INTERNATIONAL STANDARD

ISO

604

Plastics — Determination of compressive properties

Plastiques — Détermination des propriétés en compression

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 604 was prepared by Technical Committee ISO/TC 61, *Plastics*, Sub-Committee SC 2, *Mechanical properties*.

This second edition cancels and replaces the first edition (ISO 604:1973), which has been improved with respect to the following points:

— introduction of the compressive modulus;

— simplification with respect to the buckling limit;

— introduction of preferred specimen types, which relate to the multipurpose test specimen according to ISO 3167;

— introduction of three preferred testing speeds, for measuring the modulus and for testing brittle and tough materials respectively.

Annex A forms an integral part of this International Standard. Annex B is for information only.

Plastics — Determination of compressive properties

1 Scope

1.1 This International Standard specifies a method for determining the compressive properties of plastics under defined conditions. A standard test specimen is defined and its length is adjusted to prevent buckling under load from affecting the results. A range of testing speeds is included.

1.2 The method is used to investigate the compressive behaviour of the test specimens and for determining the compressive strength, compressive modulus and other aspects of the compressive stress/strain relationship under the conditions defined.

1.3 The method applies to the following range of materials:

— rigid and semirigid thermoplastics moulding and extrusion materials, including compounds filled and reinforced by e.g. short fibres, small rods, plates or granules in addition to unfilled types; rigid and semirigid thermoplastic sheet;

— rigid and semirigid thermoset moulding materials, including filled and reinforced compounds; rigid and semirigid thermoset sheet;

— thermotropic liquid crystal polymers.

The method is not normally suitable for use with materials reinforced by textile fibres, rigid cellular materials and sandwich structures containing cellular material.

1.4 The method is performed using specimens which may be either moulded to the chosen dimensions, machined from the central portion of the standard multipurpose test specimen (see ISO 3167) or machined from finished and semifinished products such as mouldings, laminates and extruded or cast sheet.

1.5 The method specifies preferred dimensions for the test specimen. Tests which are carried out on specimens of different dimensions, or on specimens which are prepared under different conditions, may produce results which are not comparable. Other factors, such as the speed of testing and the conditioning of the specimens, can also influence the results. Consequently, when comparative data are required, these factors should be carefully controlled and recorded.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 293:1986, *Plastics — Compression moulding test specimens of thermoplastic materials.*

ISO 294:—[1], *Plastics — Injection moulding of test specimens of thermoplastic materials.*

ISO 295:1991, *Plastics — Compression moulding of test specimens of thermosetting materials.*

ISO 472:1988, *Plastics — Vocabulary.*

ISO 1268:1974, *Plastics — Preparation of glass fibre reinforced, resin bonded, low-pressure laminated plates or panels for test purposes.*

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1) To be published. (Revision of ISO 294:1975)

ISO 2602:1980, *Statistical interpretation of test re-sults — Estimation of the mean — Confidence interval.*

ISO 2818:—[2], *Plastics — Preparation of test speci-mens by machining.*

ISO 3167:1993, *Plastics — Multipurpose test speci-mens.*

ISO 5893:1985, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Description.*

3 Principle

The test specimen is compressed along its major axis at constant speed until the specimen fractures or until the load or the decrease in length reaches a pre-determined value. The load sustained by the speci-men is measured during this procedure.

4 Definitions

For the purposes of this International Standard, the following definitions apply (see also figure 1):

4.1 gauge length, L_0: Initial distance between the gauge marks on the test specimen.

It is expressed in millimetres (mm).

4.2 speed of testing, v: Rate of approach of the plates of the testing machine during the test.

It is expressed in millimetres per minute (mm/min).

4.3 compressive stress, σ (engineering): Com-pressive load, per unit area of original cross-section, carried by the test specimen (see note 3).

It is expressed in megapascals (MPa).

4.3.1 compressive stress at yield, σ_Y: First stress at which an increase in strain (see 4.4) occurs without an increase in stress; may be less than the maximum attainable stress (see figure 1, curve a, and note 3).

4.3.2 compressive strength, σ_M: Maximum com-pressive stress sustained by the test specimen during a compressive test (see figure 1 and note 3).

4.3.3 compressive stress at break (rupture), σ_B: Compressive stress at break of the test specimen (see figure 1 and note 3).

4.3.4 compressive stress at x **% strain,** σ_x: Stress at which the strain reaches a specified value of x % (see 4.5).

The compressive stress at x % strain may be meas-ured, e.g., if the stress/strain curve does not exhibit a yield point (see figure 1, curve b, and note 3). In this case, x shall be taken from the relevant product stan-dard or agreed upon by the interested parties. How-ever, in any case, x must be lower than the strain at compressive strength.

4.4 compressive strain, ε: Decrease in length per unit original length of the gauge L_0 [see 8.2, equation (3) and note 3].

It is expressed as a dimensionless ratio or percentage (%).

4.5 nominal compressive strain, ε_c: Decrease in length per unit original length l of the test specimen [see 8.2, equation (4)].

It is expressed as a dimensionless ratio and may be specified directly or as a percentage of the initial length.

4.5.1 nominal compressive yield strain, ε_{cy}: Strain corresponding to the compressive yield stress σ_Y (see 4.3.1).

4.5.2 nominal compressive strain at compressive strength, ε_{cM}: Strain corresponding to the com-pressive strength σ_M (see 4.3.2).

4.5.3 nominal compressive strain at break, ε_{cB}: Strain at break of the test specimen.

4.6 compressive modulus, E_c: Ratio of the stress difference $(\sigma_2 - \sigma_1)$ to the corresponding strain differ-ence values $(\varepsilon_2 = 0,002\,5$ minus $\varepsilon_1 = 0,000\,5)$ [see 8.3, equation (7)].

It is expressed in megapascals, MPa.

NOTES

1 The compression modulus is calculated on the basis of the compressive strain ε only (see 4.4).

2 With computer-aided equipment, the determination of the modulus E_c using two distinct stress/strain points may be replaced by a linear regression procedure applied on the part of the curve between these mentioned points.

3 In compression tests the stresses σ and strains ε are negative. The negative sign, however, is generally omitted. If this generates confusion, e.g. in comparing tensile and compressive properties, the negative sign may be added for the latter. This unnecessary for the nominal compressive strains ε_c.

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2) To be published. (Revision of ISO 2818:1980)