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

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

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*Assistances et aides techniques pour les personnes invalides ou
handicapées — Systèmes d'attache du fauteuil roulant et de retenue de
l'occupant* — ISO 10542-1:2001

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Partie 1: Exigences générales et méthodes d'essai pour tous les systèmes



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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 3.

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 part of ISO 10542 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10542-1 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

[ISO 10542-1:2001](#)

Annexes A, B, C, D and E form a normative part of this part of ISO 10542. Annexes F and G are for information only.

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Introduction

Providing effective protection for the wheelchair-seated occupant of a motor vehicle usually requires that equipment be installed to secure the wheelchair and restrain the occupant of the wheelchair. ISO 10542 is applicable to this motor-vehicle adaptive equipment, which is referred to as wheelchair tiedown and occupant restraint systems (WTORS). The requirements and test methods of this part of ISO 10542 apply to all WTORS that use belt-type occupant-restraint systems. Additional parts of ISO 10542 will address specific types of WTORS, or deal with particular applications, and will supplement and/or modify the requirements of this part of ISO 10542. If an additional part of ISO 10542 exists for a particular type of WTORS, this part of ISO 10542 is not to be used alone for that WTORS.

This part of ISO 10542 places particular emphasis on design requirements, test procedures, and requirements with regard to the performance of WTORS in a frontal impact. Performance of WTORS used with rear-facing wheelchairs involved in frontal impacts, performance of WTORS in rear, side and rollover impacts, and performance of WTORS used with wheelchair-seated children, may be addressed in future versions of this part of ISO 10542 and its additional parts. Transportation-related requirements for wheelchairs that are suitable for occupant seating during motor-vehicle transportation are specified in ISO 7176-19.

The use of only a pelvic belt as an occupant restraint is unlikely to provide adequate safety to a wheelchair user in the event of a frontal impact. Therefore, this part of ISO 10542 only includes test set-ups and procedures for occupant restraints that incorporate both a pelvic and an upper torso restraint.

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

Part 1: Requirements and test methods for all systems

1 Scope

This part of ISO 10542 specifies test methods and requirements for design and performance, for instructions and warnings to installers and users, and for product marking and labelling for wheelchair tiedown and occupant-restraint systems (WTORS). It applies to all WTORS that use belt-type occupant restraints that are intended for adult-occupied wheelchairs used as forward-facing seats by passengers and drivers of motor vehicles.

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

This part of ISO 10542 applies to WTORS intended for use with all types of manual and powered wheelchairs intended for use by adults, including three- and four-wheeled scooters.

2 Normative references

ISO 10542-1:2001

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The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 10542. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 10542 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3795, *Road vehicles, and tractors and machinery for agriculture and forestry — Determination of burning behaviour of interior materials.*

ISO 6487, *Road vehicles — Measurement techniques in impact tests — Instrumentation.*

UN/ECE R 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 part of ISO 10542, the following terms and definitions apply.

3.1

adult

person having a mass greater than 36 kg

3.2

airbag

inflatable restraint system

supplementary restraint system

supplemental occupant-restraint system, consisting primarily of a sensor or sensors, diagnostics, inflator(s) and module(s), which inflates a bag in certain vehicle crashes to assist in preventing the occupant(s) from impacting the interior portions of the vehicle

3.3

anchor point

point (area) on a vehicle interior component, floor, or wall, wheelchair or wheelchair tiedown, to which an anchorage is attached

3.4

anchorage

assembly of components and fittings by which loads are transferred directly from the wheelchair tiedown to the vehicle, or from the occupant restraint to the vehicle, wheelchair, wheelchair tiedown or vehicle interior component

3.5

anthropomorphic test device

ATD

articulated physical analogue of a midsize male used to represent a wheelchair occupant in a test

3.6

automatic-locking retractor

belt retractor incorporating adjustment by means of a positive, self-locking mechanism which is capable of withstanding occupant-restraint forces

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3.7

back restraint

device or system intended to limit rearward movement of an occupant during an impact by providing support to the back of the torso

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3.8

belt

length of webbing material used as part of an occupant restraint or postural support

