INTERNATIONAL STANDARD

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Cellular plastics and rubbers — Determination of apparent density

Caoutchoucs et plastiques alvéolaires — Détermination de la masse volumique apparente

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 845 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 10, *Cellular plastics*.

This third edition cancels and replaces the second edition (ISO 845:1988), which has been technically revised.

Cellular plastics and rubbers — Determination of apparent density

1 Scope

This International Standard specifies a method for determining the apparent overall density and the apparent core density of cellular plastics and rubbers.

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

For shaped materials, a different method such as buoyancy method may be used.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
apparent overall density
⟨cellular material⟩ mass per unit volume of a sample, including all skins formed during moulding

3.2
apparent core density
⟨cellular material⟩ mass per unit sample after all skins formed during moulding have been removed

4 Apparatus

Ordinary laboratory apparatus and the following.

4.1 **Balance**, capable of determining the mass of a test specimen to an accuracy of 0,1 %.

4.2 **Measuring instruments**, in accordance with ISO 1923.

5 Test specimens

5.1 Dimensions

Each specimen 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 specimen should preferably be as large as possible, commensurate with the apparatus available and with the shape of the original material. The total volume of a specimen shall be at least 100 cm^3.

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

5.2 Number of test specimens

A minimum of five specimens shall be tested.

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.

5.3 Conditioning

5.3.1 For measurement purposes, wait at least 72 h after manufacture before cutting the specimens from product samples.

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 specimen shall be kept for at least 16 h at standard atmospheres or in a desiccator (dry conditions) as defined below. This conditioning period may be part of the 72 h period following manufacture.

Standard atmospheres in accordance with ISO 291 are

a) (23 ± 2) °C, (50 ± 10) % relative humidity,

b) (23 ± 5) °C, (50 $^{+20}_{-10}$) % relative humidity, or

c) (27 ± 5) °C, (65 $^{+20}_{-10}$) % relative humidity.

Dry conditions are

— (23 ± 2) °C, or

— (27 ± 2) °C.

6 Procedure

6.1 Measure the dimensions, in millimetres, of the specimen 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 volume of the specimen.

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

7 Expression of results

7.1 The density ρ (apparent overall density or apparent core density) of a test specimen, in kilograms per cubic metre, is given by the formula:

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

where

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

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

Calculate the mean value of the density from the result for all test specimens 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 15 kg/m^3, buoyancy may be a cause of error. Allowance for this factor may be made as follows:

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

where m_a is the mass of displaced air, in grams, calculated by multiplying the volume, in cubic millimetres, of the test specimen by the density, in grams per cubic millimetres, 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 × 10^{-6} g/mm^3; the density of air at 27 °C and 101 325 Pa is 1,195 5 × 10^{-6} g/mm^3.

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

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

where

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 Accuracy

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

8.2 The inter- and intra-laboratory accuracy of this test method can be expected to vary for different materials. Results of a five-laboratory collaborative 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 material.

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 specimens were conditioned;

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

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

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

g) the mean value of the density (apparent overall density or apparent core 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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