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Furniture — Mattresses — Test methods for the determination of functional characteristics

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Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 General test conditions	2
4.1 Preliminary preparation.....	2
4.2 Tolerances.....	2
5 Test apparatus	2
5.1 Standard test bed base for mattresses.....	2
5.2 Side support profile.....	2
5.3 Standard table/test board (measuring).....	3
5.4 Loading pad.....	3
5.5 Equipment for recording the load/deflection curves.....	4
5.6 Equipment for the durability test.....	4
5.7 Edge loading pad.....	5
5.8 Small loading pad.....	5
6 Test procedures—Durability and impact	6
6.1 General.....	6
6.2 Durability of mattress surface.....	6
6.3 Durability of mattress edge.....	7
6.4 Vertical durability.....	7
6.5 Impact test.....	8
7 Test procedures—functional characteristics	8
7.1 General.....	8
7.2 Load/deflection curve.....	8
7.3 Determination of height loss.....	9
7.4 Determination of hardness value.....	9
7.5 Determination of firmness rating.....	10
8 Test report	11
Annex A (normative) Edge loading pad data	12
Annex B (informative) Impact test	14

ISO/DIS 23769:2020(E)

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.

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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee 136, furniture.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The International Organization for Standardization (ISO) *[and/or]* International Electrotechnical Commission (IEC) draw[s] attention to the fact that it is claimed that compliance with this document may involve the use of a patent.

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Furniture — Mattresses — Test methods for the determination of functional characteristics

1 Scope

This document specifies test methods for the determination of the durability, height loss and hardness of mattresses (and mattress pads when they form a unit with the mattress).

This document applies to mattresses for domestic and non-domestic use. It does not apply to water mattresses, air mattresses, mattresses for cots and cribs or mattresses which cannot be separated from the bed bases.

Test methods for the assessment of aging, degradation, fire resistance and electrical functions are not included.

This document does not give any product requirements. Where no requirements document is available the desired functional characteristics should be determined by the specifier.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 1334, *Domestic furniture — Beds and mattresses — Methods of measurement and recommended tolerances*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

load/deflection curve

curves that are obtained by pressing a load pad into the mattress and measuring the associated value of indentation and force simultaneously

3.2

hardness value (*H*)

determined from load/deflection measurement, in N/mm

3.3

firmness rating (*H_s*)

a number (1 decimal) on a scale from 1 to 10 which expresses the firmness of a mattress

3.4

height loss

change in the height of a mattress, in mm, as a result of the durability test or impact test

ISO/DIS 23769:2020(E)

3.5 mattress pad

product, comprising a cover and filling (s), or filling material (s) alone, used in conjunction with a mattress or upholstered bed base

Note 1 to entry: This product is not intended to be used separately.

4 General test conditions

4.1 Preliminary preparation

The tests shall be carried out in indoor ambient conditions at a temperature between 15 °C and 25 °C. If during a test the temperature is outside of the range of 15 °C to 25 °C, the maximum and/or minimum temperature shall be recorded in the test report.

All conditioning shall be carried out in a standardised climate of (23 ± 2) °C and (50 ± 5) % RH.

During conditioning and handling, mattresses shall be kept flat and unloaded.

If a test cannot be carried out as specified, e.g. because a loading pad cannot be used for the application of a force due to the design of product, the test shall be carried out as far as possible as specified.

If necessary, mattress pads shall be prevented from moving during testing by a suitable means, e.g. adhesive tape or pins.

In cases where mattresses are adjustable in hardness, the setting during the test shall be recorded in the test report.

If the product information states that the mattress has a soft side and a firm side, both sides shall be tested using separate mattresses.

4.2 Tolerances

Unless otherwise stated the following tolerance are applicable to the test equipment:

- a) all forces shall have an accuracy of ± 5 % of the nominal force;
- b) all masses an accuracy of $\pm 0,5$ % of the nominal mass;
- c) all dimensions less than 200 mm shall have an accuracy of ± 1 mm of the nominal dimension; the other dimensions shall have an accuracy of $\pm 0,5$ %;
- d) the tolerance for position of loading pads shall be ± 5 mm.

NOTE For the purposes of uncertainty measurement, test results are not considered to be adversely affected when the above tolerances are met.

