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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

Reference number
ISO 4585 : 1989 (E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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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 ± 5 % and in which the error in the recorded load does not exceed ± 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

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

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

The span L between the supports shall be adjustable.

The angle of inclination α of the upper surface of the supports shall be 5° ± 1°.

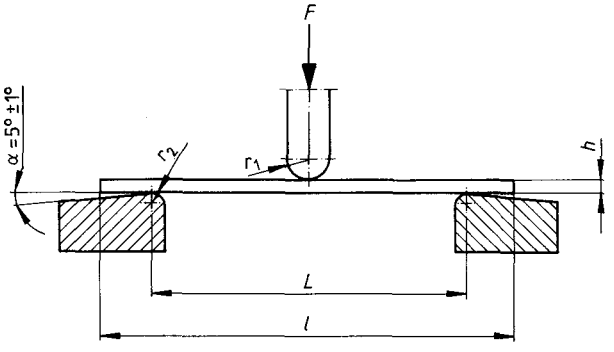

Figure 1 — Test device

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:

length $l = 18 \pm 0,5$

width $b = 10 \pm 0,2$

height $h = 3 \pm 0,2$

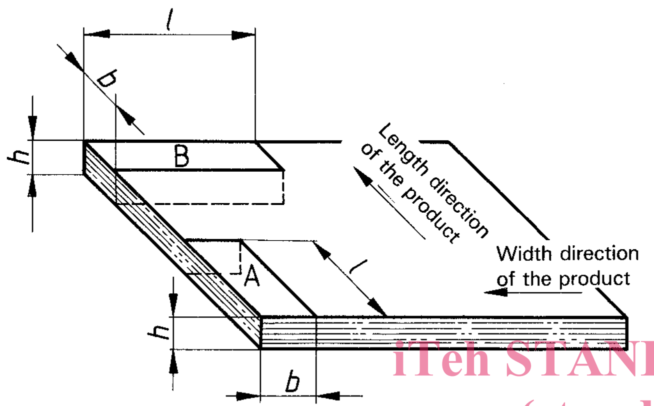

Figure 2 — Locations and dimensions of test specimens

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 °C ± 2 °C and 50 % ± 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 mm/min ± 0,2 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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Descriptors: reinforced plastics, glass reinforced plastics, textile glass, laminated, tests, shear tests.

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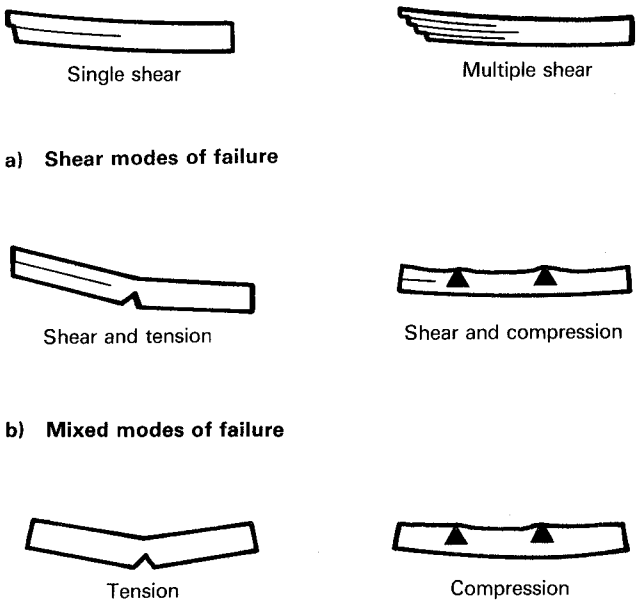

Figure 3 — Modes of failure

10 Expression of results

Calculate the apparent shear strength τ, expressed in megapascals, as follows [see 9.1 b)]:

$$\tau = \frac{3}{4} \times \frac{F}{bh}$$

where

F is the maximum load, in newtons;

b is the width of the test specimen, in millimetres;

h is the height of the test specimen, in millimetres.

11 Precision

The precision of this test method is not known because inter-laboratory data are not available. This method may not be suitable for use in specifications or in case of disputed results as long as these data are not available.

12 Test report

The test report shall include the following particulars:

a) a reference to this International Standard;

b) a complete identification of the material tested;

c) all pertinent information on the preparation of the test specimens, including information on the direction of cutting (specimen A or B in figure 2);

d) the dimensions of the specimens and the span used;

e) the radii of the loading edge and the supports;

f) the conditioning time, temperature and relative humidity, if different from those specified in this International Standard;

g) for test specimens which have broken in shear [see 9.2 — figure 3a)], the mode of failure (single or multiple shear), plus the individual shear strength values, their arithmetic mean and the standard deviation;

h) for test specimens which have not broken in shear [see 9.2 — figures 3b) and 3c)], a full description of the mode of failure together with the statement that the calculated values are not true shear strengths, plus the individual values, their arithmetic mean and the standard deviation;

i) any operation not specified in this International Standard, as well as any incident likely to have affected the results.