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Textile glass reinforced plastics — Determination of apparent interlaminar shear properties by short-beam test

*Plastiques renforcés de fibres de verre textile — Détermination des caractéristiques
de cisaillement interlaminaire apparent par essai de flexion sur appuis rapprochés*

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Reference number
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Foreword

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International Standard ISO 4585 was prepared by Technical Committee ISO/TC 61, *Plastics*.

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Textile glass reinforced plastics — Determination of apparent interlaminar shear properties by short-beam test

1 Scope

This International Standard specifies a method for determining the apparent interlaminar resistance in shear of laminates made from textile glass fibres.

This method of test is especially intended for those textile glass fibre reinforced plastics in which the reinforced layers are superimposed on each other. The method can provide information on the behaviour of the bonding at the fibre/resin interface.

The method is not suitable for the determination of design parameters, but may be used for screening materials, or as a quality-control tool.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 291 : 1977, *Plastics — Standard atmospheres for conditioning and testing*.

ISO 1268 : 1978, *Plastics — Preparation of glass fibre reinforced, resin bonded, low-pressure laminated plates or panels for test purposes*.

ISO 5893 : 1985, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Description*.

3 Definition

For the purposes of this International Standard, the following definition applies.

apparent interlaminar shear strength: The shear stress experienced by a laminate during a shear test at the moment of

failure, or when the load reaches a maximum value. The result, determined by dividing the maximum force by the cross-sectional area of the test specimen, is expressed in megapascals.

4 Principle

A bar of rectangular cross-section is tested in interlaminar shear as a simple beam, the bar resting on two supports and the load being applied by means of a loading edge midway between the supports.

5 Apparatus

Test machine, which can be operated at a crosshead speed constant to within $\pm 5\%$ and in which the error in the recorded load does not exceed $\pm 1\%$ (see ISO 5893).

The speed v of the loading edge shall be

$$v = 1 \text{ mm/min} \pm 0,2 \text{ mm/min}$$

The radii of the loading edge r_1 and the supports r_2 (see figure 1) shall be

$$3 \text{ mm} \pm 0,1 \text{ mm} \leq r_1 \leq 5 \text{ mm} \pm 0,1 \text{ mm}$$

$$2 \text{ mm} \pm 0,2 \text{ mm} \leq r_2 \leq 3 \text{ mm} \pm 0,2 \text{ mm}$$

The span L between the supports shall be adjustable.

The angle of inclination α of the upper surface of the supports shall be $5^\circ \pm 1^\circ$.

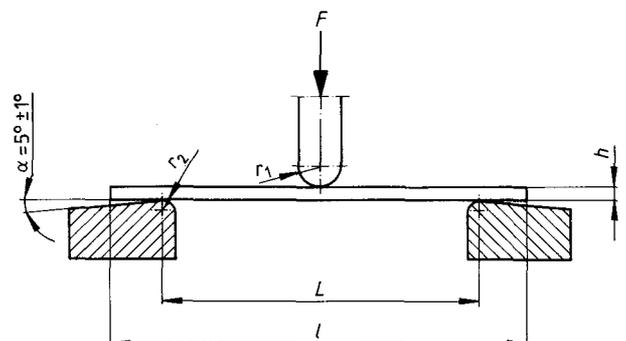


Figure 1 — Test device

6 Test specimens

Bars of rectangular cross-section shall be prepared in accordance with ISO 1268.

The standard dimensions (see figure 2), in millimetres, shall be as follows:

$$\text{length } l = 18 \pm 0,5$$

$$\text{width } b = 10 \pm 0,2$$

$$\text{height } h = 3 \pm 0,2$$

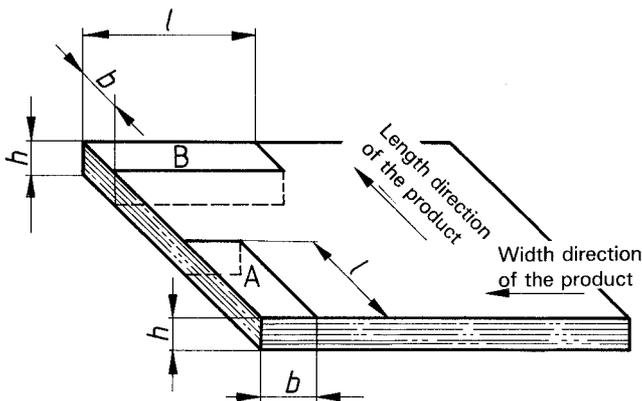


Figure 2 — Locations and dimensions of test specimens

When, for any reason, it is not possible or desirable to use standard specimens, the following rules shall be observed:

The length and the height of the test specimen shall be in the same ratio as in the standard specimen, i.e.

$$l = 6 h$$

The width shall be chosen in the same ratio to the height as in the standard specimen, i.e.

$$b = 3,3 h$$

The apparent shear strength will vary with the height of the specimen. For comparative purposes, specimens of the same height shall always be used. Depending upon the material being tested, specimens of 3 mm height may fail in shear or experience compression failure under load, or exhibit extreme deflection without shear failure. As specimen height is increased, the probability of compression failure under load increases and the probability of extreme deflection with no failure decreases. As specimen height is decreased, the reverse is true. It is important to select a specimen height which will cause specimens to fail in horizontal shear [see 9.2a)].

7 Number of test specimens

7.1 At least five test specimens shall be tested.

7.2 When the fibre orientation and distribution in the material to be tested does not differ significantly between the two principal directions, shear specimens shall be taken in each of these two directions (see figure 2, specimens A and B).

When the material has a preferred orientation, the specimens shall be taken in this direction.

8 Conditioning

The test specimens shall be conditioned in one of the standard atmospheres defined in ISO 291 for a minimum of 16 h.

9 Procedure

9.1 Carry out the test at $23 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ and $50 \% \pm 5 \%$ relative humidity. Measure the dimensions b and h (see figure 2) to the nearest 0,05 mm and adjust the span L (see figure 1) to $5 h \pm 0,3$ mm. Load the specimen, without bumping, as a simple beam at midspan (see figure 1). Move the loading edge downwards with a velocity v of $1 \text{ mm/min} \pm 0,2 \text{ mm/min}$. Record the maximum load.

There are two possible cases:

a) If a test specimen fails in horizontal shear approximately at the neutral axis [see figures 3a) and 3b)], calculate the apparent interlaminar shear strength in accordance with the formula given in clause 10.

b) If a test specimen fails in flexure, i.e. tension or compression failure of the outer surface [see figure 3c)], the results calculated using the formula given in clause 10 are not true shear strengths. In this case, the results may only be used to compare test specimens taken from the same material.

NOTE — Translucent materials will turn an off-white colour.

9.2 Modes of failure

The various possible failure modes are classified as follows (see figure 3):

- a) shear modes of failure [figure 3a):
 - single shear, multiple shear;
- b) mixed modes of failure [figure 3b):
 - shear and tension, shear and compression;
- c) non-shear modes of failure [figure 3c):
 - tension, compression.

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