
Wheelchair seating —

Part 2:

**Determination of physical and
mechanical characteristics of seat
cushions intended to manage tissue
integrity**

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Sièges de fauteuils roulants —

*Partie 2: Détermination des caractéristiques physiques et mécaniques
des coussins d'assise et dispositifs de répartition de pression*

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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 173, *Assistive products for persons with disability*, Subcommittee SC 1, *Wheelchairs*.

This second edition cancels and replaces the first edition (ISO 16840-2:2007), significant elements of which has been technically revised.

A list of all the parts of ISO 16840 can be found on the ISO website.

Introduction

Wheelchair seating is a sub-speciality of rehabilitation services involving the selection and provision of wheelchair seating products that provide improved body support and injury prevention to the wheelchair user. Seating products are designed and manufactured to meet the needs of persons with varying types and degrees of disability. Some products, such as wheelchair cushions, are designed to manage tissue integrity for persons who are at risk or have pressure ulcers.

The tests described herein are intended to differentiate performance characteristics between cushions and are not appropriate for ranking or scoring cushions or for directly matching these characteristics with the requirements of individual users. The link to clinical efficacy, although implied, has not been validated. It is intended that this document will evolve when the evidence of clinical relevance is confirmed. This document specifically describes test methods that characterize the physical and mechanical properties of seat cushions. Test conditions simulate a symmetric anatomy and posture. The loads used in this document are based on the 50th percentile wheelchair user and are not intended to characterize any cushion properties under bariatric loading conditions or to assess the weight capacity of a cushion. [Annex B](#) provides typical ranges for the values measured. Flammability testing is subject to either ISO 7176-16 or, for postural support devices intended to manage tissue integrity, ISO 16840-10.

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Wheelchair seating —

Part 2:

Determination of physical and mechanical characteristics of seat cushions intended to manage tissue integrity

1 Scope

This document specifies apparatus, test methods and disclosure requirements for wheelchair seat cushions intended to maintain tissue integrity and prevent tissue trauma. Test conditions simulate a symmetric anatomy and posture and do not represent cushion performance for specific individual users. Loads are intended to represent those seen under the pelvis of a 50th percentile wheelchair user and are not intended to assess the weight capacity of the cushion or to characterize the cushion under bariatric loads. It is possible that not all test methods apply to existing and future cushion technologies. It does not include test methods or requirements for determining the fire resistance of cushions.

This document can also be applicable to tissue integrity management devices used as other support systems, as well as to cushions used in situations other than a wheelchair.

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2 Normative references (standards.iteh.ai)

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.

ISO 1302:2002, *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*

ISO 7176-26, *Wheelchairs — Part 26: Vocabulary*

ISO 9073-8, *Textiles — Test methods for nonwovens — Part 8: Determination of liquid strike-through time (simulated urine)*

ISO 10993-1, *Biological evaluation of medical devices — Part 1: Evaluation and testing within a risk management process*

ISO 16840-1, *Wheelchair seating — Part 1: Vocabulary, reference axis convention and measures for body segments, posture and postural support surfaces*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

FMVSS 209, *Standard No. 209; Seat Belt Assemblies. Federal Motor Vehicle Safety Standards, 49 CFR part 571.209, 1 October 1992*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7176-26, ISO 16840-1 and the following 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 cushion loading indenter

CLI
apparatus that is used to apply indentation forces to a seat cushion to determine its support characteristics

Note 1 to entry: A cushion loading indenter can be comprised of loading components that are compliant or rigid.

3.1.1 loaded contour indenter

LCI
CLI (3.1) representing the ischial tuberosities and trochanters that is used to measure the ability of a seat cushion to contour under load

3.1.2 rigid cushion loading indenter

RCLI
CLI(3.1) with a rigid exterior surface contour

3.1.2.1 impact damping rigid cushion loading indenter

IDRCLI
RCLI (3.1.2) that is instrumented and used to apply loads rapidly to the cushion to determine its capacity to absorb impact

3.2 base-points

most inferior points on the surface of a *RCLI* (3.1.2) when positioned for use

Note 1 to entry: The base-points on the *RCLI* represent the ischial tuberosities of the human pelvis.

