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Textiles — Test methods for nonwovens —

Part 5: Determination of resistance to mechanical penetration (ball burst procedure)

Textiles — Méthodes d'essai pour nontissés —

Partie 5: Détermination de la résistance à la pénétration mécanique (méthode d'éclatement à la bille)

Reference number
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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.

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 9073-5 was prepared by Technical Committee ISO/TC 38, *Textiles*.

ISO 9073 consists of the following parts, under the general title *Textiles — Test methods for nonwovens*:

— *Part 1: Determination of mass per unit area*

— *Part 2: Determination of thickness*

— *Part 3: Determination of tensile strength and elongation*

— *Part 4: Determination of tear resistance*

— *Part 5: Determination of resistance to mechanical penetration (ball burst procedure)*

— *Part 6: Absorption*

— *Part 7: Determination of bending length*

— *Part 8: Determination of liquid strike-through time (simulated urine)*

— *Part 9: Determination of drapability including drape coefficient*

— *Part 10: Lint and other particles generation in the dry state*

— *Part 11: Run-off*

— *Part 12: Demand absorbency*

— *Part 13: Repeated liquid strike-through time*

— *Part 14: Coverstock wetback*

— *Part 15: Determination of air permeability*

— *Part 16: Determination of resistance to penetration by water (hydrostatic pressure)*

— *Part 17: Determination of water penetration (spray impact)*

— *Part 18: Determination of breaking strength and elongation of nonwoven materials using the grab tensile test*

Textiles — Test methods for nonwovens —

Part 5: Determination of resistance to mechanical penetration (ball burst procedure)

1 Scope

This part of ISO 9073 specifies a method for determining the resistance to mechanical penetration of nonwoven fabrics by a ball of a given diameter.

The method is primarily designed to be used on nonwovens with some degree of elasticity, for which a regular burst test is not applicable.

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 139, *Textiles — Standard atmospheres for conditioning and testing*

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

ISO 10012:2003, *Measurement management systems — Requirements for measurement processes and measuring equipment*

3 Terms and definitions

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

3.1
nonwoven fabric
fabric made directly from a web of fibres, without the yarn preparation necessary for weaving and knitting

3.2
constant-rate-of-traverse (CRT) testing machine
testing machine in which the moving clamp moves at a uniform rate

3.3
bursting strength
force or pressure required to rupture a textile by distending it with a force, applied at right angles to the plane of the fabric, under specified conditions

3.4
elongation
distance the crosshead travels from the plane of the sample at the start of the test to the point of peak load

4 Principle

A specimen of nonwoven is securely clamped under tension between two grooved, ring-shaped plates secured horizontally in the position of the lower, fixed, clamp of a constant-rate-of-traverse (CRT) tensile-testing machine (see Figure 1). A force is exerted vertically downwards against the specimen by a polished hardened-steel ball that is attached in the position of the upper, movable, clamp. The test is terminated when the ball ruptures the material.

5 Apparatus

5.1 Constant-rate-of-traverse (CRT) tensile-testing machine, converted for use in the compression mode and fitted with a ball burst attachment (5.2) replacing the two clamp assemblies (see Figure 1).

5.2 Ball burst attachment, consisting of

a) a polished steel ball (5.3) that replaces the upper, moving, clamp of the tensile-testing machine;

b) a ring-clamp mechanism (5.4) that replaces the lower, fixed, clamp of the tensile-testing machine.

5.3 Polished steel ball, having a diameter of (25,400 ± 0,005) mm and spherical to within 0,005 mm.

The size of the ball may differ from that stated if so agreed upon by all interested parties and recorded in the test report.

5.4 Ring clamp, having an internal diameter of (44,500 ± 0,025) mm.

The size of the ring clamp may differ from that stated if so agreed upon by all interested parties and recorded in the test report.

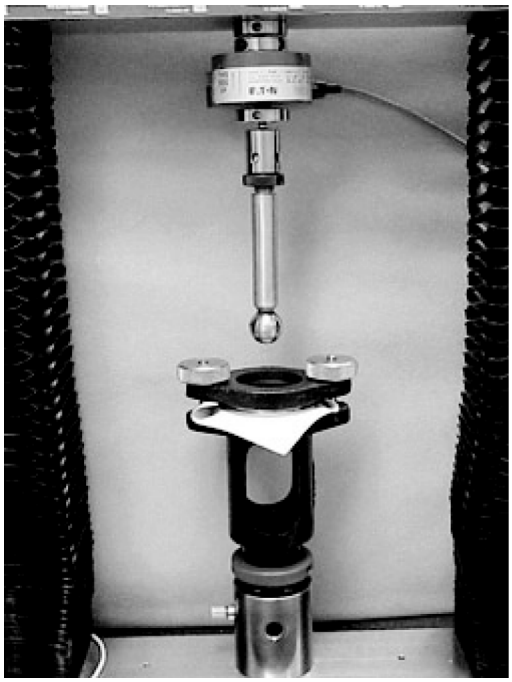

Figure 1 — Apparatus

6 Procedure

6.1 Specimens shall be selected in accordance with ISO 186. Bring the specimens from the prevailing atmosphere to moisture equilibrium for testing in the standard atmosphere as prescribed in ISO 139. If agreed upon by all parties, conditioning and testing may be carried out without preconditioning the test specimens.

