

# INTERNATIONAL STANDARD



# 3014

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## Aviation turbine fuels — Determination of smoke point

*Carburants aviation pour turbines — Détermination du point de fumée*

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## FOREWORD

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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 drawn up by Technical Committee ISO/TC 28, *Petroleum products*, and circulated to the Member Bodies in March 1973.

It has been approved by the Member Bodies of the following countries :

Australia	India	South Africa, Rep. of
Belgium	Iran	Spain
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France	Poland	U.S.S.R.
Germany	Portugal	
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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 the smoke point of an aviation turbine fuel.

## 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

The sample is burned in an enclosed lamp provided with a scale. The maximum flame height of a carefully defined flame that can be achieved without smoking is estimated to the nearest 0,5 mm.

## 4 REFERENCE FUEL BLENDS

The materials used to make the reference fuel blends are the knock test reference fuels, *iso*-octane and reference fuel grade toluene. Details of the essential requirements of the specified grades of *iso*-octane and toluene are given in the annex. The composition and smoke points of these blends are as follows :

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

## 5 APPARATUS

**5.1 Smoke point lamp**, as illustrated in figure 1, conforming to the dimensions given in tables 2 and 3 and in figures 2 and 3.

The use of a sighting device is convenient for eliminating parallax but is not required. 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 must 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, 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.

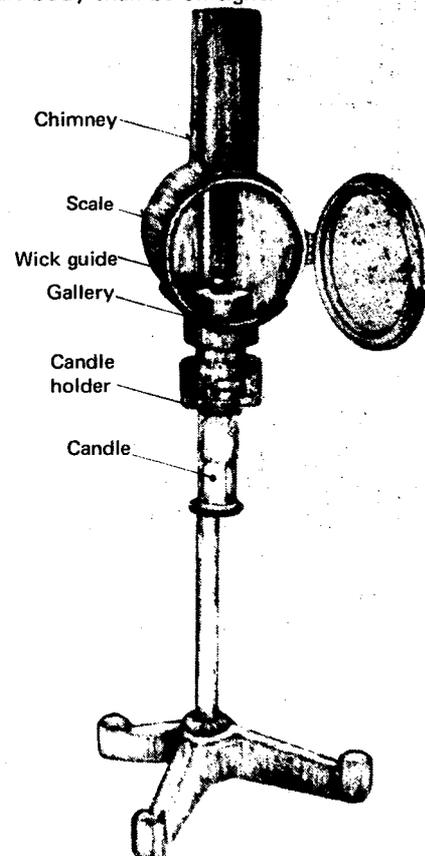


FIGURE 1 – Smoke point lamp



Dimensions in millimetres

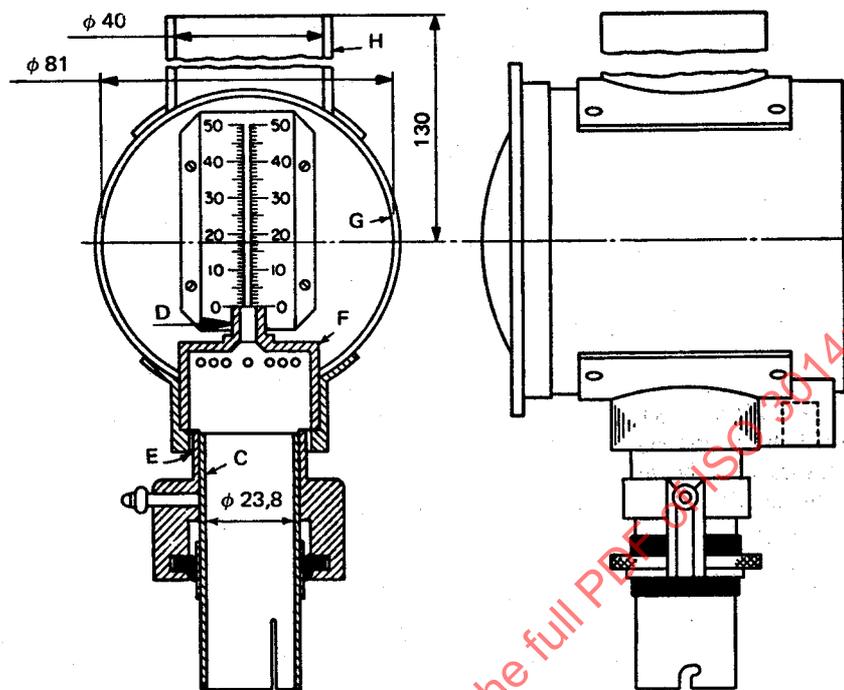


FIGURE 3 — Lamp body

TABLE 3 — Critical dimensions of body for smoke point lamp (figure 3)

Dimensions in millimetres

<b>Candle holder (C)</b>	
internal diameter	23,8 ± 0,05
<b>Wick guide (D)</b>	
internal diameter	6,0 ± 0,02
<b>Air inlets (E)</b>	
20 in number, diameter	2,9 ± 0,05
<b>Gallery (F)</b>	
external diameter	35,0 ± 0,05
air inlets (20), diameter	3,5 ± 0,05
<b>Lamp body (G)</b>	
internal diameter	81,0 ± 1,0
internal depth	81,0 ± 1,0
<b>Chimney (H)</b>	
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 results 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 shall 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

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** The apparatus is calibrated by testing, in accordance with clause 9, two of the reference fuel blends in clause 4 which, if possible, bracket the smoke point of the test fuel. If this is not possible, the two blends nearest the smoke

point should be used. The determined smoke point of the test fuel is multiplied by a correction factor determined as follows :

$$\text{Correction factor} = \frac{(A_s/A_d) + (B_s/B_d)}{2}$$

where

$A_s$  is the standard smoke point for the first reference fuel blend;

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

$B_s$  is the standard smoke point for the second reference fuel blend;

$B_d$  is the determined smoke point for 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, the second bracketing reference fuel shall be the reference fuel blend with the next higher smoke point if there is one; otherwise the one with the next closest smoke point shall be used.

**8.2** The required reference fuel blends should be tested each day by each operator. A test on a given reference fuel blend need not be repeated in 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 in the wick tube of the candle. Any twists arising from this operation should be eased out carefully. 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.