INTERNATIONAL STANDARD

ISO 8791-4

Second edition
2007-11-15

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

Part 4: Print-surf method

Papier et carton — Détermination de la rugosité/du lissé (méthodes du débit d'air) —
Partie 4: Méthode Print-surf

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Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 8791-4 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*.

This second edition cancels and replaces the first edition (ISO 8791-4:1992), which has been technically revised.

This version of ISO 8791-4 differs from the previous (1992) version as follows:

— a definition of Print-surf compressibility has been added;

— a description of a modified backing holder for testing high-stiffness papers and board has been added;

— Annex D describing the calibration of Print-surf instruments has been revised and expanded;

— some minor editorial changes have been made.

ISO 8791 consists of the following parts, under the general title *Paper and board — Determination of roughness/smoothness (air leak methods)*:

— *Part 1: General method*

— *Part 2: Bendtsen method*

— *Part 3: Sheffield method*

— *Part 4: Print-surf method*

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

Part 4:
Print-surf method

1 Scope

This part of ISO 8791 specifies a method for determining the roughness of paper and board using an apparatus which complies with the Print-surf method, as defined in this part of ISO 8791. It is applicable to all printing papers and boards with which it is possible to form a substantially airtight seal against the guard lands of the measuring head.

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 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 4094, *Paper, board and pulps — International calibration of testing apparatus — Nomination and acceptance of standardizing and authorized laboratories*

3 Terms and definitions

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

3.1
Print-surf roughness
mean gap between a sheet of paper or board and a flat circular land pressed against it under specified conditions

NOTE The mean gap is expressed as the cube root mean cube gap calculated as specified in Annex A. The Print-surf roughness is expressed directly as the average value of roughness, in micrometres.

3.2
Print-surf compressibility
K
percentage decrease in surface roughness when measurements are made consecutively at the two standard clamping pressures specified in this part of ISO 8791

4 Principle

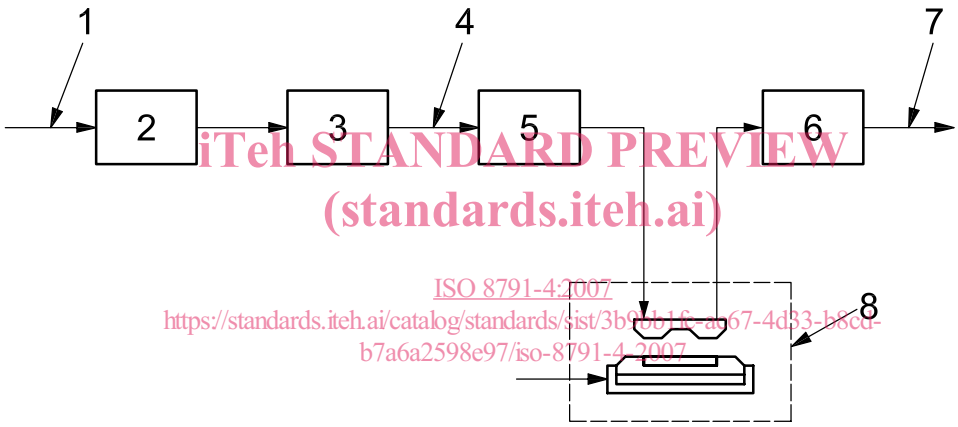
The test piece is placed between a circular flat metal sensing surface and a resilient backing, and inner and outer circular lands form a seal with the test piece. Under the influence of a pressure difference, air flows across the measuring land between the measuring land and the test piece. The rate of air flow is measured on a variable-area flowmeter, or the pressure difference across the measuring land is compared to the pressure difference across a known impedance. In both cases, the result is expressed as the air gap, in micrometres.

5 Apparatus

5.1 Print-surf tester (two types)

5.1.1 Print-surf tester, which operates according to one of the following principles.

5.1.1.1 Variable-area flowmeter type, in which a standard pressure difference is created across the measuring land and the air-flow rate is measured on a variable-area flowmeter. The air-flow rate varies with roughness and the flow rate is converted to roughness, in micrometres. The flow diagram for this type of instrument is shown in Figure 1.

