



BSI Standards Publication

Wheelchairs

Part 19: Wheelchairs for use as seats in motor vehicles

National foreword

This British Standard is the UK implementation of [ISO 7176-19:2022](#). It supersedes BS ISO 7176-19:2008+A1:2015, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CH/173, Assistive products for persons with disability.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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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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Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Design requirements and recommendations	9
4.1 General	9
4.2 Wheelchair securement	9
4.2.1 Securement with strap-type tiedowns	9
4.3 Occupant restraints	9
4.3.1 Accommodation of vehicle-mounted three-point belt restraints	9
4.3.2 Wheelchair-mounted occupant restraints	9
4.4 Wheelchair head and back supports for small children	10
4.5 Risk management in modifying wheelchairs that conform to this document	10
5 Performance requirements and recommendations	10
5.1 General	10
5.2 Frontal impact	10
5.2.1 Frontal impact with strap-type tiedowns	10
5.2.3 During the test	10
5.2.4 After the test	11
5.3 Accessibility of securement points intended for use with strap-type tiedowns	12
5.4 Clear paths for strap-type tiedowns	12
5.5 Accommodation of vehicle-mounted belt restraints	12
5.6 Wheelchair-mounted belt restraints	13
6 Identification, labelling, user instructions, warning, and disclosure requirements and recommendations	13
6.1 General	13
6.2 Identification and labelling	13
6.3 Presale literature	14
6.4 User and maintenance instructions	15
6.4.1 General	15
7 Documentation of conformance	18
7.1 General	18
7.2 Frontal impact test	18
7.3 Design, labelling, and literature requirements	19
Annex A (normative) Method for frontal impact test	20
Annex B (normative) Specifications for securement points on wheelchairs intended for attachment of four-point strap-type tiedowns	28
Annex C (normative) Method for testing accessibility and tiedown clear paths of wheelchair securement points intended for attachment of four-point strap-type tiedowns	32
Annex D (normative) Methods for rating wheelchair accommodation of vehicle-mounted occupant belt restraints	41
Annex E (normative) Specifications for Surrogate Wheelchair Tiedown and Occupant Restraint System (SWTORS) with four-point strap-type tiedown and three-point belt restraint	47
Annex F (informative) Specifications for wheelchair Universal Docking Interface Geometry (UDIG)	60

Annex G (informative) Wheelchair design, performance, and labelling recommendations for improved protection of occupants seated facing forward in wheelchairs during rear impacts	65
Annex H (normative) Design and performance requirements for five-point harness restraints for children less than 23 kg	74
Annex I (informative) Performance considerations for five-point harness restraints for children less than 23 kg	76
Annex J (informative) Design and performance requirements for wheelchair-mounted occupant restraints for use by people with body mass equal to or greater than 23 kg	77
Annex K (normative) Requirements and recommendations when providing more than four securement points	83
Annex L (informative) Checklist of requirements	86
Annex M (informative) Indication of main values in imperial units	88
Bibliography	89

