
Aerospace series - Glass fibre reinforced plastics - Test method - Determination of apparent interlaminar shear strength

Aerospace series - Glass fibre reinforced plastics - Test method - Determination of apparent interlaminar shear strength

Luft- und Raumfahrt - Glasfaserverstärkte Kunststoffe - Prüfverfahren zur Bestimmung der scheinbaren interlaminaren Scherfestigkeit

Série aérospatiale - Plastiques renforcés de fibres de verre - Méthode d'essai - Détermination des propriétés en cisaillement apparent interlaminaire

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English version

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This European Standard was accepted by CEN on 1988-03-17. CEN members are bound to comply with the requirements of CEN Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to CEN Central Secretariat has the same status as the official versions.

CEN members are the national standards organizations of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat : Rue Bréderode 2, B—1000 Bruxelles

Brief History

This draft European Standard has been prepared by the European Association of Aerospace Manufacturers (AECMA).

After enquiries and votes carried out in accordance with the rules of this Association, this draft has successively received the approval of the National Associations and the Official Services of the member countries of AECMA, prior to its presentation to CEN.

In accordance with the Common CEN/CENELEC Rules, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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1 Scope and field of application

This standard defines a method for the determination of the apparent interlaminar shear strength by delamination of textile glass fibre reinforced plastics produced in sheet form for aerospace use.

2 References

- EN 62 Glass reinforced plastics - Standard atmospheres for conditioning and testing
- EN 2374 Aerospace series - Glass fibre reinforced mouldings and sandwich composites - Production of test panels

3 Definition

The apparent interlaminar shear strength is the maximum interlaminar shear stress at the moment of first failure. It is expressed in MPa.

4 Principle of the method

For the determination of the resistance in interlaminar shear parallel to the layers of reinforcement, a specimen of rectangular cross section is tested in flexion. The specimen resting on two supports and the force applied by means of a loading nose midway between the supports.

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5 Test specimens

The test specimens are prepared according to EN 2374.

5.1 Dimensions

5.1.1 Standard specimens

Length l : ($20 \pm 0,5$) mm

Width b : ($10 \pm 0,2$) mm

Thickness h : ($3 \pm 0,2$) mm

5.1.2 Alternative specimens

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

a) The length and the thickness of the test specimen shall be in the same ratio as in the standard specimen :

$$l = 6,7 h \pm 0,5 \text{ mm}$$

b) The width and the thickness of the test specimen shall be in the same ratio as in the standard specimen :

$$b = 3,3 h \pm 0,2 \text{ mm.}$$

Warning : If the thickness of the test specimen is greater than 3 mm excessive compressive stresses may occur under the loading nose.

5.2 Position of specimens

See figure 1.

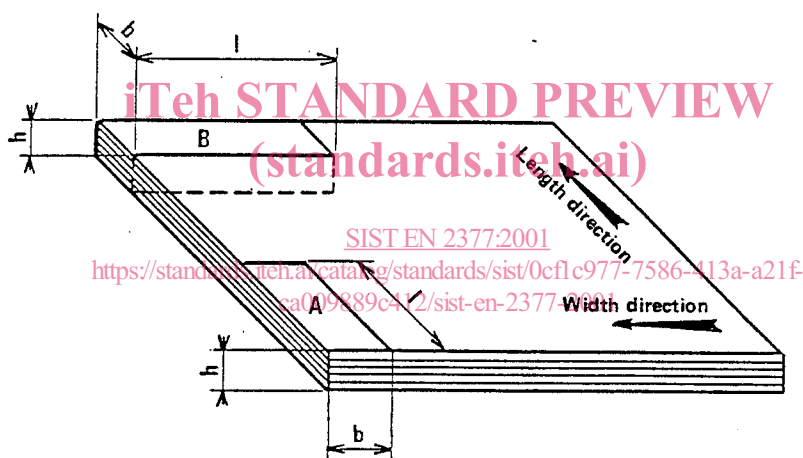


Figure 1

5.3 Number of test specimens

5.3.1 The number of test specimens shall be a minimum of 5 from each direction.

5.3.2 When the material shows a significant difference in shear properties in two principal directions, it is to be tested in these two directions (see figure 1, specimen A and B).

