INTERNATIONAL STANDARD

ISO 3374

Third edition
2000-06-15

Reinforcement products — Mats and fabrics — Determination of mass per unit area

Renforts — Mats et tissus — Détermination de la masse surfacique ou grammage

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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 3374 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 13, *Composites and reinforcement fibres*.

This third edition cancels and replaces the second edition (ISO 3374:1990), which has been technically revised.

Annex A of this International Standard is for information only.

Reinforcement products — Mats and fabrics — Determination of mass per unit area

1 Scope

This International Standard specifies a method for determining the mass per unit area of mats (either chopped-strand mat or continuous-strand mat) or fabrics which may be manufactured with glass or carbon or aramid yarns.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 291:1997, *Plastics — Standard atmospheres for conditioning and testing*.

ISO 3344:1997, *Reinforcement products — Determination of moisture content*.

ISO 5725-1:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions.*

ISO 5725-2:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method.*

3 Term and definition

For the purposes of this International Standard, the following term and definition apply:

3.1
mass per unit area
the ratio of the mass of a piece of mat or fabric of specified dimensions to the area

NOTE This mass includes both the strands and any other material protecting or binding the strands or yarns.

4 Principle

The mass of a test specimen of known area is determined, and the mass per unit area calculated.

5 Apparatus

5.1 Polished metal template, which yields a test specimen with

— a square shape of area 1 000 cm^2 for mats;

— a square or circular shape of area 100 cm^2 for fabrics.

The permissible error in the area of the resulting specimens shall be 1 % or less.

By agreement between the interested parties, a larger specimen may be used. In such cases, the shape and dimensions of the specimen shall be noted in the test report.

5.2 Suitable cutting tool, for example knife, scissors, cutting disc or punch.

5.3 Specimen holder, which provides optimum air circulation around the specimen, made from a heat-resistant material and such that there is no loss of the product under test. This may be a basket constructed from stainless-steel wire mesh.

5.4 Balance, having the following characteristics:

Material	Measuring capability	Limit of permissible error	Resolution
Mats, all weights	0 to 150 g	0,5 g	0,1 g
Fabrics $\geqslant$ 200 g/m^2	0 to 150 g	10 mg	1 mg
Fabrics $<$ 200 g/m^2	0 to 150 g	1 mg	0,1 mg

In cases where larger specimens are taken (see 5.1), a balance shall be used that provides equivalent accuracy.

5.5 Apparatus to be used in cases when specimens must be dried:

5.5.1 Ventilated drying oven, with an air change rate of 20 to 50 times per hour, capable of maintaining a temperature of 105 °C $\pm$ 3 °C.

5.5.2 Desiccator, containing a suitable drying agent (for example silica gel, calcium chloride or phosphorus pentoxide).

5.5.3 Stainless-steel tongs, for handling the specimen and specimen holder.

6 Test specimens

Unless otherwise agreed between the interested parties, the number of specimens taken from each roll or from the laboratory sample shall be

for mats: three 1 000 cm^2 specimens per metre of width (in practice, normally one specimen for every 31,6 cm across the width of the mat);

for fabrics: one 100 cm^2 specimen per 50 cm of width.

In all cases, a minimum of two specimens shall be taken.

Suggested methods for cutting specimens are shown in Figure 1 for mats and Figures 2 and 3 for fabrics.

Note that

for mats:

— specimens are taken in one row, generally side by side,

— the distance from the edge may be zero for trimmed mats, but the distance from any untrimmed edges shall be at least 10 cm;

for fabrics:

— specimens are taken separately, preferably involving different weft yarns,

— the distance from the edge/selvedge shall be at least 5 cm.

Special instructions shall be provided, as needed, to the operators to assure that the cutting procedure results in specimens areas which are within the tolerance range for this method.

For mats narrower than 31,6 cm and fabrics narrower than 25 cm, the specimen type and dimensions shall be agreed between the purchaser and supplier.

