INTERNATIONAL STANDARD

ISO 1209-2

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Cellular plastics, rigid — Flexural tests —

Part 2:
Determination of flexural properties

Plastiques alvéolaires rigides — Essais de flexion —

Partie 2: Détermination des propriétés de flexion

Reference number
ISO 1209-2:1990(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 1209-2 was prepared by Technical Committee ISO/TC 61, *Plastics*.

Together with ISO 1209-1, ISO 1209-2 cancels and replaces ISO 1209:1976, which standardized only a bending test. The scope of ISO 1209 has been extended to include not only the bending test (ISO 1209-1) but also a similar method for determining flexural strength and apparent flexural modulus of elasticity (ISO 1209-2).

ISO 1209 consists of the following parts, under the general title *Cellular plastics, rigid — Flexural tests*:

— *Part 1: Bending test*

— *Part 2: Determination of flexural properties*

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Cellular plastics, rigid — Flexural tests —

Part 2:
Determination of flexural properties

1 Scope

This International Standard specifies a method of test for determining the flexural strength and the apparent flexural modulus of elasticity of rigid cellular plastics.

2 Normative references

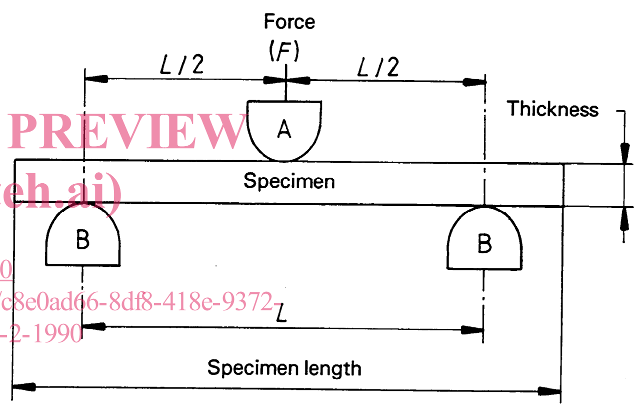
The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 1209. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 1209 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 291:1977, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 1923:1981, *Cellular plastics and rubbers — Determination of linear dimensions.*

3 Principle

A load is applied at a uniform rate by means of a loading edge to a test specimen supported at two positions. The load is applied perpendicularly to the specimen at a position midway between the supporting positions (see figure 1). The load and deformation are recorded; the flexural strength and the apparent flexural modulus of elasticity are calculated.



A Loading edge with cylindrical edge having a radius of 15 mm ± 1 mm

B Support edges with cylindrical edge having a radius of 15 mm ± 1 mm

L Distance between support edges

Figure 1 — Side view of test specimen and support edges

4 Apparatus

4.1 Test machine.

A universal mechanical-testing machine capable of operating at a constant rate of movement of the moveable head. The range of the machine shall be such that the applied load and deformation can be measured with an accuracy of ± 1 %. The machine shall include a device for simultaneous recording of force and the corresponding deformation.

4.2 Test specimen support, consisting of two parallel cylindrical support edges set in the same horizontal plane, each having an edge radius of 15 mm ± 1 mm. The length of the support edges shall be greater than the width of the test specimens.

The span L between the support edges shall be adjustable in the range 200 mm to 450 mm. The recommended span is 300 mm.

4.3 Test specimen loading edge, having the same shape and dimensions as the support edges. The loading edge shall be located midway between and parallel to the support edges.

4.4 Dial-gauge micrometer, as described in ISO 1923.

5 Test specimens

5.1 Shape and dimensions

Each test specimen shall be a rectangular parallelepiped having the dimensions given, together with the corresponding values of the span L between the support edges, in table 1.

Table 1

Dimension	Recommended dimension mm	Limit(s) on dimension mm
Length	350	$\geqslant L + 50$
Width b	$4d$	$\geqslant 2d$
Thickness d	25	15 to 38
Span L	300	$12d$ to $16d$
NOTE — At high thickness values, it will be necessary to select a span value at the low end of the range $12d$ to $16d$ in view of the limits on the adjustment of the span (see 4.2, second paragraph). Conversely, at low thickness values, it will be necessary to select a span value at the high end of the range $12d$ to $16d$		

5.2 Preparation

Test specimens shall be cut without deformation of the original cell structure. The test specimens may have a skin on one or more sides; if so, this fact shall be recorded.

5.3 Number

At least five specimens shall be tested for each sample. When testing materials which are suspected of being anisotropic, duplicate sets of test specimens shall be prepared having axes respectively parallel to and normal to the suspected direction of anisotropy.

