.3).

5.5 Heptane, minimum purity 99,75 % (*m/m*).

Table 1 — Reference fuel blends

Standard smoke point at 101,3 kPa	Toluene	2,2,4-trimethylpentane
mm	% (*V/V*)	% (*V/V*)
14,7	40	60
20,2	25	75
22,7	20	80
25,8	15	85
30,2	10	90
35,4	5	95
42,8	0	100

6 Apparatus

6.1 Smoke-point lamp, as shown in figure 1, complying with the dimensional requirements given in tables 2 and 3 and as shown in figures 2 and 3.

NOTE 2 A medium-density cobalt glass may be used to reduce eye fatigue when viewing the flame.

The following essential requirements shall be met:

a) The top of the wick guide shall be exactly level with the zero mark on the scale.

b) The scale shall be marked in white lines on black glass on each side of a white or black strip 2 mm in width. It shall have a range of 50 mm graduated in 1 mm intervals, figured at each 10 mm and with longer lines at each 5 mm.

c) An efficient device for raising or lowering the flame shall be provided. The total distance of travel shall be not less than 10 mm and the movement shall be smooth and regular.

d) The glass window of the door shall be curved to prevent the formation of multiple images.

e) The joint between the base of the candle and the candle body shall be oil-tight.

6.2 Wick, of woven solid circular cotton of ordinary quality, having the following characteristics:

— casing: 17 ends, 66 tex × 3

— filling: 9 ends, 100 tex × 4

— weft: 40 tex × 2

— picks: 6 per centimetre.

6.3 Pipettes or **burettes**, class A.

7 Sampling and preparation of samples

Samples shall be taken by the procedures described in ISO 3170, ISO 3171 or an equivalent national standard. Use the sample as received.

Allow all samples to come to ambient temperature (20 °C ± 5 °C), without artificial heating. If the sample is hazy or appears to contain foreign material, filter through qualitative filter paper.

8 Preparation of apparatus

8.1 Place the lamp in a vertical position in a room where it can be completely protected from draughts. Carefully inspect each new lamp to ensure that the air holes in the gallery and the air inlets to the candle holder are all clean, unrestricted and of proper size. The gallery shall be so located that the air holes are completely unobstructed.

NOTE 3 Slight variations in these items all have a marked effect on the precision of the result obtained.

If the room is not completely draught-free, place the lamp in a vertical position in a box constructed of heat-resistant material (not containing asbestos), open at the front. The top of the box shall be at least 150 mm above the top of the chimney and the inside of the box painted dull black.

8.2 Extract all wicks, either new or from a previous determination, for at least 25 cycles in an extractor, using a mixture of equal volumes of toluene (5.1) and anhydrous methanol (5.3). Allow the wicks to dry partially in a hood before placing in the oven, or use a forced-draught and explosion-proof oven for drying wicks, or both. Dry for 30 min at 100 °C to 110 °C and store in a desiccator until used.

