

(DZONGKHA TITLE)

**BHUTAN STANDARD**

**Paper and board – Determination of grammage**



**ICS 85.060**

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**BHUTAN STANDARDS BUREAU**  
The National Standards Body of Bhutan  
**THIMPHU 11001**

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## **NATIONAL FOREWORD**

This Bhutan Standard which is identical with ISO 536: 2019 Paper and board – Determination of grammage issued by the International Organization for Standardization (ISO) was adopted by Bhutan Standards Bureau by Wood and Timber Products Technical Committee TC 07 and approved by the Bhutan Standards Bureau Board (BSB Board) on XXXXX, 2020.

The text of the ISO Standard has been approved as suitable for publication as Bhutan Standard without deviation. Certain conventions are however, not identical to those used in Bhutan Standard.

Attention is particularly drawn to the following:

a) Where the words “ISO Standards” appear referring to this standard, they should be read as “Bhutan Standard”.

b) Wherever page numbers are quoted, they are “ISO Standard” page numbers.

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## Paper and board — Determination of grammage

*Papier et carton — Détermination du grammage*

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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](http://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](http://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](http://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 fourth edition cancels and replaces the third edition (ISO 536:2012), which has been technically revised. The main changes compared to the previous edition are as follows:

- several inconsistencies and imprecisions have been addressed e.g. [5.1](#) permits the nominal area of test pieces cut by the cutter to be used in calculating grammage rather than for the area of each test piece to be determined, in certain circumstances, but this was not recognised in subsequent clauses;
- sharper wording in [Clause 8](#) when a reduced test area is used;
- additional information required in [Clause 10](#);
- a more accurate description of the determinate of “as-taken” grammage near top of a reel in [A.2](#).

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](http://www.iso.org/members.html).

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# Paper and board — Determination of grammage

## 1 Scope

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

## 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 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.

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

#### **grammage**

#### **mass per unit area**

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

Note 1 to entry: 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.

For details regarding the test method precision, see [Annex B](#).

## 5 Apparatus

**5.1 Cutting device**, capable of repeatedly cleanly cutting test pieces to within  $\pm 1,0$  % of the same nominal area, for most paper and board products. This shall be checked frequently by measurement. Provided that the above accuracy is attained, the nominal area 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 to within  $\pm 1,0$  % of the nominal area. In such instances the dimensions of each test piece shall be determined to the nearest 0,5 mm and its area calculated.

**5.2 Balance**, sufficiently accurate, over the range of mass for which it is used, to measure the test piece mass 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.

**5.3 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 for determination of mass are fulfilled and that the area of each test piece on a single weighing is not less than 50 000 mm<sup>2</sup> (500 cm<sup>2</sup>) and not more than 100 000 mm<sup>2</sup> (1 000 cm<sup>2</sup>) (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. If tests are made on another type of sample, make sure that the specimens taken are representative of the sample received. If possible, take at least five specimens and take an area sufficient for at least 20 test pieces.

If the "as taken" grammage is to be determined, the influence of the ambient atmosphere on the moisture content of the specimens shall be minimised (see [A.2](#)).

## 7 Conditioning

For the determination of conditioned grammage, and "oven-dry" grammage, the specimens shall be conditioned in accordance with ISO 187.

## 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.

For the determination of conditioned grammage and oven dry (see [A.1](#)) grammage, using the cutting device ([5.1](#)), cut test pieces from conditioned specimens. If possible, cut at least 20 test pieces from at least five specimens, taking the same number from each specimen. For the determination of "as-taken" grammage, follow the same procedure, minimising the influence of the ambient atmosphere on the moisture content of the test pieces (see [A.2](#)).

Whenever possible, each test piece shall have an area of not less than 50 000 mm<sup>2</sup> (preferably 200 mm × 250 mm) and not more than 100 000 mm<sup>2</sup>. If necessary, it may be composed of several smaller pieces.

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 mm<sup>2</sup> (100 cm<sup>2</sup>) may be used. This shall be reported as a deviation from the preferred range of 50 000 mm<sup>2</sup> to 100 000 mm<sup>2</sup> specified in this document.

If the variation in area of test pieces of the type of paper or board being tested exceeds the limits specified in [5.1](#), at the moisture content at which the grammage is determined, or if it is unknown, determine the dimensions of each test piece to the nearest 0,5 mm and calculate the area of each.

Weigh each test piece on the balance ([5.2](#)) and express its mass, or indicated grammage if a special sheet-weighing balance is used ([5.3](#)), 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 value obtained from the balance is the test piece mass, calculate the grammage of each test piece,  $g$ , in grams per square metre, to three significant figures, using [Formula \(1\)](#):

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

where

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

$A$  is the area, in square millimetres, of the test piece or is the area determined by the cutting device if the specification on the variation in the test piece area is met (see [5.1](#)).

**9.2** If a special sheet-weighing balance such as described in [5.2](#) is used, calculate the grammage of each test piece,  $g$ , in grams per square metre, to three significant figures, using [Formula \(2\)](#):

$$g = \frac{A_1}{A} \times g_1 \quad (2)$$

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 or is the area determined by the cutting device if the specification on the variation in the test piece area is met (see [5.1](#)).

**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 document, i.e. ISO 536;
- b) the date and place of testing;
- c) all the information necessary for identification of the sample;
- d) the conditioning atmosphere used unless the “as-taken” grammage is determined;
- e) condition of the test pieces at the time of weighing (conditioned, oven-dry or “as taken”);
- f) the test piece area. If outside the range 50 000 mm<sup>2</sup> to 100 000 mm<sup>2</sup> this shall be reported as a deviation from the preferred range specified in this document;
- g) the number of replicate tests;
- h) the mean and standard deviation of the results;
- i) 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;

- j) any departure from the procedure specified in this document and any circumstances that may have influenced the results.

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## **Annex A**

### **(normative)**

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

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

If necessary (see [5.1](#)), 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 or grammage (if a direct sheet-weighing balance is used). Calculate the grammage according to [9.1](#) or [9.2](#), as appropriate.

### **A.2 Determination of grammage “as-taken”**

This is based on the material in the condition pertaining at the time of sampling. Select specimens, cut test pieces and determine their mass or grammage (if a direct sheet-weighing balance is used) as quickly as the need for accuracy will allow. If the “as taken” grammage near the top of a reel is to be determined, cut the specimens out from a depth such that their moisture content has remained unaffected by the ambient atmosphere. Calculate the grammage according to [9.1](#) or [9.2](#), as appropriate.

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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 area of the test pieces used in the above testing service is less than the preferred minimum of 50 000 mm<sup>2</sup>

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

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<sup>[3]</sup>.

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.:

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

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

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

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

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## Bibliography

- [1] ISO/TR 24498:2019, *Paper, board and pulps — Estimation of uncertainty for test methods by interlaboratory comparisons*
- [2] TAPPI Test method T 1200 sp-07, *Interlaboratory evaluation of test methods to determine TAPPI repeatability and reproducibility*
- [3] ISO 5725-1:1994/Cor 1:1998, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

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