INTERNATIONAL STANDARD

ISO 12625-3

First edition
2005-04-15

Tissue paper and tissue products —

Part 3: Determination of thickness, bulking thickness and apparent bulk density

Papier tissu et produits en tissu —

Partie 3: Détermination de l'épaisseur, de l'épaisseur moyenne d'une feuille en liasse et de la masse volumique moyenne

Reference number
ISO 12625-3:2005(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web 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.

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 12625-3 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 172, *Pulp, paper and board*, in collaboration with Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition cancels and replaces EN 12625-3:1999, which has been technically revised.

With regard to EN 12625-3:1999, the following changes have been made:

a) more precise definitions;

b) more precise description of the apparatus;

c) preparation of test pieces more precisely described;

d) editorial updating.

ISO 12625 consists of the following parts, under the general title *Tissue paper and tissue products*:

— *Part 1: General guidance on terms*

— *Part 3: Determination of thickness, bulking thickness and apparent bulk density*

— *Part 4: Determination of tensile strength, stretch at break and tensile energy absorption*

— *Part 5: Determination of wet tensile strength*

— *Part 6: Determination of grammage*

— *Part 7: Determination of optical properties*

— *Part 8: Water absorption time and water absorption capacity, basket immersion test method*

— *Part 9: Determination of ball burst strength*

Introduction

Thickness is an important property of tissue paper and tissue products.

In the tissue industry, thickness-related parameters, such as the roll diameter of rolled products (kitchen towel) or the stack height of folded products (paper towels) are often measured. However, the fact that not only end-use tissue products, but also the base tissue paper from which these products are made, is the subject of trade between companies and countries, means that there is a genuine need for a consistent measure of thickness that can be applied to tissue products at any stage of their manufacture.

The thickness of tissue paper and tissue products is known to be dependent on the pressure applied to the material at the time of measurement. Several different loading pressures, pressure-foot diameters and loading speeds have been used within the tissue industry. This part of ISO 12625 has been prepared by harmonising those standards applicable to tissue and tissue products currently in use. It specifies a single loading pressure, foot diameter and loading speed to be used for all thickness measurements of tissue and tissue products.

Tissue paper and tissue products —

Part 3:
Determination of thickness, bulking thickness and apparent bulk density

1 Scope

This part of ISO 12625 specifies a test method for the determination of thickness and bulking thickness, and the calculation of apparent bulk density, of tissue paper and tissue products under a pressure of 2,0 kPa.

NOTE This part of ISO 12625 has been developed to provide a consistent test method for the determination of thickness and density of tissue paper and tissue products. Corresponding test methods for paper and board in general are covered in ISO 534.

It is expressly stated that the detection of impurities and contraries in tissue paper and tissue products should be applied according to ISO 15755.

For the determination of moisture content in tissue paper and tissue products, ISO 287 should be applied.

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

ISO 12625-6, *Tissue paper and tissue products — Part 6: Determination of grammage*

3 Terms and definitions

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

3.1
single-ply thickness
distance between the two principal surfaces of a single ply of tissue paper measured under the applied static load specified in this part of ISO 12625

NOTE A “ply” of tissue is an unlaminated tissue, like that made directly from a tissue machine.

3.2
single sheet thickness
distance between the two principal surfaces of a single sheet of tissue product measured under the applied static load specified in this part of ISO 12625

NOTE A "sheet" of tissue is a laminated or unlaminated tissue, like that present in the finished tissue product.

3.3
bulking thickness
thickness of a single sheet of tissue paper or tissue product, calculated from the thickness of several superimposed sheets, measured under the applied static load specified in this part of ISO 12625

3.4
apparent bulk density
mass per unit volume of tissue paper or tissue product, calculated from its grammage and bulking thickness

NOTE The apparent bulk density is expressed in grams per cubic centimetre.

4 Principle

Measurement of the thickness of a test piece of tissue paper sampled during the manufacturing process, or of a tissue product supplied as a finished article. The measurement is made as the distance between a fixed reference plate on which the sample rests and a parallel pressure-foot that exerts a specified load on the area under test.

5 Apparatus

5.1 Precision dead-weight micrometer

This has two parallel, horizontal faces, flat to within 0,001 mm, between which the test piece is placed. The lower face shall be fixed and the upper face (pressure-foot) moveable in a direction perpendicular to the plane of the fixed face.

The upper, circular, pressure-foot shall have a diameter of (35,7 ± 0,1) mm giving a nominal area of 10,0 cm^2 and shall be parallel to the lower face within the limits defined in A.3.

The lower face shall be constructed to support the test piece, such that the test piece lies flat whilst under test. In practice, the lower face should have minimum dimensions 20 % larger than the diameter of the pressure-foot. The pressure between the two faces shall be (2,0 ± 0,1) kPa (see Annex B).

The speed at which the pressure-foot is lowered shall be controlled automatically and shall be set to (2,0 ± 0,2) mm/s.

