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# INTERNATIONAL STANDARD



# 3597

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## Textile glass reinforced plastics — Composites in the form of rods made from textile glass rovings — Determination of flexural (cross-breaking) strength

*Plastiques renforcés au verre textile — Composites sous forme de joncs à base de stratifils — Détermination de la résistance à la flexion*

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## FOREWORD

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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.

International Standard ISO 3597 was developed by Technical Committee ISO/TC 61, *Plastics*, and was circulated to the member bodies in November 1974.

It has been approved by the member bodies of the following countries :

Austria	India	Portugal
Belgium	Iran	Romania
Brazil	Ireland	South Africa, Rep. of
Canada	Israel	Sweden
Chile	Italy	Switzerland
Czechoslovakia	Japan	Turkey
Finland	Netherlands	United Kingdom
Germany	New Zealand	U.S.A.
Hungary	Poland	Yugoslavia

No member body expressed disapproval of the document.

# Textile glass reinforced plastics – Composites in the form of rods made from textile glass rovings – Determination of flexural (cross-breaking) strength

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for determining, by a three-point loading technique, the flexural (cross-breaking) strength of composites in the form of rods of circular cross-section made from textile glass rovings impregnated with resin.

## 2 REFERENCES

ISO 178, *Plastics – Determination of flexural properties of rigid plastics.*

ISO 291, *Plastics – Standard atmospheres for conditioning and testing.*<sup>1)</sup>

ISO 1172, *Textile glass reinforced plastics – Determination of the loss on ignition.*

## 3 APPARATUS AND MATERIAL

**3.1 Mould**, in the form of a straight rigid cylinder having a minimum length of 400 mm and a standard internal diameter of  $6 \pm 0,1$  mm; if other diameters are chosen, these shall be selected upon agreement between the interested parties from the range of 4 to 10 mm (with tolerances of  $\pm 0,1$  mm). The mould may be constructed of glass, polytetrafluorethylene, or any other suitable material.

### 3.2 Resin

Not all resin systems are necessarily suitable and the system to be used shall be at the discretion of the roving supplier. In the event of dispute, the system used shall be declared and shall form the basis for the test, subject to an

agreement between the interested parties. The selected resin system shall be mixed in accordance with the resin manufacturer's detailed instructions.

**3.3 Suitable wire**, for pulling the roving through the mould (3.1).

**3.4 Oven with air circulation**, for curing and/or postcuring the resin at the recommended temperature.

**3.5 Flexural test apparatus**, as specified in ISO 178, but with the following additional characteristics :

- the loading nose and supports shall be steel rods waisted in the middle to ensure specimen alignment. An example for a 6 mm diameter test specimen is shown in figure 1;
- the span shall be 16 times the chosen rod diameter.

Dimensions in millimetres

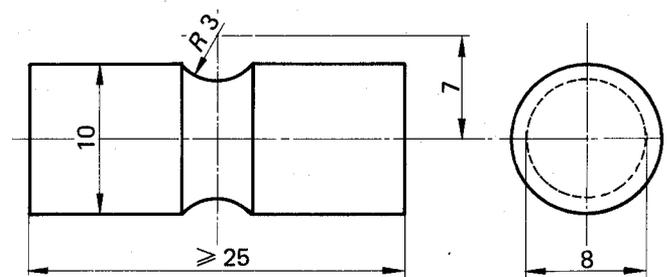


FIGURE 1 – Example of supports and loading nose for testing textile glass fibre reinforced plastic rods of 6 mm diameter

1) At present at the stage of draft. (Revision of ISO/R 291.)

**4 CONDITIONING AND TESTING ATMOSPHERES**

The hank of rovings shall be conditioned for at least 16 h in one of the standard laboratory atmospheres defined in ISO 291.

The test shall be carried out in the same atmosphere as has been used for conditioning.

**5 PROCEDURE**

**5.1 Preparation of the rovings**

Take a parallel assembly of rovings, 1 m long and of the correct mass (approximately 15 g) to give a glass content in the moulded rod of  $62 \pm 3\%$  (*m/m*).

**5.2 Preparation of reinforced rods**

Fold the roving assembly about its midpoint and secure the hank at this point to a length of the wire (3.3). Condition for at least 16 h in one of the standard laboratory atmospheres defined in ISO 291. Take care to minimize contamination of the roving during handling.

Impregnate the hank by immersion in a trough containing the catalysed resin (3.2) or by any other suitable means. When the hank is completely impregnated, draw it vertically into the mould (3.1) by means of the wire. Draw the lower end of the hank a few millimetres into the mould and seal the opening of the mould with a plastic or cork stopper to prevent run-out of resin.

