
**Flexible cellular polymeric materials —
Determination of resilience by ball
rebound**

*Matériaux polymères alvéolaires souples — Détermination de la
résilience par rebondissement d'une bille*



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.



COPYRIGHT PROTECTED DOCUMENT

© ISO 2007

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principle	1
5 Apparatus	1
5.1 General	1
5.2 Apparatus with manual reading	2
5.3 Apparatus with automatic reading	3
6 Test pieces	3
7 Number of test pieces	3
8 Test conditions	3
9 Procedure	4
9.1 Preflex conditioning	4
9.2 Test method	4
10 Expression of results	4
11 Precision	4
12 Test report	4
Annex A (informative) Example of electronic measurement procedure	6

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 8307 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*.

This second edition cancels and replaces the first edition (ISO 8307:1990), which has been technically revised. The main change is the inclusion of an automatic method, using an electronic sensor, of measuring the ball rebound height.

Flexible cellular polymeric materials — Determination of resilience by ball rebound

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

This International Standard specifies a method for determining the resilience by ball rebound of flexible cellular polymeric materials.

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 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

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

3.1

open-cell flexible cellular material

flexible cellular material with less than 25 % of its cell volume closed

3.2

closed-cell flexible cellular material

flexible cellular material with more than 25 % of its cell volume closed

4 Principle

A steel ball is dropped on to a test piece from a specified height and the height of rebound is measured.

5 Apparatus

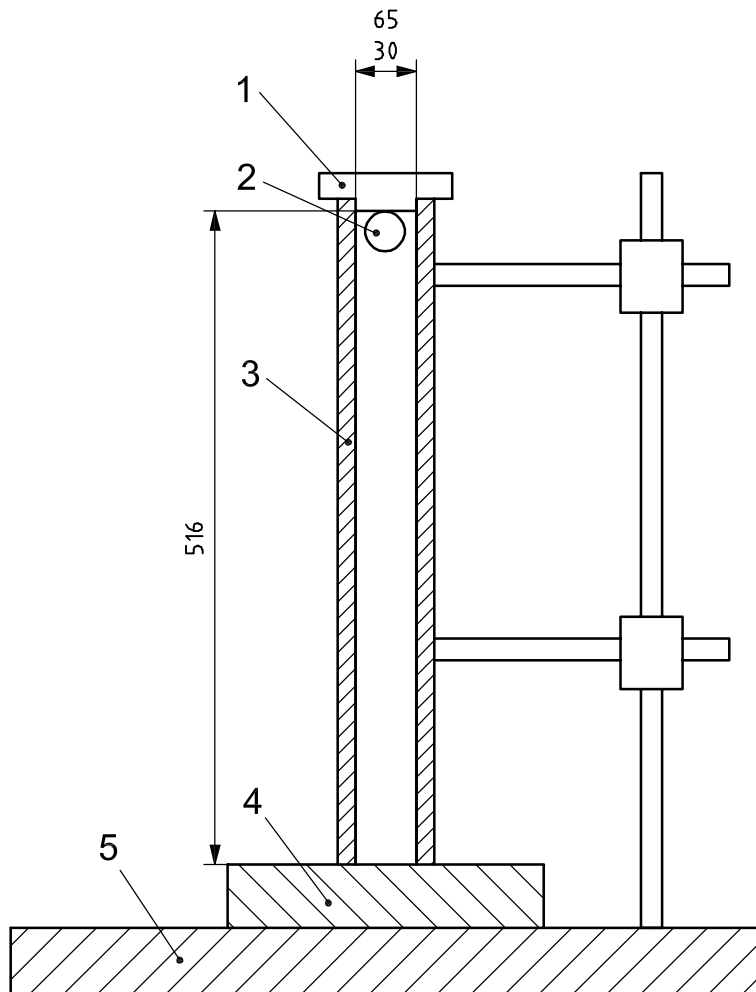
5.1 General

The ball rebound test apparatus (see Figure 1) shall consist of a 30 mm to 65 mm inside diameter vertical transparent tube, into which a 16 mm \pm 0,5 mm diameter steel ball with a mass of 16,8 g \pm 1,5 g is released by a magnet or other suitable device. The steel ball shall be released so that it falls without rotation and is

effectively centred. The height of the drop shall be $500 \text{ mm} \pm 0,5 \text{ mm}$. Since it is most convenient to note the position of the top of the ball on rebound, the top of the ball shall be 516 mm above the surface of the test piece. Thus, "zero" rebound shall be the diameter of the ball above the specimen surface.

Measurement errors can arise if the tube is not held in a vertical position, and measurements may be invalid due to contact of the rebounding ball and the inner surface of the tube. It is therefore important to use a spirit level or similar device to ensure that the tube is mounted at right angles to the rigid baseplate, and that the baseplate itself is horizontal.

Dimensions in millimetres



Key

- 1 magnet or other suitable device
- 2 steel ball
- 3 transparent tube
- 4 test piece
- 5 rigid baseplate

Figure 1 — Diagrammatic arrangement of test apparatus

5.2 Apparatus with manual reading

The scale on the back of the tube shall be graduated directly in per cent as follows: every 5 % (25 mm) a complete circle shall be scribed and at every 1 % a 120° arc shall be scribed on the tube. The complete circles are an essential part of the apparatus, since they are used to eliminate parallax error.