5 Test apparatus

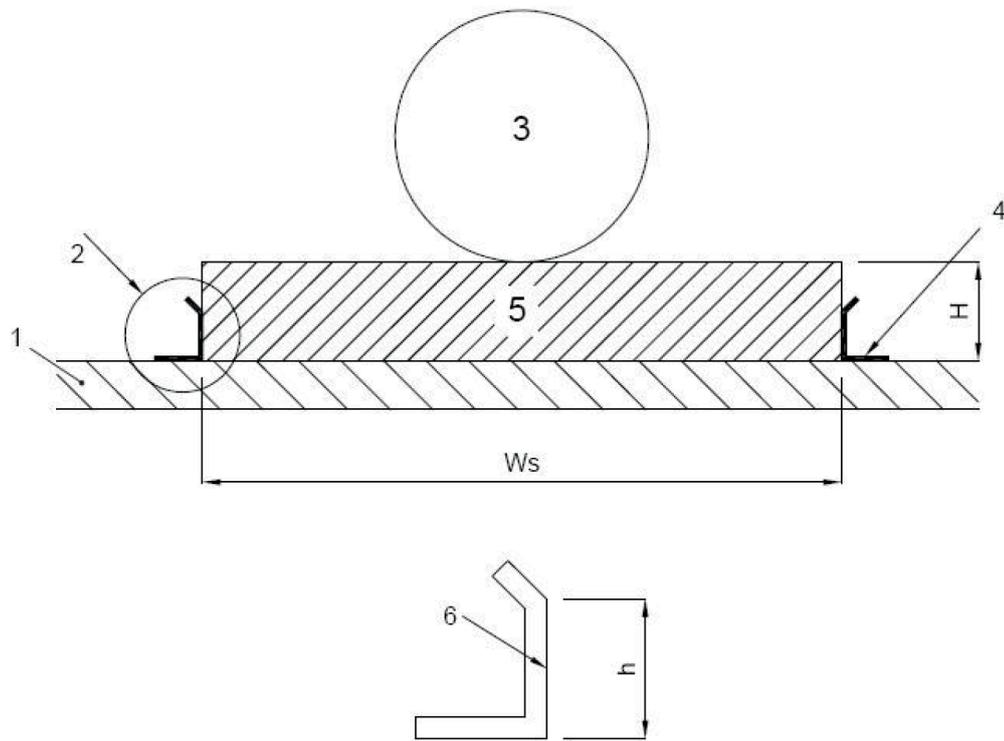
5.1 Standard test bed base for mattresses

Rigid, horizontal, flat and smooth.

5.2 Side support profile

The mattress shall be prevented from moving during durability test by two side support profiles as illustrated in [Figure 1](#). The internal distance between the supports (W_s) shall be equal to the width of the mattress measured according to EN 1334, ± 10 mm. The height of the support profiles (h) shall

not exceed one third of the mattress thickness (H), measured according to EN 1334. The length of the support profiles shall be at least equal to the length of the test unit.



Key

- | | | | |
|-------|---------------------------|---|--|
| 1 | standard test bed base | 4 | side support profile |
| 2 | side support profiles | 5 | mattress |
| 3 | roller | 6 | enlargement of side support profiles (2) |
| H | height of mattress | h | height of support profiles |
| W_s | distance between supports | | |

Figure 1 — Side support profile

5.3 Standard table/test board (measuring)

Horizontal, flat and smooth surface, large enough to fully support the mattress in any measuring position. At the loading position, the deflection shall not exceed 1 mm under 1000 N load. The overall flatness tolerance of the test board shall be 2 mm/1000 mm.

5.4 Loading pad

Rigid circular object 355 mm in diameter the face of which has a convex spherical curvature of (800 ± 20) mm radius with a 20 mm front edge radius (see [Figure 2](#)).

The loading pad shall have a smooth surface and shall be mounted to the loading system of the test machine ([5.5](#)) by a ball joint as close as possible to the indenter surface (see [Figure 2](#)).

