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Textile glass — Chopped-strand and continuous-filament mats — Determination of average thickness, thickness under load and recovery after compression

Verre textile — Mats à fils coupés et mats à fils continus — Détermination de l'épaisseur moyenne, de l'épaisseur sous charge et de la recouvrance après compression

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Foreword

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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).

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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.

This document 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 3616:2001), which has been technically revised. It also incorporates the Amendment ISO 3616:2001/Amd. 1:2017.

The main changes are as follows:

— an “Introduction” has been added;

— the sampling method (former Clause 6) has been deleted and subsequent clauses have been renumbered;

— the duration for conditioning test specimens has been changed to from at least 16 h to at least 2 h.

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.

Introduction

Chopped-strand and continuous-filament mats are mainly used as reinforcement materials for polymer matrix composites. The average thickness, thickness under load and recovery after compression of the mat are the most basic parameters provided for the composites process design and the final product structure and size design.

Textile glass — Chopped-strand and continuous-filament mats — Determination of average thickness, thickness under load and recovery after compression

1 Scope

This document specifies a method for the determination of the average thickness, the thickness under load and the recovery after compression of chopped-strand and continuous-filament textile-glass mats.

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 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 3374, *Reinforcement products — Mats and fabrics — Determination of mass per unit area*

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 https://www.electropedia.org/

3.1
average thickness
thickness of a mat, in millimetres, measured in accordance with the specified method, under a specified nominal light pressure

Note 1 to entry: The average thickness determined by this method does not necessarily bear a direct relation to the thickness of a single layer. The regularity of thickness of a mat must be measured on a single layer and with apparatus with a much smaller contact area than that specified in this document.

3.2
thickness under load
thickness of a mat, measured in accordance with the specified method, under a specified heavy pressure applied for a specified time, expressed as a percentage of the initial *average thickness* (3.1)

3.3
recovery after compression
thickness to which the mat recovers after a specified interval following removal of the specified heavy pressure, expressed as a percentage of the initial *average thickness* (3.1)

4 Principle

The distance between the outer surfaces of a pile of superimposed layers of mats, having a total thickness of at least 5 mm, is measured under a specified light pressure. The average thickness is calculated by dividing the value obtained by the number of layers in the pile.

The distance between the outer surfaces of the pile is measured both during the application of a specified high pressure and again after a specified interval following removal of the pressure. The thickness under pressure and the recovery after compression, respectively, are calculated by dividing the two values obtained by the number of layers in the pile and expressing the results as a percentage of the average thickness.

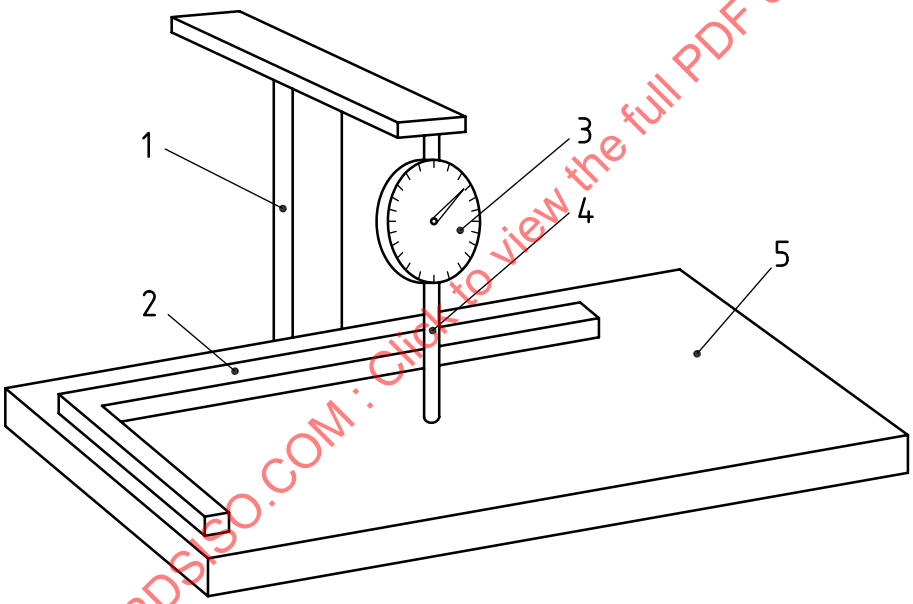
5 Apparatus

5.1 Sharp knife.

5.2 Template for cutting out test samples, of dimensions 316 mm × 316 mm or 400 mm × 250 mm (see Clause 7).

5.3 Template for cutting out test specimens, of dimensions 158 mm × 158 mm or 200 mm × 125 mm (see Clause 7).

5.4 Stand, having a plane base-plate for supporting the test specimens and a suitable support for a dial-gauge micrometer (see Figure 1).



