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Paper and board — Determination of roughness/smoothness (air leak methods) —

Part 5: Oken method

Papier et carton — Détermination de la rugosité/du lissé (méthodes du débit d'air) —
Partie 5: Méthode Oken

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*.

A list of all the parts in the ISO 8791 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Paper and board — Determination of roughness/ smoothness (air leak methods) —

Part 5: Oken method

1 Scope

This document specifies the Oken method for determining the smoothness of paper and board using an apparatus which complies with the Oken method, as defined in this part of ISO 8791. It is applicable to all printing papers and boards.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRDH and 100 IRDH)*

ISO 186, *Paper and board — Sampling to determine average quality*

ISO 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

ISO 4662, *Rubber, vulcanized or thermoplastic — Determination of rebound resilience*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
oken smoothness
time required for a specific volume of air to leak from the gap between the flat measuring lands of the Oken tester and the surface of a test piece under specified conditions

Note 1 to entry: Oken smoothness is expressed in seconds per 100 ml (s/100 ml).

4 Principle

A test piece is placed between a rubber plate and measuring lands.

The air pressure on the inlet side of a narrow capillary of controlled dimensions is maintained at a constant value above atmospheric pressure. The air passes through the capillary and then leaks between the surface of the test piece and the measuring lands. The air pressure between the outlet side of the capillary and a test piece depends on the rate of flow of air between the measuring lands

and the surface of the test piece. It is measured and converted to Oken smoothness. For further details regarding the measurement principle, see Annex A.

For details regarding the test method precision, see Annex B.

5 Apparatus

5.1 Oken Smoothness apparatus (two types)

Use either the water column type described in 5.2 or the electronic sensor type described in 5.3.

5.2 Water column type

5.2.1 The water column type, see Figure 1, consists of an air compressor, filter, pressure regulator, water column regulator, capillary, water column manometer, measuring head, and scale plate.

5.2.1.1 The measuring head, see Figure 2, consists of a loading weight, rubber plate, and sensing head.

5.2.1.1.1 The loading weight and rubber plate, the loading weight has a circular even surface of not less than 48 mm in diameter and a mass that clamps the test piece at a pressure of (98,1 ± 1,0) kPa. The rubber plate has a diameter of not less than 48 mm, a thickness of (4 ± 0,2) mm, a hardness of (50 ± 5) IRHD in accordance with ISO 48, and a rebound resilience of not less than 62 % in accordance with ISO 4662.

5.2.1.1.2 The sensing head, has 10 concentric measuring lands and nine grooves. The outermost measuring land has a width of (0,5 ± 0,03) mm, and an outside diameter of (46 ± 0,03) mm. The width of the other nine measuring lands is (1 ± 0,03) mm. The inside diameter of innermost measuring land is (9 ± 0,03) mm. All grooves have a width of (1 ± 0,03) mm, and a depth of 0,5 mm to 1,2 mm. Five grooves have air outlet holes and four grooves have air inlet holes arranged alternately. A tube connects the sensing head to the pressure measuring chamber.

5.2.1.2 The air compressor and regulator, supply compressed and filtered air. The air is controlled to approximately 10 kPa by the air regulator.

5.2.1.3 The water column regulator and capillary, provide a constant pressure. The water column regulator consists of a water tank with an internal diameter of approximately 100 mm and a height of approximately 700 mm, and a constant pressure chamber with a side tube. The open end of the side tube is (500 ± 0,5) mm below the water surface.

The air at approximately 10 kPa introduced into the constant pressure chamber is controlled to (4,90 ± 0,01) kPa (500 ± 1 mmH_2O) and transferred to the pressure measuring chamber through the capillary.

The capillary consists of a narrow tube made of stainless material with an inner diameter of approximately 0,3 mm and a length of approximately 50 mm. The capillary length shall be strictly adjusted so that constant K in Formula (1), see 5.2.1.4, is 100.

5.2.1.4 The water column manometer and scale plate, comprise the pressure measurement system. The water column manometer is connected to the water tank at a depth greater than 500 mm below the surface of the water in the water tank by a pipe with a diameter large enough (with a minimum of 3 mm) to allow water to transfer smoothly between the manometer and water tank. The manometer is connected to the sensing head and capillary. The scale plate for reading smoothness is marked in the units of seconds per 100 ml. The scale of smoothness is determined by Formula (1):

$$T = \frac{K * P}{P_c - P} \tag{1}$$

T is the Oken smoothness;

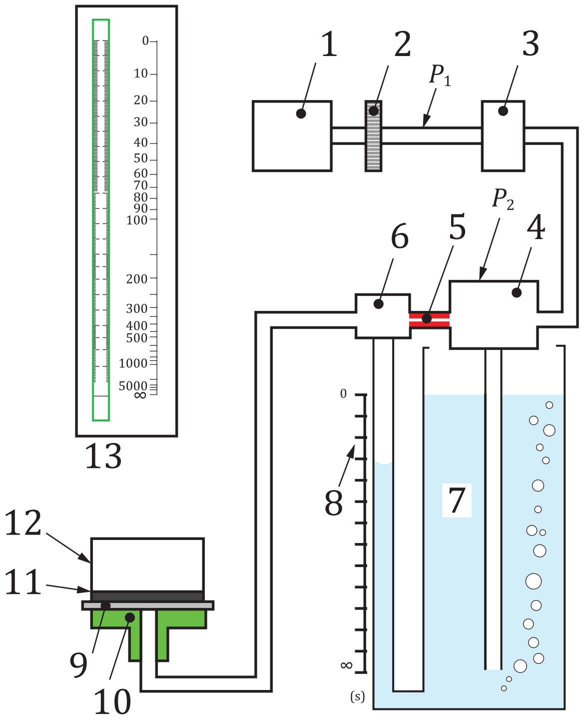
K is the constant;

P is the pressure at the pressure measuring chamber;

P_c is the pressure at the constant pressure chamber.

