International Standard

ISO 3689

Third edition
2024-10

Paper and board — Determination of bursting strength after immersion in water

Papier et carton — Détermination de la résistance à l'éclatement après immersion dans l'eau

Reference number
ISO 3689:2024(en)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

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.

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

This third edition cancels and replaces the second edition (ISO 3689:1983), which has been technically revised.

The main changes are as follows:

— Clause 2 has been updated;

— Terms for burst index (3.3), felt side (3.4), and wire side (3.5) have been added in Clause 3;

— Clause 5 has been revised;

— 7.2 “conditioning” has been updated;

— Clause 8 “Procedure” is revised, especially immersion time (8.1.2) and excess water removal (8.1.3) has been added;

— Former 8.3 “determination” in particular the limits of the bursting strength are revised;

— Former 8.4 “number of tests” is revised;

— Former Clause 9 “Expression of results” is technically revised;

— Clause 10 “Precision” has been updated;

— Clause 11 “Test report” is revised;

— Annex A with examples of possible support systems has been added;

— editorially revised.

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 bursting strength after immersion in water

1 Scope

This document specifies a method for the determination of the wet strength of paper and board by measuring its bursting strength after it has been immersed in water for a specified period.

The method is applicable to most kinds of paper and board, provided that an appropriate immersion time is agreed between the interested parties.

Different results can be found if the sample is re-tested after a period of time.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 536, *Paper and board — Determination of grammage*

ISO 2758, *Paper — Determination of bursting strength*

ISO 2759, *Board — Determination of bursting strength*

ISO 14487, *Pulps — Standard water for physical testing*

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 https://www.electropedia.org/

3.1
bursting strength after immersion
limited resistance offered by a single sheet of paper or board, after immersion in water to a uniformly distributed pressure applied at right angles to its surface up to the point at which it breaks, under the specified conditions of test

3.2
bursting strength retention after immersion
percentage ratio of the bursting strength of a single sheet of paper or board after immersion in water to that of the same paper or board in the dry state measured under the specified conditions of test

3.3
burst index
bursting strength of paper, in kilopascals, divided by the grammage of the paper

Note 1 to entry: Grammage of the paper is determined in accordance with ISO 536.

[SOURCE: ISO 2758:2014, 3.2, modified — text from the definition moved to Note 1 to entry.]

3.4
felt side
Right side
Top side
side of a sheet of machine-made paper that was not in contact with the wire of the papermaking machine during manufacture

3.5
wire side
side of a sheet or web of paper that was formed in contact with the papermaking machine's forming wire, as opposed to that formed on the top side of the paper

4 Principle

Immersion in water for the specific period (see 8.1.2) of a test piece of the paper or board to be tested and determination of the bursting strength.

5 Apparatus, reagents and materials

5.1 Burst testing apparatus in accordance with ISO 2758 or ISO 2759

5.1.1 Burst tester, configured in accordance with ISO 2758**,** for papers having expected wet bursting strengths within the range of 70 kPa to 1 400 kPa.

5.1.2 Burst tester, configured in accordance with ISO 2759**,** for all types of board (including corrugated and solid fibreboard) having bursting strengths within the range 350 kPa to 5 500 kPa and for papers or boards having bursting strengths as low as 250 kPa if the paper or board is to be used to prepare a material of higher bursting strength, such as corrugated board.

5.2 Blotting paper, with a grammage of 250 g/m^2 ± 25 g/m^2. The blotting paper shall have dimensions larger than the test piece and smaller than the width of the metal roller (5.3).

5.3 Metal roller with a smooth face, 200 mm wide ±10 mm, a diameter of 90 mm ± 10 mm, and a mass of 10 kg ± 0,5 kg.

5.4 Tank of water, maintained under a standard atmosphere according to ISO 187, large enough to hold the test pieces in a vertical position, cleaned with reagent water (5.6) to ensure that it is free from surfactants. The temperature shall be measured with a thermometer before immersion (5.7) to ensure that the water temperature is maintained in accordance with ISO 187.

If the tank (5.4) is maintained in a non-conditioned atmosphere, the tank shall include thermostatic control in accordance with ISO 187. If evaporation could expose samples to the air, a lid shall be added and the water level shall be monitored. Tanks should be cleaned periodically using tap water, cloths, and brushes with a following tap water rinse to eliminate any paper fibre film on the tank side walls and bottoms.

The used temperature shall be stated in the test report (see Clause 11).

