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**Wheelchair seating —**

Part 2:

**Determination of physical and mechanical characteristics of devices intended to manage tissue integrity — Seat cushions**

iTeh STANDARD PREVIEW

*Sièges de fauteuils roulants —*

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

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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 16840-2 was prepared by Technical Committee ISO/TC 173, *Assistive products for persons with disability*, Subcommittee SC 1, *Wheelchairs*.

ISO 16840 consists of the following parts, under the general title *Wheelchair seating*:

- *Part 1: Vocabulary, reference axis convention and measures for body segments, posture and postural support surfaces*
- *Part 2: Determination of physical and mechanical characteristics of devices intended to manage tissue integrity — Seat cushions*
- *Part 3: Determination of static, impact and repetitive load strengths for postural support devices*
- *Part 4: Seating systems for use in motor vehicles*

## 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 part of ISO 16840 will evolve when the evidence of clinical relevance is confirmed. This part of ISO 16840 specifically describes test methods that characterize the physical and mechanical properties of seat cushions. Further parts of ISO 16840 are planned that describe test methods for disclosing the pressure distributing characteristics of seat cushions and their heat and water vapour dissipation characteristics.

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# Wheelchair seating —

## Part 2:

# Determination of physical and mechanical characteristics of devices intended to manage tissue integrity — Seat cushions

## 1 Scope

This part of ISO 16840 specifies apparatus, test methods and disclosure requirements for wheelchair seat cushions intended to maintain tissue integrity and prevent tissue trauma. It does not include test methods or requirements for determining the fire resistance of cushions. Annex B provides guidance on selecting cushions with appropriate fire resistance characteristics. This part of ISO 16840 does not address the interface pressure distributing characteristics of seat cushions nor the heat and water vapour dissipation characteristics of seat cushions that will be addressed in further parts of ISO 16840.

This part of ISO 16840 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.

## 2 Normative references (standards.iteh.ai)

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 554:1976, *Standard atmospheres for conditioning and/or testing — Specifications*

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

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

ISO 9073-8:1995, *Textiles — Test methods for nonwovens — Part 8: Determination of liquid strike-through time (simulated urine)*

ISO 10993-1:2003, *Biological evaluation of medical devices — Part 1: Evaluation and testing*

ISO 10993-10:2002, *Biological evaluation of medical devices — Part 10: Tests for irritation and delayed-type hypersensitivity*

ISO 16840-1:2006, *Wheelchair seating — Part 1: Vocabulary, reference axis convention and measures for body segments, posture and postural support surfaces*

GUM:1993, *Guide to expression of uncertainty in measurement, BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML*

BS 3424-10:1987, *Testing coated fabrics. Methods 12A and 12B. Determination of surface drag*

ECE Regulation 16, *Uniform provisions concerning the approval of safety belts and restraint systems for adult occupants of power-driven vehicles, Revision 3, Amendment 3, 27 February 1996*

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.

#### 3.1

##### **cushion loading indenter**

###### **CLI**

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

NOTE A cushion loading indenter can comprise loading components that are compliant or rigid.

#### 3.2

##### **impact damping rigid contoured loading indenter**

###### **IDRCLI**

apparatus that is used to rapidly apply loads to the cushion to determine its capacity to absorb impact energy by measuring the rate of deceleration of the indenter as its weight is rapidly transferred to the cushion

#### 3.3

##### **loaded contour depth**

maximum depth of contour resulting from load on the cushion's surface at the site designed for buttock loading

#### 3.4

##### **loaded contour jig**

###### **LCJ**

means of loading cushions with an indenter representing the ischial tuberosities and trochanters used to measure bottoming and ability of seat cushion to contour under load by representing buttock loading

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#### 3.5

##### **overload deflection**

additional deflection imparted by a 33 % overload condition

#### 3.6

##### **rigid cushion loading indenter**

###### **RCLI**

cushion loading indenter with a rigid exterior surface contour

#### 3.7

##### **sliding tendency**

measure of the propensity for a CLI to slide off a seat cushion

NOTE This quantity is affected by both the frictional properties of the CLI (3.1) and the cushion as well as the cushion surface geometry.

### 4 Symbols and abbreviated terms

$a$  acceleration

$l$  overall length

$t$  time for the recording period (associated units: s = seconds; d = days)

$h_{th}$  cushion thickness



## 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  $\pm 1$  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.