The scale shall cover the range 0 s to infinity (∞ s) with scale readings of 0 s/100 ml at a pressure drop of zero (0 mmH_2O), 100 s/100 ml at the midpoint 250 mm below the surface level in the tank and (∞) s/100 ml at a pressure of 4,90 kPa (500 mmH_2O).

NOTE High or low air resistance type of Oken tester with different capillary dimensions or measurement areas are available for shorter measurement time or higher precision. However, these types of Oken tester are out of the scope of this part of ISO 8791.

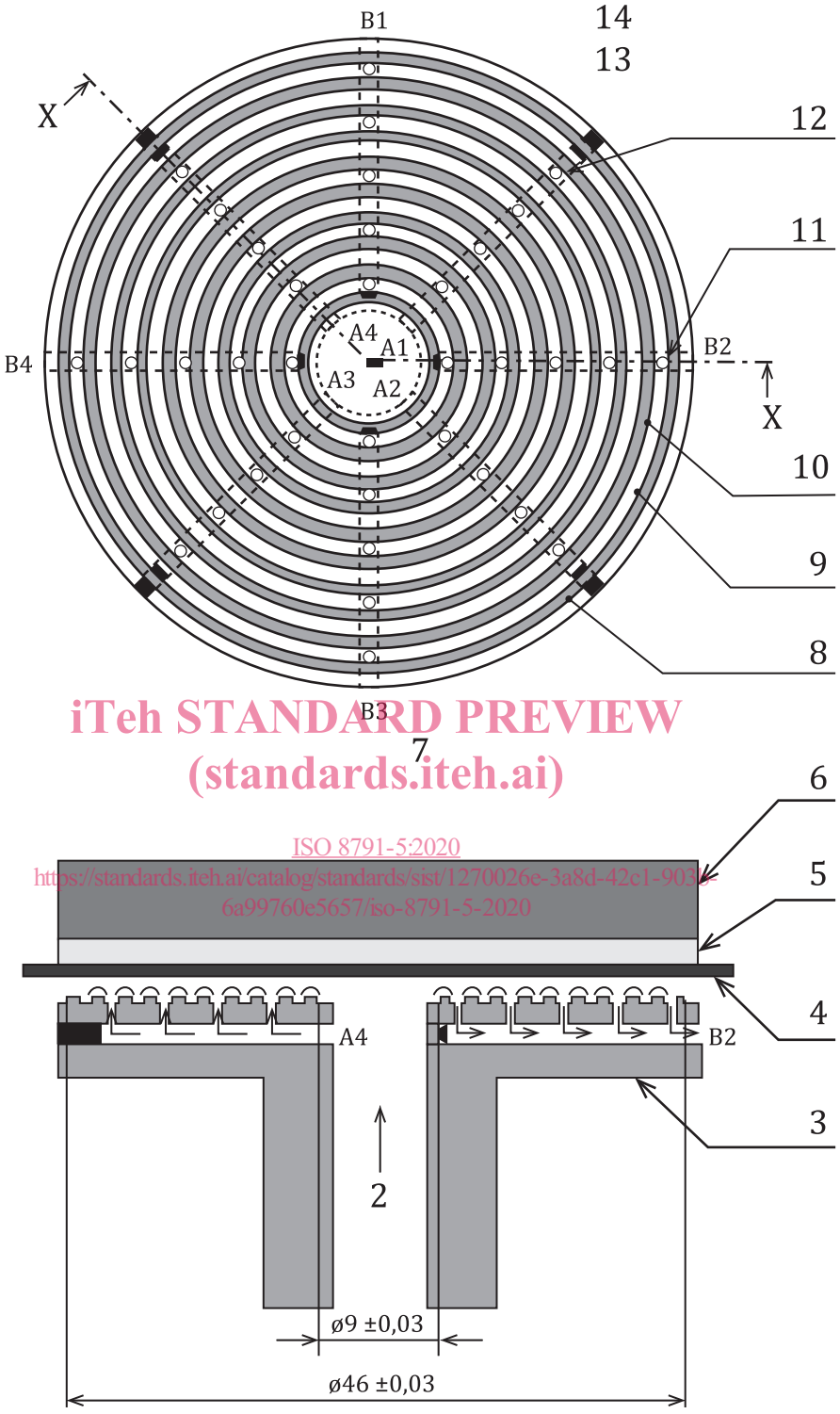


Key

1	air compressor	9	test piece
2	filter	10	sensing head
3	pressure regulator	11	rubber plate
4	water column regulator / constant pressure chamber	12	loading weight
5	capillary	13	example of scale plate
6	water column regulator / pressure measuring chamber sensor	P_1	approximately 10 kPa
7	water tank	P_2	4,90 kPa
8	scale plate		

Figure 1 — Diagram of water column type Oken tester

Dimensions in millimetres



1

Key

1 sectional view X-X
2 air
3 specified ring shape
4 test piece
8 outermost contact ring
9 groove
10 contact ring
11 air outlet hole