INTERNATIONAL STANDARD ISO 844

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Cellular plastics — Compression test for rigid materials

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FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 844 was developed by Technical Committee ISO/TC 61, *Plastics*, and was circulated to the member bodies in November 1975.

It has been approved by the member bodies of the following countries :

Australia	Hungary	Romania
Austria	India	South Africa, Rep. of
Belgium	Iran	Spain
Brazil	Israel	Sweden
Canada	Italy	Switzerland
Czechoslovakia	Japan	Turkey
Finland	Mexico	United Kingdom
France	New Zealand	U.S.A.
Germany	Poland	U.S.S.R.

No member body expressed disapproval of the document.

This International Standard cancels and replaces ISO Recommendation R 844-1968, of which it constitutes a technical revision.

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Cellular plastics — Compression test for rigid materials

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method of determining

a) the compressive strength and corresponding relative deformation,

or

b) the compressive stress at 10 % relative deformation

of rigid cellular plastics.

2 REFERENCES

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

ISO 1923, *Cellular materials — Determination of linear dimensions.*

3 PRINCIPLE

Application, at constant speed, of a compressive force in an axial direction to the faces of a rectangular parallelepiped test specimen. Calculation of the maximum stress supported by the test specimen.

If the value of the maximum stress corresponds to a relative deformation of less than 10 %, it is noted as the "compressive strength". Otherwise, the compressive stress at 10 % relative deformation is calculated and its value noted as the "compressive stress at 10 % relative deformation".

4 DEFINITIONS

4.1 relative deformation (ϵ) : Quotient of the reduction (in relation to its initial value) in thickness of the test specimen by its initial thickness. It is expressed as a percentage.

4.2 compressive strength (σ_M) : Quotient of the maximum compressive force F_M, reached when the relative deformation ϵ is < 10 %, by the initial surface area of the cross-section of the test specimen. The relative deformation corresponding to σ_M is noted as ϵ_M.

4.3 compressive stress at 10 % relative deformation (σ_{10}) : Quotient of the compressive force F_{10} at 10 % relative deformation (ϵ_{10}), by the initial surface area of the cross-section of the test specimen.

5 APPARATUS

5.1 Compression testing machine

Any compression testing machine suited to the range of force and displacement involved and having two square or circular plane parallel plates which are polished and cannot be deformed, and of which the length of one side (or the diameter) is at least 10 cm. One of the plates shall be fixed and the other movable; the latter shall be capable of moving at a constant rate of displacement in accordance with the conditions laid down in clause 7.

5.2 Measuring devices for displacement and force

5.2.1 *Measurement of displacement*

The compression testing machine shall be fitted with a system allowing continuous measurement of the displacement x of the movable plate with an accuracy of ± 5 % or ± 0,1 mm if this latter value is a more accurate measurement (see note after 5.2.2).

5.2.2 *Measurement of force*

A force sensor shall be fixed to one of the machine plates in order to measure the force F produced by the reaction of the test specimen upon the plates during the test. This sensor shall be such that its own deformation during the course of the measuring operation is negligible compared with that being measured and in addition it shall allow the continuous measurement of the force at any point in time with an accuracy of ± 1 %. (See note.)

NOTE — It is recommended that a device be used for the simultaneous recording of the force F and the displacement x that allows, by obtaining a curve of $F = f(x)$, the graphical determination of the pair of values of F, x, required in clause 8 with the accuracy laid down in 5.2.1 and 5.2.2 and provides additional information on the behaviour of the product.

5.2.3 *Calibration*

The readings of force and displacement provided by the measuring devices of the compression testing machine (and, if applicable, by its graphical recording device) shall be checked periodically using a series of standard masses (corresponding to the sensitivity used for the forces) and spacers of thickness all of which are known to a greater degree of accuracy than that required in 5.2.1 and 5.2.2.