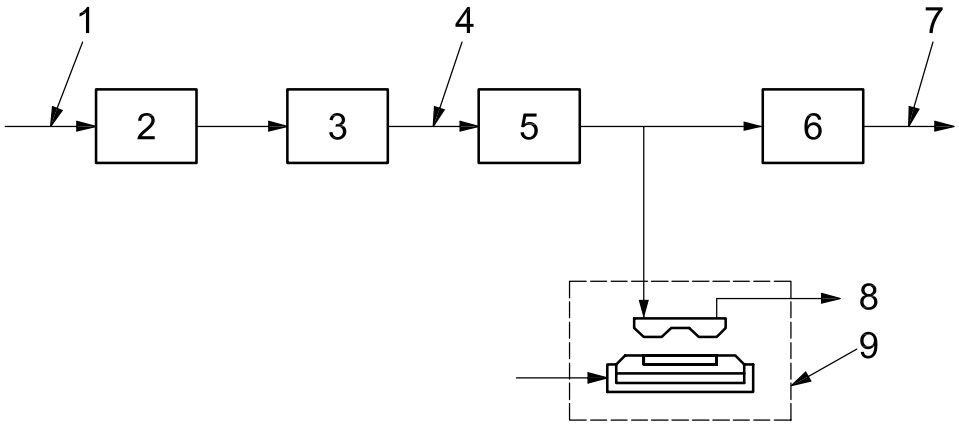


Key

1 incoming air 300 kPa to 600 kPa
2 filter
3 pressure-regulator valve
4 6,2 kPa or 19,6 kPa
5 on/off valve
6 flow indicator tubes
7 to atmosphere
8 sensing head and clamping device

Figure 1 — Flow diagram for variable-area flowmeter type

5.1.1.2 Impedance type, in which the air from the controlled pressure source passes first through a fluidic impedance and then through the sensing head, after which it discharges to atmosphere. The pressure differences across the fluidic impedance and across the land are each measured by a transducer. These pressure differences vary with roughness and the signals are converted to roughness, in micrometres. The flow diagram for this type of instrument is shown in Figure 2.



Key

1 incoming air 300 kPa to 600 kPa
2 filter
3 pressure-regulator valve
4 19,6 kPa
5 fluidic impedance
6 pressure transducer
7 analog signal
8 to atmosphere
9 sensing head and clamping device

Figure 2 — Flow diagram for impedance instrument type

5.1.2 Procedures for maintaining these testers in good working order are given in Annex B.

5.2 Principal components of the system

5.2.1 Air supply, supplying clean air, free of oil and water droplets, at a steady pressure within the range 300 kPa to 600 kPa.

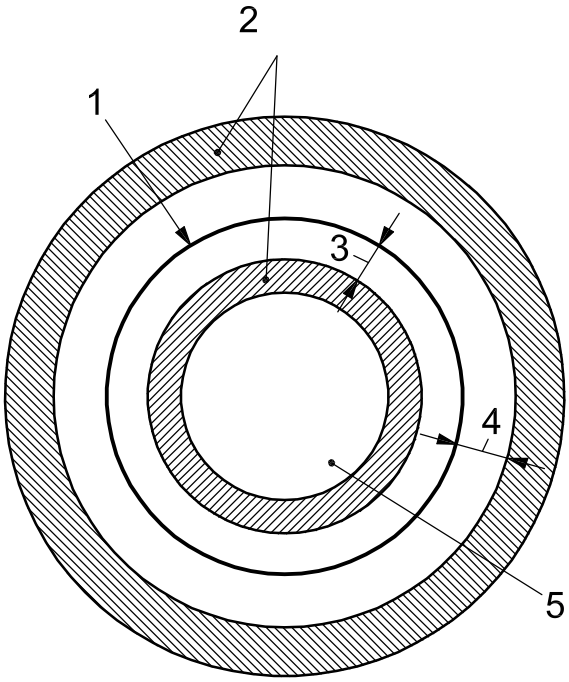
5.2.2 Sensing-head pressure regulator, allowing setting of the sensing-head differential pressure to 19,6 kPa ± 0,1 kPa or, on variable-area flowmeter instruments only, to either 6,2 kPa ± 0,1 kPa or 19,6 kPa ± 0,1 kPa.

5.2.3 Sensing head, (see Figures 3 and 4), consisting of three concentric, annular lands composed of suitable material which have coplanar, polished surfaces. The centre or measuring land shall be 51,0 µm ± 1,5 µm wide and have an effective length of 98,0 mm ± 0,5 mm. The two guard lands shall each be at least 1 000 µm wide at any point, and the radial distance between them at any point shall be 152 µm ± 10 µm. The measuring land shall be centred between them to within ± 10 µm.

The lands shall be mounted in an airtight mounting, constructed so that air can be passed into the gap between one guard land and the measuring land, and exhausted from the gap between the measuring land and the other guard land. The back of the mounting shall be flat and form a ground mating surface with the flat surface of a manifold fitted with air inlet and outlet ports.

A spring-loaded protective collar may be fitted outside the guard lands. If such a protective collar is fitted, the force exerted by the loading spring shall be taken into account when setting the clamping pressure.

