

INTERNATIONAL  
STANDARD

**ISO**  
**3597-4**

First edition  
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**Textile-glass-reinforced plastics —  
Determination of mechanical properties on  
rods made of roving-reinforced resin —**

**Part 4:**

Determination of apparent interlaminar shear  
strength

*Plastiques renforcés verre textile — Détermination des propriétés  
mécaniques sur joncs de stratifils —*

*Partie 4: Détermination de la résistance en cisaillement interlaminaire  
apparent*



Reference number  
ISO 3597-4:1993(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 voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 3597-4 was prepared by Technical Committee ISO/TC 61, *Plastics*, Sub-Committee SC 13, *Composites and reinforcement fibres*.

This first edition, together with the other parts of ISO 3597, cancels and replaces ISO 3597:1977, which has been technically revised.

ISO 3597 consists of the following parts, under the general title *Textile-glass-reinforced plastics — Determination of mechanical properties on rods made of roving-reinforced resin*:

- Part 1: *General considerations and preparation of rods*
- Part 2: *Determination of flexural strength*
- Part 3: *Determination of compressive strength*
- Part 4: *Determination of apparent interlaminar shear strength*

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# Textile-glass-reinforced plastics — Determination of mechanical properties on rods made of roving-reinforced resin —

## Part 4:

### Determination of apparent interlaminar shear strength

#### 1 Scope

This part of ISO 3597 specifies a test method for determining the apparent interlaminar shear strength of composite rods of circular cross-section made of roving-reinforced resin.

This test may be carried out on as-made rods or on rods that have been pretreated by immersion in boiling water for a specified time.

This test is intended for inspection and quality control of rovings. The results obtained are not intended for the generation of design data.

#### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 3597. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 3597 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 178:1993, *Plastics — Determination of flexural properties*.

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

ISO 1172:1975, *Textile glass reinforced plastics — Determination of loss on ignition*.

ISO 3597-1:1993, *Textile-glass-reinforced plastics — Determination of mechanical properties on rods made of roving-reinforced resin — Part 1: General considerations and preparation of rods*.

#### 3 Apparatus

**3.1 Flexural testing apparatus**, as specified in ISO 178, but having the following additional characteristics.

- a) The load applicator and supports shall be steel rods waisted in the middle to ensure specimen alignment. An example, suitable for a test specimen 4 mm in diameter, is shown in figure 1.

For other specimen diameters (normally within the range of 4 mm to 6 mm), the radius of the notch (dimension *A* in figure 1) in both supports and load applicator shall be equal to the radius of the test specimen so as to assure contact on half the circumference of the test specimen.

- b) The span shall be 5 times the diameter of the test rod.

#### 3.2 Micrometer.

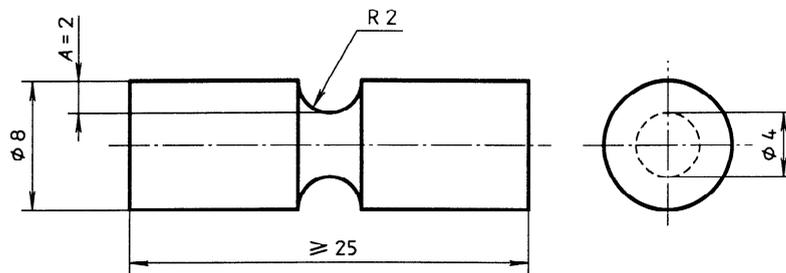


Figure 1 — Example of supports and load applicator for testing rods 4 mm in diameter

#### 4 Preparation and conditioning of the test specimens

Prepare a given number of rods in accordance with the method given in ISO 3597-1. For each rod test condition (as-made or pretreated), the required number of specimens is 10. The required specimen length is 8 times its diameter, e.g. 32 mm ± 1 mm for a rod 4 mm in diameter.

It is necessary to distribute the specimens cut from each rod so as to enable a loss on ignition test to be run on two specimens from each rod in addition to the interlaminar shear test. If this shear test is also required after pretreatment, the distribution of specimens obtained on each rod is to be balanced for the two test conditions (see for example ISO 3597-3:1993, figure 3).

For the as-made test (no pretreatment), the specimens are conditioned for 24 h in accordance with ISO 291. The specimens which have been pretreated in boiling water shall be tested for shear strength within 6 h after pretreatment.

#### 5 Test procedure

**5.1** On each rod, using two specimens tested together, verify in accordance with ISO 1172 that the glass content is within 65 % (m/m) ± 3 % (m/m). If the glass content for each rod is not between 62 % (m/m) and 68 % (m/m), prepare new rods for testing.

**5.2** Before carrying out the interlaminar shear test, with the micrometer (3.2) measure, to the nearest 0,01 mm, the diameter at two points located 90° apart around the rod circumference at the centre of each test specimen. Use the average of these measurements in the calculation of results.

**5.3** Conduct the interlaminar shear test in the same standard laboratory atmosphere as used for conditioning the specimens (see ISO 291). The standard speed of the load applicator is

1 mm/min ± 0,2 mm/min. Record the force at which the specimen fails.

#### 6 Expression of results

For each test specimen, the apparent interlaminar shear strength  $\zeta$ , expressed in megapascals, is given by the equation

$$\zeta = \frac{8F}{3\pi d^2}$$

where

- $F$  is the yield force, in newtons;
- $d$  is the diameter, in millimetres, of the test rod.

For each set of test conditions (as-made or pretreated), calculate the average of the results obtained on the 10 specimens, discarding those results which do not fall within 50 % of this average. Report the resulting value as the apparent interlaminar shear strength of the material under those conditions.

If less than five results are available for this calculation, a further set of test specimens shall be prepared and tested, exercising more precise control in order to reduce the range of results obtained. If this second set results in similar difficulties, record this situation in the test report.

#### 7 Precision of the method

The precision of this test method is not known because interlaboratory data are not available. When such data are obtained, a precision statement will be added at the next revision of this part of ISO 3597.

#### 8 Test report

The test report shall include the following information:

- a) reference to this part of ISO 3597;
- b) all information necessary for complete identification of the roving tested;

- c) all information necessary for complete identification of the type of resin used;
- d) curing and postcuring conditions;
- e) test atmosphere;
- f) diameter and length of specimens;
- g) glass content of each rod;
- h) apparent interlaminar shear strength of as-made rods: individual values, including any discarded results, and average value;
- i) if testing was also required after pretreatment:
  - type of water used,
  - duration of boiling water pretreatment,
  - apparent interlaminar shear strength after pretreatment: individual results, including any discarded results, and average value.

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