BRITISH STANDARD

BS EN
15426:2007

Candles — Specification for sooting behaviour

The European Standard EN 15426:2007 has the status of a British Standard

ICS 71.100.99; 97.180

BSI
British Standards

National foreword

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The UK participation in its preparation was entrusted to Technical Committee I/-/1, Candles.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 15426:2007) has been prepared by Technical Committee CEN BT/TF 164 “Candle safety”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2008, and conflicting national standards shall be withdrawn at the latest by May 2008.

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Introduction

Candles have accompanied mankind for more than 2 000 years serving above all as a light source. Closely connected to the development history of the candle are the efforts made to improve its quality and its safety in use. Discussions in the past and present over possible self-forming, harmful emissions and fires caused by unsafe candles and/or inappropriate use during the burning of candles have led to consumer concern for these issues.

This European Standard describes the requirements and a simple method for measuring the sooting behaviour of candles. The soot index obtained by this procedure may be considered as characteristic of the sooting behaviour of the type of candle tested.

The soot which is emitted from a candle is collected on a glass plate throughout a defined period. Afterwards the attenuation of light intensity caused by soot precipitation is quantified in a measuring chamber.

This method helps to ensure a reasonable degree of safety for normal use, thereby improving personal safety.

1 Scope

This European Standard specifies requirements and the test method for evaluating the sooting behaviour of burning candles. It is applicable to single wick candles with a diameter up to 100 mm or equivalent cross sectional area intended to be burned indoors.

2 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

2.1
base material
intended fuel source for a candle flame

2.2
candle
one or more combustible wicks supported by a material that constitutes a fuel, which is solid, semisolid or quasi-rigid at room temperature (20 °C to 27 °C)

NOTE 1 It can also contain additives, which are used for colour, odour, stability, or to modify the burning characteristics; the combined function of which is to sustain a light-producing flame.

NOTE 2 Including candles with decoration attached to or contained within the candle.

2.3
container candle
candle that is produced in and will be burned in a container

2.4
measuring period
time the candle is burned collecting soot

2.5
molten fuel pool
portion of the wax or fuel pool of a candle that is in the liquid form when the candle is burning

2.6
soot
solid, carbon enriched particles, which come into existence when the burning material in the flame is incompletely burned and which are subsequently released into the atmosphere

2.7
soot index
index number for the evaluation of the sooting behaviour of candles

2.8
soot test cycle
total length of time the candle is burned during the stabilizing period, measuring period, including pause

2.9
stabilizing period
period of time the candle is burned without collecting soot

2.10
tea light
cylindrical candle that is burned in a container, which may be suitable to keep vessels containing coffee, tea or other liquids warm, by using a warming stove

NOTE 1 Typical dimensions of a tea light are 38 mm in diameter and 15 mm in height.

NOTE 2 A tea light container can be made from metal, glass or plastic.

2.11
total measuring time
total time of all measuring periods

2.12
wax
crystalline, plastic solid or semi-solid material at 25 °C consisting of a mixture of hydrocarbons and/or hydrocarbon derivatives

NOTE Wax melts typically at temperatures equal to or greater than 40 °C and becomes a low viscosity liquid. Waxes may be of mineral (particularly petroleum), vegetable, animal (including insect), or synthetic origin.

2.13
wick
object that delivers fuel to a flame through the process of capillary action

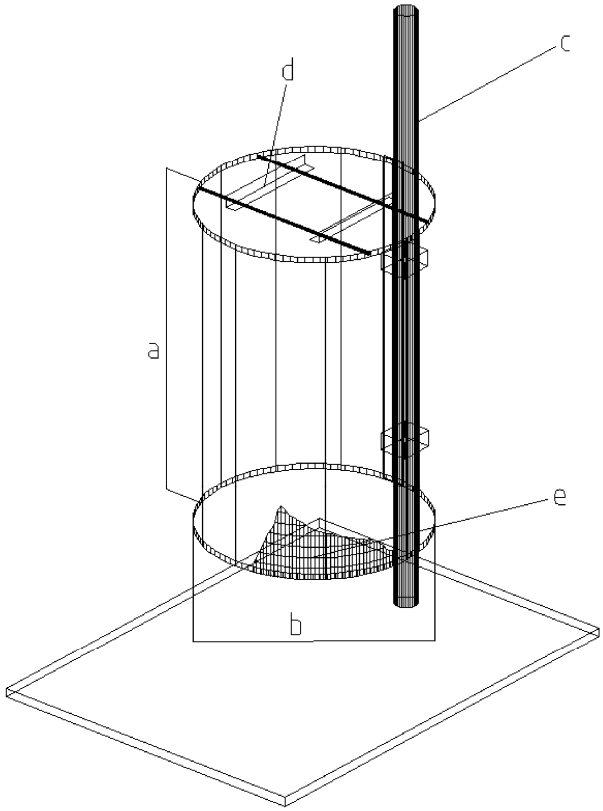
3 Sooting behaviour

When tested in accordance with clause 8, the average soot index from three tests (samples) shall be less than 1,0/h, no individual sample shall exceed 2,0/h.