Care in handling shall be observed so that test specimens do not contact any contaminants such as soap, salt, oil, etc., which might facilitate or hinder water penetration. No dirt or other foreign material shall be allowed on the specimen. Do not write on the test area of the specimen.

6.2 Each test specimen shall be at least 125 mm square or a circle at least 125 mm in diameter. Test specimens need not be cut for testing. Take no specimens nearer to the edge of the fabric than 300 mm.

6.3 Unless otherwise agreed upon and recorded in the test report, as when specified in an applicable material specification, take five test specimens from the laboratory sample(s) of fabric.

6.4 Metrological confirmation of the test apparatus shall be in compliance with Clause 7, Figure 2 and Annex A of ISO 10012:2003. Also take into account the following:

— Set-up procedures for machines from different manufacturers may vary. Prepare the machine and verify its calibration as directed in the manufacturer's instructions (see also Annex B).

— Set the distance for the travel of the ball so that it penetrates the test material but does not come in contact with the lower stage (very important).

— Set the testing machine for a crosshead speed of (300 ± 10) mm/min unless otherwise specified and agreed upon by all parties.

6.5 Verify the total operating system by testing specimens of a standard material for ball burst and comparing the data obtained with historical data from the same standard material. It is recommended that this verification of the system be carried out on a daily basis before use, but at a minimum it should be done weekly. In addition, the total operating system should be verified whenever there are changes in the load cells.

Select and prepare a standard material which has a ball burst strength in the range of interest.

Test the standard-material specimens in the same manner as unknown specimens (see 6.6).

Determine the bursting force for each standard-material specimen, the mean value and the standard deviation from the mean.

Compare the new data with previous data for the same material. If any of the data values are outside the tolerances established, recheck the total system to locate the cause for the deviation. Do not start testing until the results of standard-material testing are within these tolerances.

6.6 Place a specimen under tension in the ring clamp and fasten it securely by means of the screws or pneumatic mechanism. Start the CRT machine, using a downward crosshead speed of (300 ± 10) mm/min and continue at that speed until the specimen bursts. Record, to the nearest 5 N, the ball burst strength of the specimen.

6.7 Ignore any failure that is confined to the edge of the clamp and repeat the test on another test specimen. Ignore any test result where the test specimen slips in the clamp and repeat the test on another test specimen.

NOTE Slippage is normally evident as blurring of the marks left by the ring clamp on the test specimen.

7 Test report

The test report shall include all information needed to duplicate the test procedure and its results:

a) a reference to this part of ISO 9073;

b) the type of test specimen and its size;

c) the number of specimens tested;

d) the type of tensile-testing machine used;

e) the size of the ball and the ring clamp used, and any deviation from the standard size relationship;

f) the size of the load cell used to perform the test;

g) the name and version of any software used to calculate the results;

h) the laboratory conditions under which the testing was done (temperature and humidity);

i) whether or not the specimens were conditioned prior to testing and, if so, for how long;

j) the ball burst strength, recorded to the nearest 5 N, of each specimen and the average ball burst strength of all the specimens which gave valid results;

k) any modifications made to the test procedure specified;

l) the date of the test.

Annex A
(informative)

General information regarding precision

A study of the precision of this method was carried out in which

— the ball was (25,400 ± 0,005) mm in diameter and spherical to within 0,005 mm;

— the ring clamp had an internal diameter of (44,500 ± 0,025) mm;

— three different materials were tested;

— three different laboratories participated.

Based as it is on limited information from three laboratories, the within-laboratory and between-laboratory standard deviations (s_r and s_R) shown in Table A.1 are approximate. This table illustrates what the three laboratories found when all the readings were taken by well-trained operators using specimens randomly tested from three different samples of material.

Because tests were conducted in only three laboratories, the estimates of between-laboratory precision may be either underestimated or overestimated to some extent and should be used with special caution. However, when agreed upon between the contractual parties, the approximate analysis reported in Table A.1 may be used.

Table A.1 — Precision data

Parameter	Material 1	Material 2	Material 3
Grand average	16,533	6,800	114,57
Within-laboratory precision, s_r (repeatability)	2,217	0,864	19,059
Between-laboratory precision, s_R (reproducibility)	2,217	0,864	19,059

Annex B
(informative)

General information regarding causes for low precision when ball burst testing

The following are some of the causes for low precision (between and within laboratories) when performing this test and all of these variables should be covered by the test report:

— the use of different makes and models of tensile-testing machines (the age and design of the machine);

— the use of different sizes of load cell (to match the properties of the material);

— the use of different software to calculate the results (report name and version);

— the use of different laboratory conditions (it is important to maintain the humidity constant at 65 % or 50 % and to state which was used in the test report);

— the use of different pre-conditioning times for the test specimens (it is important to use a standard pre-conditioning time and to state that time in the test report).

The following are some of the operator sources of error:

— failure to recheck the zero after changing the load cell or other machine conditions;

— failure to carry out proper and timely calibration of the machine and all the load cells;

— failure to train the operators properly and to maintain that training, verified through periodic proficiency testing.

Bibliography

[1] ISO 9092, *Textiles — Nonwovens — Definition*

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