
International Standard



3014

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Aviation turbine fuels — Determination of smoke point

Carburants aviation pour moteurs à réaction — Détermination du point de fumée

Second edition — 1981-12-15

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UDC 665.743.3 : 536.461

Ref. No. ISO 3014-1981 (E)

Descriptors : petroleum products, aviation fuels, tests, smoking point, determination, combustion analysis.

Price based on 6 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3014 was developed by Technical Committee ISO/TC 28, *Petroleum products and lubricants*.

This second edition was submitted directly to the ISO Council, in accordance with clause 5.10.1 of part 1 of the Directives for the technical work of ISO. It cancels and replaces the first edition (i.e. ISO 3014-1974), which had been approved by the member bodies of the following countries :

| | | |
|----------------|-------------|-----------------------|
| Australia | India | South Africa, Rep. of |
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| Brazil | Israel | Sweden |
| Bulgaria | Mexico | Thailand |
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| Czechoslovakia | Norway | USA |
| France | Poland | USSR |
| Germany, F. R. | Portugal | |
| Hungary | Romania | |

No member body expressed disapproval of the document.

Aviation turbine fuels — Determination of smoke point

1 Scope and field of application

This International Standard specifies a method for the determination of smoke point of aviation turbine fuels.

2 Definition

smoke point : The maximum height, in millimetres, of flame that can be obtained without smoking when a petroleum distillate is burned in a standardized lamp under standardized conditions.

3 Principle

Burning a sample in an enclosed lamp provided with a scale. Estimation of the maximum flame height of a carefully defined flame that can be achieved without smoking.

4 Reference fuel blends

The materials used to make the reference fuel blends shall be the knock test reference fuels : reference fuel grade toluene grade 1 according to ISO 5272 and knock-test grade *iso*-octane, for which details of the essential requirements are

given in the annex. The composition and smoke points of these blends are given in table 1.

Table 1 — Reference fuel blends

| Toluene % (V/V) | <i>iso</i> -octane % (V/V) | Standard smoke point, at 1,013 bar mm |
|--------------------|-------------------------------|---|
| 40 | 60 | 14,7 |
| 25 | 75 | 20,2 |
| 15 | 85 | 25,8 |
| 10 | 90 | 30,2 |
| 5 | 95 | 35,4 |
| 0 | 100 | 42,8 |

The blends shall be made very accurately. The use of either calibrated pipettes or burettes is recommended. Calibrated flasks shall not be used.

5 Apparatus

5.1 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.

The use of a sighting device is convenient for eliminating parallax but is not essential. A sight-gauge or other suitable flame measuring device, accurate to 0,5 mm, is satisfactory. A medium density cobalt glass may be used to reduce eye fatigue when viewing the flame. The following essential requirements shall be met :

- 1) The top of the wick guide shall be exactly level with the zero mark on the scale.
- 2) 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.
- 3) 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.
- 4) The glass window of the door shall be curved to prevent the formation of multiple images.
- 5) The joint between the base of the candle and the candle body shall be oil-tight.

