
Tissue paper and tissue products —
Part 11:
Determination of wet ball burst
strength

Papier tissue et produits tissue —

Partie 11: Détermination de la résistance à l'éclatement à l'état humide, méthode à la balle

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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).

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 second edition cancels and replaces the first edition (ISO 12625-11:2012), of which it constitutes a minor revision.

The main changes compared to the previous edition are as follows:

- [Clause 12](#), addition of new "h" stating "clamping ring diameter (89 mm or 50 mm)".

A list of all parts in the ISO 12625 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.

Introduction

This document is applicable to tissue papers and tissue products. In principle, application to other types of paper is possible, but is not covered by this document.

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Tissue paper and tissue products —

Part 11: Determination of wet ball burst strength

1 Scope

This document specifies a test method for the determination of the resistance to mechanical penetration (ball burst strength procedure) of tissue paper and tissue products after wetting.

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 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 12625-1, *Tissue paper and tissue products — Part 1: General guidance on terms*

ISO 12625-9, *Tissue paper and tissue products — Part 9: Determination of ball burst strength*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12625-1 and the following 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

bursting force

F_D

maximum force, that a test piece of a tissue paper or tissue product can withstand under the test conditions, applied perpendicular to its surface

[SOURCE: ISO 12625-9:2015, 3.2, modified — right angle changed to perpendicular]

Note 1 to entry: The bursting force is expressed in newtons (N).

3.2

wet bursting force

maximum force, that a wetted test piece of a tissue paper or tissue product can withstand under the test conditions, applied perpendicular to its surface

Note 1 to entry: The wet bursting force is expressed in millinewtons (mN).

3.3

wet burst index

wet bursting force of the tissue paper or tissue product divided by the grammage of the conditioned sample determined by the standard method of test

Note 1 to entry: The wet burst index is expressed in millinewton square metres per gram ($\text{mN} \cdot \text{m}^2/\text{g}$).

3.4

wet burst retention

ratio, expressed as a percentage, of the burst strength of the wet tissue paper or wet tissue product to the burst strength of the same tissue paper or tissue product in the dry and conditioned state

Note 1 to entry: This definition is similar to the definition of wet tensile strength retention; see ISO 12625-5:2016, 3.2.

4 Principle

A test piece of tissue paper or tissue product is rigidly clamped at the periphery between two concentric annular rings, then wetted with deionized water and submitted to a perpendicular force until penetration, applied by a ball of a hard, non-deformable, material moving at a constant speed.

5 Reagents

5.1 Deionized water, with a conductivity $\leq 0,25$ mS/m at 25 °C, in accordance with ISO 14487. The water temperature should be maintained during the test at the temperature used for conditioning and testing.

6 Apparatus

6.1 General

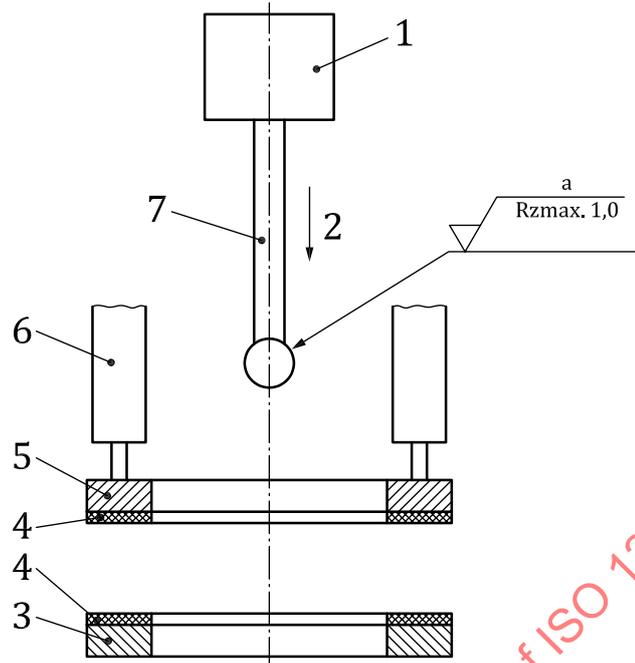
The apparatus shall be placed on a horizontal surface, free from externally induced vibrations.