3.3 loaded contour depth

maximum vertical change in shape arising from a load on a cushion's surface at the place designed for buttock loading

4 Symbols and abbreviated terms

a acceleration

5 Apparatus

5.1 Loading rig

A means of applying a vertical load of up to 830 N to a seat cushion and with the ability to measure displacement to ± 1 mm to the reference plane surface of the *RCLI* as specified in [Figure 1](#) so that the load remains normal to the reference plane throughout the test.

NOTE Use of an actuator to apply the load is not necessary to perform the recovery test ([Clause 10](#)). A vertical load may be applied to the *RCLI* with free weights for this test.

a) The load is applied at the anterior-posterior location of load as specified in [Table A.1](#) in the range 0 N to 830 N as shown in [Figure 1](#).

NOTE The load accuracy required is specified in each test method.

- b) The seat cushion is supported on a rigid horizontal surface such that the base of the cushion does not flex during loading.

5.2 Rigid cushion loading indenter (RCLI)

A means of loading a cushion with a rigid exterior surface contour, which shall:

- a) be manufactured from a rigid material such as wood or fibreglass;
- b) meet the requirements specified in [Annex A](#).

5.3 Impact damping rigid cushion loading indenter (IDRCLI)

A means of loading a cushion using an RCLI with a uniformly distributed weight of $500 \text{ N} \pm 10 \text{ N}$ with an accelerometer attached to the reference plane at the location specified in [5.6 d\)](#) to measure the deceleration of the indenter as it suddenly loads the cushion.

5.4 Force application rig

A means of applying a vertical load in the range of 0 N to $225 \text{ N} \pm 5 \text{ N}$ to the loaded contour indenter.

5.5 Displacement gauge

A means of measuring the vertical displacement of the top surface of the RCLI during loading to an accuracy of $\pm 1 \text{ mm}$ in the range 0 mm to 200 mm .

5.6 Impact damping rig (standards.iteh.ai)

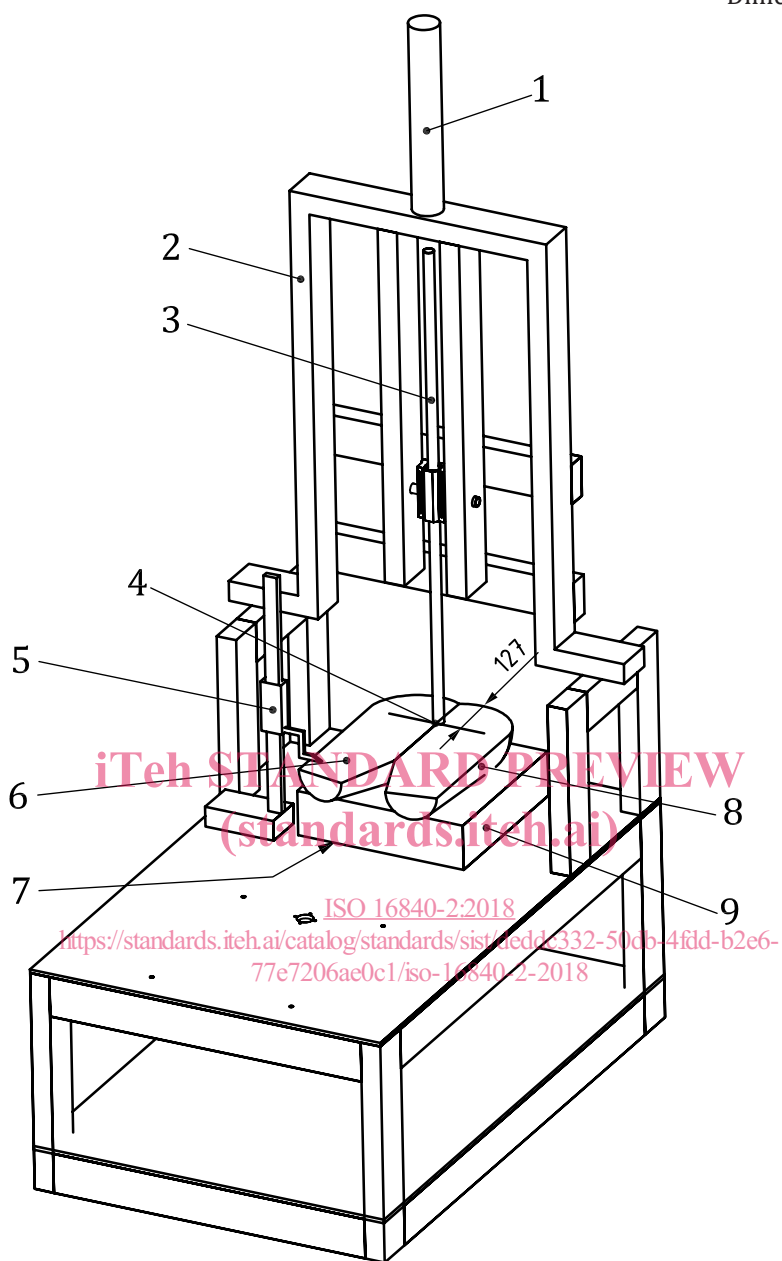
A means of measuring the dissipation of impact loading to the seat cushion:

- a) comprising a rigid hollowed shell representing the outer contour of a RCLI,
- b) with filling to achieve a total weight of the IDRCLI of $500 \text{ N} \pm 10 \text{ N}$.

NOTE This can be achieved by placing metal spheres into the bottom of the RCLI and fixing them in position (gluing or melting).

- c) capable of applying an impact load to the cushion using the IDRCLI as shown in [Figure 2](#);
- d) capable of recording acceleration in at least one axis, oriented to measure normal to the surface of the IDRCLI in the range -100 ms^{-2} to 100 ms^{-2} with a sampling frequency of at least 30 Hz incorporating an appropriate anti-aliasing filter; accelerometer shall be fixed to the top surface of the IDRCLI, on the centre line, $127 \text{ mm} \pm 2 \text{ mm}$ forward of the rear edge of the IDRCLI;
- e) including a rigid plate (plywood or equivalent) measuring $(500 \pm 5) \text{ mm} \times (500 \pm 5) \text{ mm} \times (15 \pm 1) \text{ mm}$ and hinged at one edge providing a means of supporting the cushion and IDRCLI at an angle of $10^\circ \pm 1^\circ$;
- f) including two $25 \text{ mm} \pm 5 \text{ mm}$ diameter rubber cylindrical stops located with their centres at the corners of the rigid plate, 25 mm from the front and lateral edges of the plate, with a hardness of Shore A 60 ± 5 supporting the edge of the plate opposite the hinge such that it is horizontal when resting on the stops;
- g) including a block to support the rigid plate at an angle of $10^\circ \pm 1^\circ$ to the horizontal which can be removed in less than $0,1 \text{ s}$ resulting in the plate falling to horizontal;
- h) capable of consistent placement of IDRCLI relative to the rigid plate.