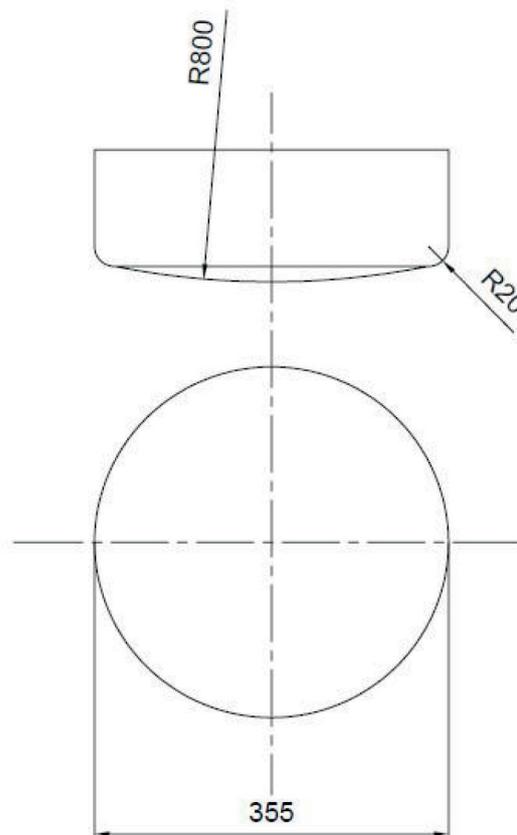


Figure 2 — Loading pad

5.5 Equipment for recording the load/deflection curves

The equipment for recording the load/deflection curves shall be loading pad (5.4) and a testing machine capable of applying a vertical downward load up to 1000 N.

The travel speed for both loading and unloading shall be (90 ± 5) mm/minute.

Load and height with reference to a fixed datum shall be measured.

The accuracy of the height measuring system shall be $\pm 0,5$ mm or better.

The accuracy of the load measuring system shall be ± 1 % of the max load (1000N) or better.

The equipment shall be so that horizontal forces do not influence the measurement.

5.6 Equipment for the durability test

The equipment consists of a roller with dimensions and a shape illustrated in Figure 3 and a mechanism capable of relative horizontal movement of the roller on the unit surface.

The roller surface shall be hard, smooth and without scratches or other surface defects.

The total rolling system shall apply a load of (1400 ± 7) N measured in the static condition.

The roller shall have a rotation moment of inertia of $0,5 \text{ kgm}^2 \pm 0,05 \text{ kgm}^2$. The roller shall be free to pivot along its longitudinal and lateral axis relative to the horizontal.

The roller shall be capable of following the surface of the mattress, and it shall be free to move up and down to follow the mattress surface.

The forces on the roller shall act horizontally at the centre point. The motion shall be approximately sinusoidal (within $\pm 10\%$) and symmetrical along the longitudinal symmetry axis of the unit. The frequency shall be (16 ± 2) cycles per minute.

Dimensions in millimetres

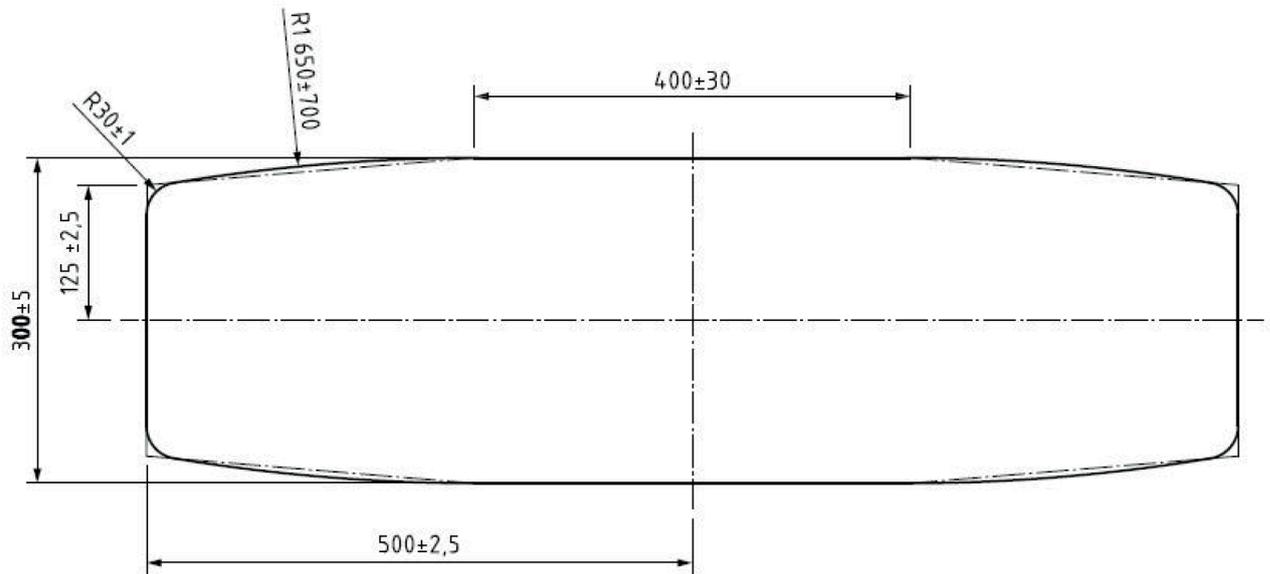


Figure 3 — Roller

5.7 Edge loading pad

The edge loading pad is a naturalistically shaped rigid indenter with a hard, smooth surface having over dimensions within the limits shown in [Figure A.1](#).

