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Technical systems and aids for disabled or handicapped persons — Wheelchair tiedown and occupant-restraint systems —

Part 5: Systems for specific wheelchairs

Assistances et aides techniques pour les personnes invalides ou handicapées — Systèmes d'attache du fauteuil roulant et de retenue de l'occupant —

Partie 5: Systèmes pour fauteuils roulants particuliers

Reference number
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Foreword

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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 10542-5 was prepared by Technical Committee ISO/TC 173, *Technical systems and aids for disabled or handicapped persons*, Subcommittee SC 1, *Wheelchairs*.

ISO 10542 consists of the following parts, under the general title *Technical systems and aids for disabled or handicapped persons — Wheelchair tiedown and occupant-restraint systems*:

— *Part 1: Requirements and test methods for all systems*

— *Part 2: Four-point strap-type tiedown systems*

— *Part 3: Docking-type tiedown systems*

— *Part 4: Clamping tiedown systems*

— *Part 5: Systems for specific wheelchairs*

Introduction

Providing effective crash protection for wheelchair-seated occupants of motor vehicles generally requires the installation and use of equipment to tie down the wheelchair and restrain the occupant of the wheelchair. ISO 10542-1 establishes general requirements and test methods for wheelchair tiedown and occupant restraint systems (WTORS) that are designed for use with a wide range of wheelchairs and adult occupants. This part of ISO 10542 establishes additional or alternative requirements for WTORS that are intended to be used with specific makes and models of wheelchairs. The belt-type occupant restraints may attach to the wheelchair such that occupant-restraint loads will be transferred through the wheelchair. This part of ISO 10542 applies to WTORS intended for use with children whose mass is greater than 22 kg, in addition to WTORS intended for use by adults. Children whose mass is less than 22 kg should be transferred from their wheelchairs into appropriate child restraint systems intended for use in vehicles.

The provisions of ISO 10542-1 apply except as amended and supplemented by this part of ISO 10542. ISO 10542-1 and this part of ISO 10542 place particular emphasis on design requirements, performance requirements, and associated test methods with regard to the performance of WTORS for forward-facing wheelchairs and occupants in frontal impacts. Because this part of ISO 10542 addresses WTORS intended for use with specific makes and models of wheelchairs, the 48-km/h frontal impact test is conducted with a specific make or model of wheelchair, rather than with a surrogate wheelchair specified in ISO 10542-1. As such, the performance of both the WTORS and wheelchair are evaluated as a total system.

Transportation-related requirements for wheelchairs that are suitable for adult occupant seating during motor vehicle transportation are specified in ISO 7176-19.

Technical systems and aids for disabled or handicapped persons — Wheelchair tiedown and occupant-restraint systems —

Part 5: Systems for specific wheelchairs

1 Scope

This part of ISO 10542 specifies test methods as well as requirements for design and performance, for instructions and warnings to installers and users, and for product marking and labelling of wheelchair tiedown and occupant restraint systems (WTORS).

It applies only to WTORS that are intended to be used with particular makes and models of wheelchairs when used as a forward-facing seat by a passenger or a driver of a motor vehicle.

This part of ISO 10542 applies to WTORS intended for use with manual or powered wheelchairs, including scooters with three or more wheels, intended for use by children or adults of mass equal to or greater than 22 kg.

This part of ISO 10542 applies primarily to complete WTORS, but portions of this International Standard can also be applied to components and subassemblies sold separately and for replacement parts.

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 7176-22, *Wheelchairs — Part 22: Set-up procedures*

ISO 10542-1:2001, *Technical systems and aids for disabled or handicapped persons — Wheelchair tiedown and occupant-restraint systems — Part 1: Requirements and test methods for all systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10542-1:2001, with the exception of 3.5, and the following apply.