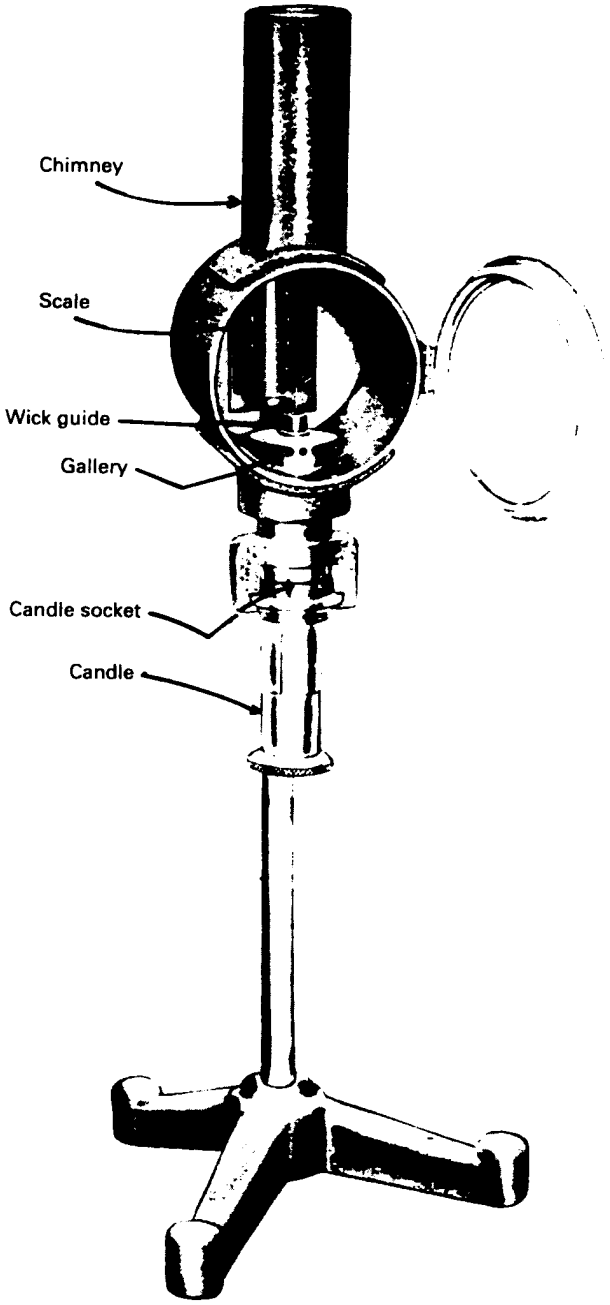

Figure 1 — Smoke-point lamp

Table 2 — Critical dimensions of candle for smoke-point lamp (see figure 2)

Dimensions in millimetres

Candle body	
internal diameter	21,25 ± 0,05
external diameter	sliding fit in candle holder
length, without cap	109,0 ± 0,05
thread on cap	Ø 9,5, pitch 1,0
Wick tube (A)	
internal diameter	4,7 ± 0,05
external diameter	close fit in flame guide
length	82,0 ± 0,05
Air vent (B)	
internal diameter	3,5 ± 0,05
length	90,0 ± 0,05

Table 3 — Critical dimensions of body for smoke-point lamp (see figure 3)

Dimensions in millimetres

Candle holder (C)	
internal diameter	23,8 ± 0,05
Wick guide (D)	
internal diameter	6,0 ± 0,02
Air inlets (E)	
20 in number, diameter	2,9 ± 0,05
Gallery (F)	
external diameter	35,0 ± 0,05
air inlets (20), diameter	3,5 ± 0,05
Lamp body (G)	
internal diameter	81,0 ± 1,0
internal depth	81,0 ± 1,0
Chimney (H)	
internal diameter	40,0 ± 1,0
height, from top to centre of lamp body	130,0 ± 1,0