4 Test equipment and apparatus

4.1 A wire mesh cylinder RMG 2.1[1)] fixed to a stand of which the height can be adjusted, with a fixture for a glass plate (see Figure 1). The cylinder has a minimum height of 300 mm and consists of wire mesh with a permeability of (60 ± 5) %.

1) Wire mesh cylinder RMG 2.1 is the trade name of a product supplied by Heil Metalle GmbH, Germany. This information is given for the convenience of the user of this European Standard and does not constitute an endorsement by CEN of the product named. Equivalent products may be used if they can be shown to lead to the same results.

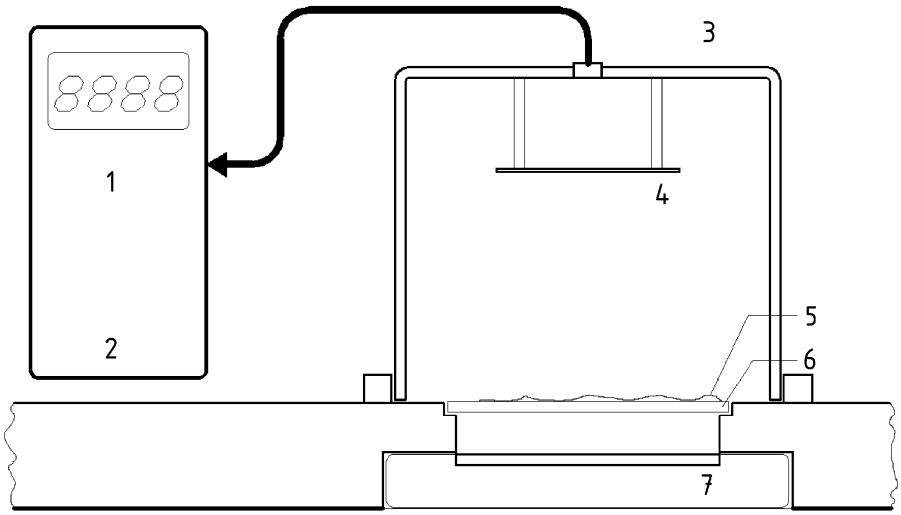


a min. height = 300 mm
b diameter, Type 1: d = 230 mm; Type 2: d = 300 mm
c stand
d glass plate
e wire mesh

Figure 1 — Wire mesh cylinder

4.2 Measurement unit consisting of an indication instrument and a measuring chamber. The measuring chamber consists of the light source, fixture for the heat resisting glass plate, a cover with light reflecting interior coating with a photodiode integrated in it, which is connected with the indication instrument (see Figure 2).

NOTE First operation and calibration of the measurement unit refer to Annex 1.



Key

1 detector current
2 photometer
3 photo detector
4 shutter
5 soot precipitation
6 heat resistant glass plate
7 light source

Figure 2 — Measurement unit

4.3 Heat resistant glass plates, 100 mm x 100 mm, with a thickness of 3,5 mm to 4,5 mm. Each glass plate is to be marked in such a way that it can be easily identified and the marking does not affect the measurement results. The light absorption of these glass plates shall not exceed 25 % (see Equation 1). *E* is the individually measured illuminance.

$$1-\frac{E_1}{E_0}\times 100 \le 25 \qquad (1)$$

where

E_1 is the illuminance of the measuring chamber with a clean glass plate, in Lux;

E_0 is the illuminance of the empty measuring chamber, in Lux.

4.4 Stop watch

4.5 Balance, precision 0,1 g

4.6 Rule

4.7 Standard, fat dissolving detergent

4.8 Lint free paper towels

4.9 Pair of scissors

4.10 Suitable candle holder

4.11 Stand for height adjustment

4.12 Glass platform, maximum 70 mm in diameter for tea lights

5 Sampling

The test shall be carried out on finished candles representative of those intended to be supplied commercially. For the test result to represent a specific candle type, a minimum of three samples shall be tested.

6 Sample preparation

Remove any outer wrapping and label material and prepare the sample for use according to the manufacturer's instructions if any given, e.g. trim the wick. For identification of the sample, measure the dimensions and mass of the candle. The temperature of the sample shall be (20 ± 5) °C before the test is started.