3.9

emergency-locking retractor

belt retractor incorporating a locking mechanism that is activated by vehicle acceleration, deceleration, or rate of webbing movement relative to the vehicle, and that is capable, when locked, of withstanding occupant-restraint forces

3.10

end fitting

anchorage or securement hardware to which wheelchair-tiedown or occupant-restraint webbing is fastened, that attaches directly to an anchor point or to the securement point on the wheelchair

3.11

excursion

horizontal movement of an ATD or wheelchair target relative to its initial position on an impact sled during a test

3.12

fastener

device used to physically secure hardware components and parts in place

NOTE These include, but are not limited to, bolts, nuts, screws, pins and rivets.

3.13**forward-facing**

orientation in which the wheelchair-seated occupant faces the front of the vehicle, with the wheelchair reference plane within 10° of the longitudinal axis of the vehicle

3.14**four-point tiedown**

wheelchair tiedown system that attaches to the wheelchair frame at four separate securement points and also attaches to the vehicle at four separate anchor points

3.15**four-point strap-type tiedown**

a four-point tiedown that uses four strap assemblies to secure the wheelchair in the vehicle

3.16**harness**

occupant-restraint assembly consisting of at least one belt designed to provide pelvic restraint and two belts that restrain the upper torso by applying forces to both shoulders

3.17**head restraint**

device intended to limit rearward displacement of the occupant's head

3.18**impact simulator**

device for decelerating, accelerating, or a combination of decelerating and accelerating a section of a vehicle or assembly of simulated vehicle structures, including instrumentation for measuring data required by this part of ISO 10542

3.19**impact sled**

part of an impact simulator to which components can be mounted for impact testing

3.20**occupant restraint**

system or device intended to restrain a motor-vehicle occupant during an impact in order to prevent ejection, and prevent or minimize contact with the vehicle interior components and other occupants

3.21**pelvic restraint****pelvic belt**

lap belt

lap restraint

lower torso restraint

belt-restraint assembly intended to limit movement of the pelvis

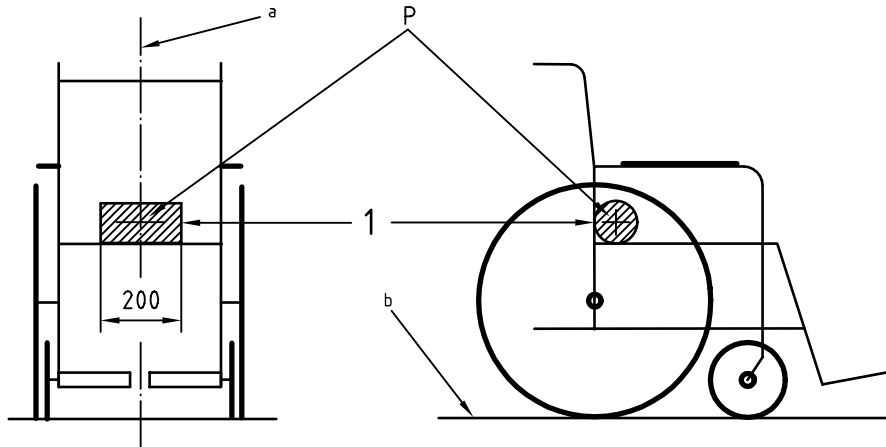
3.22**point P**

reference point that lies at the cross-sectional centre of a cylinder of diameter 100 mm and length 200 mm, positioned with the longitudinal axis perpendicular to the wheelchair reference plane such that the curved surface of the cylinder contacts the backrest and the upper surface of the seat

See Figure 1.

3.23**postural support****postural belt**

component or belt used to support a person in a desired seated position, but not intended to provide occupant restraint in a vehicle impact



Key

- 1 Cylinder, diameter 100 mm
- a Wheelchair reference plane
- b Wheelchair ground plane

Figure 1 — Wheelchair reference point P and wheelchair reference plane

**3.24
securement hardware**

components of a wheelchair tiedown that attach to the wheelchair

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**3.25
securement points**

points on the wheelchair to which wheelchair tiedowns are connected

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NOTE Securement points may be located on hardware components that are permanently or temporarily fastened to the wheelchair.

