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Flexible cellular polymeric materials — Determination of fatigue by constant-load pounding

Matériaux polymères alvéolaires souples — Détermination de la fatigue par indentation à charge constante

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products other than hoses*.

This fourth edition cancels and replaces the third edition (ISO 3385:1989), which has been technically revised.

Flexible cellular polymeric materials — Determination of fatigue by constant-load pounding

1 Scope

This International Standard specifies a method for the determination of loss in thickness and loss in hardness of flexible cellular materials intended for use in load-bearing applications such as upholstery.

It provides a means of assessing the service performance of flexible cellular materials based on rubber latex or polyurethane used in load-bearing upholstery.

The method is applicable both to standard size test pieces cut from slabstock material and to shaped components. The measured loss in thickness and loss in hardness are related to, but are not necessarily the same as, the losses likely to occur in service.

This international Standard is not intended to function as a detailed engineering design specification for fatigue apparatus.

2 Normative references

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

ISO 2439:2008, *Flexible cellular polymeric materials — Determination of hardness (indentation technique)*

3 Principle

Repeated indentation of a test piece by an indentor smaller in area than the test piece, the maximum load reached during each cycle being kept within specified limits. The typical loading cycle is shown in Figure A.1.

4 Apparatus

4.1 Pounding test machine of either Type A (see 4.2) or Type B (see 4.3), having the following parts.

4.1.1 Plane platen, capable of fully supporting the test piece, and suitably vented with holes approximately 6 mm in diameter at approximately 20 mm pitch in order to allow air to escape from the test piece.

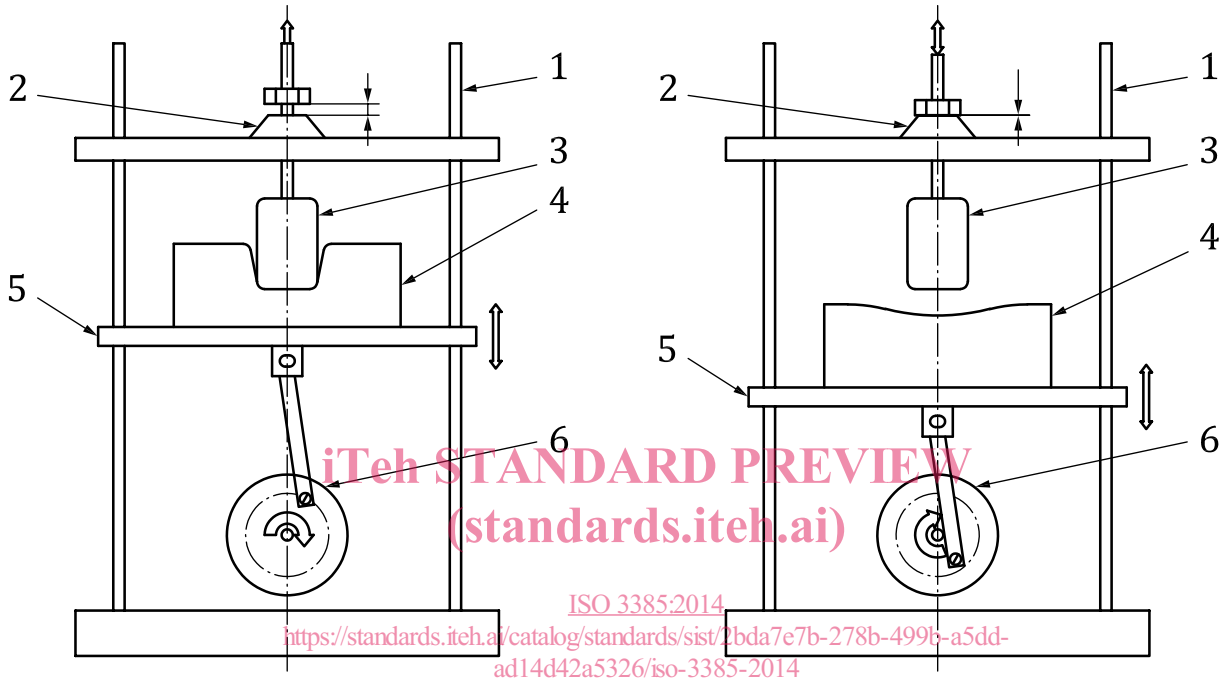
4.1.2 Indentor, having an overall diameter of 250 mm ± 1 mm with a 25 mm ± 1 mm radius at its lower edge, provided with a device for applying a maximum force of 750 N ± 20 N during the loading cycle. The indentor shall be rigidly fixed to its guide and its surface shall be smooth but not polished.

