BRITISH STANDARD AEROSPACE SERIES

BS EN
2155-13:1993

Test methods for transparent materials for aircraft glazing —

Part 13: Determination of temperature at deflection under load

The European Standard EN 2155-13:1993 has the status of a British Standard

UDC 629.73.023.26:620.1:536.4

Cooperating organizations

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This British Standard, having been prepared under the direction of the Aerospace Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 April 1993

The following BSI references relate to the work on this standard:
Committee reference ACE/62
Draft for comment 90/70825 DC

ISBN 0 580 22066 4

Amendments issued since publication

Amd. No.	Date	Comments

Contents

National foreword

This British Standard has been prepared under the direction of the Aerospace Standards Policy Committee and is the English language version of EN 2155-13:1993, *Aerospace Series — Test methods for transparent materials for aircraft glazing — Part 13: Determination of temperature at deflection under load*, published by the European Committee for Standardization (CEN).

EN 2155-13 was produced as a result of international discussion in which the UK took an active part.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 6, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 2155-13

February 1993

UDC 629.73.023.26:620.1:536.4

Descriptors: Aircraft industry, glazing, glass, transparent plastics, bend test, flexing, determination, temperature

English version

Aerospace series
Test methods for transparent materials for aircraft glazing
Part 13: Determination of temperature at deflection under load

Série aérospatiale — Méthode d'essais pour matériaux transparents pour vitrages aéronautiques
Partie 13: Détermination de la température de flechissement sous charge

Luft- und Raumfahrt — Prüfverfahren für transparente Werkstoffe zur Verglasung von Luftfahrzeugen
Teil 13: Bestimmung der Temperatur bei Durchbiegung unter Belastung

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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 successively 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 August 1993, and conflicting national standards shall be withdrawn at the latest by August 1993.

According to the CEN/CENELEC Internal Regulations, 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 United Kingdom.

Contents

1 Scope and field of application

1.1 This standard specifies a procedure for determining the temperature at which an arbitrary deformation occurs when the specimens are subjected to arbitrary bending loads, under conditions of continually rising temperatures.

1.2 The procedure applies to materials in sheet form in thicknesses $\geqslant$ 3 mm.

It does not apply to stretched/pressed (homogenous) acrylic materials.

2 Definitions

For the purpose of this test the temperature of deflection under load is that temperature (attained during conditions of steady increase of temperature) at which a specimen of the material exhibits a specified deflection.

3 Apparatus

3.1 The apparatus used is constructed essentially as shown in Figure 1 and shall conform to the description given below.

3.2 *Specimen supports*

The specimen rests horizontally on metal supports (see Figure 1); the load is applied vertically on the upper face of the specimen at midway between supports by means of a rod.

The vertical members, which attach the specimen supports to the upper plate are made of material having the same coefficient of linear expansion as is used for the rod (see note).

NOTE Unless these parts have the same coefficient of linear expansion, the differential change in length of these parts introduces an error in the reading of the apparent deformation of the specimen. A blank test is made on each apparatus using a test bar made of rigid material having a low coefficient of expansion[1)]. All temperature ranges to be used shall be covered and a correction factor is determined for each temperature. If the correction factor is 0,010 mm or greater, its algebraic sign is noted and the factor is applied to each test by adding it algebraically to the reading of apparent deflection of the tested specimens.

3.3 *Immersion bath*

The specimen is immersed in a suitable liquid heat-transfer medium (see note). The bath is well stirred during the test and provided with a means of raising the temperature at an average rate of 2 °C/min and the temperature shall not deviate from the average by more than ± 1 °C at any time measured over periods of 5 min.

NOTE A liquid heat-transfer medium is chosen which is stable and which does not affect the specimen at the temperatures used.

3.4 *Weights*

A set of weights of suitable sizes is made available so that the specimen can be loaded to a fibre stress of 1,8 MPa.

The weight of the rod which applies the testing force is determined and included as part of the total load.

If a dial gauge is used, the force exerted by its spring is determined and included as part of the total load (see notes 1 and 2).

The load is calculated from the following formula:

$$F = \frac{2 \sigma B d^2}{3 l}$$

where

F = Total load in N of the rod and weights with due allowance for any force exerted by the spring of a dial gauge

σ = 1,8 MPa

B = Width of specimen in mm

d = Depth of specimen in mm

l = Width of span between supports in mm.

The actual load applied is the calculated load ± 2,5 %.

The dimensions of the cross-section of the specimen used in the calculation are measured to the nearest 0,02 mm. The space between supports is measured to the nearest 0,1 mm.

NOTE 1 In certain forms of the apparatus, the force of the dial gauge spring is directed upward and shall be subtracted from the load, while in other forms this force acts downward and shall be added to the load.

NOTE 2 Since the force exerted by the spring in certain dial gauges varies considerably over the stroke, this force is measured in that part of the stroke which is to be used.

3.5 *Thermometers*

The thermometer is a mercury in glass thermometer of the partial immersion type, graduated in °C. The graduation marks shall permit reading 1 °C and the scale error at any reading shall not exceed 0,5 °C. The thermometers are immersed to the depth for which they have been calibrated and which shall be at least 50 mm.