6.2 Clamping system

The clamping system is designed to clamp the test piece firmly and uniformly between two concentric annular plane, parallel surfaces. The clamping rings can be activated mechanically or pneumatically.

The clamping pressure shall be sufficient to prevent slippage during the test, without damaging the test pieces.

The clamping surfaces of the clamping rings are coated with a commercial grade of a band made of rubber material, typically 1,0 mm to 2,0 mm thick, having an IRHD hardness (International Rubber Hardness Degree) of 70 IRHD to 85 IRHD. The inner edges of the coated band shall be coincident with the inner diameter of the clamping rings and be at least 12,5 mm wide. The internal diameter of the two concentric rings shall be $(50,0 \pm 0,2)$ mm. For an example of a pneumatic clamping system, see [Figure 1](#).

**Key**

- | | | | |
|---|--|---|---------------------|
| 1 | load cell | 5 | movable centre-ring |
| 2 | travel | 6 | pneumatic cylinder |
| 3 | stationary ring | 7 | probe |
| 4 | suitable band made of rubber
(e. g. chloroprene rubber) | | |
| a | Polished ball. | | |

Figure 1 — Principle of the clamping system, pneumatic fixture

6.3 Penetration system

The penetration (burst) system shall consist of a spherical ball attached to a rod designed to transmit the force applied to the ball. The penetration ball shall be made of highly polished stainless steel and shall have the following dimensions:

- diameter: $(16 \pm 0,2 \text{ mm})$;
- sphericity: better than $1 \mu\text{m}$.

The penetration ball shall be centred with the annular clamps. It is permanently attached to the end of a solid hard rod designed to transmit the force applied to the ball.

6.4 Force measuring system

The force measuring system shall measure the loads with a class of machine range of 1 or better and shall be calibrated and verified in accordance with the requirements of ISO 7500-1.

The load cell system shall have a measuring range of 0,1 N to 15 N.

The readout system shall have a display that shows the maximum force at burst.

6.5 Drive mechanism

The drive mechanism shall consist of a static uniaxial testing machine with a suitable mechanism for moving either the clamping system or the penetration system so that they approach each other at a constant rate in a direction perpendicular to the clamping system plane.

The penetration test speed shall be (125 ± 5) mm/min.

6.6 Water application system

A water application system shall be either a pipette or any automatic volumetric water application system like Dosimat ®¹⁾ with a volume accuracy of $(5,0 \pm 0,1)$ ml and capable of delivering 5 ml water within 3 s to 4 s.

7 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 specimens taken are representative of the sample.

When sampling finished roll products, possible presence of adhesives or mechanical damage shall be avoided. Therefore, exclude at least the first and the last six windings of the roll.

8 Conditioning

8.1 General

Condition the samples according to ISO 187, unless otherwise agreed between the parties concerned, and keep them in the standard atmosphere throughout the test.

8.2 Rapid ageing (curing)

8.2.1 General

The wet strength of tissue paper is frequently enhanced by addition of a wet strength agent. A rapid ageing with heat is frequently used to develop the maximum wet strength that a tissue paper or tissue product will achieve after a period of natural ageing at ambient conditions which may vary from a few days to several weeks, depending on the wet strength agent used.

NOTE The decision on whether or not to use rapid ageing will be determined by the user of this document, based upon the information about the tissue paper or tissue product sample being tested. Rapid ageing is not a requirement of this document, but is an allowed option. There is no rule for determining whether to rapid age or not, but the following principles are generally applied.

8.2.2 Production test pieces, which have not left the manufacturing environment, are generally rapid aged. To rapid age a tissue paper or tissue product, it is recommended to heat in air at (80 ± 2) °C for 30 min.

After heating, condition the test piece in a standard atmosphere at (23 ± 1) °C and (50 ± 2) % relative humidity for at least 1 h prior to testing.