- a) The load is applied at the point specified in Table A.1 on the mid-line of the RCLI reference plane surface in the range 0 N to 830 N as shown in Figure A.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 shall:

- a) be manufactured from a rigid material such as wood or fibreglass;
- b) have the dimensions specified in Table A.1.

NOTE Detailed construction/assembly information is found 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 mass of  $500 \text{ N} \pm 10 \text{ N}$  with an accelerometer attached to the reference plane at the location specified in 5.6 b) to measure the deceleration of the indenter as it suddenly loads the cushion.

**5.4 Force application rig**, a means of applying a load in the range of 0 N to  $180 \text{ N} \pm 5 \text{ N}$  to the loaded contour jig.

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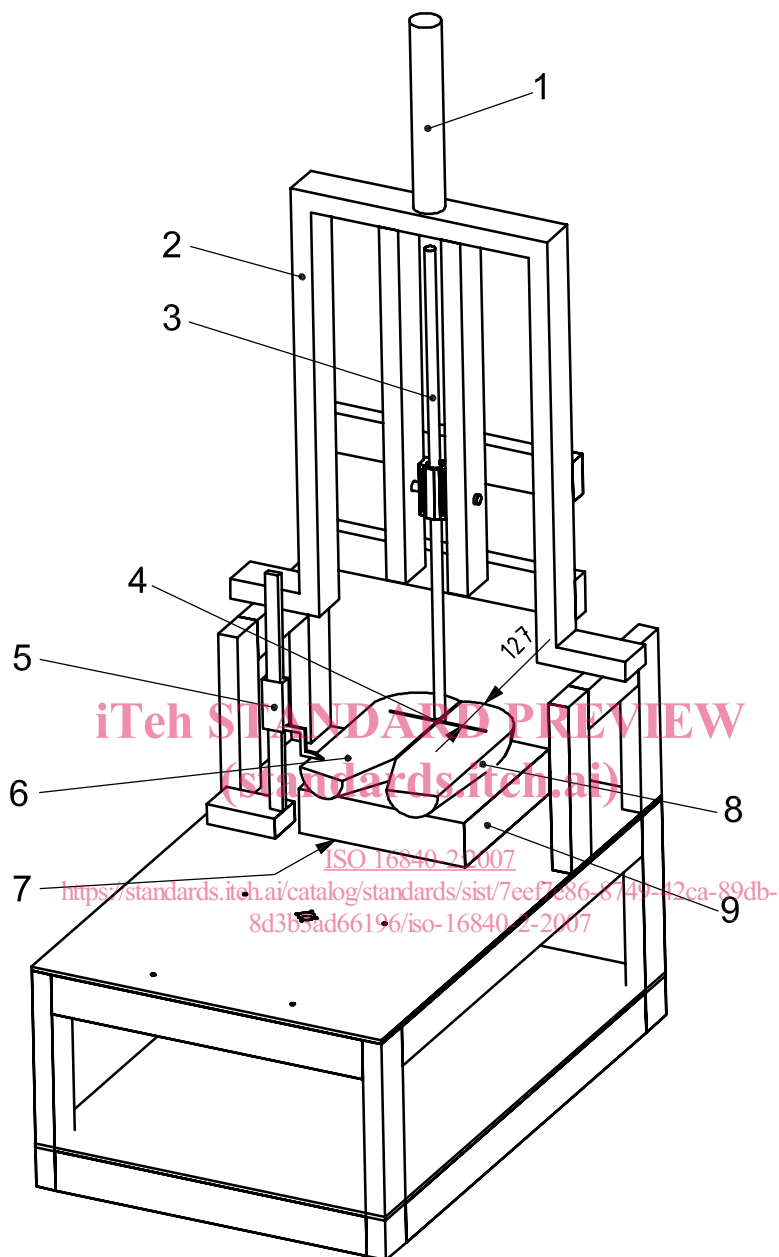
**5.5 Displacement gauge**, a means of measuring the displacement of the top surface of the RCLI during loading to an accuracy of  $\pm 1$  mm in the range 0 mm to 200 mm.

**5.6 Impact damping rig**, a means of measuring the dissipation of impact loading to the seat cushion.

- a) Such that a shell is formed representing the outer contour of a RCLI. Metal spheres are poured into the bottom of the RCLI of uniform diameter then glued or melted to form a total mass of the IDRCLI of  $500 \text{ N} \pm 10 \text{ N}$ .

