Flexible cellular polymeric materials – Determination of stress-strain characteristics in compression

Part 1: Low-density materials (ISO 3386-1 : 1986)

English version of DIN EN ISO 3386-1

DIN

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ICS 83.100

Descriptors: Polymers, flexible cellular materials, stress-strain characteristics, testing.

This standard, together with DIN EN ISO 3386-2, June 1998 edition, supersedes DIN 53577, December 1988 edition.

Polymere Materialien, weich-elastische Schaumstoffe – Bestimmung der Druckspannungs-Verformungseigenschaften – Teil 1: Materialien mit niedriger Dichte (ISO 3386-1 : 1986)

European Standard EN ISO 3386-1 : 1997 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been published in accordance with a decision taken by CEN/TC 249 to adopt, without alteration, International Standard ISO 3386-1 as a European Standard.

The responsible German body involved in its preparation was the *Normenausschuß Materialprüfung* (Materials Testing Standards Committee), Technical Committee *Prüfung weich-elastischer Schaumstoffe*.

Amendments

DIN 53577, December 1988 edition, has been superseded by the specifications of EN ISO 3386-1.

Previous editions

DIN 53577: 1963-03, 1976-01, 1988-12.

EN comprises 4 pages.

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EN ISO 3386-1

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ICS 83.100

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English version

Polymeric materials, cellular flexible

Determination of stress-strain characteristics in compression

Part 1: Low-density materials

(ISO 3386-1 : 1986)

Matériaux polymères alvéolaires souples – Détermination de la caractéristique de contrainte-déformation relative en compression – Partie 1: Matériaux à basse masse volumique (ISO 3386-1 : 1986)

Polymere Materialien, weich-elastische Schaumstoffe – Bestimmung der Druckspannungs-Verformungseigenschaften – Teil 1: Materialien mit niedriger Dichte (ISO 3386-1 : 1986)

This European Standard was approved by CEN on 1997-10-16.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

International Standard

ISO 3386-1 : 1986 Flexible cellular polymeric materials – Determination of stress-strain characteristics in compression – Part 1: Low-density materials,

which was prepared by ISO/TC 45 'Rubber and rubber products' of the International Organization for Standardization, has been adopted by Technical Committee CEN/TC 249 'Plastics', the Secretariat of which is held by IBN, as a European Standard.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, and conflicting national standards withdrawn, by May 1998 at the latest.

In accordance with the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard:

Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 3386-1 : 1986 was approved by CEN as a European Standard without any modification.

NOTE: Normative references to international publications are listed in Annex ZA (normative).

1 Scope and field of application

This part of ISO 3386 specifies a method for the determination of the compression stress/strain characteristic of low-density flexible cellular materials up to 250 kg/m^3. It also indicates a method for the calculation of the compression stress value of such materials.

The compression stress/strain characteristic is a measure of the load-bearing properties of the material, though not necessarily of its capacity to sustain a long-term load.

The compression stress/strain characteristic differs from the indentation hardness characteristics (as determined in accordance with ISO 2439), which are known to be influenced by the thickness and the tensile properties of the flexible cellular material under test, by the shape of the compression plate and by the shape and size of the test piece.

ISO 3386/2 specifies a method for high-density materials and differs from part 1 in the following ways:

— it is mainly concerned with materials of density above 250 kg/m^3;

— compression stress values have been deleted;

— it does not permit the use of a cylindrical test piece.

2 References

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

ISO 2439, *Polymeric materials, cellular flexible — Determination of hardness (indentation technique)*.

3 Definitions

For the purposes of this International Standard the following definitions apply.

3.1 compression stress/strain characteristic (CC): The stress, expressed in kilopascals*, required to produce a compression, at a constant rate of deformation during the fourth loading cycle of the test specified below, expressed as a function of the compression.

3.2 compression stress value (CV_{40}): The compression stress/strain characteristic for a compression of 40 %.

4 Apparatus

4.1 Test machine

The test machine shall be capable of compressing the test piece between a support surface (see 4.2) and a compression plate (see 4.3), which shall have a uniform relative rate of motion in the vertical direction of 100 ± 20 mm/min.

The test machine shall be capable of measuring the force required to produce the specified compression with a precision of ± 2 % and of measuring the test piece thickness under load with a precision of ± 0,2 mm. Autographic recording of the stress-strain values is preferred.

4.2 Supporting surface

Unless otherwise specified, the test piece shall be supported on a smooth, flat, horizontal and rigid surface, larger than the test piece, which may be vented with holes about 6 mm in diam-

* 1 kPa = 10^3 N/m^2

eter, and approximately 20 mm pitch, to allow the escape of air from below the test piece.