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

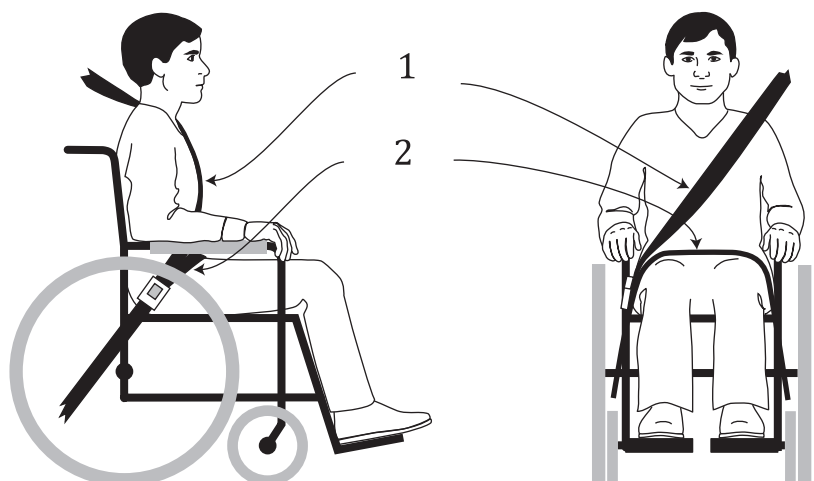
3.28

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

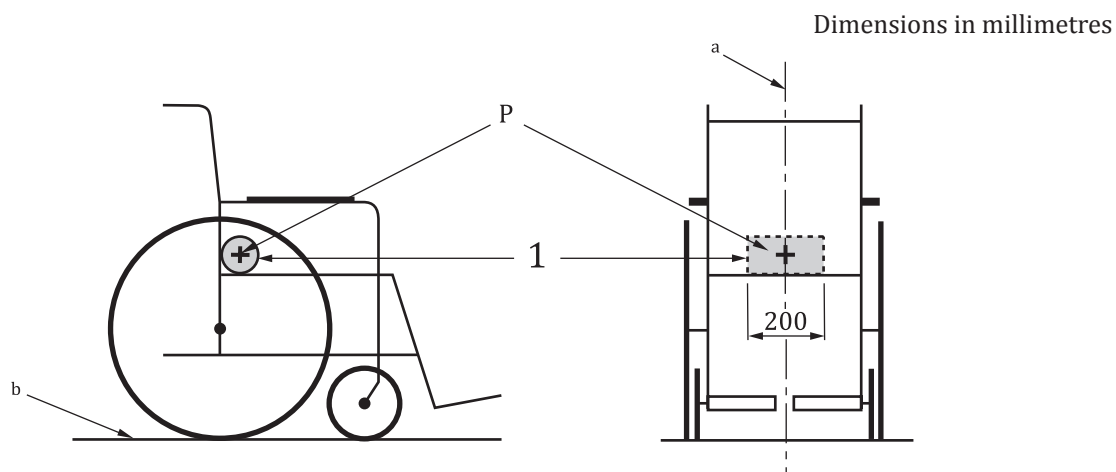
Figure 1 — Three-point-belt restraint comprised of a pelvic-belt restraint and a shoulder-belt restraint that connect together near the hip of the occupant

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

3.49

webbing guide

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

3.50

wheelchair

device to provide wheeled mobility with a seating support system for a person with impaired mobility

Note 1 to entry: A walking aid with wheels is not a mobility device

Note 2 to entry: The term encompasses for example standard manual wheelchairs, push wheelchairs, powered wheelchairs and three- and four-wheeled scooters, with different type of seating systems.

3.51

wheelchair frame frame

assembly of structural members of a wheelchair to which wheels and postural support devices are attached.

3.52

wheelchair footprint

space outlined on the wheelchair ground plane by projecting vertically down from the outermost edges of the structural members that comprise the frame or powerbase and seating system of the wheelchair

Note 1 to entry: The footrests are included in the wheelchair footprint.

3.53

wheelchair ground plane

horizontal plane representing the surface on which the wheelchair rests

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

3.54

wheelchair powerbase powerbase

component of an electrically powered wheelchair which contains the drive system, batteries and wheels, and can be separated from the seating system.

3.55

wheelchair reference plane

vertical plane in the longitudinal centreline of the wheelchair

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

3.56

wheelchair securement wheelchair tiedown

device or system designed to attach a forward-facing wheelchair to a motor vehicle

3.57

wheelchair securement adaptor

wheelchair tiedown adaptor

hardware that is attached temporarily or permanently to the wheelchair frame, powerbase and/or seat frame to provide a securement point or points

3.58

wheelchair tiedown and occupant restraint system WTORS

complete set of safety equipment for an occupant seated in a wheelchair when traveling in a motor vehicle comprised of equipment for wheelchair securement and occupant restraint

4 Design requirements and recommendations

4.1 General

[Annex L](#) provides a checklist of the requirements in [Clause 4](#).

4.2 Wheelchair securement

4.2.1 Securement with strap-type tiedowns

- a) The wheelchair shall be designed to provide for forward-facing securement in a motor vehicle using a four-point strap-type tiedown that conforms with [ISO 10542-1](#), using two securement points at the front and two securement points at the rear, placed symmetrical about the wheelchair reference plane, that conform to the specifications given in [Annex B](#) and the applicable performance requirements in [Clause 5](#), or
- b) Where the wheelchair cannot meet the requirements in a) due to high mass features or facilities that accommodate the special needs of the intended occupant and requires additional securement points, the wheelchair shall meet the requirements of [Annex K](#).

NOTE The four-point strap-type tiedown system is the most commonly available strap-type tiedown system in wheelchair transport worldwide. The use of a four-point strap-type tiedown system will improve ease of use and reduce misuse during the wheelchair securement process in the vehicle.

4.2.2 In addition, the wheelchair may be designed for forward-facing securement using other methods of wheelchair securement, including docking-type securement.

