
Paper and board — Determination of grammage

Papier et carton — Détermination du grammage

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Published in Switzerland

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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 536 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 536:1995), of which it constitutes a minor revision. Mainly editorial changes have been made and precision data have been added as an informative Annex B.

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Paper and board — Determination of grammage

1 Scope

This International Standard specifies a method for determining the grammage of paper and board.

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 287, *Paper and board — Determination of moisture content of a lot — Oven-drying method*

3 Terms and definitions

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

3.1

grammage

mass per unit area

mass of a unit area of paper or board determined by a specific method of test

NOTE Grammage is expressed in grams per square metre.

4 Principle

The area of the test pieces and their masses are determined and the grammage is calculated.

5 Apparatus

5.1 Cutting device, capable of repeatedly cleanly cutting test pieces of the same nominal size, whose area falls within $\pm 1,0$ % of a known area. This shall be checked frequently by measurement and, provided that the above accuracy is attained, the mean area obtained in these checks shall be used for calculating grammage.

With certain types of paper and board it will be found, after carrying out this determination of area, that test pieces cannot be cut with the accuracy just defined; in such instances, the area of every test piece shall be determined individually.

5.2 Balance, sufficiently accurate, over the range of mass for which it is used, to measure to within 0,5 % of the actual mass. It shall be sensitive enough to detect a change of $\pm 0,2$ % in the mass to be weighed and, if the balance is of the direct-reading type, it shall be graduated so that readings may be taken to this degree of accuracy.

Special sheet-weighing balances, designed to weigh test pieces of a given size and which indicate grammage directly, may be used, provided that the above conditions are fulfilled and that the area of each test piece on a single weighing is not less than 50 000 mm² (500 cm²) and not more than 100 000 mm² (1 000 cm²) (see Clause 8 and 9.2).

When in use, the balance shall be shielded from air currents.

6 Sampling

The selection of units and sheets and the taking of specimens shall be carried out in accordance with ISO 186. The number of specimens taken (at least five) shall be sufficient for at least 20 test pieces. If tests are made on another type of sample, make sure that the specimens taken are representative of the sample received.

7 Conditioning

For the determination of conditioned grammage, the specimens shall be conditioned in accordance with ISO 187.

If a determination is made in the "oven-dry" or "as-taken" condition (see Annex A), or if any other conditioning atmosphere is used, the reported results shall be qualified by a statement indicating the condition of the test pieces at the time of weighing.

8 Procedure

For the determination of conditioned grammage, prepare and weigh the test pieces in the same atmospheric conditions as used to condition the specimens.

Using the cutting device (5.1), cut at least 20 test pieces from at least five specimens, if possible taking the same number from each specimen.

Whenever possible, each test piece shall have an area of not less than 50 000 mm² (preferably 200 mm × 250 mm) and not more than 100 000 mm²; it may, if necessary, be composed of several smaller pieces.

NOTE In cases where there is only a limited sample area available and it is not possible to make up a test piece comprising several smaller pieces, a test area of not less than 10 000 mm² (100 cm²) may be used.

Determine the area of each test piece by calculation, from measurements taken to the nearest 0,5 mm.

Weigh each test piece on the balance (5.2) and express its mass to three significant figures.

It is recommended, especially when dealing with small pieces, that contact of the test piece with bare hands be avoided.

9 Calculation and expression of results

9.1 If the procedure in Clause 8 is followed, calculate the grammage, g , in grams per square metre, to three significant figures, for each test piece, using Equation (1):

$$g = \frac{m}{A} \times 10^6 \quad (1)$$

where

m is the mass, in grams, of the test piece;

A is the area, in square millimetres, of the test piece.

Alternatively, the grammage may be calculated using Equation (2):

$$g = \frac{\bar{m}}{\bar{A}} \times 10^6 \quad (2)$$

where

$\bar{m}$ is the average mass, in grams, of the test pieces;

$\bar{A}$ is the average area, in square millimetres, of the test pieces.