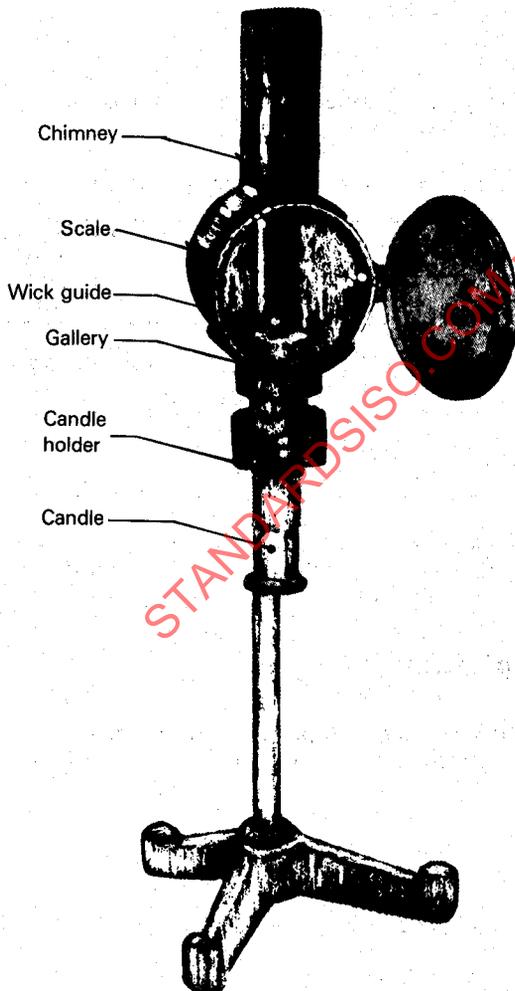


Figure 1 – Smoke point lamp

Dimensions in millimetres

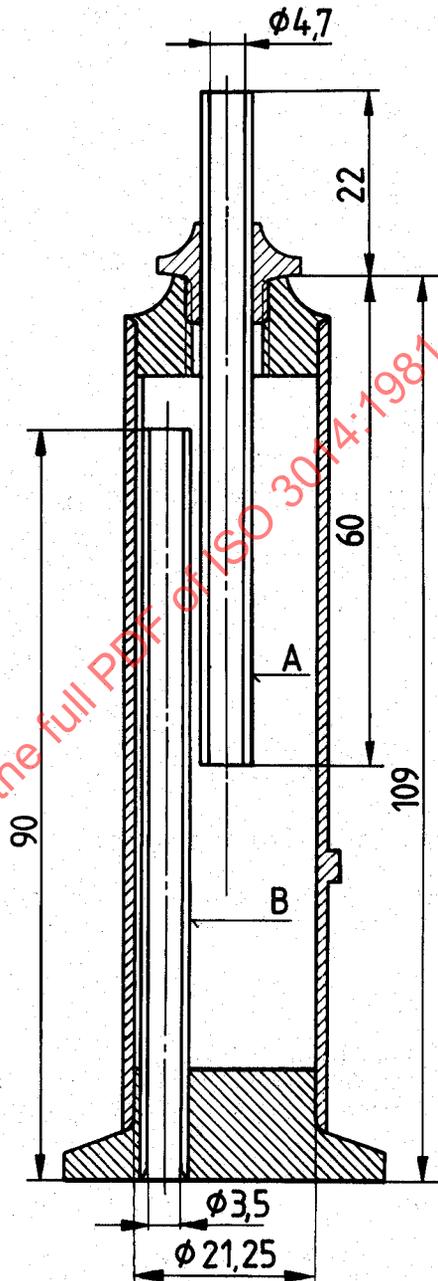


Figure 2 – Candle

Table 2 – Critical dimensions of candle for smoke point lamp (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 | φ 9,5, screwed 1,0 pitch |
| Wick tube (A) | |
| internal diameter | 4,7 ± 0,05 |
| external diameter | close fit in wick guide |
| length | 82,0 ± 0,05 |
| Air vent (B) | |
| internal diameter | 3,5 ± 0,05 |
| length | 90,0 ± 0,05 |

