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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Cellular plastics and rubbers — Determination of apparent (bulk) density

Caoutchoucs et plastiques alvéolaires — Détermination de la masse volumique apparente

Reference number
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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 approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 845 was prepared by Technical Committee ISO/TC 61, *Plastics.*

This second edition cancels and replaces the first edition (ISO 845 : 1977), of which it constitutes a technical revision.

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Cellular plastics and rubbers — Determination of apparent (bulk) density

1 Scope

This International Standard specifies a method for determining the apparent overall density and the apparent core density of rigid cellular plastics, and the bulk density of semi-rigid and flexible cellular plastics and rubbers.

If the material to be tested includes skins formed during moulding, the apparent overall density or the apparent core density, or both, may be determined. If the material does not have skins formed during moulding, the term overall density is not applicable.

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 listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 1382 : 1982, *Rubber — Vocabulary.*

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

3 Definitions

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

3.1 apparent overall density (of a cellular material): The mass per unit volume of a sample, including all skins formed during moulding.

3.2 apparent core density (of a cellular material): The mass per unit volume of a sample after all skins formed during moulding have been removed.

3.3 bulk density[1] (of a cellular material): The mass per unit volume of a material measured under specified conditions and including both permeable and impermeable voids present in the material.

4 Apparatus

Ordinary laboratory apparatus and

4.1 Balance, capable of determining the mass of a test piece to an accuracy of 0,5 %.

4.2 Measuring instruments, in accordance with ISO 1923.

5 Test pieces

5.1 Dimensions

Each test piece shall be of a shape such that its volume can be easily calculated. It shall be cut without deforming the original cell structure of the material.

The size of a test piece should preferably be as large as possible, commensurate with the apparatus available and with the shape of the original material. For rigid materials, the total surface area of a test piece shall be at least 100 cm^2. For semi-rigid and flexible materials, the volume of a test piece shall be at least 100 cm^3.

For rigid materials, when the apparent overall density is being determined using test pieces cut from a larger sample, the ratio of the area of skin formed during moulding to total volume shall be the same for the test pieces as for the sample.

5.2 Number of test pieces

A minimum of three test pieces shall be tested for flexible materials and a minimum of five shall be tested for rigid materials.

The sample may be a manufactured object whose mass and volume can be measured accurately. Its total mass and total volume may be used to determine the sample density (see 8.3).

1) See ISO 1382.

5.3 Conditioning

5.3.1 Wait at least 72 h after manufacture before cutting from product samples the test pieces required for measurement purposes.

If required, this period may be reduced to 48 h or 16 h if experience shows that, 48 h or 16 h after manufacture, the difference in density compared with the density 72 h after manufacture is less than 10 %.

5.3.2 The test pieces shall be kept for at least 16 h at ambient conditions or in a desiccator (dry conditions) as defined below. This conditioning period may be part of the 72 h period following manufacture.

Ambient conditions in accordance with ISO 291 :

23 °C ± 2 °C, 50 % ± 5 % relative humidity

or

27 °C ± 2 °C, 65 % ± 5 % relative humidity

Dry conditions :

23 °C ± 2 °C

or

27 °C ± 2 °C

6 Procedure

6.1 Measure the dimensions, in millimetres, of the test pieces in accordance with ISO 1923. Make a minimum of three separate measurements of each dimension. For rigid materials in board form, make at least five measurements of the central area. Calculate the mean values for each dimension and from these measurements calculate the volumes of the test pieces.

6.2 Weigh each test piece to an accuracy of 0,5 % and record its mass in grams.

7 Expression of results

7.1 The density ϱ_a (apparent overall density, apparent core density or bulk density) of a test piece, in kilograms per cubic metre, is given by the formula

$$\frac{m}{V} \times 10^6$$

where

m is the mass, in grams, of the test piece;

V is the volume, in cubic millimetres, of the test piece.

Calculate the mean value of the density from the results for all test pieces and round it to the nearest 0,1 kg/m^3.

NOTE — With certain low-density closed-cell materials, for example those with densities less than 30 kg/m^3, buoyancy may be a cause of error. Allowance for this factor may be made as follows :

$$\varrho_a = \frac{m + m_a}{V} \times 10^6$$

where

m_a is the mass, in grams, of displaced air, calculated by multiplying the volume, in cubic millimetres, of the test piece by the density, in grams per cubic millimetre, of air at atmospheric temperature and pressure. The density of air at a temperature of 23 °C and a pressure of 101 325 Pa (760 mmHg) is $1{,}220 \times 10^{-6}$ g/mm^3; the density of air at 27 °C and 101 325 Pa is $1{,}195\,5 \times 10^{-6}$ g/mm^3.

7.2 Calculate the standard deviation (estimated) as follows and report it to two significant figures :

$$s = \sqrt{\frac{\Sigma x^2 - n\bar{x}^2}{n - 1}}$$

where

s is the estimated standard deviation;

x is the value of a single measurement;

$\bar{x}$ is the arithmetic mean of the set of measurements;

n is the number of measurements made.

8 Precision

8.1 The values given in this clause were developed from data obtained using rigid materials only and with test pieces conditioned for 72 h. Their validity for other materials and conditioning periods has yet to be determined.

8.2 Inter- and intra-laboratory precision of this test method can be expected to vary for different materials. Results of a five-laboratory round-robin test programme showed that, for certain materials, measured absolute density differences can be limited to 1,7 % (at 95 % confidence) within a single laboratory. Measured absolute density differences between laboratories can be limited to 2,6 % (at 95 % confidence) for the same materials.

8.3 The density of an item measured as a whole should agree to within 4 % with the density measured by cutting five test pieces from the whole, for a single laboratory and material.

NOTE — The above data are based upon results from a round-robin test programme between five laboratories in the USA and reported in ASTM Research Report RR : D 20-1105 of the American Society for Testing and Materials. The most variable material included in the round-robin tests showed measured absolute differences in density of 8 % within a laboratory and 15 % between laboratories (at 95 % confidence).

9 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) a complete identification of the material tested;

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

d) the presence or absence of surface skins and if skins were removed for testing;

e) the presence of densification, striations or other defects of the test pieces;

f) the individual test results, stating details of test piece shape, test piece dimensions and the locations from which they were taken;

g) the mean value of the density (apparent overall density, apparent core density or bulk density) and the standard deviation;

h) whether any allowance was made for buoyancy and, if so, the size of the correction and details of the temperature, pressure and relative humidity of the ambient air during the test;

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

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