5.5 Support system, either in the vertical or horizontal attitude, to facilitate immersion (8.1) in water and to prevent a test piece from folding over on itself or coming in contact with other test pieces (examples

are given in Annex A, Figures A.1 to A.4). A sketch of a possible support system is shown in Figure 1. The support system shall keep the test pieces:

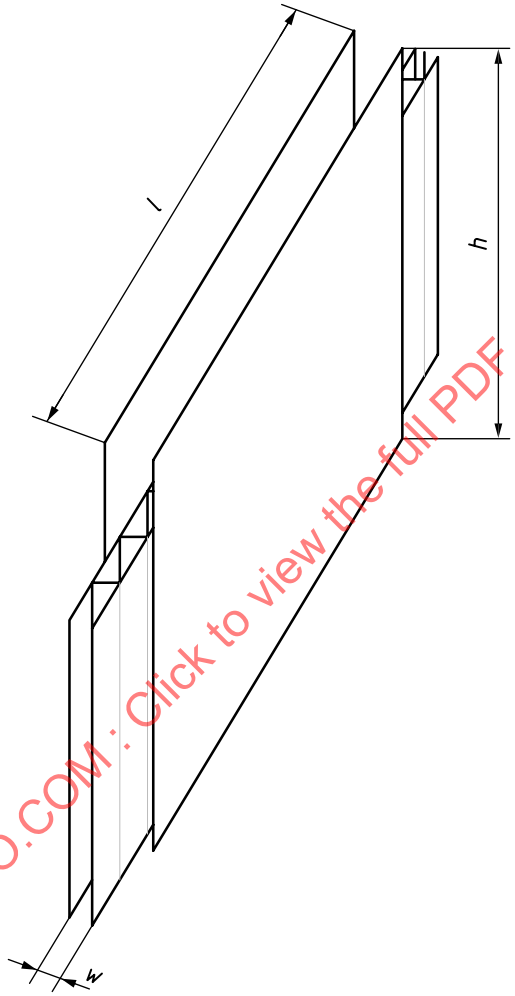
a) above the bottom of the soak tank;

b) 20 mm below the surface of the water;

c) away from the sides/ends of the soak tank;

d) hang straight and vertical (not able to fold over on themselves);

e) away from each other.



Key

l length of cell shorter than test piece shall provide for support for corrugated board or paper test piece ends

h height of cell to accommodate test piece height

w cell width to accommodate the thickness of a triplewall test piece

Figure 1 — Sketch of a possible support system

5.6 Water, distilled or deionized at the laboratory conditioning temperature, i.e. 23 °C ± 1 °C or 27 °C ± 1 °C in tropical countries. The water shall fulfil the requirements of ISO 14487.

5.7 Thermometer, with the accuracy of ±0,1 °C.

6 Sampling

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

7 Test pieces

7.1 Preparation

Test pieces shall be prepared as specified in ISO 2758 or ISO 2759. Ten test pieces are required for the wet bursting test; if bursting shall be performed with several sheets of paper or board together (see 8.2), a larger number of test pieces is required. A duplicate set shall be prepared for the dry bursting test, if required, for example, if a comparison is desired, either actual or as a percentage, between wet and dry burst or the customer requires it.

7.2 Conditioning

For wet testing, conditioning of the test pieces is not necessary.

8 Procedure

8.1 Immersion

8.1.1 Immersion of the test pieces

Immerse each test piece vertically in clean water (5.6) in the tank (5.4), so that the upper edge is at least 20 mm below the surface. Ensure that the test pieces are separated from each other and from the bottom and sides of the tank.

For paper test pieces, the machine direction is vertical, and test pieces are held in place by the clips to the support system (5.5).

Corrugated fibreboard shall be immersed with the flutes and the glue lines vertical, in order to avoid trapping air, which could affect the amount of water absorbed during immersion. Clips to the support system can be needed unless the support system has restraints preventing test pieces from floating to the surface of the water.

Immersed test pieces shall be observed periodically to ensure the test pieces remain below the water level and that air bubbles are not observed. If air bubbles are observed, a gentle manual vibration of the support system (5.5) shall be performed (with the test pieces remaining under water) to allow the air bubbles to dissipate.

8.1.2 Immersion times

Typical immersion times:

— 1 h ± 1 min;

— 2 h ± 2 min;

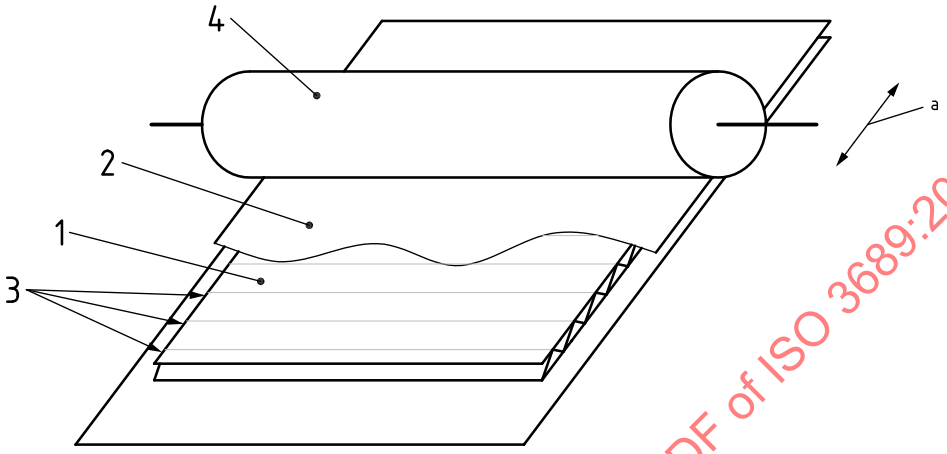
— 24 h ± 15 min

It is common to use other immersion times to result in complete saturation of samples. The time shall be agreed by the relevant parties and shall be stated in the test report.

