
Wheelchairs —

Part 19:

**Wheelchairs for use as seats in motor
vehicles**

Fauteuils roulants —

*Partie 19: Fauteuils roulants destinés à être utilisés comme sièges
dans des véhicules à moteur*

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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 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 ISO/TC 173, *Assistive products*, Subcommittee SC 1, *Wheelchairs*.

This third edition cancels and replaces the second edition (ISO 7176-19:2008), which has been technically revised. It also incorporates the Amendment ISO 7176-19:2008/Amd.1:2015.

The main changes are as follows:

- scope has been expanded to include wheelchairs for occupants with a mass less than 22 kg;
- clause has been added to address risk management in modification of wheelchairs;
- the conformance label has been revised;
- design and performance requirements have been expanded, for example related to wheelchair tiedown clear-paths, wheelchair-mounted occupant restraints, and wheelchair securement with strap-type tiedowns;
- specifications for the surrogate WTORS have been enhanced;
- a checklist of the requirements has been added in [Annex L](#).

A list of all parts in the ISO 7176 series can be found on the ISO website.

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

Transportation safety research has shown that the vehicle seat is an important part of the occupant restraint system and therefore plays a key role in reducing the risk of serious injuries to vehicle occupants in many types of vehicle crashes. In particular, the seat needs to allow and facilitate the proper positioning of belt restraints on the skeletal regions of the occupant, not add to forces on the occupant during impact loading, and provide effective support for the occupant so that the belt restraint will remain in place over skeletal regions throughout a crash. People with physical disabilities often remain in their wheelchairs whilst travelling in motor vehicles as drivers or passengers. Since many wheelchairs were not designed for this purpose, wheelchair-seated occupants are often at higher risk of injury in crashes than are people seated in seats provided by the vehicle manufacturer.

ISO 10542-1 provides design, performance, labelling and manufacturer literature requirements, and specifies associated test methods, for Wheelchair Tiedown and Occupant Restraint Systems (WTORS). This document addresses the seating part of wheelchair-user occupant-protection systems by establishing design, performance, labelling and manufacturer literature requirements, as well as associated test methods, for wheelchairs that can be used as seats in motor vehicles.

Whilst wheelchairs can be secured by various types of tiedown and securement systems that were available throughout the world at the time this document was developed, effective wheelchair securement in the real world cannot be achieved without compatibility of the wheelchair tiedown system available in the vehicle and the method of securement provided on the wheelchair. At the time that this document was developed, the four-point strap-type tiedown was considered to be the most effective, common, and universally adaptable system for securing a wide range of wheelchair types and sizes. Therefore the provisions and test methods of this document are based on the use of four-point strap-type tiedowns to secure the wheelchair in the vehicle. However, wheelchairs can also be designed for securement in motor vehicles by other methods, such as docking-type devices, which are commonly used by wheelchair-seated drivers. Manufacturers who wish to evaluate wheelchairs with other methods of securement can make use of provisions and test methods of this document.

To evaluate the crashworthiness performance of wheelchairs, [Annex A](#) specifies procedures for dynamically testing a wheelchair loaded with an appropriate-size crash-test dummy using a 48 km/h crash pulse with the wheelchair secured facing forward on the impact sled. This test is based on well-documented motor vehicle crash and injury statistics, which show that more than 50 % of all serious injuries to occupants of motor vehicles occur in frontal crashes, and that more than 95 % of frontal crashes result in a longitudinal change in vehicle speed of less than 48 km/h. Dynamic performance for forward-facing wheelchairs in rear impacts is addressed in [Annex G](#). Recent research has shown that some commercial wheelchairs offer significantly less protection in rear-impact than conventional motor vehicle seats. Manufacturers who wish to test wheelchairs to determine their performance in rear-impact conditions can use the test methods and performance measures in [Annex G](#).

This document has also been developed with the recognition that the use of a pelvic-belt restraint alone does not provide the wheelchair occupant with the same level of crash protection in a frontal impact as does the use of both pelvic-belt and shoulder-belt restraints for adults or five-point harness restraints for children. Therefore, the provisions and test methods of this document are based on the use of both pelvic- and shoulder-belt-type restraints or five-point harness restraints.