Key

1 support for dial-gauge micrometer
2 positioning jig
3 dial-gauge micrometer
4 micrometer stem
5 base-plate

Figure 1 — Example of stand for test specimens and dial-gauge micrometer

5.5 Dial micrometer thickness gauge, readable to 0,01 mm and with a stem of length at least 70 mm.

5.6 Positioning jig, to ensure that the test specimens and steel plates A and B (see 5.7 and 5.8) are placed with their centres directly under the foot of the micrometer, and of such thickness that plate B rests on the mats (and not on the jig).

5.7 Polished steel plate, plate A (see Figure 2), of dimensions 158 mm × 158 mm × 1,3 mm (plate A_1) or 200 mm × 125 mm × 1,3 mm (plate A_2), having a mass of about 255 g and exerting a pressure of 100 Pa on the test specimens). Other dimensions or details of construction may be varied as long as it conforms to the values given for area and pressure.

The surfaces of the plate shall be plane and parallel.

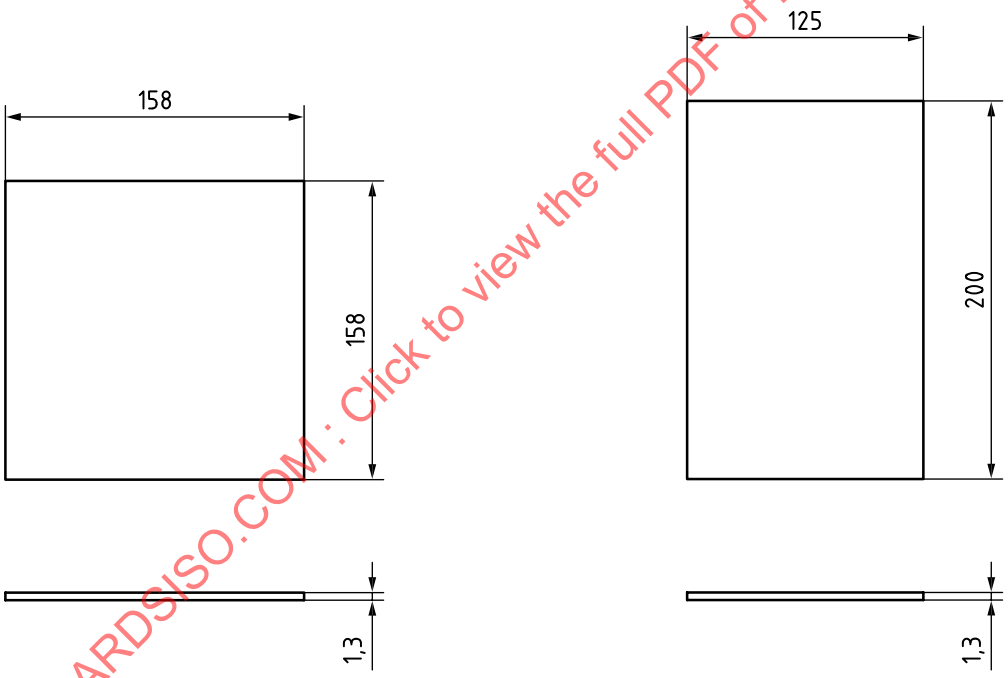
A hydraulic system may be used in place of the plate provided that the same pressure is produced.

5.8 Polished steel plate, plate B (see Figure 3), of dimensions either 158 mm × 158 mm × 65,5 mm (plate B_1) or 200 mm × 125 mm × 65,5 mm (plate B_2), having a mass of about 12,25 kg and exerting a pressure of 5 kPa on the test specimens when used together with plate A. Plate B has a cut-out as shown in Figure 3. Other dimensions or details of construction may be varied as long as it conforms to the values given for area and pressure.

The surfaces of the plate shall be plane and parallel.

A hydraulic system may be used in place of the plate provided that the same pressure is produced.