9.2 If a special sheet-weighing balance such as described in 5.2 is used, calculate the grammage, g , in grams per square metre, to three significant figures, using Equation (3):

$$g = \frac{A_1}{A} \times g_1 \quad (3)$$

where

g_1 is the indicated grammage, in grams per square metre, of the test piece;

A_1 is the area, in square millimetres, of the test piece for which the balance is calibrated;

A is the area, in square millimetres, of the weighed test piece.

9.3 Calculate the mean of the results and the standard deviation and express them to three significant figures.

10 Test report

The test report shall include the following information:

- a) a reference to this International Standard (ISO 536:2012);
- b) the date and place of testing;
- c) all the information necessary for identification of the sample;
- d) the conditioning atmosphere used;
- e) the area of the test piece used;
- f) the number of replicate tests;
- g) the mean and standard deviation of the results;
- h) if specimens have been taken from more than one position across a reel or sheet and information on grammage variation is required, the details listed in c), d), e) and f) shall be reported for each position separately;
- i) any departure from the procedure specified in this International Standard and any circumstances that may have influenced the results.

Annex A

(normative)

Determination of grammage on an “oven-dry” and “as-taken” basis

A.1 Determination of grammage on an “oven-dry” basis

Determine the area of each test piece after conditioning in accordance with Clause 7. Dry the test pieces in accordance with ISO 287 and determine their mass. Calculate the grammage according to 9.1.

A.2 Determination of grammage “as-taken”

This is based on the material in the condition pertaining at the time of sampling. Select specimens and cut and weigh test pieces from them as quickly as the need for accuracy will allow. When taking specimens from a roll, cut them out from a depth such that their moisture content has remained unaffected by the ambient atmosphere.

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Annex B (informative)

Precision

The precision data presented in Tables B.1 and B.2 has been obtained from CEPI-CTS, the Comparative Testing Service of the Confederation of European Paper Industries. Estimates of repeatability and reproducibility from the CEPI-CTS programme are based on round-robin work in 2011 in which 17 laboratories from 11 European countries tested three different sample materials.

The calculations have been made according to ISO/TR 24498^[1] and TAPPI T 1200^[2].

The repeatability standard deviation reported in Table B.1 is the “pooled” repeatability standard deviation; that is, the standard deviation is calculated as the root-mean-square of the standard deviations of the participating laboratories. This differs from the conventional definition of repeatability in ISO 5725-1^[3].

The repeatability and reproducibility limits reported are estimates of the maximum difference which should be expected in 19 out of 20 instances, when comparing two test results for material similar to those described under similar test conditions. These estimates may not be valid for different materials or different test conditions.

Repeatability and reproducibility limits are calculated by multiplying the repeatability and reproducibility standard deviations by 2,77.

NOTE 1 The *repeatability standard deviation* and the *within-laboratory standard deviation* are identical. However, the *reproducibility standard deviation* is NOT the same as the *between-laboratory standard deviation*. The reproducibility standard deviation includes both the between-laboratory standard deviation and the within-laboratory standard deviation, viz.:

$$s_{\text{repeatability}}^2 = s_{\text{within lab}}^2 \quad \text{but} \quad s_{\text{reproducibility}}^2 = s_{\text{within lab}}^2 + s_{\text{between lab}}^2$$

NOTE 2 $2,77 = 1,96 \times \sqrt{2}$, provided that the test results have a normal distribution and that the standard deviation s is based on a large number of tests.

Table B.1 — Estimation of repeatability of the test method from CEPI-CTS

Sample	Number of laboratories	Mean value g/m ²	Repeatability standard deviation s_r g/m ²	Coefficient of variation $C_{V,r}$ %	Repeatability limit r g/m ²
Level 1	17	51,0	0,51	1,00	1,41
Level 2	16 ^a	94,6	1,04	1,10	2,88
Level 3	17	281	1,60	0,57	4,44
^a Outlier not included.					

Table B.2 — Estimation of reproducibility of the test method from CEP-CTS

Sample	Number of laboratories	Mean value g/m ²	Reproducibility standard deviation s_R g/m ²	Coefficient of variation $C_{V,R}$ %	Reproducibility limit R g/m ²
Level 1	17	51,0	0,65	1,27	1,80
Level 2	16 ^a	94,6	1,47	1,56	4,08
Level 3	17	281	3,67	1,31	10,2
^a Outlier not included.					