SLOVENSKI STANDARD
SIST EN 2562:2001

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Aerospace series - Carbon fibre reinforced plastics - Unidirectional laminates - Flexural test parallel to the fibre direction

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Luft- und Raumfahrt - Kohlenstoffaserverstärkte Kunststoffe - Unidirektionale Laminate - Biegeprüfung parallel zur Faserrichtung

Série aérospatiale - Plastiques renforcés de fibres de carbone - Stratifiés unidirectionnels - Essais de flexion parallele a la direction des fibres

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English version

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CEN

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

Central Secretariat: rue de Stassart,36 B-1050 Brussels

Foreword

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

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

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 1997, and conflicting national standards shall be withdrawn at the latest by September 1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard specifies the method for the determination of the flexural strength and flexural modulus of carbon fibre reinforced plastics in the form of unidirectional laminates by a flexural test.

This method is only applicable to specimens where the length is parallel to the direction of the fibres.

NOTE : The elastic modulus measured by this method can only be considered as an approximate value for YOUNG's modulus.

2 Normative references

This European Standard incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 2489 Aerospace series - Fibre reinforced plastics - Determination of the action of test fluids

EN 2565 Aerospace series - Preparation of carbon fibre reinforced resin panels for test purposes 1)

EN 2743 Aerospace series - Reinforced plastics - Standard procedures for conditioning prior to testing 1)

EN 2744 Aerospace series - Non-metallic materials - Preferred test temperatures

EN 2823 Aerospace series - Fibre reinforced plastics - Test method for the determination of the effect of exposure to humid atmosphere on physical and mechanical charasteristics 1)

3 Definitions

For the purposes of this standard, the following definitions apply :

3.1 **Deflection** (*f*) : The distance travelled during the test by a point on the upper or lower face of the specimen at the centre of its span measured from its initial position.

3.2 **Flexural stress** : The stress at the surface of the material in the middle of the span of the specimen between the supports at any time during the test.

1) Published as AECMA Prestandard at the date of publication of this standard

3.3 **Flexural strength** (σ_b) : The flexural stress at the time failure occurs.

3.4 **Flexural modulus between $P_R/10$ and $P_R/2$ (E_b) :**

When the stress/strain diagram is derived from the load/deflection recording, the secant modulus is defined as the slope of the straight line passing through :

- the point of the diagram corresponding to a stress calculated from $P_R/2$;
- the point on the same diagram corresponding to a stress calculated from $P_R/10$.

P_R is the load at failure of the specimen.

The calculated stresses and strains are those present at the surface of the specimen and parallel to its axis.

4 Principle

The method consists of the measurement of the deflection at the central loading nose as a function of the applied load during a flexural test on three supports carried out at constant rate of displacement until failure occurs. The strain parallel to the fibre direction is calculated as a function of the applied stress.

5 Apparatus

5.1 Micrometer with 6 mm diameter flat faces and accurate to 0,01 mm

5.2 Testing machine, accurate to within 1 % in the load range used

5.3 Device for recording the deflection as a function of load, accurate to 1 % in the deflection range used

5.4 If necessary, heated cabinet, regulated so as to conform to EN 2744 for tests at temperatures other than ambient.

5.5 Thermocouple and recorder for tests at temperatures other than ambient.

5.6 Test fixture

See figure 1 and table 1.

It shall ensure accurate positioning of the specimen.

Misalignment between loading nose and supports shall not exceed 0,1 mm.

6 Specimens

Take specimens from panels prepared according to EN 2565.

6.1 Shape and dimensions

See figure 1 and table 1.

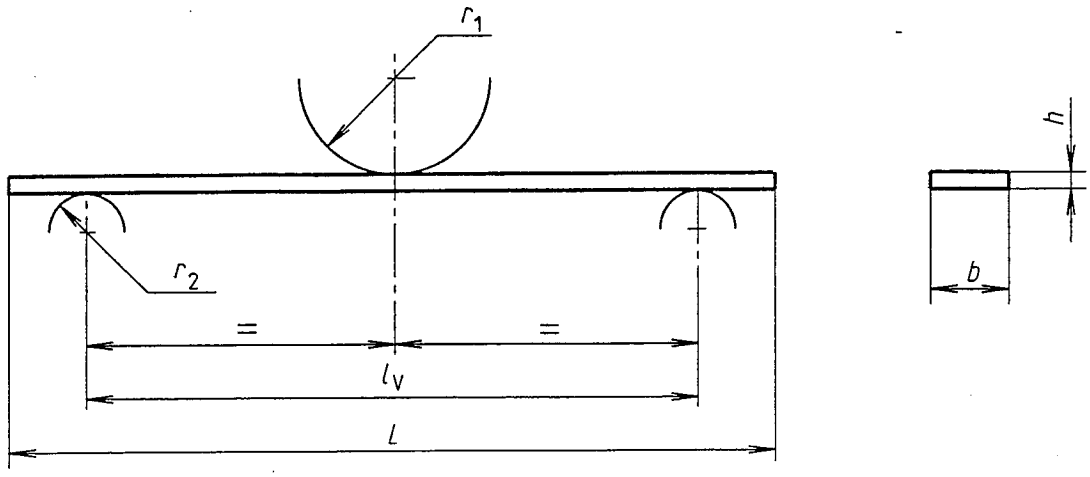

Figure 1

Table 1

Dimensions in millimetres

Symbols	Type A [2]	Type B
b	10 ± 0,2	10 ± 0,2
L	100 ± 1	60 ± 1
l_v	80 ± 0,5	50 ± 0,5
h [1]	2 ± 0,2	2 ± 0,2
r_1	12,5 ± 0,1	12,5 ± 0,1
r_2	5 ± 0,1	5 ± 0,1

1) If the ply thickness causes any uncertainty regarding the number of layers necessary to obtain a laminate of the required thickness, this number of layers shall be specified in the relevant material standard.
2) Type A specimens shall be used unless otherwise specified in material standard.