4.2.3 If a wheelchair is intended by the manufacturer to also be secured by a docking securement device in public transportation and/or different private vehicles (i.e. in a multiple-user setting), the securement points on the wheelchair and/or of the wheelchair securement adaptors should conform to the specifications given in [Annex F](#) and the applicable performance requirements in [Clause 5](#).

4.3 Occupant restraints

4.3.1 Accommodation of vehicle-mounted three-point belt restraints

The wheelchair shall be constructed so that it does not interfere with the proper use and fit of vehicle-mounted belt restraints, and it shall allow the pelvic-belt restraint to make contact with the lower region of the occupant's pelvis and not prevent the shoulder-belt restraint from making good contact with the occupant's shoulder and chest. The wheelchair shall be constructed so that it achieves at least the performance requirements specified in [5.5](#).

NOTE [Annex D](#) contains test methods and [5.5](#) contains performance criteria for scoring and rating the wheelchair with regard to accommodating the proper use and placement of vehicle-mounted occupant belt restraints.

4.3.2 Wheelchair-mounted occupant restraints

- a) Wheelchairs designed for use by people with a body mass under 23 kg shall provide a wheelchair-mounted five-point harness restraint in accordance with [Annex H](#). The wheelchair shall be equipped with the belt restraint when purchased by, and delivered to, the consumer.
- b) If a wheelchair designed for use by people with a body mass equal to or greater than 23 kg provides for the attachment of, or is equipped with, a wheelchair-mounted pelvic- and/or shoulder-belt restraint, the restraint and the anchorages shall be in accordance with [Annex J](#).

NOTE The value of 23 kg is drawn from a child restraint classification using 50 lb (22,7 kg) as mass limit for needing it to be equipped with a five-point harness restraint.

4.4 Wheelchair head and back supports for small children

For a wheelchair designed to accommodate children with a body mass under 23 kg, the height of the back support at the centreline from the junction of the back support with the seat (i.e. the seat bight) to the top of the head support/restraint shall not be less than 555 mm.

NOTE [Annex G](#) provides additional design guidelines for wheelchair back and head supports for equipment that is also intended to serve as back and head restraints that provide occupant protection in a vehicle rear-impact crash event.

4.5 Risk management in modifying wheelchairs that conform to this document

If it is necessary to physically modify a wheelchair conforming with this document to accommodate medical needs of the occupant, the modifier shall conduct a risk management process in conformance with [ISO 14971](#) to identify risks related to crashworthiness.

Changes to wheelchairs that are likely to affect conformance relative to this document include but are not limited to: moving the securement-point brackets, lowering the back-support height, shortening the seat length, adding rigid postural supports with mass greater than 150 g that are not firmly attached to the wheelchair, installing after-market postural seating, installing augmentative and alternative communication aids or other devices to suit the specific needs of the occupant, adding components that have sharp edges, or any change that compromises the structural integrity of the wheelchair frame.

5 Performance requirements and recommendations

5.1 General

[Annex L](#) provides a checklist of the requirements in [Clause 5](#).

5.2 Frontal impact

5.2.1 Frontal impact with strap-type tiedowns

- a) When tested in accordance with [Annex A](#) using a four-point tiedown that conforms with [ISO 10542-1](#), the wheelchair shall meet the requirements of [5.2.3](#) and [5.2.4](#), or
- b) Where the wheelchair cannot meet the requirements in a) due to high mass features or facilities that accommodate the special needs of the intended occupant and requires additional securement points, the wheelchair shall meet the requirements of [Annex K](#).

5.2.2 In addition to [5.2.1](#), the wheelchair may also be tested using other methods of securement that conform with [ISO 10542-1](#), such as a docking-type securement. To state conformance of the wheelchair with the frontal impact requirements for the additional securement method, the wheelchair shall meet the requirements of [5.2.3](#) and [5.2.4](#) when tested in accordance with [Annex A](#) using this other securement method.

5.2.3 During the test

- a) The horizontal excursions of the ATD and the wheelchair with respect to the impact sled shall not exceed the limits in [Table 1](#) until motion of the ATD and the wheelchair has ceased.
- b) If the wheelchair is tested with a vehicle-mounted pelvic-belt, the peak forward ATD knee excursion shall exceed the peak forward wheelchair point P excursion by 10 % or more, as indicated by:

$$X_{\text{knee}} / X_{\text{wc}} \geq 1,1$$

NOTE Conformance with this requirement reduces the potential for the mass of the wheelchair to apply additional restraint forces to the wheelchair occupant in a crash, thereby reducing the risk of seatbelt-induced injury.