3.6 *Preparation of apparatus*

The apparatus is arranged so that the deflection of the midpoint of the specimen can be measured on a scale calibrated in hundredths of 1 mm. The apparatus may be arranged to shut off the heat automatically and sound an alarm when the deflection specified in the Table has been reached.

[1)] Invar or borosilicate glass has been found suitable for this purpose.

4 Specimens

4.1 At least two specimens are used to test each sample. The specimens are at least 110 mm in length, between 3,0 mm and 13,0 mm in width and between 10,0 mm and 13,0 mm in depth. The specimens are cut from sheet material as indicated in Figure 2 their width corresponding to the thickness of the sheet.

4.2 If the thickness of the sheet exceeds 13,0 mm, the width of the specimens shall be reduced to 13,0 mm by machining of one face, the other face being left untouched.

5 Conditioning

The specimens shall be conditioned in an air circulating oven for 48 h at (80 ± 2) °C, followed by cooling to room temperature in a desiccator until tested.

6 Procedure

The specimen is placed in the apparatus the load being applied as shown in Figure 1 and Figure 3. The thermometers extend to within 10 mm of the specimen but shall not touch it.

The temperature of the bath shall be 20 °C to 23 °C at the start of each test, unless previous tests have shown that, for the particular materials under test, no error is introduced by starting at other temperatures.

The load is adjusted to give a fibre stress of 1,8 MPa, as calculated by the formula given in clause **3.4**.

The load is allowed to act for 5 min (see note) the zero reading or setting of the measuring device is then made and the heating started.

Tests are conducted by raising the temperature of the bath, as required in clause **3.3**. The temperature at which the bar has reached the arbitrary deflection as given in the Table is recorded as the temperature of deflection under load at 1,8 MPa fibre stress.

Table — Deflections

Dimensions in millimetres

Depth d	Deflection
10,0 to 10,39	0,32
10,4 to 10,69	0,31
10,7 to 10,99	0,30
11,0 to 11,49	0,29
11,5 to 11,99	0,28
12,0 to 12,39	0,27
12,4 to 12,79	0,26
12,8 to 13,0	0,25

NOTE The 5 min waiting period is provided to compensate partially for the creep exhibited by certain materials at room temperature when subjected to the prescribed fibre stress.

That part of the creep which occurs in the initial 5 min is usually a large fraction of that which occurs in the first 30 min.

This waiting period may be omitted when testing materials which show no appreciable creep during the initial 5 min.

7 Test report

The test report shall include:

— reference to this standard,

— **B** and **d** of the specimens measured to the nearest 0,02 mm,

— the temperature of deflection under load for each specimen in °C and the fibre stress,

— the nature of the immersion medium,

— any peculiar characteristics of the specimens noted during the test or after removal from the apparatus.