**3.26
strap**

length of webbing material used in a wheelchair tiedown

**3.27
surrogate wheelchair**

SWC

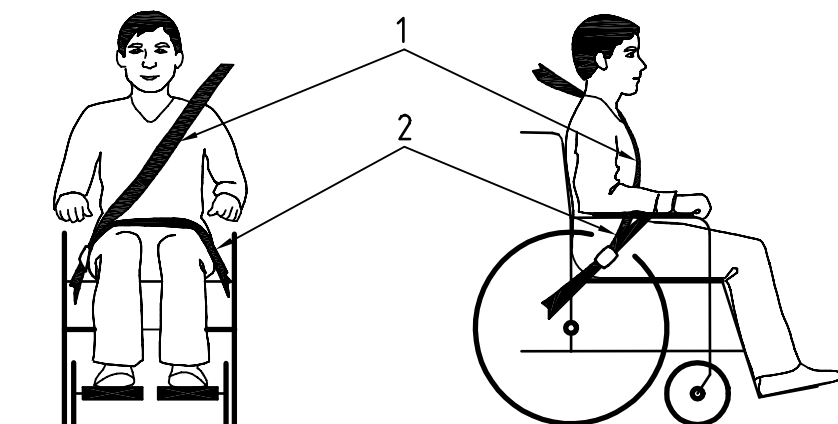
rigid, reusable device that conforms to the requirements of annex E and that is used to simulate a wheelchair for the purpose of testing wheelchair-tiedown and occupant-restraint systems

**3.28
three-point restraint**

three-point belt

occupant-restraint assembly comprised of both a pelvic belt and a diagonal shoulder belt that connect together near the hip of the user

See Figure 2.

**Key**

- 1 Diagonal shoulder restraint
2 Pelvic restraint

Figure 2 — Three-point belt

3.29**two-point restraint****two-point belt**

belt-type occupant-restraint assembly comprised of a single length of webbing and related hardware that anchors at both ends

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See Figure 3.

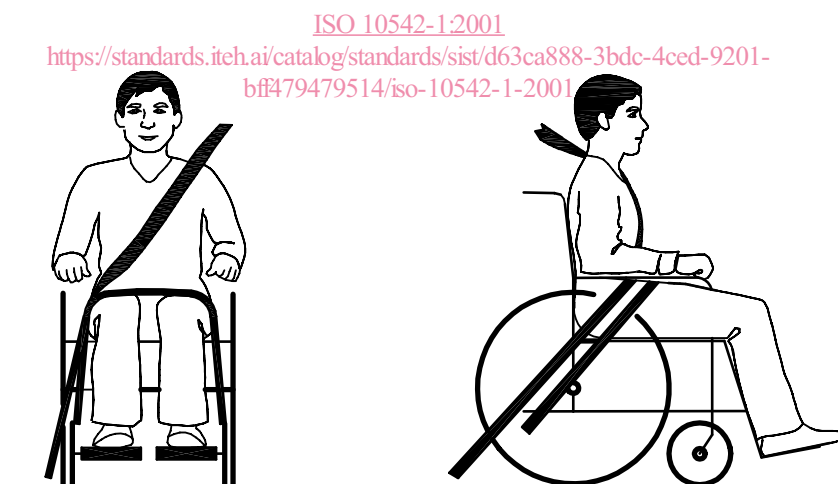


Figure 3 — Two versions of a two-point belt restraint: a two-point shoulder belt and a two-point pelvic belt

3.30**upper-torso restraint****shoulder belt**

diagonal belt

diagonal restraint

chest harness

portion of an occupant restraint intended to limit movement of the chest and head by application of restraint forces to the shoulders and chest

3.31

webbing

woven material, usually made from nylon or polyester yarn, used in belt and strap assemblies of occupant restraints and wheelchair tiedowns

3.32

webbing guide

hardware loop or ring anchored to a structural member in the vehicle or wheelchair back, through which an occupant-restraint belt passes, and changes direction, along the path to the vehicle anchor point

3.33

wheelchair ground plane

plane representing the surface on which the wheelchair rests

See Figure 1.