For details of design, see [Annex A](#).

5.8 Small loading pad

Rigid circular object 200 mm in diameter the face of which has a convex spherical curvature of (300 ± 5) mm radius with a 12 mm front edge radius (see [Figure 4](#)). The loading pad shall be rigidly mounted to the loading system of the test machine.

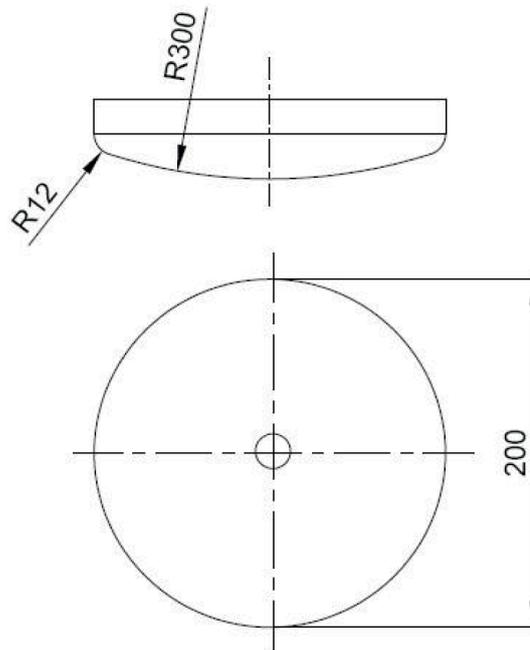


Figure 4 — Small loading pad

6 Test procedures—Durability and impact

6.1 General

All tests shall be carried out on the same mattress and in the sequence as the clauses are numbered in this document.

The mattress shall be tested for durability with the standard test bed base for mattresses (5.1) with side support profiles (5.2).

6.2 Durability of mattress surface

The test shall be carried out with the roller apparatus (5.6). Before beginning the test, adjust the roller mechanism so that:

- The driving forces act horizontally ($- 0^\circ$, $+2^\circ$) when the roller rests on the centre line of the sleeping area.
- The length of travel of the roller shall be 250 mm on either side of the longitudinal centre line of the sleeping area and perpendicular to its longitudinal axes.

One cycle includes one travel back and forth.

Unless otherwise specified by the manufacturer, the mattress shall be conditioned for at least 72 h in the standardised climate (according to 4.1) before testing. The test shall be carried out in the following sequence:

- a) durability: 100 cycles;
- b) conditioning, at least 5 h in the standardised climate (according to 4.1.);

- c) measurement of the mattress height (according to [7.3](#)) at 100 cycles and hardness measurement (according to [7.4](#)) beginning within 5 min from moving the mattress from the standardised climate (according to [4.1](#));
- d) durability test: 29 900 cycles;
- e) conditioning, at least 5 h in the standardised climate (according to [4.1](#));
- f) determination of hardness (according to [7.4](#)) and height loss (according to [7.3](#)) between 100 cycles and after the test.

6.3 Durability of mattress edge

Apply a force of 1 000 N for 5 000 cycles by means of the edge loading pad ([5.7](#)).

Testing shall be carried out on one edge at the middle of the length.

The load application point shall be 200 mm from the edge of the top surface of the mattress.

During each application maintain the force for (3 ± 1) s.

The test shall be carried out in the following sequence:

- a) durability test:100 cycles;
- b) conditioning, at least 5 h in the standardised climate (according to [4.1](#));
- c) measurement of the mattress height (according to [7.3](#)) at 100 cycles;
- d) durability test: 4 900 cycles;
- e) conditioning, at least 5 h in the standardised climate (according to [4.1](#));
- f) measurement of the mattress height and height loss (according to [7.3](#)) between 100 cycles and after the test.

6.4 Vertical durability

Apply a vertical downward force of 1 000 N using the small loading pad (see [5.8](#)).

Apply the load 10 000 cycles at each position shown in [Figure 5](#).