3.1
anthropomorphic test device
ATD
articulated physical analogue used to represent a wheelchair occupant in a test

3.2
child
person having a mass equal to or greater than 22 kg and less than 36 kg

[ECE R44]

3.3
H Points
points located on the left and right sides of the pelvic region of an anthropomorphic test device (ATD) that represent the approximate locations of the human hip joint centres in the side views, as specified by the ATD manufacturer

4 Design requirements

The requirements of ISO 10542-1:2001 Clause 4 apply with the exception of the following:

a) Delete 4.1 b), 4.3.1 b) and 4.3.1 c) NOTE.

b) Add the following to 4.1 WTORS.

WTORS shall include a belt-type occupant restraint either by specifying use of the belt-type occupant restraint and anchorages provided with the vehicle, or as a part of a complete WTORS from one manufacturer or as a part of a WTORS compiled from different manufacturers' equipment. The belt-type occupant restraint of the WTORS may be fixed to the vehicle, the wheelchair or a part (or parts) of the tiedown system.

c) Add the following to 4.3 Belt-type occupant restraints.

Occupant restraints shall be designed to either:

— function independently of the wheelchair, so that restraint belts anchor to either the vehicle or the wheelchair tiedown components, or

— anchor to the wheelchair so that occupant restraint loads are transmitted through the wheelchair frame.

5 Identification, labelling, instruction and warning requirements

The requirements of ISO 10542-1:2001 Clause 5 apply with the exception of the following.

a) Delete 5.1.1 c), 5.2.2 c) and 5.3.2 a).

b) Add the following to 5.1 Identification and labelling:

1) WTORS and replacement parts shall be permanently and legibly marked showing that they conform to this part of ISO 10542.

2) WTORS components and subassemblies shall be accompanied by information that includes the make and model of the wheelchairs and the maximum wheelchair plus occupant mass which can be used with the WTORS.

c) Add the following to 5.2 Instructions for installers:

Manufacturers of WTORS components and subassemblies shall provide written information that includes the following:

1) the make and model of wheelchairs and the maximum wheelchair plus occupant mass which can be used with the components and or subassemblies or WTORS;

2) a statement that the component or subassemblies or complete WTORS conforms to the requirement of this part of ISO 10542;

3) diagrams and/or drawings which describe the method of installation if the occupant restraint is to be attached to the wheelchair.

d) Add the following to 5.3 User and maintenance instructions:

1) a statement that the WTORS conforms to this part of ISO 10542;

2) where applicable, descriptions of the features required of a wheelchair or tiedown system for effective attachment of occupant restraint end fittings;

3) warnings that the WTORS, or if applicable a component or subassemblies, are only for use with specific makes and models of wheelchairs and the stated maximum wheelchair plus occupant mass.

6 Performance requirements

The performance requirements of ISO 10542-1:2001 Clause 6 apply with the exception of the following:

a) Substitute the term “SWC” with the term “test wheelchair” throughout 6.2.1.

b) Delete 6.2.2 a) and Table 3.

c) Add the following:

1) When tested in accordance with Annex A, the horizontal excursions of the ATD and the wheelchair with respect to the impact sled shall not exceed the values given in Table 1.

2) During the test, batteries of powered wheelchairs or their surrogate replacement parts shall

i) not move completely outside the plan view of the wheelchair,

ii) not move into the wheelchair user's space (e.g. shall not contact the back of the ATD's legs).

3) When tested as specified in Annex A, the following requirements shall be met at the end of the test.

i) The wheelchair shall remain in an upright position on the test platform and the ATD shall be retained in the wheelchair in a seated posture, as determined by the ATD torso being oriented at not more than 45° to the vertical when viewed from any direction.

ii) The wheelchair securement points shall not show visible signs of failure.

iii) Release of wheelchair from the tiedown system shall not require the use of tools.

iv) For wheelchairs designed for securement by manually operated tiedowns, securement points shall not show deformation or distortion that prevents manual disengagement and removal of the end fittings of the tiedown system.

v) Components, fragments or accessories of the wheelchair with a mass in excess of 100 g shall not have completely separated from the wheelchair.

vi) Wheelchair components that may contact the occupant shall not fragment or separate in a manner that produces sharp edges with a radius of less than 2 mm.

vii) Locking mechanisms of tilt-in-space seat adjusters shall not show signs of failure.

viii) Removal of the ATD from the wheelchair shall not require the use of tools other than a hoist.

ix) The post test height of the average of left and right ATD H-points, relative to the wheelchair ground plane, shall not decrease by more than 20 % from the pre-test height.