3.34

wheelchair reference plane

vertical plane in the longitudinal centreline of the wheelchair

See Figure 1.

3.35

wheelchair-tiedown and occupant-restraint system

WTORS

complete restraint system for wheelchair-seated occupants comprised of equipment for wheelchair tiedown and a belt-type occupant restraint

3.36

wheelchair tiedown

wheelchair securement

device or system designed to secure a forward-facing wheelchair in place in a motor vehicle

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4 Design requirements

4.1 WTORS

WTORS shall

- a) be for use with only one wheelchair and one occupant at a time, and
- b) include a belt-type occupant restraint, either by specifying use of the belt restraint and anchorages provided with the vehicle, or by providing a belt-type occupant restraint with the wheelchair tiedown as part of a complete WTORS,
- c) not require components of wheelchair tiedowns and occupant restraints to pass through the wheels of a wheelchair,
- d) not require removal of wheelchair frame material, drilling into the wheelchair frame, deformation of the wheelchair, welding, or use of an adhesive process during installation,
- e) once installed, be operable without tools,
- f) incorporate features to prevent unintentional loosening of all fasteners,
- g) have all small manually detachable hardware and fittings tethered to WTORS subassemblies, and
- h) include a manual override in case of power failure for any power-operated tiedown or restraint.

Specification of a vehicle-equipped belt-restraint system is primarily for situations in which the WTORS is intended for use by drivers but, even in this situation, it is recommended that the WTORS manufacturer provide a complete system, including both wheelchair tiedown and occupant restraint, for after-market installation in the vehicle.

4.2 Wheelchair tiedowns

Wheelchair tiedowns and tiedown components shall

- a) not release if any wheelchair component deforms, or if one or more tyres deflate during a vehicle impact,
- b) include a means to minimize vehicle-induced movement of the wheelchair that does not require the use of tools,
- c) not depend on the wheelchair brakes, and
- d) not utilize the occupant restraint to secure any portion of the wheelchair.

4.3 Belt-type occupant restraints provided by the WTORS manufacturer

4.3.1 Occupant restraints provided by the WTORS manufacturer shall

- a) have both pelvic and upper torso belts designed to apply forces to the occupant's skeletal regions,
- b) function independently of the wheelchair, such that the restraint belts anchor to either the vehicle or wheelchair tiedown components so that occupant-restraint loads are not transmitted through the wheelchair,
- c) have belt restraints that can be adjusted in length without the use of tools.

NOTE WTORS designed with occupant restraints that transfer occupant-restraint loads through the wheelchair require special labelling and will be dealt with in a future part of ISO 10542.

4.3.2 When set up and measured in accordance with annex B, occupant restraints provided by the WTORS manufacturer shall

- a) produce rear-view projected angles of the pelvic belt within the zones shown in Figure 4,
- b) produce side-view projected angles of the pelvic belt between 30° and 75° to the horizontal, as shown in Figure 4,
- c) provide for a range of adjustment of the pelvic restraint that allows for increasing and decreasing the total belt length by 200 mm from the nominal setup conditions, with at least 25 mm of webbing extending through any fitting where adjustment takes place,
- d) provide for a range of adjustment in the upper-torso restraint that allows for increasing the length by 200 mm, and shortening the length by 300 mm, from the nominal setup conditions, with at least 25 mm of webbing extending through any fitting where adjustment takes place, when tested in accordance with annex B, and
- e) have the junction of the shoulder and pelvic belts of three-point belt restraints located not less than 150 mm from the ATD centreline.

4.3.3 If occupant restraints include structural components for the attachment of upper anchorages or guides for upper torso belts, locations for the upper anchor points shall be provided that are

- a) adjustable in height so they can be positioned at or above the shoulder level of the intended user(s), or that are
- b) located at least 1 100 mm above the wheelchair ground plane.

4.3.4 Occupant restraints shall

- a) only use an airbag for supplementary restraint in conjunction with a wheelchair tiedown and belt-type occupant restraint that conform with the requirements of this part of ISO 10542, and
- b) not depend on an airbag in order to conform with the performance requirements of this part of ISO 10542.