BS EN 3864:2013

BSI Standards Publication

Aerospace series — Non-metallic materials — Glass transparencies — Test methods — Determination of modulus of rupture

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee ACE/65, Non-metallic materials for aerospace purposes.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Luft- und Raumfahrt - Nichtmetallische Werkstoffe - Transparente Glaswerkstoffe - Prüfverfahren - Bestimmung des Bruchmoduls

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Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 3864:2013) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries 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 ASD, 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of an identical text or by endorsement, at the latest by November 2013, and conflicting national standards shall be withdrawn at the latest by November 2013.

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Introduction

This standard is part of the series of EN non-metallic material standards for aerospace applications. The general organisation of this series is described in EN 4385. This standard is a level 3 document as defined in EN 4385. It has been prepared in accordance with TR 4386.

1 Scope

This European Standard defines the requirements for the determination of the modulus of rupture of glass transparencies for aircraft applications, whether in the annealed or chemically or thermally tempered condition.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 3001, *Aerospace series — Tempered float glass plies for aircraft applications — Technical specification* [1)]

EN 4385, *Aerospace series — Non-metallic materials — General organisation of standardisation — Links between types of standards* [1)]

TR 4386, *Aerospace series — Non-metallic materials — Rules for the drafting and presentation of test method standards* [2)]

3 Terms, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply.

3.1
modulus of rupture
MOR
the surface fibre stress applied to a glass in bending, at the point at which rupture takes place

4 Health, safety and environment

This standard does not necessarily include all health, safety and environment requirements, associated with it's use.

Persons using this standard shall be familiar with normal laboratory / test house practices.

It is the responsibility of the user to establish satisfactory health, safety and environment practices and to ensure conformity with any European, National or local laws / regulations.

5 Principle/technique

A specimen of glass representing the transparency is subjected to four points bending to failure, and the MOR is then calculated from the breaking load and specimen dimensions.

1) Published as ASD-STAN Prestandard at the date of publication of this standard (www.asd-stan.org).

2) Published as ASD-STAN Technical Report at the date of publication of this standard (www.asd-stan.org).

6 Resources

6.1 Apparatus/facilities

Four point bending jig (see Figure 1).

Hardened steel cylindrical loading rollers. The centre pair of rollers shall be joined by a frame able to pivot at its centre, to ensure equal application of the load by the loading members. Roller radius and roller spacing shall be as specified in Table 1.

Loading machine capable of the required rate of loading. The machine shall be equipped with a method of recording the maximum load applied during the test, and shall have a valid certificate of calibration.

Micrometer to measure thickness of test beams.

Calliper to measure width of test beams.

6.2 Materials/reagents

Not applicable

6.3 Qualification of personnel

Not applicable

7 Test samples/test pieces

Beams of rectangular cross section shall be cut to size using diamond or wheel cutting. The beams shall be edge finished by the same process as the full scale glass that they represent.

The width to thickness ratio of the beams shall be between 2:1 and 10:1 with a minimum beam width of 10 mm. Recommended beam sizes are specified in Table 1.

Table 1 — Recommended test beam dimensions and loading roller dimensions

Dimensions in millimetres

Beam dimensions		**Distance between rollers** (see Figure 1)			**Roller radius**
Thickness	Length × width				
d	$L \times w$	a	b	c	%
< 6	120 × 40	15	70	40	3 ± 25
	152,4 × 25,4	44,5	127	38	
≥ 6	250 × 40	50	200	100	6 ± 25
	254 × 38,1	62,5	200	75	

8 Test procedure

See Figure 1.

The thickness of each beam shall be measured to the nearest 0,1 mm.

The width of the beam shall be measured at a minimum of three equally spaced positions, and the mean width calculated.

The test beam shall be inserted into the test machine, and the loading rollers set to the values stated in Table 1.

The load shall be uniformly applied until failure occurs. A small load may be applied prior to loading to failure, in order to locate and hold the beam in position. If this option is taken, the preload shall not exceed 10 % of the estimated load required to produce failure.

The loading rate shall be as given in Table 2.