NOTE Lead shot can be used for this purpose.

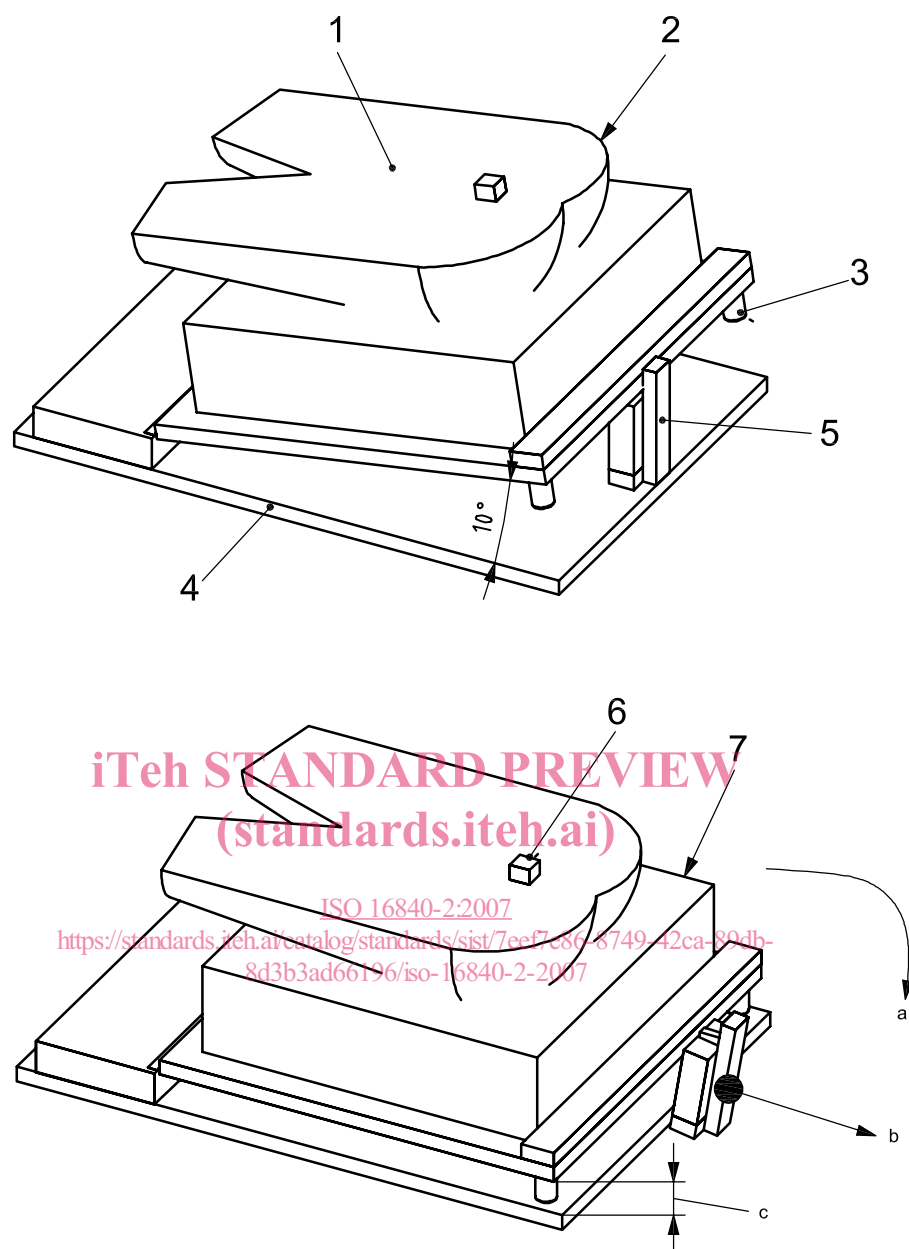
- b) Capable of applying an impact load to the cushion using the IDRCLI as shown in Figure 2.
- c) Capable of recording acceleration in at least one axis, oriented to measure normal to the surface of the IDRCLI in the range  $0 \text{ ms}^{-2}$  to  $10 \text{ ms}^{-2}$  with a frequency response in the range 0 Hz to at least 200 Hz incorporating an appropriate anti-aliasing filter, fixed to the top surface of the IDRCLI, on the centre line,  $127 \text{ mm} \pm 25 \text{ mm}$  forward of the rear edge of the IDRCLI.
- d) Including a rigid plate (plywood or equivalent) measuring  $500 \text{ mm} \pm 10 \text{ mm} \times 500 \text{ mm} \pm 10 \text{ mm} \times 15 \text{ mm} \pm 1 \text{ mm}$  and hinged at one edge providing a means of supporting the cushion and IDRCLI at an angle of  $10^\circ \pm 1^\circ$ .
- e) Including two  $25 \text{ mm} \pm 5 \text{ mm}$  diameter hard 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  $60 \pm 0$  supporting the edge of the plate opposite the hinge such that it is horizontal when resting on the stops.
- f) 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 0,5 s resulting in the plate falling to horizontal.