In the case where the materials/constructions of head and feet are identical, the test shall be performed in the middle (Position A) and at one end (Position B₁ or B₄) only.

In the case where the materials/constructions of left and right are identical, the test shall be performed in the middle (Position A) and at one side (Position B₂ or B₃) only.

In the case where the materials/constructions of the head and foot end are not identical and the left and right side are also not identical, then the test shall be carried out at ALL positions (Positions A, B₁, B₂, B₃ and B₄).

During each application maintain the force for (3 ± 1) s.

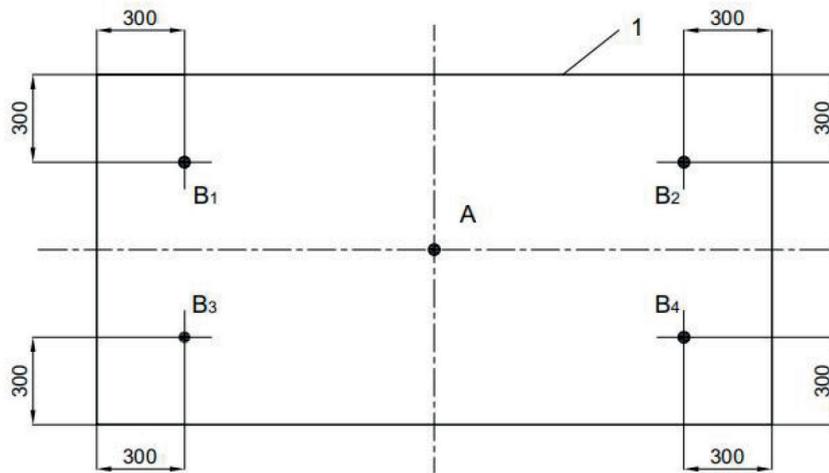
The test for each position shall be carried out in the following sequence:

- a) durability test:100 cycles;
- b) conditioning, at least 5 h in the standardised climate (according to [4.1](#));
- c) measurement of the mattress height (according to [7.3](#)) at 100 cycles;
- d) durability test: 9 900 cycles;

ISO/DIS 23769:2020(E)

- e) conditioning, at least 5 h in the standardised climate (according to [4.1](#));
- f) measurement of the mattress height and height loss (according to [7.3](#)) between 100 cycles and after the test.

Dimensions in millimetres



Key

- 1 mattress
- A, B₁, B₂, B₃, B₄ force application points

Figure 5 — Vertical durability

6.5 Impact test

The impact test is shown in [Annex B](#).

7 Test procedures—functional characteristics

7.1 General

The measurable functional characteristics are determined or calculated before and after the durability test and are based on the load/deflection curve as in [7.2](#).

For the assessment of the load/deflection curves, the mattress shall be placed on the standard table/test board ([5.3](#)).

7.2 Load/deflection curve

The load/deflection curve shall be obtained using the equipment specified in [5.4](#) and [5.5](#).

Hardness measurement shall begin within 5 min from moving the mattress from the standardised climate (see [4.1](#)).

The initial measurement shall be taken after 100 cycles of durability (see [6.2](#)).

The measuring point shall be in the centre of the roller tested area (see [6.2](#)).

The measuring procedure shall be as follows:

- a) Before carrying out any measurements, the mattress shall be allowed to recover for at least 5 h in the standardised climate (see 4.1).
- b) Preload the measuring point with 1000 N and unload. Repeat the preload and unload sequence a further 2 times, with the time between each preload cycle not exceeding 30 s. The measurement shall begin within 30 s of the end of the last preload cycle.
- c) The measurement shall consist of paired observations of deflection and load, while the load is increased up to 1000 N.

When logging data for the load deflection curve, there should be no less than 250 points from 0 to 1000 N. From 0 to 450 N, the distance between the points should not be more than 2 N. When calculating the slopes, this can be done by taking 5 points above and 5 points below each measuring valve and calculating the slopes by linear regression.

It may be of interest to record the Hysteresis curve by taking load/deflection measurement with the load decreasing from 1000 N to 0.

7.3 Determination of height loss

The height of the mattress shall be measured by equipment for the assessment of the load/deflection curve (see 5.4 and 5.5). The height is the distance in mm from the standard table/test board (5.3) or floor surface (5.1) to a point on the top surface of the mattress, where the force, acting on the mattress from the loading pad (5.4), equals 50 N.