The first edition of this document only addressed wheelchairs designed for use by people who weigh 22 kg or more because it is best practice to have those under 22 kg transfer to a child safety seat that meets applicable standards (e.g. FMVSS 213, UN Regulation No. 44). Whilst transfer to a child safety seat should continue to be the first choice, there is a portion of people who use wheelchairs and weigh less than 22 kg that cannot safely or practically transfer and these individuals would be safer in a crashworthy wheelchair. To fill this need, the scope of this document has been expanded (see scope) to include products designed for people who weigh between 12 kg and 22 kg and includes additional design features and performance criteria (including buckle release characteristics, restraint belt width, back-support height, restraint fit and adjustment) for these products that have been shown to provide a higher level of protection for smaller occupants.

The four-point strap-type tiedown system relies on the involvement of a second person and cannot be implemented by the wheelchair occupant. Accordingly, it is desirable to progress toward a securement method that can be implemented independently by the wheelchair-seated passenger who might travel in different public transportation and private vehicles. As a step toward this goal, [Annex F](#) establishes universal docking interface geometry (UDIG) for securement points on wheelchairs when it is intended for the wheelchair to be secured by docking-type securement devices in public transportation and/or multiple private vehicles.

It is recognized that single sample testing does not mean that every variation of a given wheelchair model will exhibit exactly the same performance behaviour. However, it is also recognized that it is not feasible for manufacturers to independently test every variation of a given wheelchair model. As such, the expectation is that wheelchair manufacturers will test a suitably representative sample (or samples) that adequately represents the range of model variation for which conformance is claimed, based on an engineering assessment. In addition, where requested, manufacturers should make details of the wheelchair configuration used for testing available to suppliers and/or purchasers, and specify which options are available on the wheelchair when used as a seat in a motor vehicle.

Finally, this document should be viewed in the totality of daily wheelchair use and the range of standards to which all wheelchairs are expected to conform. Wheelchairs primarily serve as mobility devices. Transportation is only one of many daily activities that introduce unique circumstances and requirements that wheelchairs and people who use wheelchairs can experience. Wheelchair products that conform with this document will have additional features that provide increased levels of occupant security and safety whilst their occupants are riding in motor vehicles. However, a wheelchair's failure to conform with this document cannot be used to limit access to, and availability of, motor vehicle transportation for people who use wheelchairs.

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Wheelchairs —

Part 19:

Wheelchairs for use as seats in motor vehicles

1 Scope

This document specifies test methods, requirements and recommendations for wheelchairs intended for use as seats in motor vehicles related to design, performance, labelling, presale literature, user instructions and user warnings.

This document is applicable to all manual and powered wheelchairs, including scooters, which, in addition to their primary function as wheeled mobility devices, are also likely to be used as forward-facing seats in motor vehicles by children and adults with a body mass equal to or greater than 12 kg.

This document is applicable to complete wheelchairs, including a frame or powerbase and seating system. It is also applicable to wheelchairs equipped with additional components designed to facilitate conformity with one or more of the requirements of this document.

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.

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

ISO 7176-5, *Wheelchairs — Part 5: Determination of dimensions, mass and manoeuvring space*

ISO 7176-15, *Wheelchairs — Part 15: Requirements for information disclosure, documentation and labelling*

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

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

ISO 14971, *Medical devices — Application of risk management to medical devices*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 7176-26 and the following apply.

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

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

3.1

accessible transport vehicles for sitting and standing passengers

ATV-SS

large motor vehicle used in relatively slow-speed travel that allows for seated and standing passengers, and that provides for transporting people with disabilities who remain seated in their wheelchairs

**3.2
anchor point**

location on a vehicle interior component, floor or sidewall, on a wheelchair, or on a wheelchair tiedown assembly or securement system, that represents the centre of where tiedown and/or securement loads or belt-restraint loads are transferred to the vehicle, wheelchair, tiedown assembly or securement system when the wheelchair and occupant is in the traveling position

Note 1 to entry: This is a location based on a particular anchorage, and not necessarily any physical components or hardware that comprise the anchorage.