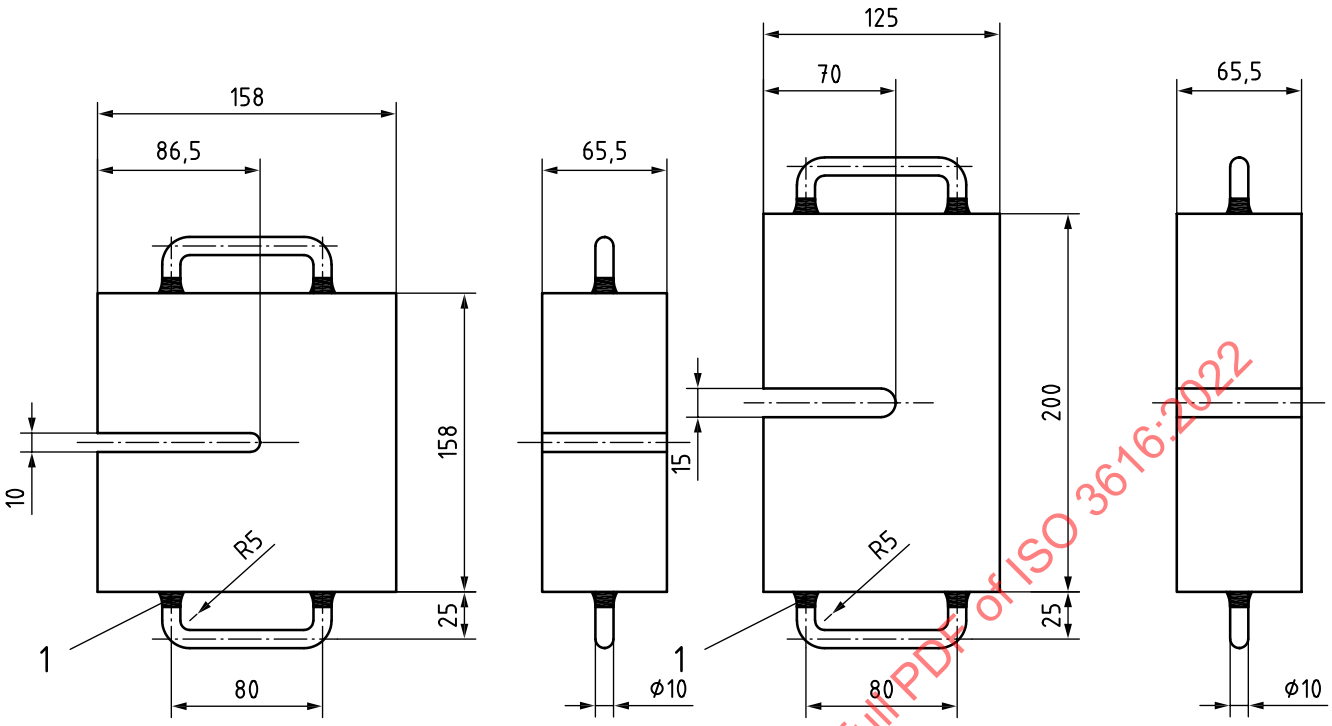
Dimensions in millimetres



a) Plate A_1 **b) Plate A_2**

Figure 2 — Light mild-steel plate (density of steel 7,84 Mg/m^3) for determination of average thickness

Dimensions in millimetres



a) Plate B_1 **b) Plate B_2**

Key

1 weld

Figure 3 — Examples of heavy mild-steel plate (density of steel 7,84 Mg/m^3) for determination of thickness under load and recovery after compression

6 Preparation of test specimens

Using the template (5.2) and sharp knife (5.1), cut out three test samples, evenly distributed across the mat, of dimensions 316 mm × 316 mm or 400 mm × 250 mm, following the procedure specified in ISO 3374.

Using the template (5.3) and sharp knife, cut each test sample into four test specimens of dimensions 158 mm × 158 mm or 200 mm × 125 mm.

7 Conditioning of test specimens

Condition the test specimens for at least 2 h in one of the standard atmospheres specified in ISO 291.

The atmosphere during the test shall be the same as that used for conditioning.

8 Procedure

8.1 Place steel plate A (5.7) on the base-plate of the stand (5.4), under the foot of the dial-gauge micrometer (5.5). Ensure that the axis of the micrometer foot is perpendicular to plate A.

8.2 Record the dial-gauge reading, h_1, in millimetres, to the nearest 0,1 mm.

8.3 Remove plate A.

8.4 Place four test specimens, cut from the same test sample, one above the other on the base-plate and with two adjacent sides contacting the positioning jig (5.6).

8.5 Cover them with plate A, aligning this too in the positioning jig.

8.6 With the micrometer foot resting on plate A, record the dial-gauge reading, h_2, in millimetres, to the nearest 0,1 mm.

8.7 If $h_2 - h_1$ is less than 5 mm, cut out a further test sample and add the four new test specimens to the pile on the base-plate. Repeat steps 8.5 and 8.6 to obtain a new value for h_2 (to be used in the calculation).

8.8 Place steel plate B (5.8) on top of plate A, aligning it with the positioning jig.

8.9 Allow 10 s to elapse and then, with the micrometer foot passing through the cut-out in plate B and resting on plate A, record the new dial gauge reading, h_3, in millimetres, to the nearest 0,1 mm.

8.10 Immediately after taking the reading, remove plate B.

8.11 Allow 20 s to elapse and then, with the micrometer foot resting on plate A, record the new dial-gauge reading, h_4, in millimetres, to the nearest 0,1 mm.

8.12 Repeat steps 8.4 to 8.11 twice using new test specimens.

9 Calculation and expression of results

9.1 Average thickness

The average thickness, in millimetres, is given by Formula (1):

$$\frac{h_2 - h_1}{n} \tag{1}$$

where

h_1 is the dial-gauge reading, in millimetres, with the micrometer foot resting on plate A only;

h_2 is the dial-gauge reading, in millimetres, with the micrometer foot resting on plate A, with the test specimens in position;

n is the number of the test specimens in the pile (4 or a multiple of 4).

Express the result to three significant figures.