Dimensions in millimetres

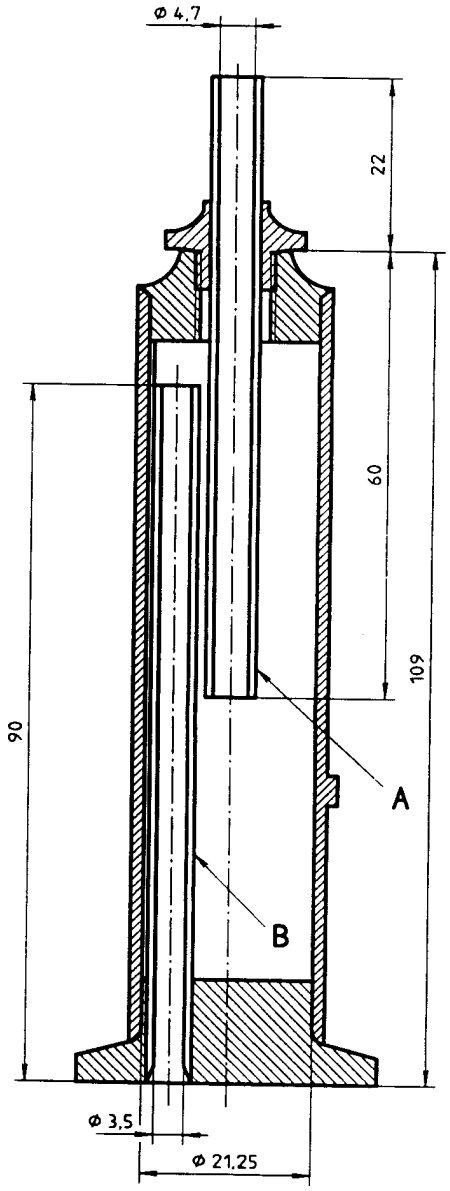

Figure 2 — Candle

Dimensions in millimetres

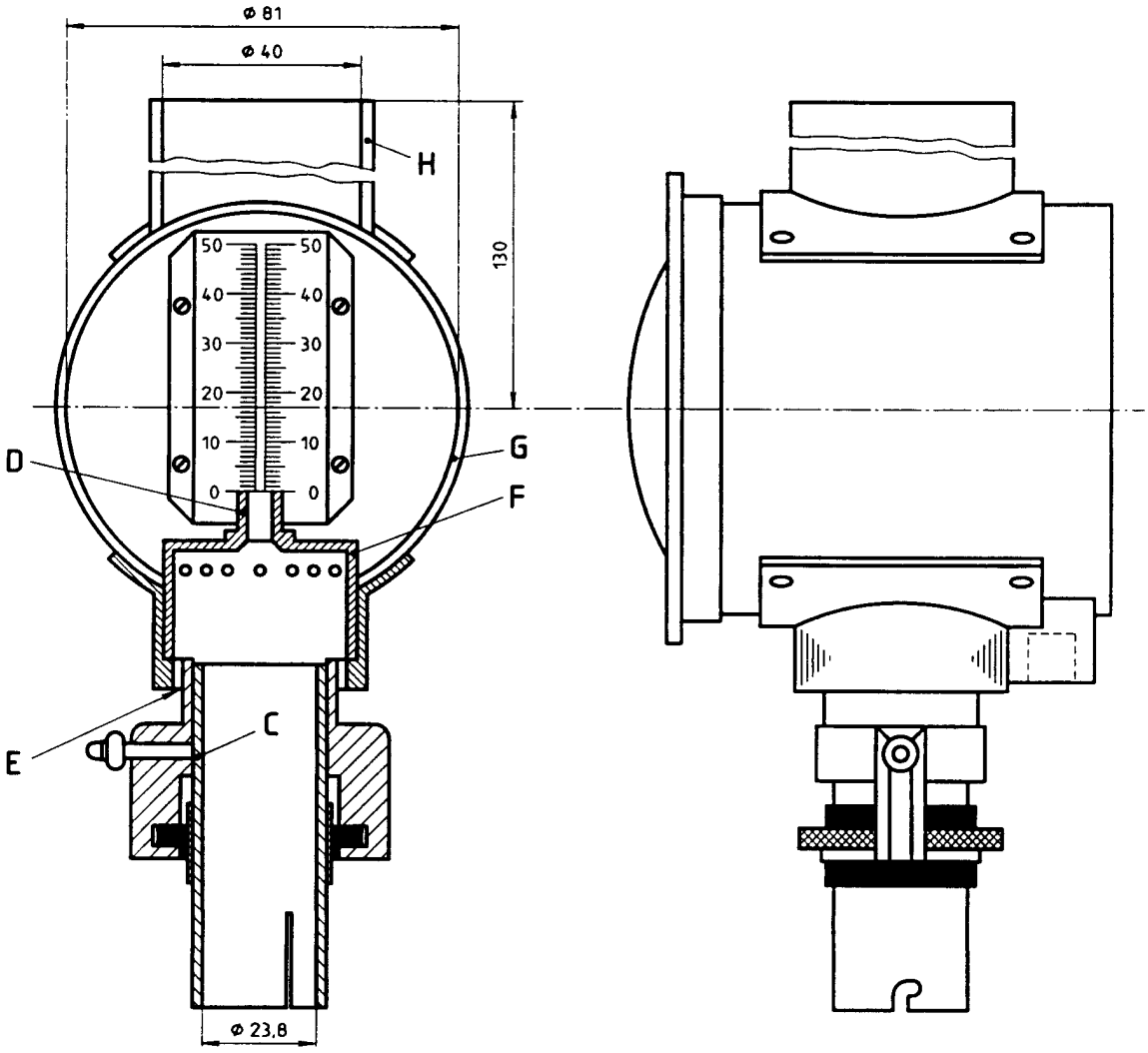

Figure 3 — Lamp body

9 Calibration of apparatus

9.1 Calibrate the apparatus in accordance with 9.2. Recalibrate at regular intervals of not more than seven days or when there has been a change in the apparatus or operator, or when a change of more than 0,7 kPa occurs in the barometric pressure reading.

9.2 Calibrate the apparatus by testing two of the reference fuel blends specified in 5.4, using the procedure specified in clause 10 and, if possible, bracketing the smoke point of the sample. If this is not possible, use the two blends having their smoke points nearest to the smoke point of the sample.

Determine the correction factor f for the apparatus from the equation

$$f = \frac{(A_s/A_d) + (B_s/B_d)}{2}$$

where

A_s is the standard smoke point of the first reference fuel blend;

A_d is the smoke point determined for the first reference fuel blend;

B_s is the standard smoke point of the second reference fuel blend;

B_d is the smoke point determined for the second reference fuel blend.

If the smoke point determined for the test fuel exactly matches the smoke point determined for a reference fuel blend, use as the second bracketing reference fuel the reference fuel blend with the next higher smoke point, if there is one. Otherwise, use the one with the next closest smoke point.

10 Procedure

10.1 Soak a piece of extracted and dried wick, not less than 125 mm long, in the sample and place it in the wick tube of the candle. Carefully ease out any twists arising from this operation.

NOTE 4 It is advisable to resoak the burning-end of the wick in the sample after the wick is inserted in the wick tube.