When testing specimens with only one surface skin, unless otherwise specified, duplicate sets of test specimens shall be tested, one set with the skin in tension and one set with the skin in compression. Report the results separately.

5.4 Conditioning

The test specimens shall be conditioned in one of the atmospheres specified in ISO 291. Normal test conditions are 23 °C ± 2 °C and (50 ± 5) % R.H. Temperatures of −196 °C, −70 °C, −10 °C, 0 °C, 27 °C and 40 °C are preferred alternative temperatures, although other conditions may be used, for example those reflecting end use.

6 Procedure

Determine the dimensions of the test specimens in accordance with ISO 1923. Place a test specimen symmetrically upon the support edges and apply an increasing force perpendicularly to the longitudinal axis of the specimen by moving the loading edge at a constant speed of

— 20 mm/min ± 1 mm/min for the determination of flexural modulus;

— either 20 mm/min ± 1 mm/min or 100 mm/min ± 10 mm/min for the determination of other flexural properties.

Record the force/deformation curve and draw a line tangential to the steepest part of the curve (see figure 2).

Record the breaking load when the break occurs before 5 % deflection is reached. It is normally not necessary to continue the test beyond a flexural strain of 5 %.

NOTE 1 With the recommended test specimen and loading arrangements the strain is at 5 % when the deflection reaches 30 mm.

Inspect the test specimen for any sign of crushing. If any crushing is found, disregard the flexural strength value.

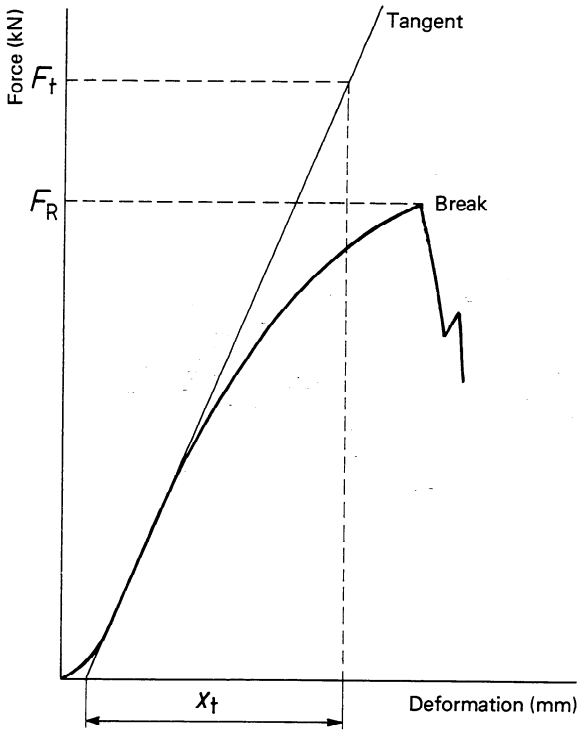


Figure 2 — Typical force/deformation diagram

7 Expression of results

7.1 The flexural strength R, in kilopascals, is given by the equation

$$R = 1{,}5F_R \times \frac{L}{bd^2} \times 10^6$$

where

F_R is the maximum force applied, in kilonewtons;

L is the span between the support edges, in millimetres;

b is the test specimen width, in millimetres;

d is the test specimen thickness, in millimetres.

7.2 The apparent flexural modulus of elasticity E, in kilopascals, is given by the expression

$$E = \frac{L^3}{4bd^3} \times \frac{F_t}{x_t} \times 10^6$$

where

F_t is the force, in kilonewtons, corresponding to the deformation x_t (see figure 2);

x_t is the corresponding deformation, in millimetres;

L, b and d are as defined in 7.1.

8 Precision

The precision of this method is not known because interlaboratory round-robin data are not yet available. This method may not be suitable for use in specifications or in the case of disputed results as long as these data are not available.

9 Test report

The test report shall include the following information:

a) a reference to this part of ISO 1209;

b) a description and identification of the material;

c) the presence or absence of skins or facings on test specimens and, if applicable, on which faces;

d) the conditioning procedure used;

e) the dimensions of the test specimens and the test conditions (span between support edges, speed of loading edge, temperature of test, humidity of test);

f) the direction of application of the load with respect to any anisotropy;

g) the individual values of the flexural strength, in kilopascals;

h) the individual values of the apparent flexural modulus of elasticity, in kilopascals;

i) the individual values of the breaking load, where applicable, in newtons;

j) the arithmetic mean of the flexural strength values;

k) the arithmetic mean of the flexural modulus of elasticity values;

l) the arithmetic mean of the breaking load values, where applicable;

m) details of any deviation from this part of ISO 1209, and any incident which may have influenced the results;

n) the date of the test.

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