8.1.3 Excess water removal

After immersion for the specified period (8.1.2), remove the test pieces from the water individually and place the test pieces between two sheets of blotting paper (5.2) quickly, with the least possible delay. When corrugated board is tested, gently agitate (shake) the test piece with the flutes vertical to remove water within the flute structure before placing the test piece between the two sheets of blotting paper.

Remove the excess water by rolling the metal roller (5.3) once forward and once backward over the blotting paper (5.2), without applying pressure on the metal roller (5.3) (see Figure 2).



Key

1 test piece
2 blotting paper
3 gluelines
4 metal roller
a Rolling direction of the metal roller, axis parallel to the glue lines of the corrugated board.

Figure 2 — Application of metal roller

8.2 Determination

For each test piece, perform the procedure given in 8.1.3. Immediately after the removal of excess water, perform the test in accordance with ISO 2758 for paper or ISO 2759 for board.

The bursting strength of paper or board after immersion (3.1) shall be at least 70 kPa for paper or 250 kPa for board. If the bursting strength of paper or board is lower, test sufficient test pieces together to obtain a reading above 70 kPa for paper or 250 kPa for board. The sheets, when combined, shall have the same face up (felt side or wire side).

8.3 Number of tests

Test 5 test pieces with the felt side (paper) or the outer side (board) uppermost and 5 test pieces with the wire side (paper) or the inner side (board) uppermost to get 10 valid test results.

Repeat with the same number of test pieces if the dry bursting strength is required.

9 Expression of results

The results shall be expressed as one of the following according to what is agreed between the interested parties:

a) Mean bursting test of wet test pieces

$$\overline{B_W} = \frac{\sum_1^N B_W}{N} \quad (1)$$

where

$\overline{B_W}$ is the mean bursting test, after immersion, in kPa;

B_W is an individual test result, after immersion, in kPa;

N total number of tests.

b) Burst index

$$B_I = \frac{\overline{B_W}}{g} \quad (2)$$

where

B_I is the burst index, in $\mathrm{kPa\,m^2 g^{-2}}$;

$\overline{B_W}$ is the mean bursting test, after immersion, in kPa;

g grammage of the board (dry) determined in accordance with ISO 536, in $\mathrm{gm^{-2}}$.

c) Mean bursting strength retention

$$B_R = \frac{\overline{B_W}}{\overline{B_C}} \times 100 \quad (3)$$

where

B_R is the mean bursting strength retention after immersion, in percentage;

$\overline{B_W}$ is the mean bursting test, after immersion, in kPa;

$\overline{B_C}$ is the mean bursting strength of dry and conditioned set of samples in kPa (see ISO 2758 for paper and ISO 2759 for board).

10 Precision

The precision for this test method is currently not known because interlaboratory data are not available. As soon as data from interlaboratory studies are being obtained, a precision statement will be added in one of the following revisions of this document.

11 Test report

The test report shall contain at least the following information:

a) a reference to this document, i.e. ISO 3689:2024;

b) date and place of testing;

c) type of bursting tester used (according to ISO 2758 or ISO 2759);

d) mean results (in accordance with 9 a), b), c) or as agreed between the interested parties.);

e) minimum and maximum values of B_W ;

f) immersion time, in h;

g) in the case of multiple sheet testing, the number of test pieces used;

h) standard deviation of the bursting strength (wet);

i) temperature of the water used for immersion of the test pieces;

j) details of any items regarded as optional, or not specified in this document or in the International Standards to which reference is made, and any other features that may have affected the results;

k) any deviation, by agreement or otherwise, from the procedure specified;

l) all necessary information for complete identification of the test piece.

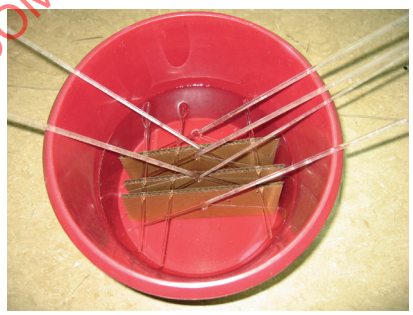
Annex A
(informative)

Examples for support systems

A.1 Possible support systems

a) System to prevent the test pieces from touching the ground

b) System to prevent the test pieces from touching each other



c) System to prevent the test pieces from rising

Figure A.1 — Example of a support system