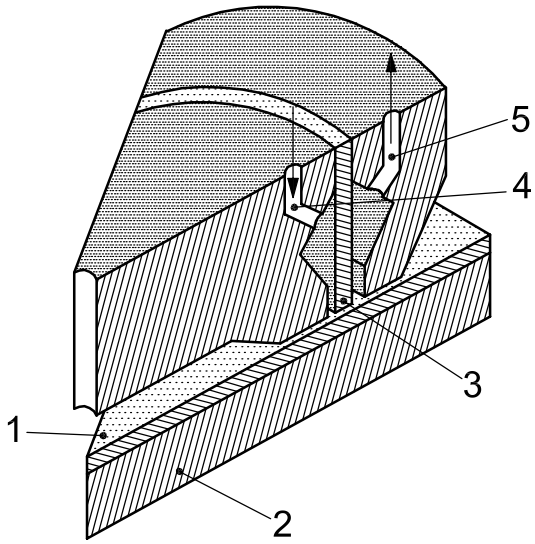
NOTE In many instruments fitted with the protective collar, the force exerted by the loading spring is 9,8 N.



Key

1 measuring land
2 guard lands
3 passage connected to air supply
4 passage leading to flowmeters or atmosphere
5 recess vented to atmosphere

Figure 3 — Plan of the measuring and guard lands of the sensing head



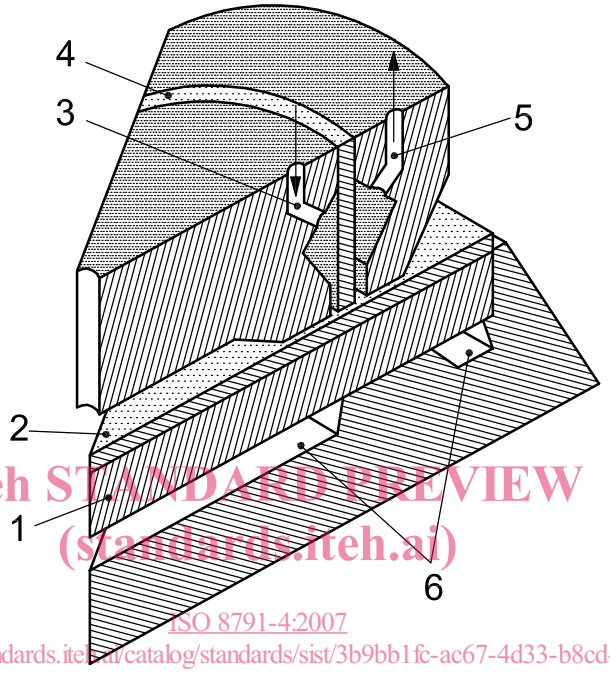
Key

1 paper
2 resilient backing
3 measuring land
4 regulated low-pressure air
5 to flowmeters or atmosphere

Figure 4 — The sensing head sectioned on two radii

5.2.4 Backing holders, consisting of rigid metal discs of known mass, each recessed to accommodate a resilient backing at least 10 mm greater in diameter than the outside diameter of the outer guard land. The mass of both the resilient backing and the holder shall be allowed for in the initial adjustment of the clamping pressure.

It has been observed that high-stiffness papers and boards can interact negatively with the flat metal backing holder and cause erroneously high roughness results. This problem can be solved by using a modified backing holder which relieves those areas of the backing holder not directly below the measuring land, as shown in Figure 5.



Key

1 resilient backing
2 paper
3 regulated low-pressure air
4 measuring land
5 to flowmeters or atmosphere
6 new modified clamp platen showing machined cut-away

Figure 5 — The sensing head sectioned on two radii showing cut-away platen

5.2.5 Two resilient backings, of different types, which can be held in the recessed holders by means of double-sided adhesive tape.

5.2.5.1 Soft backing, resilient, consisting of an offset printing blanket composed of a layer of synthetic rubber, at least 600 µm thick, bonded to a fabric backing giving an overall thickness of 2 000 µm ± 200 µm. The apparent hardness of the complete backing shall be 83 IRHD ± 6 IRHD (International Rubber Hardness Degrees).

5.2.5.2 Hard backing, resilient, usually made from a polyester film bonded at its periphery to cork, offset blanket or similar material. A small exhaust hole shall be provided to prevent air being trapped between the film and the backing. The apparent hardness of the assembly shall be 95 IRHD ± 2 IRHD.

5.2.6 Clamping mechanism, allowing clamping of the resilient backing at pressures of either 980 kPa ± 30 kPa or 1 960 kPa ± 30 kPa, the pressure being calculated from the total area of the measuring and guard lands.

NOTE 1 On some earlier instruments, these values may be displayed on the gauge as 10 kgf/cm^2 and 20 kgf/cm^2.

Note that the spring loading in the protective collar (5.2.3) and the weight of the backing and its holder need to be taken into account. The rate of clamping shall be such that the pressure reaches 90 % of its final value in about 0,4 s, and 99 % of its final value in about 0,8 s.