Preload the measuring point with 50 N and unload. Repeat the preload and unload sequence a further 2 times, with the time between each preload cycle not exceeding 30 s. The measurement shall begin within 30 s of the end of the last preload cycle.

For durability of mattress surface (6.2), the measurement point shall be the geometric centre of the mattress surface. For durability of mattress edge (6.3), vertical durability (6.4) and impact test (6.5), the measurement point shall be the appropriate centre of the area where the edge loading pad (5.7), small loading pad (5.8) or impactor (B.3) contact with the mattress surface. If available, the height of all the loading and impact positions shall be measured.

For durability test, the height loss is the difference between the initial measurement at 100 cycles and after testing. For impact test, the height loss is the difference between the height measured before and after testing.

7.4 Determination of hardness value

The hardness value (H), in N/mm, is the average of the slopes of the load/deflection curves at 210 N, 275 N and 340 N (see Figure 6) as shown in Formula (1):

$$H = \frac{C_1 + C_2 + C_3}{3} \quad (1)$$

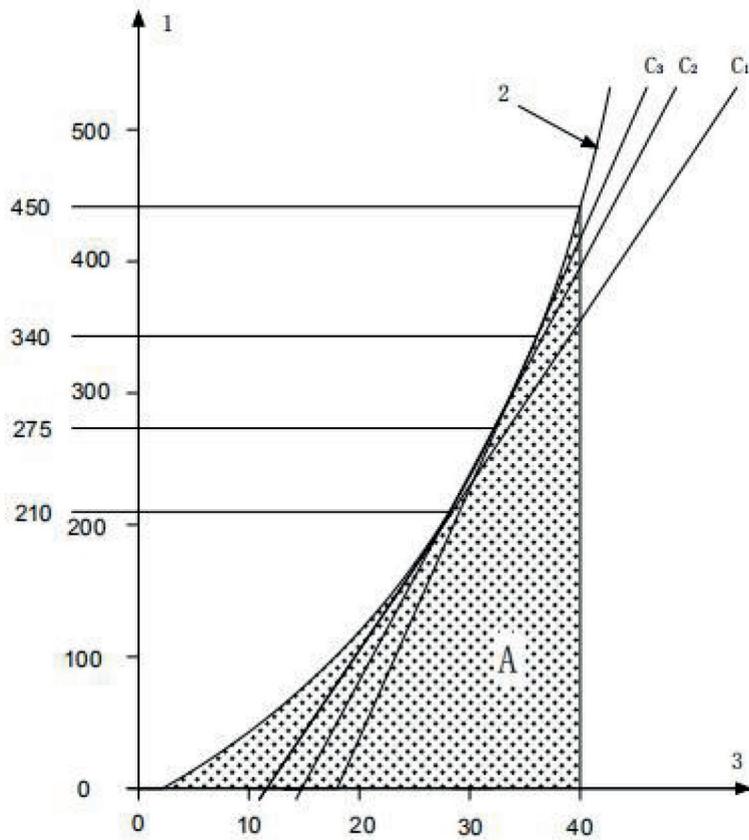
where

C_1 = slope at 210 N load

C_2 = slope at 275 N load

C_3 = slope at 340 N load

ISO/DIS 23769:2020(E)



- Key**
- 1 force[N]
 - 2 load/deflection curve
 - 3 indentation depth [mm]
 - A area under the load/deflection curve

Figure 6 — Determination of hardness value

7.5 Determination of firmness rating

The firmness rating (H_s) is a number (1 decimal) on a scale from 1 to 10 which expresses the firmness of a mattress.

$H_s = 1$ is a firm mattress

$H_s = 10$ is a soft mattress

H_s is determined by [Formula \(2\)](#):

$$H_s = 10(1 - \exp^{-(ka+b)})^2 \tag{2}$$

where

k is calculated from the load/deflection curve by Formula (3):

$$a = 5,92 \times 10^{-4}$$

$$b = 0,148$$

$$k = \frac{A}{H} \tag{3}$$

A = area under the load/deflection curve (under the load curve from 0 to 450 N)

H = hardness value

8 Test report

The test report shall include at least the following information:

- a) a reference to this document, i.e. ISO 23769:####;
- b) name and address of the laboratory;
- c) name and address of the client;
- d) piece of item tested;
- e) details of defects observed before testing;
- f) any variation from the specified temperature range;
- g) date of issue of the report;
- h) test results.