NOTE Some specifications may stipulate that the mass per unit area is based on a method using the whole roll as the test specimen. In that case, the mass of the roll is divided by the full area of the roll.

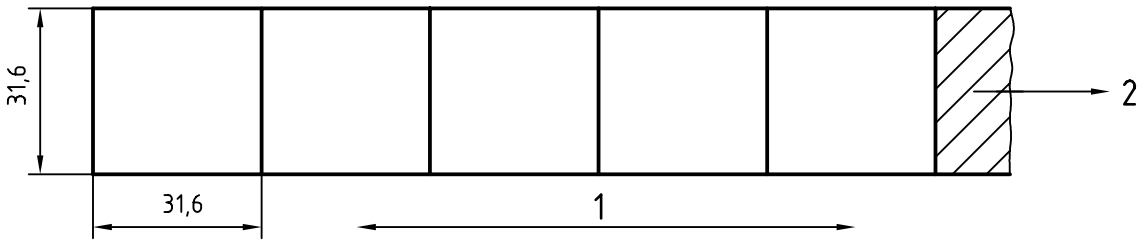
The result obtained (in these specifications, usually called the "actual mean weight") is not necessarily comparable with that obtained with the method described in this International Standard.

7 Conditioning and test atmospheres

Unless otherwise specified in the product specification or by the person ordering the test, no conditioning of the specimens is required.

If conditioning is utilized, refer to ISO 291.