5.3 Apparatus with automatic reading

A device capable of determining the rebound height of the steel ball by electronic means can also be used, as long as it has been demonstrated to give the same results as the manual-reading apparatus. The rebound height can be calculated from, for example, the rebound velocity or the time interval between the first and second contacts of the ball with the foam surface (see Annex A). The apparatus can be equipped with any such device provided it is capable of determining the rebound height to a precision of $\pm 1\%$ of the total drop height (i.e. ± 5 mm). For this type of apparatus, the tube does not require graduations.

6 Test pieces

6.1 The test pieces shall have plane, parallel top and bottom surfaces.

6.2 The test pieces shall consist of the entire product sample or a suitable portion of it, except that in no case shall the thickness be less than 50 mm or the area less than 100 mm \times 100 mm. Test pieces less than 50 mm thick shall be plied up, without the use of cement, to a minimum of 50 mm. For moulded products, the top skin shall be removed.

NOTE The minimum test piece thickness of 50 mm may not be sufficient for very soft materials: if spuriously high results are obtained, a thicker test piece can be used. Very low density materials may also cause problems due to rebound of the test piece itself. With multiple-ply test pieces, slipping can occur between the plies. This problem can be overcome by using the largest possible area of test piece.

7 Number of test pieces

Three test pieces per sample shall be tested. The three test pieces may be obtained by using separate items or different locations on a given item.

8 Test conditions

Material shall be tested not less than 72 h after manufacture, unless, at either 16 h or 48 h after manufacture, it can be demonstrated that the mean rebound resilience values obtained do not differ by more than $\pm 10\%$ from those obtained after 72 h. Testing is permitted at either 16 h or 48 h if, at the selected time, the above criterion has been satisfied.

Prior to the test, the test pieces shall be conditioned undeflected and undistorted for at least 16 h in one of the following atmospheres as given in ISO 23529:

- 23 °C \pm 2 °C, (50 \pm 5) % relative humidity;
- 27 °C \pm 2 °C, (65 \pm 5) % relative humidity.

This period can form the latter part of the period following manufacture.

In the case of quality-control tests, test pieces can be taken a shorter time (down to a minimum of 12 h) after manufacture and testing carried out after conditioning for a shorter period (down to a minimum of 6 h) in one of the atmospheres specified above.

9 Procedure

9.1 Preflex conditioning

Open-cell material as defined in 3.1 shall be subjected to preflex conditioning before testing. Preflex the test piece by compressing it twice to 75 % to 80 % of its original thickness at 0,4 mm/s to 6 mm/s, then allow the test piece to recover for a period of 10 min \pm 5 min.

NOTE This preflex conditioning is not applicable to closed-cell material as defined in 3.2.

9.2 Test method

9.2.1 Carry out the test immediately after conditioning, preferably in the same atmosphere as was used to condition the test pieces (see Clause 8).

9.2.2 Centre the test piece at the base of the tube (see Clause 5) and adjust the height of the tube so that zero rebound is 16 mm \pm 0,5 mm above the surface of the test piece. Clamp the tube to make light contact with the test pieces without causing visible compression.

9.2.3 Mount the steel ball on the release mechanism, then drop it and note the maximum rebound height to the nearest percentage point. If the ball strikes the tube on the drop or rebound, the value obtained is invalid. This condition is usually due to the tube not being vertical or to irregularities on the test piece surface. In order to minimize parallax error, the eye-level of the observer shall be such that the markings on the tube in the region where the percentage rebound value is read appear as straight lines. Trial drops are necessary in order to establish the correct eye-level.

9.2.4 At least three rebound values in succession within 1 min shall be obtained on each of the three test pieces.

10 Expression of results

For each test piece, determine the median of the three rebound height values. If any value deviates by more than 20 % (one-fifth) of the median value from the median, make two additional drops and determine the median for all five rebound height values. Using the median values obtained for the three test pieces, determine the overall median value as the rebound resilience value of the material.

If automated measurement is employed, the results shall also be expressed to the nearest integer.

11 Precision

At the present time, precision data are not available for this test method.

12 Test report

The test report shall include the following information:

- a) a reference to this International Standard;
- b) a description of the material tested, including whether open-cell or closed-cell as defined in Clause 3;
- c) the temperature and humidity at which the test piece was conditioned and tested;
- d) whether or not electronic measurement was used;

- e) the rebound resilience value as the median of the three test piece medians;
- f) the individual rebound height values of the three (or five) tests per test piece;
- g) the material lot number or date of manufacture;
- h) the date of the test.

Annex A (informative)

Example of electronic measurement procedure

The basic construction of the apparatus is as shown in Figure 1. In addition, a light barrier for time measurement is mounted at the lower end of the tube. The time measurement starts with the first contact of the steel ball with the test piece surface and stops with the second contact. The time interval is given by the equation

$$t_{\text{tot}} = 2\sqrt{\frac{2h}{g}}$$

where

t_{tot} is the time between the two contacts, expressed in seconds;

h is the ball rebound height, expressed in millimetres;

g is the acceleration due to gravity, expressed in millimetres per second squared.

Rearranging the equation gives the ball rebound height h :

$$h = \frac{g \times t_{\text{tot}}^2}{8}$$

The percentage rebound value R can then be calculated from the equation

$$R = \frac{h}{h_{\text{max}}} \times 100$$

where h_{max} is the height of the drop (500 mm).

This page is intentionally blank.