**3.3
anchorage**

component, or an assembly of components and fittings, which transfer loads directly from a WTORS assembly to the vehicle or wheelchair

EXAMPLE 1 The hardware at the end of a wheelchair tiedown strap that attaches to a vehicle floor (e.g. onto a track or other component on the vehicle floor).

EXAMPLE 2 An item of hardware such as a D-ring, and its associated fastener at the end of a wheelchair-mounted occupant restraint belt that attaches to the anchor point on the wheelchair.

**3.4
anthropomorphic test device
ATD**

crash-test dummy
articulated physical analogue of the human body used to represent a wheelchair occupant in a test

**3.5
attachment hardware**
mechanical means of attaching a seating system to the wheelchair frame

**3.6
automatic-locking retractor
ALR**

device to accommodate a belt or strap that allows extraction of the belt or strap to the desired length and then lock so that further extraction of the belt or strap is prevented without voluntary intervention

**3.7
back restraint**

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

**3.8
back support**

postural support device that is part of a wheelchair seating system intended to support the posterior surface of the sacral, lumbar and/or thoracic segments of the trunk in an upright or partially reclined posture

**3.9
belt**

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

**3.10
clamp-type securement**

clamp-type tiedown
method of wheelchair securement that uses only mechanical linkages and/or grips requiring manual positioning and tightening of the securement point end fittings to the wheelchair

3.11**docking-type securement**

DEPRECATED: docking-type tiedown

method of securing a wheelchair to a vehicle interior in which one or more securement points attached to the wheelchair align and automatically engage with a docking securement device attached to the vehicle once the wheelchair is manoeuvred into position in the vehicle

Note 1 to entry: Engagement, securement and disengagement of the wheelchair can be automatic or manual.

3.12**docking securement device**

DEPRECATED: docking tiedown device

assembly of fixtures and components designed for installation in a motor vehicle for the purpose of securing a wheelchair by engaging with a wheelchair securement adaptor mounted to the wheelchair

3.13**emergency-locking retractor**

ELR

retractor mechanism used in belt restraints that locks the belt from further spool out when the vehicle acceleration or deceleration exceeds a threshold value and/or when the rate of belt spool out exceeds a threshold speed

Note 1 to entry: The vehicle acceleration or deceleration threshold value is usually 0,5 *g* or less.

Note 2 to entry: During normal driving conditions, the retractor does not restrict the freedom of movement of the wearer of the occupant restraint.

3.14**excursion**

movement of an anthropomorphic test device or wheelchair during a test relative to its initial position on an impact sled

3.15**fastener**

device used to physically secure hardware components and parts in place

Note 1 to entry: These include, but are not limited to, bolts, nuts, screws, pins and rivets

3.16**five-point harness restraint**

occupant restraint for use primarily by child occupants comprised of two shoulder belts, a pelvic-belt, and a crotch strap that uses five anchor points and/or belt guides, with two located above and behind the shoulders, two located below and behind the pelvis, and one located below and slightly forward of the crotch

Note 1 to entry: Care should be taken not to confuse a torso postural support device with a five-point harness restraint.

3.17**foot/leg strap**

length of webbing mounted forward and below the anthropomorphic test device knee to limit upward movement of the leg after peak forward motion of the anthropomorphic test device knee has occurred

Note 1 to entry: The foot/leg strap minimizes damage to the anthropomorphic test device and provides for more realistic movement of the lower extremities during frontal-impact loading by limiting extension of the knee joints and upward movement of the anthropomorphic test device's lower extremities. It does this in a manner that does not affect forward excursions of the anthropomorphic test device, but slightly reduces the severity of rearward rebound of the anthropomorphic test device while making this rebound more controlled and consistent between tests.