The instrument read-out/scale shall be graduated in increments of 0,001 mm.

The opening between the pressure-foot and the lower face is set by agreement between the instrument supplier and the customer. For most thickness measurements, instruments with an opening of 10 mm or 12 mm will normally be suitable. When only single sheet or single-ply measurement is required, an opening of 2 mm to 3 mm is sufficient.

5.2 Gauge blocks (slip gauges)

These are used for calibrating the thickness gauge and should correspond to approximately 10 %, 30 %, 50 %, 70 % and 90 % of the full-scale reading of the micrometer. Each gauge shall have an assigned thickness value better than 0,001 mm.

5.3 Balance and attachments

A suitable balance and attachments or calibrated load cell, capable of measuring up to 300 g with an accuracy of 0,01 g to be used for calibration of the pressure-foot load.

6 Conditioning

Condition the samples in a standard atmosphere at (23 ± 1) °C and (50 ± 2) % relative humidity according to ISO 187, unless otherwise agreed between the parties concerned. The sample shall remain in the standard atmosphere throughout the testing.

7 Preparation of test pieces

7.1 General

The sample shall be selected in accordance with ISO 186.

Each test piece shall be free from perforations and faults not normally inherent in the tissue.

Test piece dimensions are not critical, but they shall have a minimum dimension of 80 mm in any direction. Large test pieces shall be cut to a reasonable size using scissors, a suitable guillotine or a cutter board and press. During this operation, the test pieces shall not be subject to pressure that could alter the thickness measurement.

7.2 Single-ply thickness

Prepare ten test pieces from each ply, sampled either directly from the tissue machine, or, if practicable, from individual plies of a multi-ply product, sampled during or after the converting process. In the latter cases, care shall be taken to identify the location of the individual plies in the product.

Do not attempt to separate plies that are bonded with adhesive or pressure.

Plies from different positions in a multi-ply product shall not be assumed to be the same.

7.3 Single sheet thickness

Prepare ten test pieces of a single- or multi-ply product sampled during or after the converting process.

7.4 Bulking thickness

Prepare ten stacks comprising a number of superimposed sheets, with all the sheets orientated in the same way.

The lateral dimensions of the stack should be more than enough to allow ten independent measurements to be made.

Multi-ply products shall not be separated into individual plies. Stacks shall normally contain twelve plies. Where the stack height using twelve plies is too great for the maximum opening of the instrument in use, a lower number of plies may be used, but this should not be less than eight. In all cases, report the number of sheets and the number of plies per sheet used.

8 Procedure

Place the micrometre on a horizontal vibration-free surface within the conditioned atmosphere defined in, ISO 187 and allow it to “warm-up” according to the manufacturer's instructions.

The working faces of the micrometer shall be clean.

Check the zero setting of the micrometer and adjust it if necessary.

Verify the calibration of the micrometer as defined in A.1.

Raise the pressure-foot and insert the test pieces between the lower face and the pressure-foot. Allow the pressure-foot to move down onto the test pieces at the controlled speed. After 5 s, record the thickness to the nearest 0,001 mm.

Repeat the measurement on the remaining test pieces until at least ten measurements have been recorded. Between successive readings of two or more test pieces, make sure that the working faces are free from dust.

If the apparent bulk density of the sample is to be calculated, determine the grammage of the sample by the test method described in ISO 12625-6.

9 Calculation

9.1 Single-ply thickness

Calculate the mean and standard deviation of the ten (or more) readings, and report the single-ply thickness t_p to the nearest 0,01 mm and the standard deviation to two significant figures.

9.2 Single sheet thickness

Calculate the mean and standard deviation of the ten (or more) readings, and report the single sheet thickness t_s to the nearest 0,01 mm and the standard deviation to two significant figures.

9.3 Bulking thickness

Calculate the mean and standard deviation of the ten (or more) readings. Divide both by the number of sheets (not plies) in each pack and report the result as the bulking thickness t_b to the nearest 0,01 mm and the standard deviation to two significant figures.

9.4 Apparent bulk density

Calculate the apparent bulk density, x, in grams per cubic centimetre, according to Equation (1):

$$x = \frac{g}{t_b} \qquad (1)$$

where

g is the grammage, in grams per square metre (g/m^2);

t_b is the bulking thickness, in micrometres (µm).

Report the apparent bulk density to two significant figures.

10 Test report

The test report shall include the following information:

a) a reference to this part of ISO 12625;

b) the date and place of testing;

c) all details necessary to identify the material, including a statement of the number of plies received and the location of individual plies if single-ply thickness testing has been requested from a multi-ply product. If bulking thickness testing has been requested from a multi-ply product, identify the sample (sheet) and state the number of individual plies in each sheet and the number of sheets in each pack;

d) the number of measurements made and the results of the tests;

e) any departure from this part of ISO 12625 or any other circumstances that may have affected the results.