Dimensions in centimetres

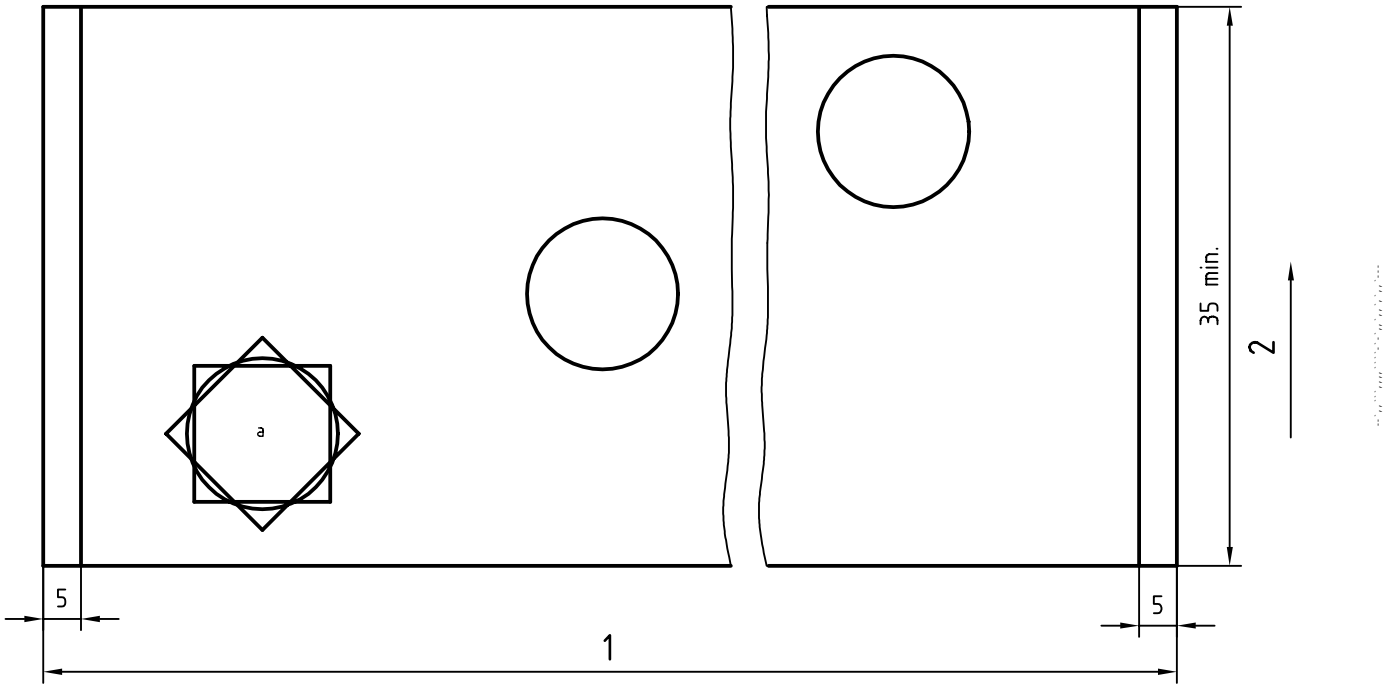


Key

1 Direction of mat width
2 Discard

Figure 1 — Suggested method for cutting out mat specimens

Dimensions in centimetres



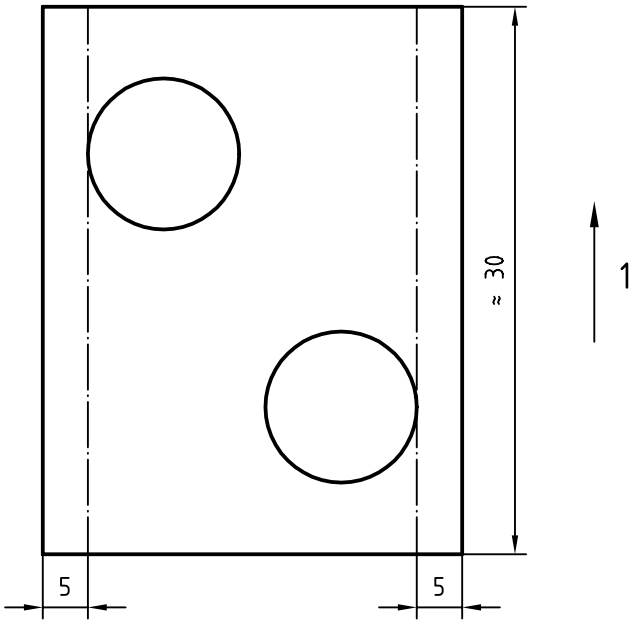
Key

1 Width of fabric
2 Warp direction

[a] Instead of circular specimens, square specimens may be taken oriented either parallel to or diagonally across the yarns.

Figure 2 — Suggested method for cutting out fabric specimens (fabrics wider than 50 cm)

Dimensions in centimetres



Key

1 Warp direction

Figure 3 — Suggested method for cutting out fabric specimens (fabrics between 25 cm and 50 cm wide)

8 Procedure

8.1 Cut a strip at least 35 cm wide across the entire width of the mat or fabric as the laboratory sample.

8.2 Using the cutting tool (5.2) and template (5.1) and a clean work surface, cut the number of specimens specified in clause 6.

If the test specimens have fibres that may be lost, utilize a holder (5.3) and, if necessary, fold the specimens, taking care to keep all strands or yarns.

8.3 Unless otherwise agreed between the interested parties, dry the specimens in a ventilated oven (5.5.1) at 105 °C ± 3 °C for 1 h in cases when the mat or fabric contains more than 0,2 % moisture (or if the moisture content is unknown), then remove to a desiccator (5.5.2) and cool to room temperature. Upon removal from the desiccator, proceed to step 8,4 immediately.

8.4 Weigh each test specimen and record the result, subtracting the tare if a specimen holder was used.

The accuracy to which this mass is recorded shall correspond to the sensitivity of the balance (see 5.4).

9 Calculation and expression of results

9.1 For each specimen, calculate the mass per unit area ρ_A, in grams per square metre, using the equation

$$\rho_A = 10\,000 \times \frac{m_S}{A}$$

where

m_S is the mass, in grams, of the specimen;

A is the area, in square centimetres, of the specimen.

9.2 Report the mass per unit area as the average value for all the specimens taken across the width of the mat or fabric.

Give the result to the nearest 1 g/m^2 for mats and fabrics weighing 200 g/m^2 or more and to the nearest 0,1 g/m^2 for fabrics lighter than 200 g/m^2.