In cases of dispute, or for referee tests, always use a new wick, prepared in the manner specified in 8.2.

10.2 Introduce as near to 20 ml of the prepared sample as available, but not less than 10 ml, at room temperature, into the clean, dry candle.

10.3 Place the wick tube in the candle and screw home. Take care that the candle air vent is free from fuel. If a wick-trimmer assembly is not being used, cut the wick horizontally and trim it free of frayed ends so that 6 mm projects from the end of the candle. Use a clean razor blade or other sharp instrument. (Some razor blades have a protective coating. In such cases, remove the coating with a solvent before using the blade.) Insert the candle into the lamp.

An alternative method of preparing a wick free of twists and frayed ends utilises a wick-trimmer assembly. The wick-trimmer holder is inserted over the top of the wick tube and the long-nosed triceps are inserted through the tube and holder. The wick is grasped and carefully pulled through the tube without twisting. A new, clean, sharp razor is used to cut the wick at the face of the holder and remove wisps and frayed ends. When the holder is removed, the wick will be at the correct height in the tube. The tube is then inserted into the candle and screwed home. The candle is inserted into the lamp.

10.4 Light the candle and adjust the wick so that the flame is approximately 10 mm high and allow the lamp to burn for 5 min. Raise the candle until a smoky tail appears. then lower the candle slowly through the following stages of flame appearance:

a) A long tip; smoke slightly visible; erratic and jumpy flame.

b) An elongated, pointed tip with the sides of the tip appearing concave upward as shown in figure 4 (flame A).

c) The pointed tip just disappears, leaving a very slightly blunted flame as shown in figure 4 (flame B). Jagged, erratic, luminous flames are sometimes observed near the true flame tip. These shall be disregarded.

d) A well rounded tip as shown in figure 4 (flame C).

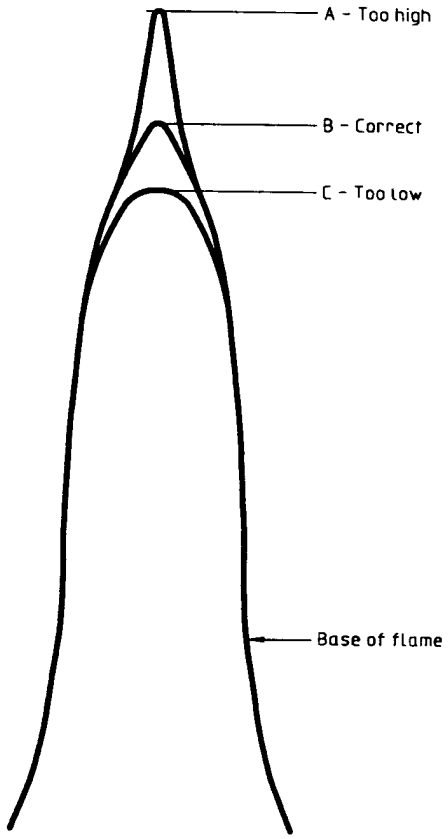

Figure 4 — Typical flame appearances

Determine the height of flame B to the nearest 0,5 mm. Record the height observed.

To eliminate errors due to parallax, the eye of the observer shall be slightly to one side of the centreline, so that a reflected image of the flame is seen on the scale on one side of the central vertical white line, and the flame itself is seen against the other side of the scale. The reading for both observations shall be identical.

10.5 Make three separate observations of the flame height at the smoke point by repeating the flame-appearance sequence specified in 10.4. If these values vary over a range greater than 1,0 mm, repeat the test with a fresh sample and another wick.

10.6 Remove the candle from the lamp, rinse with heptane (5.5), and purge with air to make ready for re-use.

11 Expression of results

Calculate the smoke point, to the nearest 0,1 mm, from the equation

$$\text{Smoke point} = L \times f$$

where

L is the average, rounded to the nearest 0,1 mm, of three individual readings;

f is the correction factor (see 9.2), rounded to the nearest 0,01.

Report the result thus obtained, rounded to the nearest 0,5 mm, as the smoke point of the sample.

12 Precision

12.1 Repeatability, r

The difference between successive test results obtained by the same operator with the same apparatus under constant operating conditions on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following value in only one case in 20:

2 mm

12.2 Reproducibility, R

The difference between two single and independent results obtained by different operators working in different laboratories on nominally identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following value in only one case in 20:

3 mm

NOTE 5 Precision values were determined by a joint ASTM/IP programme in 1972, and results were statistically examined in accordance with ISO 4259.

13 Test report

The test report shall contain at least the following information:

a) all details necessary to identify the product tested;

b) a reference to this International Standard;

c) the result of the test (see clause 11);

d) any deviation, by agreement or otherwise, from the procedure specified;

e) the date of the test.

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