11 Precision

11.1 General

In an interlaboratory test, six laboratories tested four samples according to this part of ISO 12625. The results are shown in the Tables 1 to 3.

11.2 Single sheet thickness

Table 1 — Results of an interlaboratory test

Sample	Mean single sheet thickness mm	Standard deviation between laboratories s mm	Reproducibility coefficient of variation %	Reproducibility limit [a] R mm
Paper-base, handkerchiefs	0,12	0,005	3,9	0,014
Paper-base, kitchen towels	0,19	0,007	3,8	0,019
Paper towel	0,18	0,005	3,0	0,014
Kitchen roll	0,79	0,027	3,5	0,076

[a] Agreement expected with 95 % probability, $R = 1{,}96\sqrt{2} \times s$.

11.3 Bulking thickness

Table 2 — Results of an interlaboratory test

Sample	Mean bulking thickness mm	Standard deviation between laboratories s mm	Reproducibility coefficient of variation %	Reproducibility limit [a] R mm
Paper-base, handkerchiefs	0,09	0,001	1,2	0,003
Paper-base, kitchen towels	0,13	0,004	2,7	0,011
Paper towel	0,15	0,003	1,8	0,007
Kitchen roll	0,75	0,015	2,1	0,043

[a] Agreement expected with 95 % probability, $R = 1{,}96\sqrt{2} \times s$.

11.4 Apparent bulk density

Table 3 — Results of an interlaboratory test

Sample	Mean apparent bulk density g/cm^3	Standard deviation between laboratories s g/cm^3	Reproducibility coefficient of variation %	Reproducibility limit [a] R g/cm^3
Paper-base, handkerchiefs	0,18	0,0032	1,8	0,0083
Paper-base, kitchen towels	0,16	0,0054	3,5	0,0139
Paper towel	0,27	0,0058	2,1	0,0162
Kitchen roll	0,07	0,0020	2,8	0,0559

[a] Agreement expected with 95 % probability, $R = 1{,}96\sqrt{2} \times s$.

Annex A
(normative)

Measurement conditions

A.1 Calibration

Calibration shall be checked as frequently as necessary to ensure continued accuracy. For instruments in frequent use, a simple daily check is advised for accuracy using a single thickness gauge and monthly for foot parallelism and foot pressure. Formal confirmation of accuracy, foot parallelism, evenness of the faces and foot pressure is described in A.2, A.3, A.4 and Annex B, respectively.

The gauge block used should reflect the thickness of the products normally being tested.

Check the micrometer at (23 ± 2)° C.

A.2 Accuracy

Clean the pressure faces by drawing a clean sheet of A4 copy paper (or equivalent) through the loaded faces. Set the instrument at zero. Insert a thickness gauge or a slip (block) gauge (see 5.2) between the anvil and pressure-foot and observe the scale reading. Use only one gauge block at a time. Check the thickness readings at approximately 10 %, 30 %, 50 %, 70 % and 90 % of full-scale reading.

The maximum deviation from the true thickness shall be less than 0,003 mm or ± 0,5 % of the reading, whichever is the greater.

Repeated zero settings or repeated checks with gauges shall not differ by more than 0,003 mm or ± 0,5 % of the reading, whichever is the greater.

A.3 Parallelism of the faces

Measure the parallelism of the face using the following procedure.

a) Take one of the thickness gauge blocks (5.2), open the gap between the pressure faces and insert the gauge block between the pressure face about 2 mm from the edge at one side of the pressure-foot. Allow the pressure faces to close on the gauge block and note the micrometer reading.

b) Open the gap between the pressure faces and insert the same thickness gauge block between the pressure faces, about 2 mm from the edge of the face diametrically opposite to the edge used in a). Allow the pressure faces to close on the gauge block and again note the micrometer reading.

c) Calculate the difference d_1 between the readings noted in a) and b).

d) Repeat the procedure described in a) and b) with the same thickness gauge block at positions between the pressure faces about 2 mm from the edge of the pressure faces, and on a diameter perpendicular to that passing through the points referred to in a) and b).

e) Calculate the difference d_2 between the readings noted in d).

f) Repeat the procedure described above using, in turn, each of the remaining thickness gauge blocks.

g) For each thickness gauge block at which micrometer readings are taken, calculate the error of parallelism using the Equation (A.1):

$$x = 0{,}5\sqrt{(d_1^2 + d_2^2)} \qquad \text{(A.1)}$$

where

x is the parallelism deviation;

d_1 is the difference between the readings noted in A.3 a) and A.3 b);

d_2 is the difference between the readings noted in A.3 d).

The parallelism is satisfactory if, at each particular thickness, the parallelism error x is no more than 0,004 mm.

A.4 Evenness of the faces

Check that both pressure faces are even by the following procedure:

— Carefully clean the faces of the micrometer (see A.2).

— Raise the pressure-foot slightly and view the gap against a bright light.

— Observe the gap in two directions at right angles to each other.

The gap shall appear perfectly uniform for both directions.