The machine shall be capable of oscillating either the platen (4.1.1) carrying the test piece, or the indentor towards the other in a vertical direction at a rate of (70 ± 5) strokes per minute. The amplitude of the stroke shall be adjustable.

The indentor shall be linked to a re-settable counting device which displays the number of compression cycles performed during the test.

4.1.3 Indentor drive mechanism, capable of applying the maximum force of 750 N ± 20 N for no more than 10 % of the total duration of each cycle.

4.2 Machine Type A, in its simplest form the mechanism comprises a crank drive and suspended weight. The weight shall be supported throughout the loading cycle except at that part of the stroke when the mounting and platen are closest together. At this point, the full force of the indentor shall be supported by the test piece; this shall not be for more than 10 % of the full machine cycle. This type of device is shown schematically in Figure 1 a) and Figure 1 b). The moving platen (5) shall be fitted with appropriate means to locate the test piece and prevent its lateral movement during the test.



a) Full loading point **b) Zero load point**

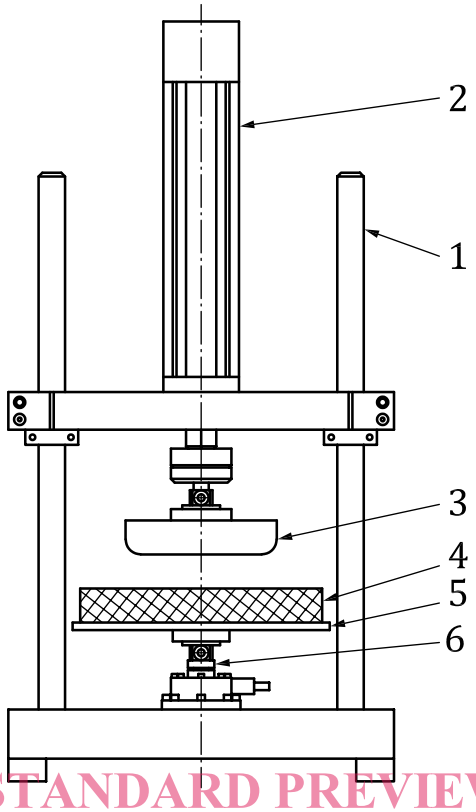
Key

1 load frame
2 indentor mounting
3 indentor
4 test piece
5 moving platen
6 drive shaft/cam

Figure 1 — Example of an arrangement of machine Type A with manual adjustment

4.3 Machine Type B, a fully controlled device driven by electro-, pneumatic or hydraulic mechanism, equipped with load cell and means to provide the necessary indentation frequency and peak force. The generic form of machine Type B is illustrated schematically in Figure 2. Figure 3 is an outline drawing of one of the commercially available machines, but is not meant to exclude other machines that comply with the essential requirements.

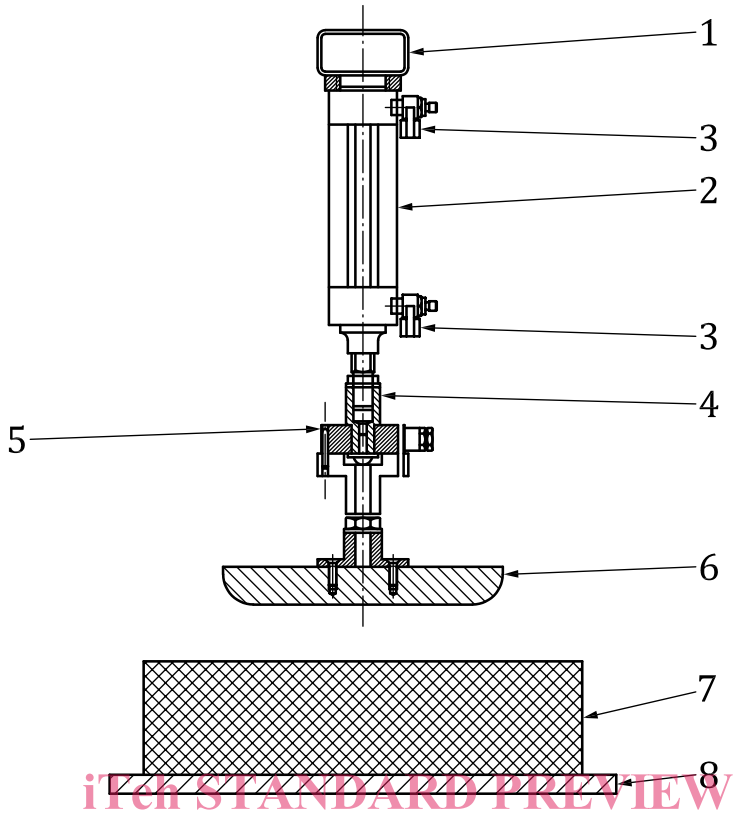
The apparatus shall be capable of measuring the maximum force with a precision of ±1 %. Compliance with specified limits shall be provided by graphical or other visual display.