When the fibres are oriented unidirectionally, the test shall be carried out in that direction only.

6 Apparatus

Calibrated standard testing machine, which can be operated at a constant rate of the loading nose and in which the accuracy of measurement shall be within $\pm 1\%$.

The loading nose and supports shall be made from steel having a tensile strength ≥ 1000 MPa.

The span shall be adjustable.

7 Conditioning

The standard atmosphere shall be in accordance with EN 62.

The test specimens shall be conditioned at $(23 \pm 2)^\circ\text{C}$ and $(50 \pm 5)\%$ relative humidity during at least 16 h.

8 Procedure

Unless otherwise specified, carry out the test at $(23 \pm 2)^\circ\text{C}$ and $(50 \pm 5)\%$ relative humidity.

Measure the dimensions of b and h to the nearest 0,05 mm, respectively and adjust the span to $l_V = 5 h \pm 0,1$ mm.

Load the specimen without bumping with a rate of the loading nose of $V = (1 \pm 0,1)$ mm/min (see figure 2).

The load shall be taken as a function of time or displacement of the loading nose.

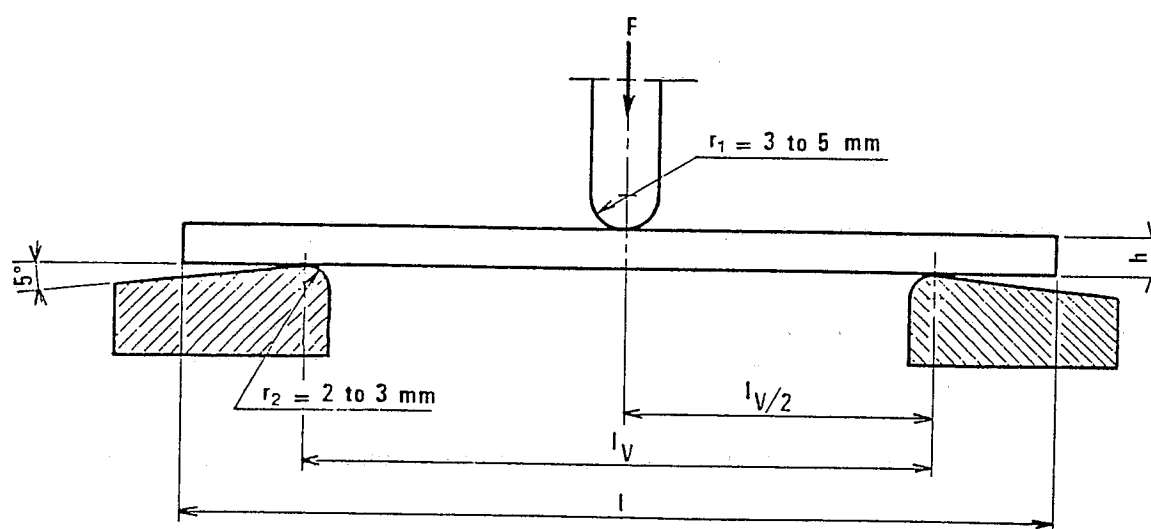


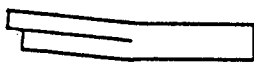
Figure 2 - Testing device

9 Test results

9.1 If the specimens fail in horizontal shear approximately at the neutral fibre axis (see figure 3.a), the true interlaminar shear stress shall be calculated in accordance with the formula in clause 10.

9.2 If test specimens fail in flexural i.e. tension or compression failure of the outer surface (see figure 3.b), the results calculated by the formula in clause 10 are not true shear stresses.

These results shall only be used for a comparison of test series of a same material (i.e. batch control).



Single shear



Multiple shear



Shear and Tension

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Figure 3.a - Shear modes of failure

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NOTE - In the case of translucent materials an off-white colour becomes evident.

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Tension



Compression

Figure 3.b - Non-shear modes of failure