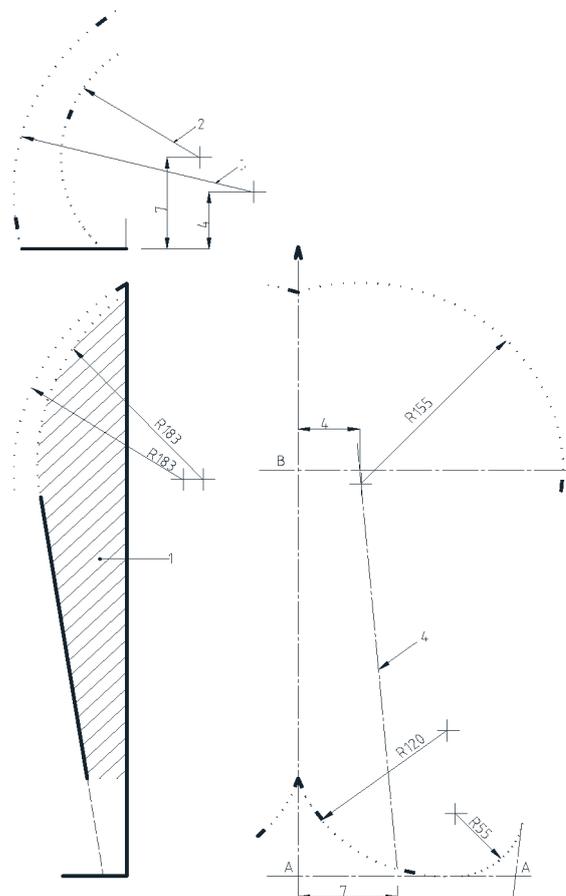
Annex A (normative)

Edge loading pad data

The edge loading pad specified in 5.7 currently exists in two versions:

- machined edge loading pad, as shown in [Figure A.1](#);
- moulded edge loading pad, as shown in [Figure A.2](#).

Dimensions in millimetres
 All dimensions: ± 5 mm



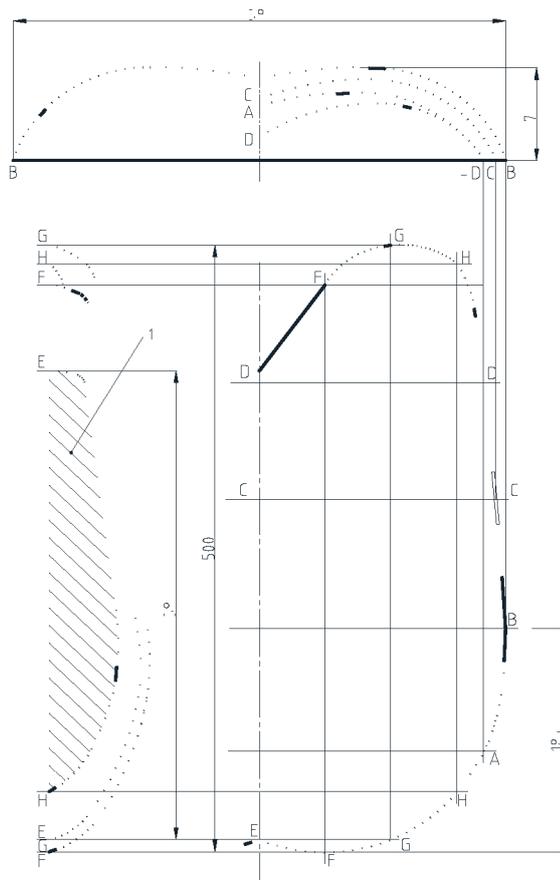
Key

- | | | | |
|---|---------------------------------------|---|---------------------------------------|
| 1 | Centre section cross hatched | 3 | R 183 (section B-B, see the top view) |
| 2 | R 105 (section A-A, see the top view) | 4 | Axis of the cone |

Figure A.1 — Edge loading pad geometry — Machined construction

Dimensions in millimetres

All dimensions: ± 5 mm



Key

- 1 centre section cross hatched

Figure A.2 — Edge loading pad geometry — moulded construction

Annex B (informative)

Impact test

B.1 Purpose

Test to change the functional characteristics of the mattress after subjected to impacts such as when a user drops themselves into the mattress or jumps on the mattress.