Table 1 — Horizontal excursion limits (mm)

Measurement point	Excursion variable	ATD		
		6-year old child	Small adult female	Midsize adult and large adult male
Wheelchair point P	d_{wc} [a]	150	200	200
ATD knee centre	d_{knee} [b]	300	375	375
ATD front of head	d_{headF} [c]	450	550	650
ATD back of head	d_{headR} [d]	−350	−400	−450

[a] d_{wc} = the horizontal distance relative to the sled platform between the contrast marker placed at or near point P on the test wheelchair at time t_o, to the Point P marker at the time of peak wheelchair excursion.

[b] d_{knee} = the horizontal distance relative to the sled platform between the dummy knee joint marker at time t_o, to the knee joint marker at the time of peak knee excursion.

[c] d_{headF} = the horizontal distance relative to the sled platform between the most forward point on the dummy's head above the nose at time t_o, to the most forward point on the dummy's head at the time of peak forward head excursion.

[d] d_{headR} = the horizontal distance relative to the sled platform between the most rearward point on the dummy's head at time t_o, to the most rearward point on the dummy's head at the time of peak rearward head excursion.

7 Test report

The test report requirements of ISO 10542-1:2001 Clause 7 apply with the exception of the following:

a) Delete 7.2 d) and 7.2 e).

b) Add the following:

   1) a description and total mass of the ATD used in the test;

   2) the model, designation and serial number of the wheelchair used in the test;

   3) the manufacturer of the wheelchair used in the test;

   4) the angle of the seat and backrest from A.2 f);

   5) a statement that the wheelchair meets or does not meet the requirements of all applicable parts of Clause 6.

Annex A
(normative)

Test method for frontal impact

A.1 Principle

The wheelchair specified for the test is mounted in a forward-facing configuration on the impact sled of an impact simulator and is loaded with an anthropomorphic test device (ATD). The WTORS is installed to secure the wheelchair and restrain the ATD. The sled platform is subjected to a defined acceleration/deceleration-time pulse, in order to achieve a defined horizontal velocity change (Δv). Observations and measurements are made to determine if the WTORS and the wheelchair conform to the requirements of this part of ISO 10542.

A.2 Test requirements

A.2, A.3, A.4 and A.5 of Annex A of ISO 10542-1:2001 apply with the exception of the following:

a) Substitute the term “SWC or surrogate wheelchair” with the term “wheelchair specified for the test” throughout the text.

b) Delete A.3.1 e), A.3.1 f) and A.4.5.

c) The ATD shall be selected from Table A.1 below and represent the wheelchair manufacturer's intended maximum user mass.

d) For wheelchairs intended for use by adults, either the midsize adult male or large adult male ATD shall be used.

e) The midsize male ATD shall be a Hybrid II or Hybrid III type. The other sizes of ATDs shall be Hybrid II, Hybrid III or VIP types.

NOTE See Annex G of ISO 10542-1:2001 for information on sources for ATDs.

f) The wheelchair specified for the test shall be in addition to the test sample A.2 of ISO 10542-1:2001.

g) A.4.1, A.4.4, A.4.9 and A.4.15 shall be replaced by the following:

1) A.4.1 The procedures for setting up the test may be undertaken in any order.

EXAMPLE It may be more convenient to position the ATD in the wheelchair prior to placing the assembly on the impact sled.