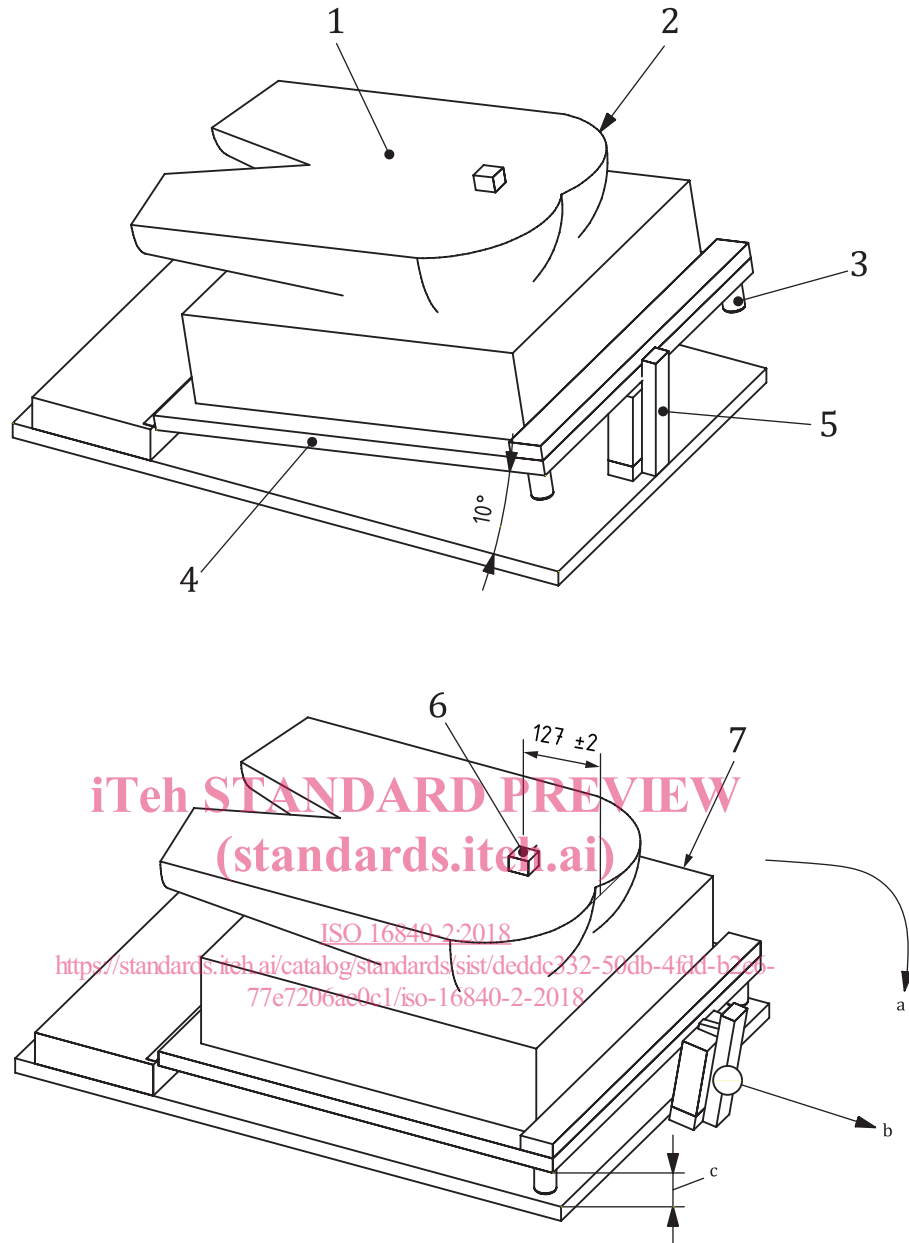
NOTE This can be accomplished with the use of an alignment rig during placement of the IDRCLI on the test cushion.



Key

- 1 actuator to apply load
- 2 frame
- 3 solid rod
- 4 point of application of load
- 5 displacement gauge
- 6 reference plane
- 7 method of restraint under cushion
- 8 RCLI
- 9 cushion

Figure 1 — Loading rig showing the reference plane on the top surface of the RCLI in plain view and a displacement gauge



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Key

- 1 top surface
- 2 IDRCLI
- 3 stop
- 4 rigid plate
- 5 support block
- 6 accelerometer
- 7 cushion
- a Direction of fall.
- b Direction of pull.
- c Boards are parallel.

Figure 2 — Impact damping rig

5.7 Loaded contour indenter (LCI)

A CLI representing the ischial tuberosities and trochanters as follows and as illustrated in [Figure 3](#).

- a) Two 50 mm \pm 2 mm diameter indenters, centres spaced 120 mm \pm 5 mm apart, representing ischial tuberosities.
- b) Two 25 mm \pm 1 mm diameter indenters, centres spaced 380 mm \pm 10 mm apart, representing the trochanters.
- c) A rigid bar 400 mm \pm 20 mm long.
- d) A 50 mm \pm 2 mm wide webbing as specified in FMVSS 209 attached to the bar at 380 mm \pm 10 mm centres using threaded mounting bolts to sandwich the belt between the 25 mm \pm 1 mm diameter indenters and the bar. The webbing is secured to the bar so that it runs over the 50 mm indenters and under the 25 mm indenters.

NOTE Dimensions have a tolerance of ± 5 % unless specified otherwise.

5.8 Seat cushion thickness measurement rig

A means to measure the thickness of a cushion at a defined location which:

- a) employs a 50 mm \pm 2 mm diameter circular platen, attached to a displacement gauge mounted on a loading rig with a rigid coupling;
- b) allows vertical displacement of the circular platen;
- c) is capable of applying 3 N \pm 1 N vertical load to the cushion;
- d) can be positioned over the test cushion located 125 mm \pm 2 mm forward of the rear edge of the seat cushion and 55 mm \pm 2 mm lateral to the midline.

NOTE It might be desirable to design this rig so that the circular platen can be placed at other points on the top surface of the seat cushion.

5.9 Test environment

An environment with an ambient temperature of 23° C \pm 2° C and relative humidity 50 % \pm 5 %, which can be determined as specified in ISO 554.