3.18

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

3.19

four-point tiedown

strap-type tiedown attaching to the wheelchair at four separate securement points

3.20

four-point strap-type tiedown

wheelchair tiedown system that uses four strap assemblies to secure the wheelchair in the vehicle, attaching to the wheelchair at four separate securement points and to the vehicle at four separate anchor points

3.21

H-point

point located on the left and right sides of the pelvic region of an anthropomorphic test device that represent the approximate locations of the human hip joint centre in the side views, as specified by the anthropomorphic test device manufacturer

3.22

head restraint

device intended to limit rearward movement of an occupant's head in a vehicle impact

3.23

head support

postural support device intended to support the head

Note 1 to entry: A head support is not designed or intended to provide head restraint in a vehicle impact

3.24

impact simulator

device for physically simulating a vehicle crash event by decelerating and/or accelerating an impact sled, including instrumentation for measuring pertinent data

3.25

impact sled

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

3.26

multiple-point tiedown

strap-type tiedown attaching to the wheelchair at more than four separate securement points

3.27

occupant restraint

system or device designed to limit movement of a motor-vehicle occupant during crash events and thereby prevent ejection of an occupant from the vehicle, and prevent or minimize occupant contact with the vehicle interior components and other occupants

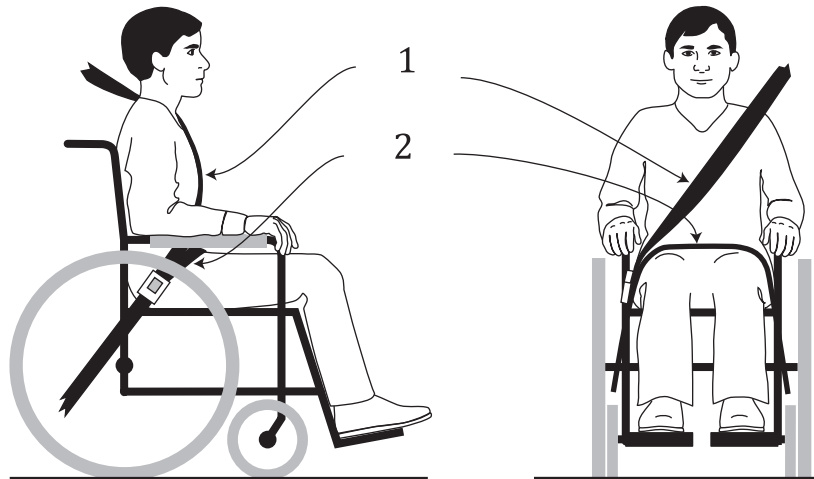
3.28

pelvic-belt restraint

lap-belt restraint

portion of a belt-type occupant restraint designed to limit movement of an occupant's lower torso in a vehicle impact by application of restraint forces to the pelvic area

Note 1 to entry: See [Figure 1](#).



Key

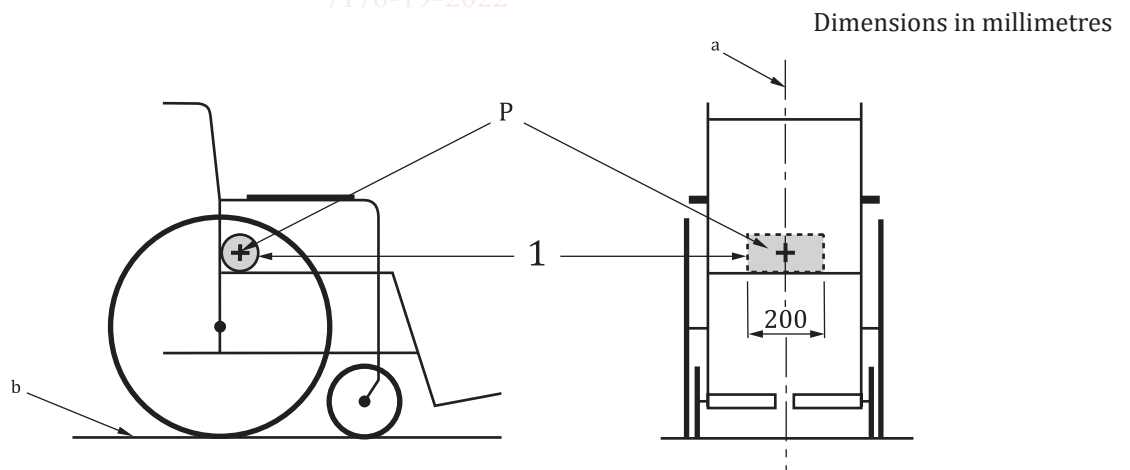
- 1 shoulder-belt restraint
- 2 pelvic-belt restraint

Figure 1 — Three-point-belt restraint comprised of a pelvic-belt restraint and a shoulder-belt restraint that connect together near the hip of the occupant

**3.29
point P**

reference point of a wheelchair seating system that lies at the cross-sectional centre of a 100 mm diameter, 200 mm long, cylinder of mass not greater than 0,5 kg positioned with the longitudinal axis perpendicular to the wheelchair reference plane, such that the curved surface of the cylinder contacts the seat and back support surfaces

Note 1 to entry: See [Figure 2](#).