Dimensions in millimetres

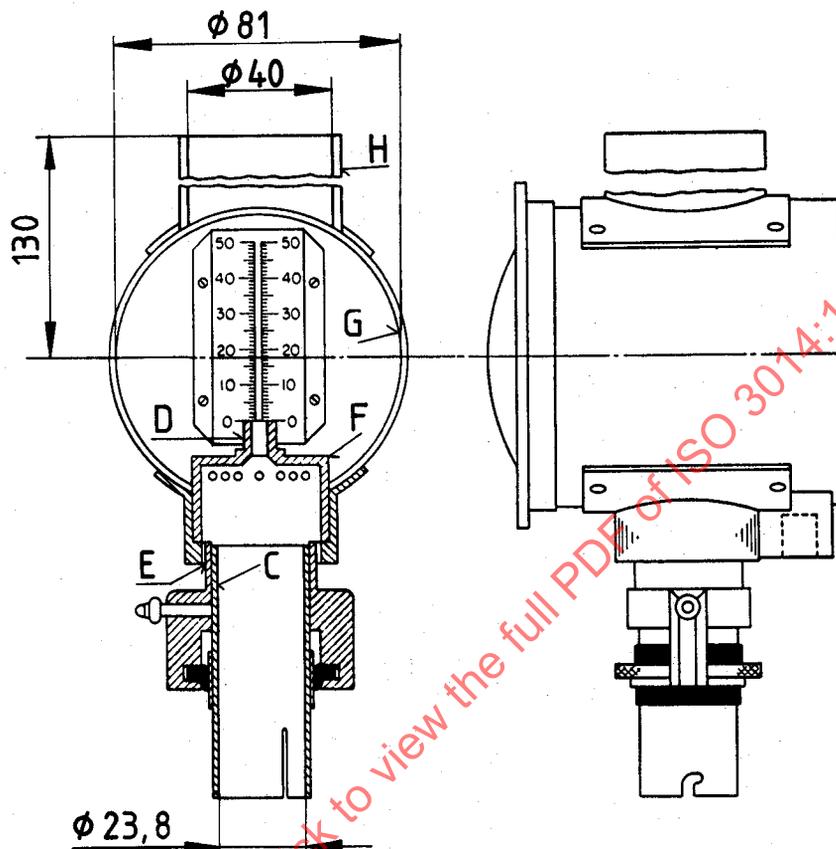


Figure 3 — Lamp body

Table 3 — Critical dimensions of body for smoke point lamp (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 |

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

- casing : 17 ends, 66 tex X 3
- filling : 9 ends, 100 tex X 4
- weft : 40 tex X 2
- picks : 6 per centimetre

Other wicks which give similar results are acceptable.

6 Preparation of apparatus

6.1 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 socket are all clean, unrestricted, and of proper size. The gallery should be so located that the air holes are completely unobstructed. Slight variations in these items all have a marked effect on the precision of the result obtained.

NOTE — If the room is not completely draught-free, place the lamp in a vertical position in a wooden or hard asbestos sheet box open at the front. The top of the box should be at least 150 mm above the top of the chimney and the inside of the box should be painted dull black.

6.2 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 and anhydrous methyl alcohol. 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 to 110 °C and store in a desiccator until used.

NOTE — Other mixtures of solvents can be used to extract wicks if equivalent results are obtained.

7 Sample

Use the sample as received. Allow all samples to come to ambient temperature (without artificial heating). If the sample is hazy or appears to contain foreign material, filter through qualitative filter paper.

8 Calibration of apparatus

8.1 Calibrate the apparatus by testing two of the reference fuel blends specified in clause 4, using the procedure specified in clause 9, and, if possible, bracketing the smoke point of the sample. If this is not possible, use two blends having smoke points nearest to the smoke point of the sample.

Determine the correction factor for the apparatus from the formula

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

where

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

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

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

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

If the determined smoke point of the test fuel exactly matches the determined smoke point of 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.

8.2 The required reference fuel blends shall be tested each day by each operator. A test on a given reference fuel blend need not be repeated on any given day unless a change in the apparatus or operator is made, or a change of more than 0,007 bar occurs in the barometric pressure reading.

9 Procedure

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

NOTE — In cases of dispute, or for referee tests, always use a new wick, prepared in the manner prescribed in 6.2.

9.2 Introduce 20 ml of the prepared sample, at room temperature, into the clean, dry candle.

NOTE — If less than 20 ml of the sample is available, as little as 10 ml may be used.

9.3 Place the wick tube in the candle and screw home. Take care that the candle air vent is free from fuel. Cut the wick horizontally and trim it free of frayed ends so that 6 mm projects from the end of the candle. Use a new and clean razor blade or other sharp instrument. Insert the candle into the lamp.

NOTE — Some razor blades have a protective coating which should be removed with a solvent.

9.4 Light the candle and adjust the wick so that the flame is about 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 appearances :

- 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, A;