2) A.4.4 Set up the test apparatus in accordance with A.3 and set up the test wheelchair as below.

i) Set up the wheelchair in accordance with ISO 7176-22.

ii) Prepare the wheelchair for use in a motor vehicle as specified by the wheelchair manufacturer's user instructions. If a range is specified for any adjustments, the midpoint of the range should be used.

iii) Equip the wheelchair with any required add-on components.

iv) If a pelvic belt, intended for use as an occupant restraint, is provided as a component of the wheelchair, install it on the wheelchair according to the manufacturer's instructions.

v) If the wheelchair is equipped with liquid electrolyte batteries, they should be replaced by the nearest equivalent gel, sealed or surrogate battery. Supplementary weights, if used, shall provide equivalent mass distribution to the original batteries.

3) A.4.9 Position the ATD in the wheelchair sitting upright and symmetrical about the wheelchair reference plane, with the pelvis and buttocks as far back on the wheelchair seat as possible, and the elbows resting on the armrests or with the hands on the ATD thighs.

4) A.4.15 If a high-speed camera or high-speed video is used for the measurements in A.3.2, apply contrast markers appropriate to the measurement system at:

   i) the lateral aspect and centre of the ATD's knee joint,

   ii) point P of the wheelchair, and

   iii) H points of the ATD.

   NOTE This may require the addition of a simple support to the wheelchair to allow the point P marker to be applied.

h) If applicable, adjust the seat and backrest as follows.

1) Rotate the backrest rearward to obtain a backrest plane angle not exceeding 10° relative to the vertical.

2) For wheelchairs with independently adjustable seat angles, adjust the seat frame to a maximum incline angle of 10° to the horizontal.

   NOTE Measure this angle with an inclinometer without the ATD in the wheelchair.

3) For tilt-in-space wheelchairs, adjust the longitudinal seat frame members to a maximum angle of 30°, relative to the horizontal, without the ATD in the wheelchair.

4) If the seat position adjusts front to back, select the position recommended by the manufacturer. If no position is recommended, select the midpoint of the adjustment range.

5) If other seat components are adjustable, they shall be adjusted to fit the ATD intended for use by the manufacturer.

6) Lock any adjustment mechanisms that provide for tilt of the seat or backrest.

Table A.1 — ATD size and mass

Mass of wheelchair user kg	**ATD size**	**Mass of ATD** kg (lb)
12 to 30	6-year-old child	22,5 (50)
31 to 52	Small adult female	47,0 (104)
52 to 95	Midsize adult male	76,3 (168)
95 to 125	Large adult male	102,0 (225)

Annex B
(normative)

References to applicable annexes of ISO 10542-1:2001

Tests and recommendations for a number of important aspects of wheelchair tiedown and occupant restraint systems for specific wheelchairs, their status (normative or informative) and their location in ISO 10542-1:2001 are given in Table B.1.

Table B.1 — References to applicable annexes of ISO 10542-1:2001

Test or recommendation	Status	Reference
Measurement of WTORS belt lengths and geometry	Normative	ISO 10542-1:2001 B.1 applies with the term “surrogate wheelchair” being replaced by the term “wheelchair specified for the test”. ISO 10542-1:2001 B.2, B.3, B.4, B.5 and B.6 apply with the substitution of the terms “SWC”, and “surrogate wheelchair” by the term “wheelchair” throughout the text.
Test for webbing slippage at adjustment devices of wheelchair tiedown straps	Normative	Annex C from ISO 10542-1:2001 applies if the WTORS includes strap tiedowns.
Test for partial engagement	Normative	Annex D from ISO 10542-1:2001 applies.
Surrogate wheelchair specifications	Normative	Annex E from ISO 10542-1:2001 does not apply, as a surrogate wheelchair is not used in this part of ISO 10542.
Recommendations for design, performance and documentation	Informative	Annex F from ISO 10542-1:2001 applies.

Bibliography

[1] ISO 7176-19, *Wheelchairs — Part 19: Wheeled mobility devices for use in motor vehicles*

[2] ECE[1)] R44, *Uniform provisions concerning approval of restraining devices for child occupants of power-driven vehicles*

1) United Nations Economic Commission for Europe.

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