Table 2 — Loading rates

Glass type	Loading rate
Annealed	(1,1 ± 0,2) MPa/s
Tempered	That required to give a mean failure time of 1 min, irrespective of glass strength.

The origin of failure shall be noted. To make this possible, a soft, transparent plastic tape is permitted on the compression side of the test beam during loading.

9 Expression of results

9.1 The Modulus of Rupture (MOR) shall be calculated as follows:

$$\text{MOR} = 3\,a\,(L / wd^2)\ \text{MPa}$$

where

L is the breaking load (N);

a is the distance between inner and outer loading rollers (mm);

w is the mean width of beam (mm);

d is the thickness of beam (mm).

9.2 The standard deviation (σ) shall be calculated as follows:

$$\sigma^2 = \frac{1}{n-1}\sum_i^n (x_i - x)^2$$

where

n is the number of beams tested;

x is the arithmetic mean MOR;

x_i is the individual beam MOR.

10 Measurement uncertainties

The precision of this test method is not known because inter-laboratory data are not available.

11 Designation

Not applicable

12 Test report

The test report shall include:

— reference to the test method designation;

— designation of the apparatus;

— any other information relevant to the test method;

— identification and traceability of the semi-finished product to be tested, in accordance with the technical specification;

— test beam dimensions;

— expression of results;

— traceability to test apparatus used;

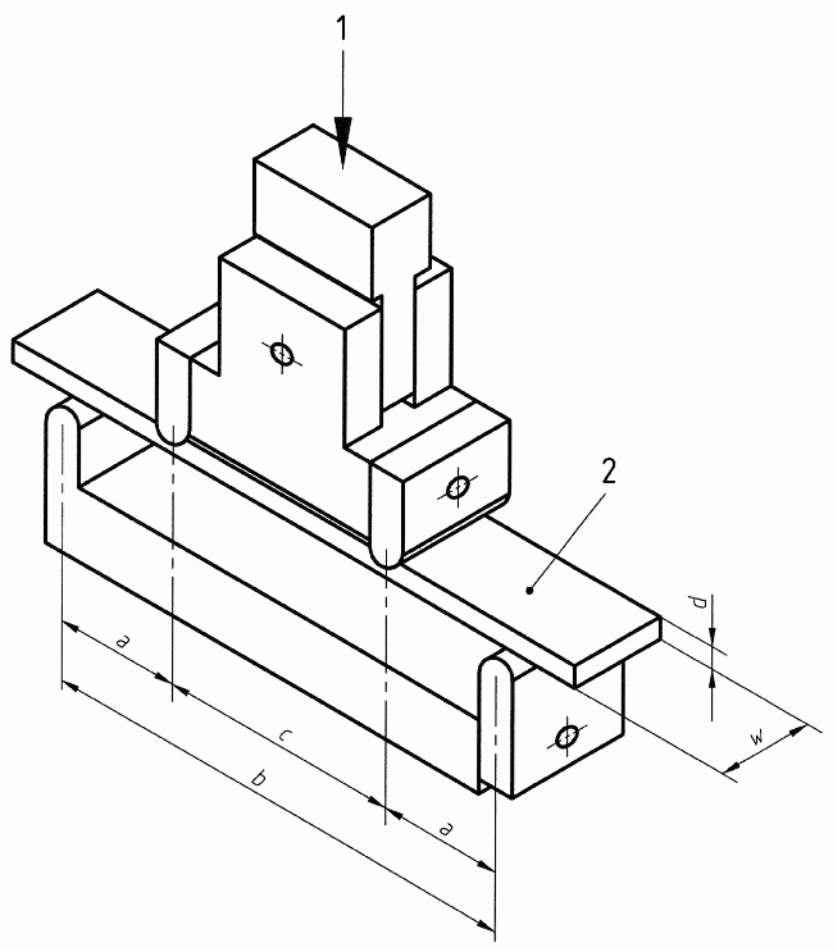
— traceability to individual performing the test work;

— any incident which may have affected the results;

— any deviation from the test method standard;

— date of test;

— location of fracture origin.



Key

1 Load application
2 Test specimen

Figure 1 — Four point bending geometry

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BSI Group Headquarters

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