7 General test conditions

The room temperature at which the burning test is to take place shall be (20 ± 5) °C. The room shall be draught free. If during the test the temperature is outside the range, the maximum and/or minimum temperature shall be recorded in the test report.

For testing floating candles, the temperature of the water shall be (20 ± 5) °C when the test is started.

NOTE Draught free means that a candle can burn without noticeable disturbance of the flame. If the flame is flickering this can be verified using a reference candle such as a paraffin candle with a diameter of 22 mm, if this candle is also flickering there is a draught, if not then it is flickering due to the candle design or quality.

8 Test method

8.1 General

In the case of candle designs not catered for in the test procedures, the test should be carried out as far as possible as described and deviations from the test procedure shall be recorded in the test report.

NOTE If sooting becomes excessive the measuring may be stopped early.

8.2 Test preparation

The wire mesh cylinder type shall be selected according to Table1.

Table 1 — Apparatus

Type of candle	Apparatus
Tea lights	Wire mesh cylinder Type 1 (Diameter: (230 ± 10) mm)
Ø ≤ 70 mm	Wire mesh cylinder Type 1 (Diameter: (230 ± 10) mm)
70 mm < Ø ≤ 100 mm	Wire mesh cylinder Type 2 (Diameter: (300 ± 10) mm)

Set up the apparatus on an even surface and select a heat resistant surface or base for the candle to stand on.

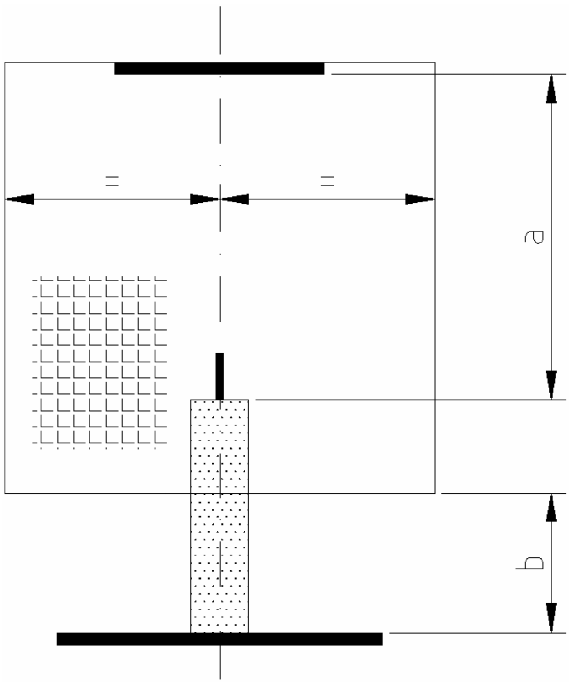
8.3 Burning test

Place the candle in an upright position on a heat resistant, non flammable surface. Non free-standing candles are placed in a suitable candleholder which does not affect the burning property of the candle. Free-standing candles are placed on a surface that does not affect the burning property. Floating candles are placed in a suitable bowl filled with water.

Position the wire mesh cylinder centrally above the sample. Adjust the distance (a) between the top of the solid base material and the glass plate to a minimum of 180 mm (see Figure 3). If the distance is more than 240 mm, adjust accordingly.

A gap (b) of at least 50 mm should remain between the bottom of the cylinder and the surface the candle is positioned on. If the gap is smaller the candle shall be placed on a stand to put it in a higher position. The diameter of this stand shall not exceed 1/3 of the diameter of the wire mesh cylinder, as the air exchange within the cylinder would otherwise be hindered (see Figure 3).

Position the wick correctly and light the candle. Place a clean glass plate in the holder of the wire mesh cylinder. The test cycles shall be chosen for different candle types according to Table 2. When the measuring period ends, remove the wire mesh cylinder or glass plate before extinguishing so that smoke from the afterglow does not affect the test result[2)] . Record the start and end times of the stabilizing periods, measuring periods and pauses.



Key

a 180 mm to 240 mm
b minimum 50 mm

Figure 3 — How to set up the equipment

Check the distance between the surface of the molten fuel pool of the candle and glass plate prior to each test period and adjust to 180 mm, if necessary. The stabilizing period takes place without the wire mesh cylinder or glass plate. The same procedure is followed for tea lights, the only deviation being that they are placed on a glass platform with a maximum diameter of 70 mm, to ensure a distance of (50 ± 5) mm between the rim of the cup/container and the glass plate.

2) The measuring periods are carried out without extinguishing the candle after the stabilizing period.