B.2 Test equipment

The impactor is as shown in [Figure B.1](#) and comprised of the following:

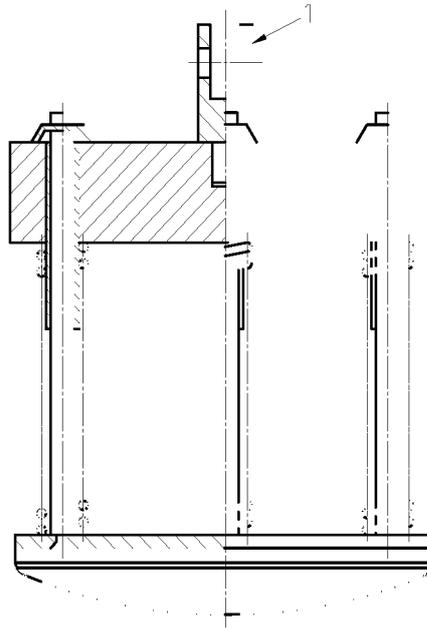
B.2.1 Circular body, approximately 200 mm in diameter separated from the striking surface by helical compression springs and free to move relative to it on a line perpendicular to the plane of the central area of the striking surface.

The body and associated parts minus the spring shall have a mass of $(17 \pm 0,1)$ kg and the whole apparatus shall have a mass of $(25 \pm 0,1)$ kg.

B.2.2 Springs, which shall be such that the combined spring system has a nominal spring rate of (7 ± 2) N/mm and the total friction resistance of the moving parts is less than 1 N.

The spring system shall be compressed to an initial load of (1040 ± 5) N (measured statically) and the amount of spring compression movement available from the initial compression point to the point where the springs become fully closed shall be not less than 60 mm.

B.2.3 Striking surface, which shall be a rigid circular object, 200 mm in diameter, the face of which has a convex spherical curvature of 300 mm radius with a 12 mm front edge radius.



Key

- 1 joint of lifting device not inhibiting free fall

Figure B.1 — Impactor

B.3 Methods

Place the mattress directly on the standard test bed base for mattresses (5.1). The impactor (B.1) shall be lifted to 180 mm (measured from the top face of the unloaded mattress). Let it drop freely onto the mattress, at the following positions (see Figure B.2):

- a) centre of the mattress (point A);
- b) one third of the longitudinal axis from the middle (point B);
- c) point opposite of B (point C);
- d) point of 200 mm measured from the adjacent edges (point D);

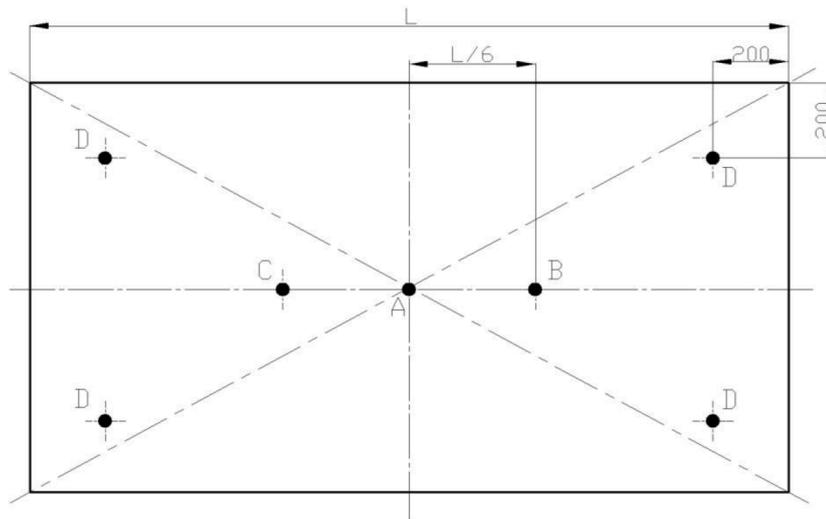
Drop the impactor at each of the selected positions of impact (see Figure B.2) for 10 cycles. Each of the 4 selected D points in Figure B.2 shall be impacted. The impactor shall be permitted to fall freely but may be guided by a guide rail.

The test for each position shall be carried out in the following sequence:

- 1) measurement of the mattress height (according to 7.3);
- 2) impact test: 10 cycles;
- 3) conditioning, at least 5 h in the standardised climate (according to 4.1);
- 4) measurement of the mattress height and height loss (according to 7.3) between before and after the test.

ISO/DIS 23769:2020(E)

Dimensions in millimetres



Key

- L length of mattress
- A,B,C,D selected positions of impact

Figure B.2 — Impact positions