4.3 Compression plate

The compression plate shall be of any convenient size and shape, provided that it overlaps the test piece in all directions. The lower surface shall be plane and smooth, but not polished, and it shall be maintained parallel to the supporting surface.

5 Test pieces

5.1 Form and dimensions

The test piece shall be a right parallelepiped or a right cylinder with a minimum width or diameter/thickness ratio of 2 : 1. The preferred thickness of a test piece is 50 ± 1 mm and in any case the thickness shall be not less than 10 mm. Sheets less than 10 mm thick shall be plied together to reach the preferred thickness range, provided that a minimum of ten cell diameters are included in the thickness of each ply.

The area of the test piece shall be not less than 2 500 mm^2 and shall be such that at no point does the test piece overlap the compression plate.

NOTE — For specimens with an area close to the lower limit, the compression forces may be very low, and specialized testing equipment may therefore be required to meet the precision specified in 4.1.

5.2 Samples showing orientation

If the products show an orientation of the cellular structure, the direction in which the indentation is to be carried out shall be agreed upon between the interested parties. Normally, testing is carried out in that direction in which the finished product will be stressed under service conditions.

5.3 Number of test pieces

Three test pieces shall be tested.

5.4 Conditioning

Samples shall not be tested less than 72 h after manufacture, unless otherwise stated in the material specification. They shall be conditioned immediately before testing for a period of not less than 16 h at either

a) a temperature of 23 ± 2 °C and a relative humidity of 50 ± 5 % for use in temperate climates; or

b) a temperature of 27 ± 2 °C and a relative humidity of 65 ± 5 % for use in tropical climates.

The conditioning may form the latter part of the 72 h following manufacture. The tests shall be carried out at a temperature of 23 ± 2 °C or 27 ± 2 °C as appropriate.

6 Procedure

Measure the dimensions of the test piece using the appropriate procedure specified in ISO 1923 and calculate the area of the load-bearing face.

Insert the test piece in such a way that the force acts along the centre line of the test machine (4.1) and compress it at 100 ± 20 mm/min by means of the compression plate (4.3) until a compression of $70\ ^{+5}_{0}$ % of the initial test piece thickness is attained or until the compression strain applied equals that specified in the material specification. Then decompress the test piece at the same rate until the separation between the compression plate and the base plate is equal to the initial test piece thickness.

Immediately repeat this procedure three times and on the fourth compression cycle read the force, in newtons, at the specified strain.

NOTE — If measurements are required at multiple compression strains on a test piece, it is unnecessary to allow recovery time or to repeat the pre-loading procedure between the readings at each strain provided that measurements are taken in order of increasing magnitude of strain.

7 Expression of results

7.1 Compression stress/strain characteristic

The compression stress/strain characteristic at any required percentage compression, expressed in kilopascals, is given by the equation

$$CC_{xx} = 1\,000\,\frac{F_{xx}}{A}$$

where

CC_{xx} is the compression stress/strain characteristic at a compression of xx %;

F_{xx} is the force, in newtons, recorded in the fourth loading cycle for a compression of xx %;

A is the surface area, in square millimetres, of the test piece.

7.2 Compression stress value

The compression stress value, expressed in kilopascals, is given by the equation

$$CV_{40} = 1\,000\,\frac{F_{40}}{A}$$

where

CV_{40} is the compression stress value at a compression of 40 %;

F_{40} is the force, in newtons, recorded in the fourth loading cycle for 40 % compression;

A is the surface area, in square millimetres, of the test piece.

8 Repeat tests

For repeat tests on the same test piece, a minimum recovery period of 16 h shall be observed.

9 Test report

The test peport shall include the following information:

a) reference to this International Standard, i.e. ISO 3386/1;

b) a description of the material;

c) the temperature and humidity at which the test pieces were conditioned;

d) the dimensions of the test piece used and, if applicable, the number of plies;

e) the compression stress/strain characteristics for individual test pieces, and their median, and/or the compression stress values for individual test pieces, and their median;

f) other relevant information.

NOTE — An example of how to express compression stress/strain characteristics briefly is as follows:

ISO 3386/1 CC_{25}
23 °C, 50 % relative humidity
Individual results
Median kPa

Annex ZA (normative)
Normative references to international publications with their relevant European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

Publication	Year	Title	EN	Year
ISO 1923		Cellular plastics and rubbers - Determination of linear dimensions	EN ISO 1923	1995