Optionally, specifications or persons ordering the test may also require that the results for each individual specimen be reported, as such data may yield information about the mass distribution across the material.

10 Test report

The test report shall include the following particulars:

a) a reference to this International Standard;

b) all details necessary for complete identification of the mat or fabric tested;

c) the mass per unit area of the mat or fabric (optionally, or if required, the result for each individual specimen may also be reported);

d) details of any operation not specified in this International Standard, as well as any information or details of any incident liable to have a bearing on the results (for instance, the number of specimens used, whether or not preliminary drying of the specimens was necessary or whether specimens different from those specified were used);

e) the date of the test.

Annex A
(informative)

Precision and bias

Table A.1 is based on a round robin conducted in 1999[1)] in accordance with ISO 5725-1 and ISO 5725-2. It involved one carbon fabric, one aramid fabric, three glass fabrics and two glass mats tested by up to 11 laboratories. Individual test specimens were prepared at the laboratories which tested them from samples supplied from a central laboratory. Each test result was the average of two individual determinations for fabrics or three individual determinations for mats. Each laboratory obtained three test results for each material.

CAUTION — The explanation of r and R which follows is only intended to present a meaningful way of considering the approximate precision of this test method. The data in Table A.1 should not be applied to acceptance or rejection of materials, as these data apply only to the materials tested in the round robin and are unlikely to be rigorously representative of other lots, formulations, conditions, materials or laboratories.

Definitions of r and R in Table A.1: If V_r and V_R have been calculated from a large enough body of data, and for test results that were averages from testing of three (two for fabrics) specimens for each test result, then:

Repeatability: Two test results obtained within one laboratory are judged not equivalent if they differ by more than the r value for that material, r being the interval representing the critical difference between two test results for the same material, obtained by the same operator using the same equipment on the same day in the same laboratory.

Reproducibility: Two test results obtained by different laboratories are judged not equivalent if they differ by more than the R value for that material, R being the interval representing the critical difference between two test results for the same material, obtained by different operators using different equipment in different laboratories.

Any judgement in accordance with the above would have an approximately 95 % (0,95) probability of being correct.

There are no recognized standards by which to estimate the bias of this method.

1) The complete results of the round robin are available from the SC 13 Secretariat (AFNOR).

Table A.1 — Round-robin summary for ISO 3374

Material No.	Material	X g/m^2	s_X g/m^2	s_r g/m^2	s_R g/m^2	r g/m^2	R g/m^2	V_r %	V_R %
1	Carbon-fibre fabric	19,590 8	0,139 1	0,127 5	0,173 9	0,357	0,487	1,8	2,5
2	Aramid-fibre fabric	6,081 7	0,184 3	0,088 5	0,198 0	0,248	0,554	4,1	9,1
3	Glass-woven roving fabric	84,407 2	1,760 9	0,427 3	1,795 3	1,197	5,027	1,4	6,0
4	Glass cloth fabric	20,852	0,318 6	0,383 7	0,447 4	1,074	1,253	5,2	6,0
5	Glass stitch fabric	215,557 7	5,321 7	2,013 0	5,571 0	5,636	15,599	2,6	7,2
6	Glass chopped-strand mat	45,165 0	0,891 9	2,110 6	2,110 6	5,910	5,910	13,1	13,1
7	Glass continuous-strand mat	30,886 6	1,757 9	0,381 6	1,785 5	1,068	4,999	3,5	16,2

The symbols used in the table are defined as follows:

X is the mean value;

s_X is the standard deviation from the mean;

V_r is the within-laboratory coefficient of variation for the material concerned;

V_R is the between-laboratory reproducibility, expressed as the coefficient of variation;

r is the within-laboratory critical interval between two test results (= 2,8 × Vr);

R is the between-laboratory critical interval between two test results (= 2,8 × V_R).

The data indicate generally good within-laboratory repeatability V_r but show wider variation of the between-laboratory reproducibility V_R.

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