Key

1 load frame
2 actuator (electro-mechanical, pneumatic or servo-hydraulic)
3 indentor
4 test piece
5 support platen
6 load cell

Figure 2 — Examples of diagrammatic arrangements of machine Type B with fully automatic adjustment — a) Generic design



Key

1 beam
2 electromechanical, pneumatic or hydraulic cylinder
3 flow control valve
4 load cell adapter
5 load cell
6 indentor
7 test piece
8 base plate

Figure 3 — Examples of diagrammatic arrangements of machine Type B with fully automatic adjustment — b) Example of one commercially available apparatus

Type B machines shall be equipped with a force-measurement device, whereby the maximum load applied to the test piece by the indentor during every cycle shall be measured. The maximum force shall be controlled within 750 N ± 20 N tolerance throughout the full duration of the pounding process.

The support platen (5) or base plate (8) (as appropriate) shall be fitted with appropriate means to locate the test piece and prevent its lateral movement during the test.

5 Test pieces

5.1 Shape and dimensions

Test pieces shall be right parallelepipeds having sides of length 380 mm ± 20 mm and a thickness of 50 mm ± 2 mm. Tests may also be conducted on components that do not comply with these dimensions subject to agreement between the interested parties.

5.2 Samples showing orientation

Normally, testing shall be conducted in that direction in which the finished product will be stressed under service conditions. If materials show cell structure orientation, the direction in which the indentation is applied may be agreed between the interested parties.

5.3 Number

Three test pieces shall be tested.

5.4 Conditioning

5.4.1 Material shall not be tested less than 72 h after manufacture, unless at either 16 h or 48 h after manufacture it can be demonstrated that the result does not differ by more than ±10 % from that obtained after 72 h. Testing is permitted at either 16 h or 48 h if, at the specified time, the above criterion has been satisfied.

5.4.2 Prior to the test, the test pieces shall be conditioned, undistorted, for at least 16 h in one of the specified atmospheres as follows:

a) 23 °C ± 2 °C, 50 % ± 5 % relative humidity, or

b) 27 °C ± 2 °C, 65 % ± 5 % relative humidity.

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

6 Procedure

6.1 Testing shall be conducted in a climate controlled atmosphere as specified in 5.4.

6.2 Perform all measurements on the same surface of the test specimen.

6.3 Measure the thickness, d_1, and its hardness index as specified in ISO 2439:2008, Method A.

6.4 Machine Type A: Place the test piece concentrically under the indentor, adjust the stroke to be equal to the thickness of the test piece with a tolerance of ±10 % and adjust the relative separation of the indentor and platen, until the specified load of 750 N ± 20 N is applied. The correct loading is achieved when the indentor is just lifted in its mounting and is completely unsupported.

As the foam softens during pounding, it is necessary for the indentor position to be continuously adjusted during the test sequence to maintain the above test load of 750 N ± 20 N.

6.5 Machine Type B: Place the test piece concentrically under the indentor and set the indentor speed to provide an indentation frequency of (70 ± 5) strokes per minute in a way that approximates to a triangular or sinusoidal travel-time sequence.

Apply contact between indentor and specimen and, within the first 10 preliminary loading cycles, bring peak load and dwell time under control within specified limits. The maximum allowed force of 770 N shall not be exceeded at any time during the test. The dwell time at peak load shall not exceed 10 % of the full period time of the indentation cycle throughout the whole test.

During the test, ensure that the peak load of 750 N ± 20 N is constantly within tolerance by appropriate adjustment e.g. of the stroke or test speed. The indentor shall be completely discharged in each loading cycle of the test.