- c) Batteries of powered wheelchairs or their surrogate replacement parts shall
 - 1) not move completely outside the wheelchair footprint, and
 - 2) not move into the wheelchair occupant's space (e.g. shall not contact the back of the ATD's legs).
- d) No components of the securement system (i.e. securement hooks of the strap-type tiedown or docking device latch mechanism) shall completely detach or disengage from a wheelchair securement point or adaptor at any time during the test. A stabilizer bracket or other component of a docking securement device whose purpose is not primarily to secure the wheelchair, but to aide in alignment or preventing rotation, may detach or disengage during the test.

Table 1 — Horizontal excursion limits

Dimensions in millimetres

Measurement point	Excursion variable	3-year old child ATD	6-year old child ATD	10-year old child ATD	Small adult female ATD	Midsize and large adult ATD
wheelchair point P	X_{wc}	150	150	175	200	200
ATD knee centre	X_{knee}	300	300	325	375	375
ATD front of head	X_{headF}	500	500	500	550	650
ATD back of head	X_{headR}	-350	-350	-400	-400	-450

X_{wc} : Horizontal distance relative to the sled platform between the point P target on the wheelchair at time t_0 , to the point P target at the time of peak wheelchair excursion.
 X_{knee} : Horizontal distance relative to the sled platform between the ATD knee joint target at time t_0 , to the knee-joint target at the time of peak knee excursion.
 X_{headF} : Horizontal distance relative to the sled platform between the most forward point on the ATD's head above the nose at time t_0 , to the most forward point on the ATD's head at the time of peak head excursion.
 X_{headR} : Horizontal distance relative to the sled platform between the most rearward point on the ATD's head at time t_0 , to the most rearward point on the ATD's head at the time of peak head excursion.
 NOTE See the last paragraph of [A.4.12](#) for a description of how to estimate the point P excursion when it is not possible to place a contrast marker at point P.

5.2.4 After the test

- a) 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.
- b) The structural components of the wheelchair securement points shall not completely fail.
- c) Rigid components, fragments or accessories of the wheelchair with a mass in excess of 150 g shall not be completely separated from the wheelchair.
- d) Wheelchair components that can contact the occupant shall not fragment or separate in a manner that produces sharp edges.
- e) Locking mechanisms of tilt seating adjusters shall not completely fail.
- f) Removal of the ATD from the wheelchair shall not require the use of tools, other than a hoist to lift the ATD.
- g) Release of the wheelchair from the securement system shall not require the use of tools.

- h) The post-test height of the average of left and right ATD H-points relative to the wheelchair ground plane shall not have decreased by more than 20 % from the pre-test height.
- i) The wheelchair and its components shall not cause complete failure of the webbing of any of the WTORS assemblies during the test.
- j) No components of the wheelchair securement (i.e. securement point end-fittings of the strap-type tiedown or the latch mechanism of a docking securement device) shall completely detach or disengage from a wheelchair securement point or wheelchair securement adaptor. A stabilizer bracket or other component of a docking securement system whose purpose is not primarily to secure the wheelchair, but to aid in alignment or preventing rotation, may be detached or disengaged.

NOTE The impact response of wheelchairs and particularly the performance of wheelchair back supports and head supports/restraints in moderate-level rear impacts can be determined using the test methods and performance measures given in [Annex G](#).

5.3 Accessibility of securement points intended for use with strap-type tiedowns

5.3.1 When tested in accordance with [Annex C](#), each wheelchair securement point intended for use with a strap-type tiedown shall

- a) allow one-handed attachment and engagement of the hook gauge specified in [Figure C.2](#) within 10 s, and
- b) allow one-handed disengagement and removal of the same hook gauge within 10 s.

5.3.2 Securement points on wheelchairs should also be provided with sufficient clear space to allow webbing and associated non-hook type securement point end fittings of tiedown assemblies to be easily inserted and attached or detached.

5.4 Clear paths for strap-type tiedowns

When tested in accordance with [Annex C](#),

- a) the path between each wheelchair securement point and the corresponding tiedown anchor point shall not deviate from a straight line by more than 40 mm,
- b) it is recommended that the deviation of the path measured in [5.4 a\)](#) is as close as possible to zero,
- c) all contactable edges of wheelchair components within a 50 mm radius of the centre of the tiedown path measured in [5.4 a\)](#) shall have a radius of 2 mm or greater.
- d) a sharp edge that is within 50 mm of the centre of the tiedown path, but that would be unlikely to be contacted by a tiedown strap during normal travel or a frontal collision (e.g. because it is above the straight-line path or behind another structural component), is not considered to constitute failure of [5.4 c\)](#).