Key

- 1 cylinder, diameter 100 mm
- P point P
- a Wheelchair reference plane.
- b Wheelchair ground plane.

Figure 2 — Wheelchair reference point P and wheelchair reference and ground planes

3.30

postural support device
postural support
postural belt

structure or belt, attached to a wheelchair, which has a surface that contacts the occupant's body and is used to either modify or accommodate the occupant's sitting posture

Note 1 to entry: Postural support devices are not designed or intended to provide occupant restraint in a vehicle impact.

3.31

retractor

device to accommodate a belt or strap, designed to retract the belt or strap, either manually or automatically

3.32

seat

postural support device intended to support the inferior surface of the buttocks and thighs

3.33

seating system

seat and back support and their attachment hardware, plus those accessories deemed necessary

Note 1 to entry: A seating system can also include postural support devices other than the seat and back support, for example lateral torso supports

3.34

securement point

structural point on the wheelchair frame, powerbase, seat frame or securement adaptor to which a tiedown securement point end fitting can be connected, or that can be effectively engaged with a securement device mounted to the vehicle

3.35

securement point end fitting

hardware at end of a wheelchair tiedown-strap assembly designed to attach to wheelchair securement points on a wheelchair frame, powerbase, seat frame or securement adaptor for the purpose of securing the wheelchair to a motor vehicle using a strap-type tiedown

3.36

seat frame

structural components that support the seat and back support

3.37

sharp edge

exposed, rigid edge with a radius of less than 2 mm

3.38

shoulder-belt restraint

DEPRECATED: upper torso restraint

portion of an occupant restraint intended to limit movement of the chest and head which passes diagonally across the front of the chest from the hip to the opposite shoulder

Note 1 to entry: See [Figure 1](#).

3.39

strap

length of webbing or other material used in a wheelchair tiedown assembly

3.40

strap-type tiedown

wheelchair tiedown that uses strap assemblies to secure the wheelchair in the vehicle

3.41**surrogate tiedown****surrogate tiedown system**

surrogate securement system

system for attaching a wheelchair to a test platform in a manner that simulates commercial tiedown or securement systems, and that includes reusable and/or replaceable components

Note 1 to entry: Specifications for design of a surrogate four-point strap-type tiedown system are provided in [Annex E](#).

3.42**surrogate wheelchair****SWC**

rigid, reusable device according to ISO 10542-1:2012, Annex E that is used to simulate a wheelchair for the purpose of testing wheelchair tiedown and occupant restraint systems

3.43**surrogate wheelchair tiedown and occupant restraint system****SWTORS**

system for attaching a wheelchair with an anthropomorphic test device to a test platform in a manner that simulates commercial WTORS and that includes reusable and/or replaceable components

Note 1 to entry: Specifications for design of a surrogate four-point strap-type tiedown system and three-point belt restraint are provided in [Annex E](#).

3.44**three-point belt restraint**

DEPRECATED: three-point restraint

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

Note 1 to entry: See [Figure 1](#).

3.45**tilt seating**

tilt-in-space

type of wheelchair seating system with integral seat frame that is mounted on the wheelchair frame or powerbase, and which allows the complete seating system to be rotated forward and backward about an axis perpendicular to the wheelchair reference plane

3.46**universal docking interface geometry****UDIG**

specifications for the size, shape, and location of wheelchair securement points, including surrounding clear zones, that provides for effective engagement with docking securement devices installed in a wide range of vehicles

Note 1 to entry: ISO 10542-1:2012, Annex F and [Annex F](#) provide detailed UDIG specifications.

3.47**UDIG adaptor**

wheelchair securement adaptor that conforms to the universal docking interface geometry

3.48**webbing**

woven material used in belt and strap assemblies of occupant restraints and wheelchair tiedowns