When the measuring periods are complete, remove the wire mesh cylinder or glass plate, extinguish the candle and allow the glass plate to cool down.

Table 2 — Summary of soot test cycles

Type of candle	Stabilizing period 1	Measuring period 1	Pause	Stabilizing period 2	Measuring period 2	Pause	Stabilizing period 3	Measuring period 3
Mass below 40 g	(5 ± 1) min	Continuous burning to residual height of (10 ± 2) mm						
Tea lights / container candles less than 40 g (net)	(5 ± 1) min	Continuous burning until self extinguishing						
Mass above 40 g and a diameter less than 70 mm	(5 ± 1) min	(240 ± 5) min	> 60 min	(5 ± 1) min	(240 ± 5) min or continuous burning to residual height of (10 ± 5) mm if the remaining burning time is less than 240 min			
Mass above 40 g and a diameter equal or over 70 mm	(5 ± 1) min	(240 ± 5) min	> 60 min	(5 ± 1) min	(240 ± 5) min	> 60 min	(5 ± 1) min	(240 ± 5) min

9 Measuring of the emission on the glass plate

Calibrate as given in A.2.

Place the sooted glass plate, soot side up, within the holder on the light source and close the cover. If necessary, adjust the measuring range, determine the illuminance of the sooted glass plate (E_3) and record the result.

Clean the glass plate with detergent (4.7) and water and dry the glass plate (4.3) afterwards using lint free paper towels (4.8).

Place the cleaned glass plate (4.3) on the light source and close the cover.

Determine the illuminance of the cleaned glass plate (E_1) and record the result.

10 Evaluation

10.1 The soot index is calculated according to Equation 2 made up of the ratio of the illuminance (E) resulting from the measurements of the sooted (E_3) glass plate / cleaned (E_1) glass plate.

$$Si = \left(1 - \frac{E_3}{E_1}\right) \cdot 100 \qquad (2)$$

where

Si is the soot index;

E_3 is the illuminance of the measuring chamber with the sooted glass plate, in Lux;

E_1 is the illuminance of the measuring chamber with the cleaned glass plate, in Lux.

10.2 The average soot index per hour is calculated as the ratio of the soot index to the total measuring time (sum of measuring periods) according to Table 2. The average soot index per hour is recorded in accordance with Equation 3.

$$Si_h = \frac{Si}{t_m} \tag{3}$$

where

Si_h is the average soot index per hour, in h^{-1};

Si is the soot index;

t_m is the total measuring time, in h.

11 Test report

The test report serves to identify the tested candle and to record the test results.

The following items shall be included in the test report:

a) reference to the number and year of publication of this European Standard (EN 15426:2007);

b) details of the test sample (e.g. identification, dimensions, mass);

c) any defects identified during sample preparation;

d) test results according to clause 10 of this European Standard;

e) details of any deviations from this European Standard;

f) name and address of the test facility;

g) date of the test.

Annex A
(normative)

Measurement unit

A.1 First operation of the measurement unit

Connect the indication instrument and light source to a suitable source of electrical power and turn on.

NOTE The light source does not reach its final and constant light intensity until a minimum of 30 min after being switched on. Do not start measuring before a constant value is indicated.

Set the indication instrument at the measuring range of 20 000 Lux. Adopt the next measuring range for lower values whilst measuring if necessary.

Prior to first use determine the illuminance of the new instrument without any glass plate ($E_{,0}$) and note it. This value for the new measurement unit should not be less than 1 500 Lux.

A.2 Calibration of the measurement unit

The measurement unit has to be checked daily by the following test measurements before real measuring commences.

NOTE The light source does not reach its final and constant light intensity until a minimum of 30 min after being switched on. Do not start measuring before a constant value is indicated.

Check the illuminance of the light source without any glass plate (E_0). The illuminance has to be at least 750 Lux, otherwise the light source has to be changed.

Check the absorption of the inner surfaces of the measurement unit (A_i) by comparing the illuminance with a glass plate (E_1) and with glass plate and calibration disc (E_2). The value A_i (see Equation A.1) shall not deviate by more than 10 % of the A_i-value of a new measurement unit.

$$A_i = \frac{E_2}{E_1} \tag{A.1}$$

where

A_i is the absorption of the inner surface of the measurement unit;

E_2 is the illuminance of the measuring chamber with a clean glass plate plus calibration disc, in Lux;

E_1 is the illuminance of the measuring chamber with a clean glass plate, in Lux.

Bibliography

[1] EN 15493; Candles – Specification for fire safety

[2] EN 15494, Candles – Product safety labels

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