Prepare six rods in this way.

**5.3 Curing of the rods**

Cure the rods in a vertical position, while still in the mould, in the oven (3.4). Curing and post-curing conditions shall be in accordance with the resin system used. The curing conditions shall be mentioned in the test report.

**5.4 Preparation and conditioning of test specimens**

5.4.1 Cut three test specimens, of length  $150 \pm 1$  mm for 6 mm diameter rods, from each of the six rods by means of a water-cooled diamond-tipped saw. The length to be cut from rods having a diameter between 4 and 10 mm shall be in agreement with 3.5 b). Form three sets (A, B and C) of six test specimens. Each set of six specimens shall contain one from each rod. The sets shall be selected as shown in figure 2.

NOTE — The end faces of the rods shall be left untreated.

5.4.2 Condition the test specimens for at least 16 h in one of the standard laboratory atmospheres defined in ISO 291.

Keep one set (A) of test specimens for testing in the dry state.

Submit the second set (B) of test specimens to boiling in distilled water for at least 2 h for polyester rods and for at least 16 h for epoxy rods; after cooling in water to room temperature, these rods shall be tested wet within 6 h.

Keep the third set (C) for the determination of the glass content as specified in ISO 1172.

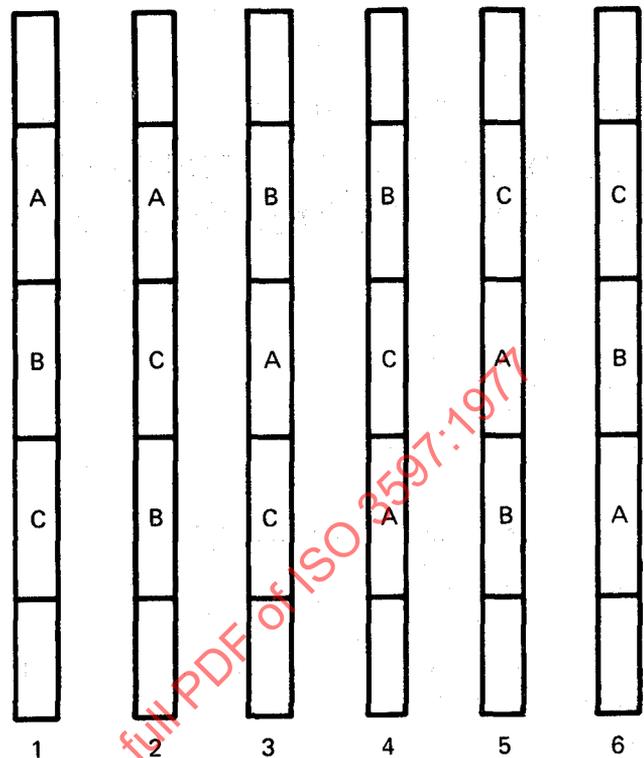


FIGURE 2 — Selection of sets of test specimens from rods made from rovings

**5.5 Determination of flexural strength**

5.5.1 Subject the test specimens of set (C) to an ignition test in accordance with ISO 1172 to verify that the glass content is  $62 \pm 3\%$  (*m/m*). If the glass content is outside the permitted tolerance, prepare new rods for testing.

5.5.2 Before carrying out the flexural strength test, measure two perpendicular diameters to the nearest 0,01 mm at the centre of each test specimen. Use the average of these measurements in the calculation.

5.5.3 Carry out the flexural strength test on the test specimens of sets A and B in accordance with ISO 178 modified as given in 3.5, in the same standard laboratory atmosphere as used for conditioning.

**6 EXPRESSION OF RESULTS**

For each test specimen, the strength  $\sigma_f$  is given, in megapascals, by the formula

$$\sigma_f = \frac{8FK}{\pi d^3}$$

where

*F* is the breaking force, in newtons;

*K* is the span, in millimetres;

*d* is the diameter, in millimetres.

For each set of test conditions ("dry" or "after boiling"), calculate the average of six results and report it as the flexural strength.

## 7 TEST REPORT

The test report shall include the following particulars :

- a) reference to this International Standard;
- b) complete identification of the roving tested;
- c) complete identification of the type of resin used;
- d) curing and postcuring conditions;
- e) testing atmosphere;
- f) flexural strength of the material in the dry state, and individual results;
- g) type of water, if different from that specified;
- h) time of immersion in boiling water;
- i) chosen diameter of the tested rods, if different from the standard (6 mm);
- j) length of the test specimens, if different from the standard (150 mm);
- k) flexural strength of the material after boiling, and individual results;
- l) glass content of each rod.

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