Dimensions in millimetres

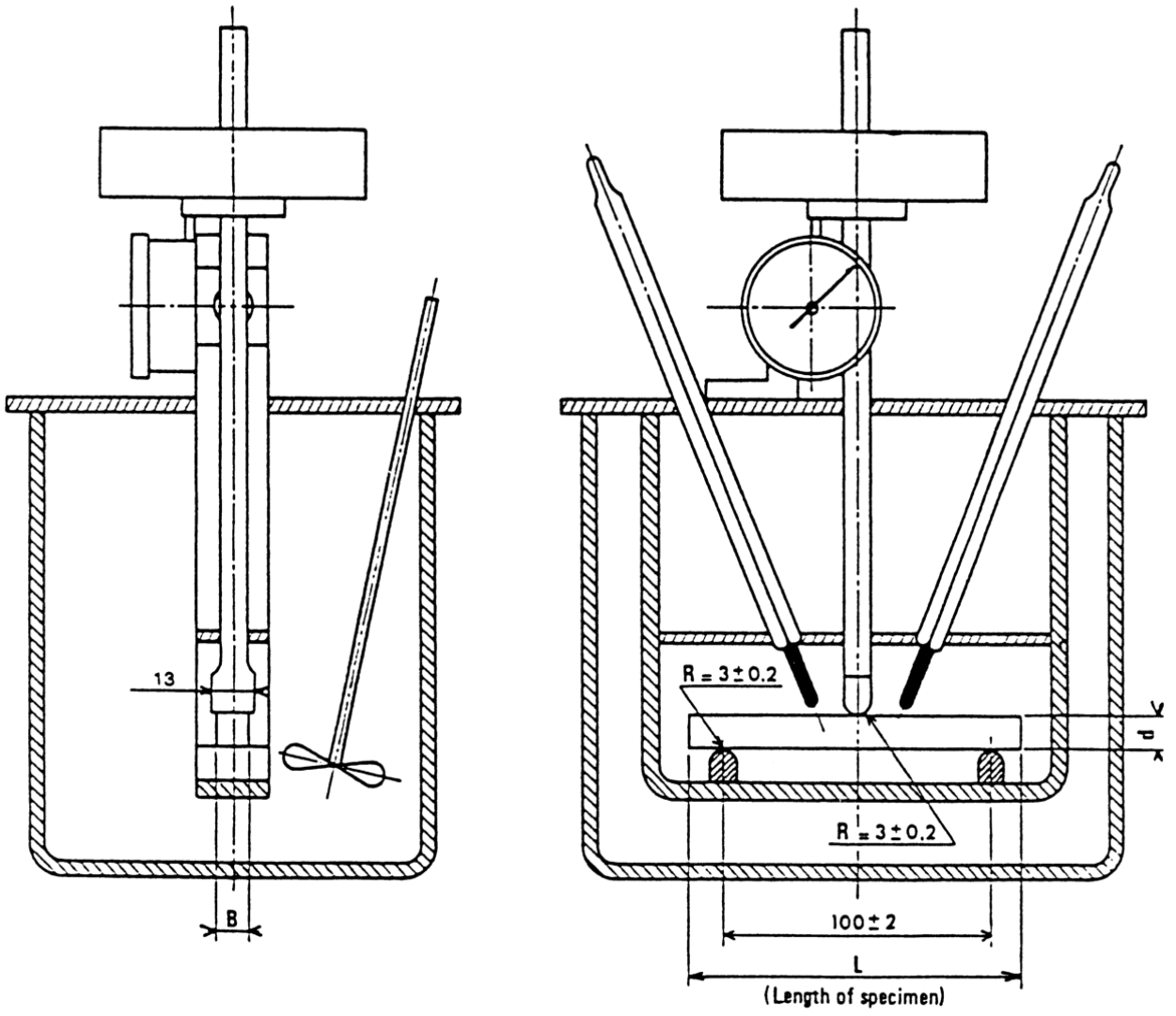
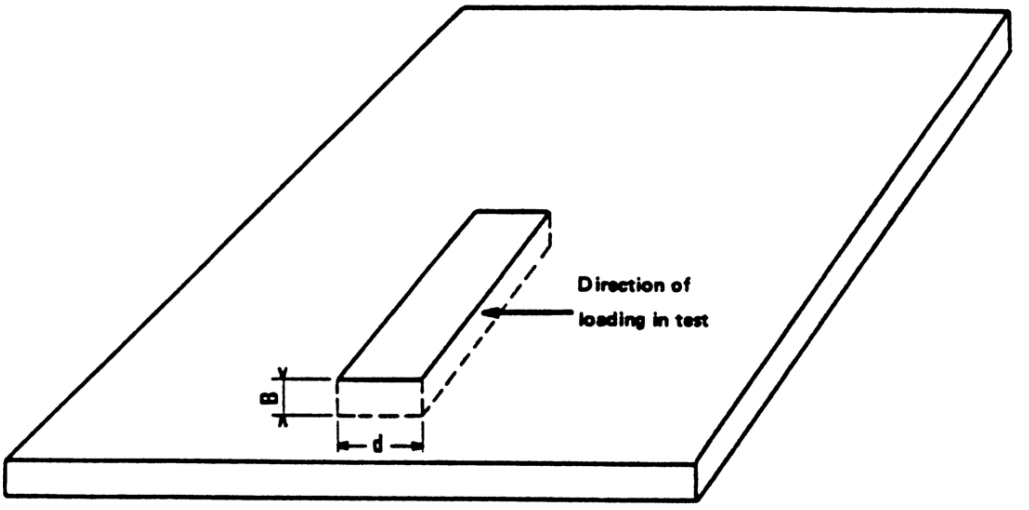


Figure 1 — Apparatus for determination of temperature at deflection under load



B = width of specimen = thickness of sheet

d = depth of specimen.

Figure 2 — Sampling from sheet

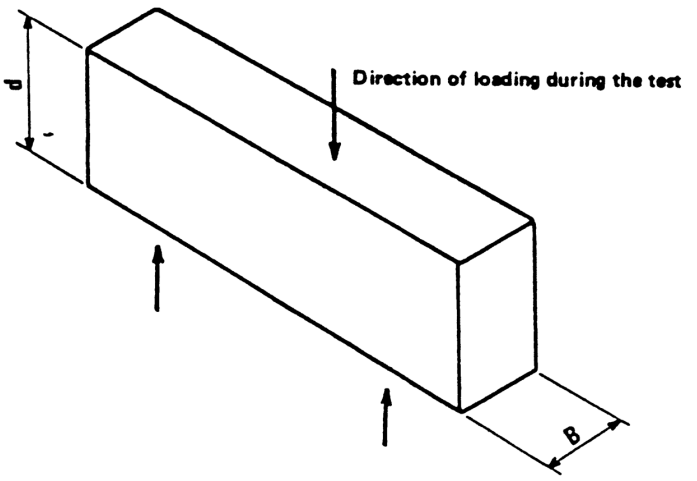


Figure 3 — Specimen and load application

National annex NA (informative)
Committees responsible

The United Kingdom participation in the preparation of this European Standard was entrusted by the Aerospace Standards Policy Committee (ACE/-) to Technical Committee ACE/62 upon which the following bodies were represented:

British Plastics Federation

Ministry of Defence

Society of British Aerospace Companies Limited

BSI — British Standards Institution

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