**Key**

- 1 actuator to apply load
- 2 frame
- 3 solid rod
- 4 point of application of load
- 5 displacement gauge
- 6 reference plane
- 7 Velcro 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 plan view and a displacement gauge**



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**Key**

- 1 top surface
- 2 IDRCLI
- 3 stop
- 4 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 jig (LCJ)**, a means of supporting an RCLI at the end of a rigid shaft allowing the RCLI to move in the lateral and forward directions on the seat cushion in one plane and with the following.

- a) A mounting system to accept the RCLI, as defined in Annex A.
- b) The capability of using a pivoting rigid member capable of swinging in an arc with a radius of 750 mm and free to move vertically in a linear bearing as shown in Figure 3.
- c) A restraint system on a rigid base with a means of constraining the cushion.

NOTE 1 A hook and loop fastening strip or a restraint bar along the edge of the cushion base are effective means of constraining the cushion on the test base.

- d) The capability of applying  $500\text{ N} \pm 10\text{ N}$  vertical load to the RCLI.
- e) The capability of applying a force perpendicular to the vertical member, acting in the plane of the cushion in both the forward and lateral directions and generating an RCLI displacement of  $10\text{ mm} \pm 2\text{ mm}$  at a rate of  $2\text{ mm/s} \pm 1\text{ mm/s}$ .
- f) Two  $50\text{ mm} \pm 2\text{ mm}$  diameter indenters, centres spaced  $120\text{ mm} \pm 5\text{ mm}$  apart, representing ischial tuberosities.
- g) Two  $25\text{ mm} \pm 1\text{ mm}$  diameter indenters, centres spaced  $380\text{ mm} \pm 10\text{ mm}$  apart, representing the trochanters.
- h) A rigid bar  $25\text{ mm} \pm 1\text{ mm}$  wide,  $400\text{ mm} \pm 20\text{ mm}$  long with a thickness of  $10\text{ mm} \pm 0,2\text{ mm}$ .
- i) A  $50\text{ mm} \pm 2\text{ mm}$  wide webbing as specified in ECE Reg. 16 and in FMVSS 209 attached to the bar at  $395\text{ mm} \pm 10\text{ mm}$  centres using threaded mounting bolts to sandwich the belt between the  $25\text{ mm} \pm 1\text{ mm}$  diameter indenters and the bar. The webbing is secured to the bar so that it runs over the  $50\text{ mm}$  indenters and under the  $25\text{ mm}$  indenters.
- j) A force application rig. <https://standards.iteh.ai/catalog/standards/sist/7eef7e86-8749-42ca-89db-8d3b3ad66196/iso-16840-2-2007>
- k) A displacement gauge.

NOTE 2 Dimensions have a tolerance of  $\pm 5\%$  unless specified otherwise.

- l) The capability of applying a displacement perpendicular to the vertical member, acting in the plane of the cushion at a rate of  $5\text{ mm/s}$ .
- m) The capability of recording (200 Hz minimum sampling rate) the force applied to the indenter.
- n) Employing a  $50\text{ mm} \pm 2\text{ mm}$  diameter circular platen, attached to the displacement gauge mounted on the loading rig with a rigid coupling.
- o) Allowing vertical displacement of the circular platen.
- p) Capable of applying  $3\text{ N} \pm 1\text{ N}$  vertical load to the cushion.
- q) Positioned over the test cushion located  $125\text{ mm} \pm 2\text{ mm}$  forward of the rear edge of the seat cushion and  $55\text{ mm} \pm 2\text{ mm}$  lateral to the midline.

NOTE 3 It may 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.

## 6 Test environment

An environment with ambient temperature of  $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  and relative humidity  $50\% \pm 5\%$  which can be determined as specified in ISO 554.