For production inspections where data must be available quickly, rapid ageing conditions of (105 ± 2) °C for 15 min may be used.

1) Dosimat is a trade name of a commercially available product. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

8.2.3 Test pieces which have been delivered to the market are generally not rapidly aged.

9 Preparation of test pieces

9.1 General

Test pieces shall be free of areas containing creases, dirt or visible damage.

9.2 Preparation of test pieces

Test pieces shall be larger than the clamping area of the testing machine. Prepare at least 10 test pieces of the sample conditioned as described in [Clause 8](#).

9.2.1 Base paper that has not been converted shall be tested as a single ply, unless otherwise agreed between the parties concerned.

9.2.2 For tissue products, testing shall be carried out on the product as received, regardless of the number of plies.

9.2.3 Cut at least 10 test pieces which are larger than the clamping area of the clamping system ([6.2](#)).

NOTE Toilet paper is frequently produced in rolls of perforated sheets. In testing such toilet tissue it is convenient to remove a specimen consisting of three connected sheets. The outer two sheets should be used for moving the test piece into the clamping system, while the middle sheet is subjected to the test.

10 Procedure

10.1 Turn on the power of the testing machine at least 30 min prior to testing.

10.2 Clamp the conditioned test piece top side up without applying any tension to it. If the top side cannot be identified, ensure that the same side of all test pieces is clamped uppermost.

10.3 After clamping the test piece in the clamping device, adjust the distance between the lowest part of the penetration system and the top surface of the test piece to $(25 \pm 0,5)$ mm. Set the rate at which the penetration system and test piece approach each other to (125 ± 5) mm/min.

10.4 Carry out the wetting procedure of the test piece by adding 5 ml of deionized water in 3 s to 4 s using a pipette or an automatic volumetric addition system (e.g. Dosimat^{®2)}).

10.5 When adding the deionized water, the delivery tip of the system touches the upper surface of the penetration ball ([6.3](#)), so that the water drips from the ball onto the test piece.

10.6 Record the maximum value of the force at burst as the bursting force F_W to three significant figures.

10.7 Dry the clamping and penetration systems.

10.8 Perform the above sequence with the remaining pieces until at least 10 valid results are obtained.

2) See the footnote in [6.6](#).

11 Calculation

Determine the average value \bar{F}_W of the wet bursting force for the 10 test pieces.

If required, determine the wet burst index, X_W , expressed in millinewton square metres per gram [$\text{mN}\cdot\text{m}^2/\text{g}$] using [Formula \(1\)](#):

$$X_W = \frac{\bar{F}_W}{g} \quad (1)$$

where

\bar{F}_W is the mean wet bursting force, expressed in millinewtons [mN];

g is the grammage of the sample, expressed in grams per square metre [g/m^2]

If required, determine the wet burst retention, W_R , as a percentage using [Formula \(2\)](#):

$$W_R = \frac{\bar{F}_W \times 100}{\bar{F}_D \times 1000} \quad (2)$$

where

\bar{F}_W is the mean wet bursting force, expressed in millinewtons [mN];

\bar{F}_D is the mean burst force of the conditioned tissue sample in newtons [N], determined according to ISO 12625-9.

NOTE F_D is measured according to ISO 12625-9 with a clamping ring diameter of 89 mm. Ring tests have not shown any significant difference in results between measurements with a 50 mm and 89 mm ring diameter.

12 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 12625-11:2019;
- b) date and place of testing;
- c) complete identification of the sample tested;
- d) the mean wet bursting force \bar{F}_W , in millinewtons, to three significant figures, the standard deviation and the maximum and minimum values measured;
- e) if required, the wet burst index X_W , in millinewton square metres per gram, to three significant figures;
- f) if required, the wet burst retention W_R , in percent, rounded to one decimal place;
- g) whether the test piece was rapid aged, and under which conditions;
- h) clamping ring diameter (89 mm or 50 mm);
- i) any departure from this document and other circumstances that may have affected the test results.