NOTE 2 A third pressure of 490 kPa (5 kgf/cm^2) is available on most instruments, but is not acceptable for use with this part of ISO 8791 because of a tendency for air to leak under the guard lands.

Variable-area flowmeter measurement systems shall have a pressure gauge fitted to the instrument to indicate the clamping pressure, which shall be adjustable. Impedance measurement systems shall have integrated pneumatic and electronic circuitry which automatically controls the clamping pressure. In each case, the actual pressure achieved shall be verified as specified in B.3.

5.3 Measuring system

5.3.1 The air-flow rate shall be measured with either a set of variable-area flowmeters or by measuring the pressure drop across an impedance.

5.3.2 Variable-area flowmeter instruments shall be fitted with flowmeters which are graduated to show the “cube root mean cube gap” between the paper and the measuring land surface, in micrometres (see Annex A). The flowmeters shall be calibrated by the procedures outlined in either Annex C or D.

5.3.3 Impedance instruments measure air leakage by means of fluidic impedance, a pressure transducer and a function generator. They display or print the roughness, in micrometres to the nearest 0,1 µm, based on automatic measurement of pressure difference, over the range 0,6 µm to 6,0 µm. The value displayed shall be the value calculated after 3 s to 5 s. This device shall be calibrated by the procedure described in Annex D.

6 Sampling

If the tests are being made to evaluate a lot, the sample should be selected in accordance with ISO 186. If the tests are made on another type of sample, make sure that the test pieces taken are representative of the sample received.

7 Conditioning

The sample shall be conditioned in accordance with ISO 187.

8 Preparation of test pieces

Prepare the test pieces in the same atmospheric conditions as those used to condition the sample. Cut at least 10 test pieces for each side to be tested. The minimum size of each test piece shall be 100 mm × 100 mm, and their surfaces shall be identified in some convenient way (for example, side one or side two).

The test area shall be free of all folds, wrinkles, holes or other defects, and should not include watermarks. Do not handle that part of the test piece which will become part of the test area.

9 Procedure

9.1 Carry out the test in the same atmospheric conditions as those used to condition the sample (see Clause 7).

9.2 Ensure that the instrument is on a rigid horizontal surface free from vibration and that it is level. Before use on any particular day, check the system for leakage as specified in B.1.

9.3 Select and fit the backing disc appropriate for the material being tested. In general, the hard backing should be used for papers that are to be printed by letterpress presses fitted with paper backings. Papers to be printed by other processes, and boards however printed, should be tested with the soft backing.

9.4 Select and adjust the clamping pressure, using the following as a guide:

— Hard backing letterpress 1 960 kPa ± 30 kPa

— Soft backing letterpress 1 960 kPa ± 30 kPa

— Soft backing offset 980 kPa ± 30 kPa

9.5 For a tester of the variable-area flowmeter type, select the lowest-range flowmeter which will give a reading greater than 20 % of the scale range.

Always start with the highest-range flowmeter and turn the flow range selector switch successively to a flowmeter of lower range, in order to avoid subjecting the low-range flowmeters to a high air flow.

9.6 Test the first test piece by the following procedure.

9.6.1 Variable-area flowmeter type

Set the sensing-head differential pressure to 6,2 kPa ± 0,1 kPa by adjusting the pressure from the low side.

NOTE 1 If the pressure gauge indicates differential pressure in metres of water gauge, 0,63 m is equivalent to 6,18 kPa.

NOTE 2 The pressure gauge on some instruments has been found to be sensitive to jolts and, if the adjustment is made downwards from a higher pressure, the resulting pressure for a given scale reading will be higher than if the adjustment is made upwards from a lower pressure.

Clamp the first test piece under the sensing head, with the side to be tested uppermost. This operation can cause the reading on the sensing-head pressure gauge to change, but such a change may be ignored. Record the reading on the flowmeter to the nearest 0,05 µm, 3 s to 5 s after application of clamping pressure. Readings shall be taken level with the top of the flowmeter float. Select the lowest-range flowmeter which gives results greater than 20 % of the scale range.

If the reading obtained is less than 20 % of the range of the lowest-range flowmeter, increase the sensing-head pressure to 19,6 kPa ± 0,5 kPa (2,0 m water gauge). All readings taken at this pressure shall be multiplied by 0,667 [(for the background of this factor, see Annex A, Equation (A.1)] to give the roughness, in micrometres, unless the flowmeters are calibrated for this pressure.

9.6.2 Impedance type

Place a test piece under the head with the side to be tested uppermost. Clamp the test piece either automatically or manually. Record the reading, 3 s to 5 s after application of clamping pressure.

9.7 Repeat step 9.6 for the other test pieces and calculate the arithmetic mean and standard deviation or coefficient of variation for the side tested. For variable-area flowmeter-type instruments, do not repeat the procedure for selection of the appropriate flowmeter and sensing-head pressure.