5.3 Instruments for measuring the dimensions of the test specimens shall be in accordance with ISO 1923.

6 TEST SPECIMENS

6.1 Dimensions

The test specimens shall be 50 ± 1 mm in thickness except for products with moulded skins which are intended to remain integrally with the product in use. With such products, the specimens shall be the full thickness provided that the minimum thickness is 10 mm or greater and that the maximum thickness is not greater than the width or diameter of the specimen. (See notes 1 and 2.)

The test specimen base shall be either square or circular, with a minimum area of 25,0 cm^2 and maximum of 230,0 cm^2. The preferred geometry and dimensions are a right prism with sides of 100,0 ± 1 mm.

The distance between two faces shall not vary by more than 1 % (tolerance on parallelism).

NOTES

1 Under no circumstances shall several test specimens be piled up to produce a greater thickness for testing.

2 Results obtained with specimens of differing thicknesses should not be compared.

6.2 Preparation

Test specimens shall be cut (see note 1) so that the specimen base is normal to the direction of compression of the product in its intended use. In some cases with anisotropic materials where a more complete characterization is desired or where the principal direction of anisotropy is unknown, it may be necessary to prepare additional sets of specimens (see note 2).

NOTES

1 Cutting of the test specimens is to be accomplished by methods that do not change the original structure of the cellular material. Moulding skins that do not remain with the product in use are to be removed.

2 In general, any anisotropy is characterized by a plane and the direction perpendicular to this plane; thus, two sets of test specimens need to be considered.

6.3 Number

Regarding the method of selecting the samples for preparation of the test specimens from the blocks or slabs of rigid cellular products and also the number of test specimens to be provided for the test, refer to the specification relating to the type of cellular product under test. In the absence of such specifications, use at least five test specimens.

6.4 Conditioning

Condition the test specimens according to ISO 291.

7 PROCEDURE

The testing temperature shall be the same as the conditioning temperature.

Measure the three dimensions of the test specimen according to ISO 1923, then place it centrally between the two parallel plates of the compression testing machine (5.1). Compress it by the movable plate at a constant speed of displacement, the value of which, in millimetres per minute, is as close as possible to 10 % of the value of the measured initial thickness h_o.

A relative deformation of at least 10 % shall be reached, if possible.

8 EXPRESSION OF RESULTS

Depending upon the case, it will be necessary to calculate σ_M and ϵ_M (see 8.1), or σ_{10} (see 8.2).

8.1 Compressive strength and corresponding relative deformation

8.1.1 *Compressive strength*

The compressive strength, σ_M, is given, in kilopascals, by the formula

$$\sigma_M = 10^3 \frac{F_M}{S_o}$$

where

F_M is the maximum force reached, in newtons;

S_o is the initial area, in square millimetres, of the cross-section of the test specimen.

8.1.2 *Relative deformation*

Using a straightedge, carefully extend to the zero force line the steepest straight portion of the force-deformation curve (see 5.2.2). Measure all displacements for deformation calculations from this "zero deformation point". Illustration of this procedure is shown for two examples in the figure. (See note.)