6.2 Number

Minimum of five

7 Procedure

7.1 Conditioning

EN 2743 for tests in the initial state,

EN 2489 for tests after immersion,

EN 2823 for tests after exposure to humid atmosphere.

7.2 Tests

7.2.1 Measure the width *b* to within 0,01 mm at the centre of the specimen.

Determine *h* by calculating the arithmetic mean of three measurements of the thickness to within 0,01 mm taken across the width at the centre of the specimen.

Measure the distance between supports to within 0,1 mm.

7.2.2 For tests at temperatures other than ambient, the period separating the conditioning and start of the test shall conform to the following conditions :

- for specimens which have not been aged or subjected to immersion, the exposure time at the test temperature shall be established by preliminary tests ;
- for specimens subjected to immersion, see EN 2489 ;
- for specimens subjected to humid atmosphere, see EN 2823.

7.2.3 Locate the specimen in the test fixture, with the face specified in the material standard in contact with the loading nose, ensuring that its axis is perpendicular to the supports.

If the face in contact with the loading nose is not specified, record its nature (for instance mould side, bag side,...).

7.2.4 The load shall be applied at constant displacement rate :

- of 5 mm/min for specimen type A ;
- of 2 mm/min for specimen type B.

7.2.5 Record the deflection *f* as a function of load

7.2.6 Record the load at failure P_R

8 Expression of results

8.1 Flexural strength σ_b (MPa)

$$\sigma_b = \frac{3}{2} \frac{P_R}{b} \frac{l_V}{h^2}$$

where :

- σ_b is the flexural strength, in megapascals ;
- P_R is the load at failure, in newtons ;
- b is the width, in millimetres ;
- h is the thickness, in millimetres ;
- l_V is the distance between supports, in millimetres.

8.2 Flexural modulus E_b (MPa) between $P_R/10$ and $P_R/2$

Measure the deflections from the diagram, see figure 2.

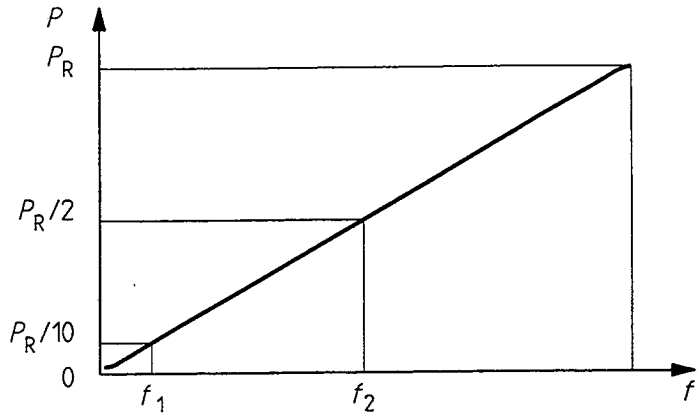

Figure 2

$$E_b = \frac{P_R \; l_V^3}{10 \; b \; h^3 \; (f_2 - f_1)}$$

where :

E_b is the flexural modulus, in megapascals ;
P_R is the load at failure, in newtons ;
b is the width, in millimetres ;
h is the thickness, in millimetres ;
l_V is the distance between supports, in millimetres ;
f_1 is the deflection corresponding to $P_R/10$, in millimetres ;
f_2 is the deflection corresponding to $P_R/2$, in millimetres.

8.3 Validity

The specimen is held over a sufficiently large span that the failure does not occur in shear and that strains due to shear loads may be neglected.

The test is only considered to be representative of the flexural behaviour of the material if the break is in tension or compression, see figure 3.

If a specimen has not broken in flexure (tension or compression failure), the calculated strength according to 8.1 will be lower than the true strength of the material.

EXAMPLES :

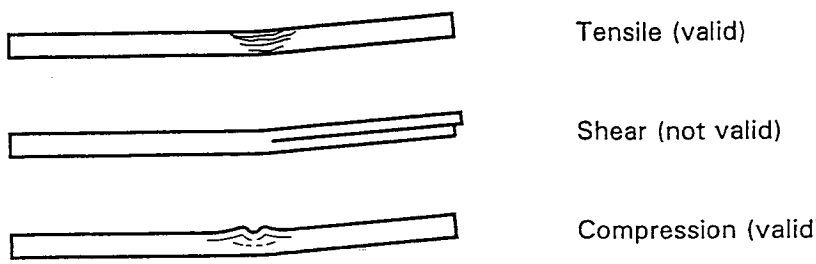

Figure 3