The relative deformation, ϵ_M, is given, as a percentage, by the formula

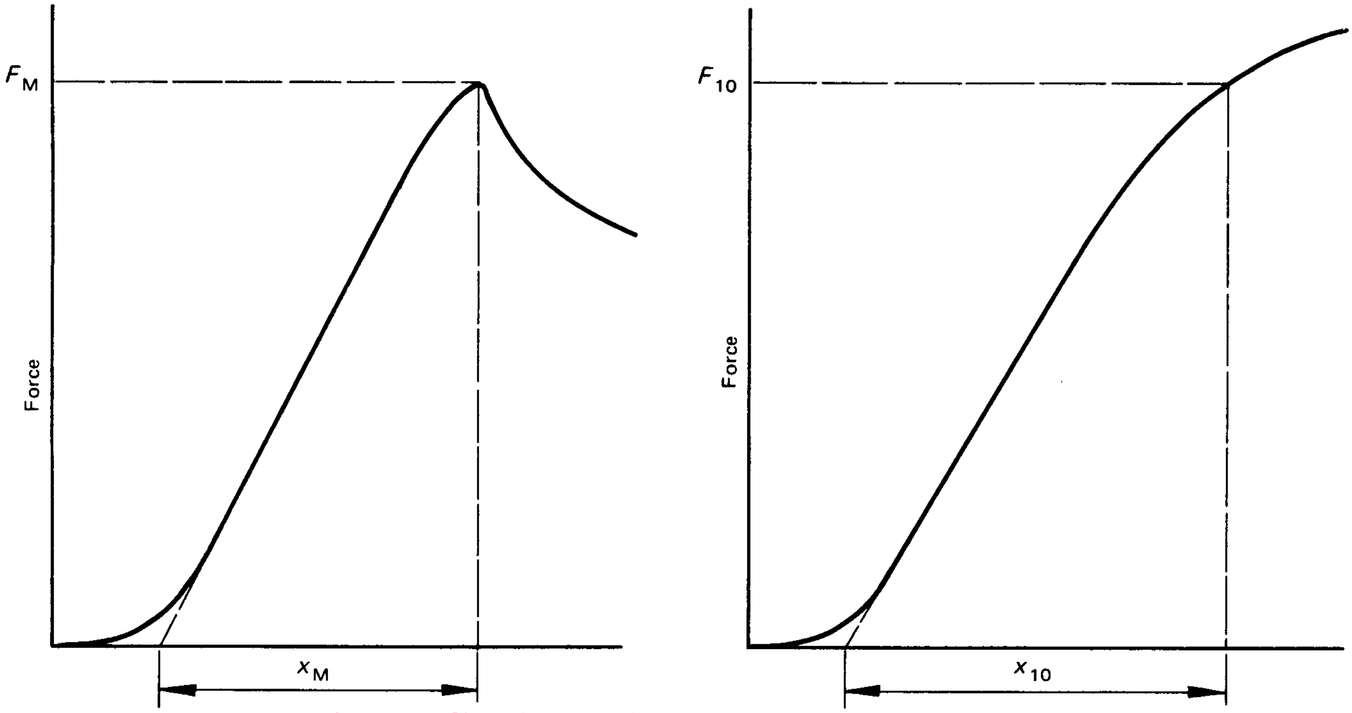
$$\epsilon_M = \frac{x_M}{h_o} \times 100$$

where

x_M is the displacement, in millimetres, corresponding to the maximum force reached;

h_o is the initial thickness, in millimetres, of the test specimen.

NOTE — If there is no well-defined straight portion of the force-deformation curve or if the "zero deformation point" obtained in this manner results in a negative value, this procedure should not be used and in such cases the "zero deformation point" shall be the deformation corresponding to a stress of 100 ± 10 kPa.



F_M = maximum force
x_M = displacement for maximum force
F_{10} = force at 10 % deformation
x_{10} = displacement for 10 % deformation

FIGURE — **Zero point determination**

8.2 Compressive stress at 10 % relative deformation

The compressive stress at 10 % relative deformation, σ_{10}, is given, in kilopascals, by the formula

$$\sigma_{10} = 10^3 \frac{F_{10}}{S_o}$$

where

F_{10} is the force, in newtons, corresponding to a relative deformation of 10 %;

S_o is as defined in 8.1.1.

9 TEST REPORT

The test report shall include the following information :

a) reference to this International Standard;

b) identification and description of the product;

c) dimensions of test specimens if other than right prism with base of 100 ± 1 mm sides and thickness of 50 ± 1 mm;

d) direction in which the force was applied in relation to anisotropy or product geometry;

e) average of the test results, expressed as :

— compressive strength (σ_M) and corresponding relative deformation (ϵ_M),

or

— compressive stress at 10 % relative deformation (σ_{10});

f) individual test results if individual specimen values vary by more than 10 %;

g) any deviation from the procedure specified in this International Standard.