5.5 Accommodation of vehicle-mounted belt restraints

When tested in accordance with the procedures of [Annex D](#) using a vehicle-mounted three-point belt restraint that conforms with [ISO 10542-1](#),

- a) the rating for the wheelchair shall be at least “acceptable” with regard to the ease of proper placement of vehicle-mounted three-point belt restraints in accordance with the criteria of [Table D.1](#) and as specified in [D.6.1](#), and
- b) the rating for the wheelchair shall be at least “acceptable” with regard to the extent to which proper positioning and geometry of the three-point belt restraint is achieved in accordance with the criteria in [Tables D.2](#) to [D.8](#) and as specified in [D.6.2](#).

5.6 Wheelchair-mounted belt restraints

- a) Wheelchair-mounted five-point harness restraint designed for use by people with a body mass under 23 kg shall meet the performance requirements in [Annex H](#).
- b) If a wheelchair designed for use by people with a body mass equal to or greater than 23 kg provides for attachment of, or is equipped with, a wheelchair-mounted pelvic- and/or shoulder-belt restraint it shall meet the performance requirements in [Annex J](#).

6 Identification, labelling, user instructions, warning, and disclosure requirements and recommendations

6.1 General

- a) [ISO 7176-15](#) shall apply with the addition of the information given in [6.2](#) to [6.4](#). [Annex L](#) provides a checklist of the requirements in [Clause 6](#).

- b) Labels should be durable so as to remain legible and not work loose or curl.

NOTE [IEC 60601-1](#) has reference procedures for label durability.

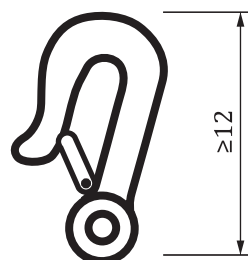
- c) If the wheelchair is designed with more than four securement points, [K.5.1](#) to [K.5.3](#) apply in addition to the requirements in [Clause 6](#).

6.2 Identification and labelling

- a) The wheelchair and/or its components shall be provided with permanent labels or markings that indicate the location of securement points for four-point strap-type tiedowns, using the symbol in [Figure 3](#), where
 - 1) each symbol has an overall height of at least 12 mm,
 - 2) the symbol is of sufficient contrast to the background to be visible in normal room lighting from a distance of 1 m.
- b) the symbol in [Figure 3](#) shall not be used to mark securement points intended for purposes other than securement of the occupied wheelchair in a vehicle.

Dimensions in millimetres

Figure 3 — Symbol required at each wheelchair securement point for strap-type tiedowns



ISO 7000 - 3743

- c) The wheelchair frame, powerbase and/or primary seating-system components, and if applicable wheelchair-mounted belt restraints, shall include permanent labels as required in [ISO 7176-15](#) with
 - 1) the manufacturer's name,
 - 2) date of manufacture,

- 3) the product model number,
- 4) a unique product serial number, and
- 5) [Figure 4](#) to indicate that the wheelchair conforms with the requirements of this document. The figure shall be
 - at least 12 mm in diameter, however larger symbols are strongly preferred whenever this is possible given the structure or surface on which the symbol is located,
 - rendered in any two contrasting colours such that the colour at the circumference contrasts with the colour of the component to which the symbol is attached
 - positioned so that the symbols can be easily seen by a vehicle operator or attendant when an occupied wheelchair enters a vehicle.

NOTE 1 A permanent label is one that will remain on the product with a high level of legibility during the expected life of the product, including after normal use and cleaning.

NOTE 2 Some information listed above under [6.2 c\)](#) can already be required by [ISO 7176-15](#).



NOTE Application in which ISO 7000-0100 and ISO 7000-3710 are used in conjunction.

Figure 4 — Figure on labels on the wheelchair, primary seating-system components, and wheelchair-mounted belt restraints to indicate conformance with this document

- d) For wheelchairs that provide securement points in addition to those required for strap-type tiedowns, (i.e. for docking type securement devices) affix appropriate markings or labels to indicate the locations of any additional securement points and the method of securement to be used.

6.3 Presale literature

In addition to the requirements in [ISO 7176-15](#), the wheelchair manufacturer's presale literature shall include the following:

- a) a statement that the wheelchair is designed to be secured facing forward when used as a seat in a motor vehicle and that it conforms with the requirements of this document;

- b) a description of the types of wheelchair securement systems that are suitable for use with the wheelchair (i.e. four-point strap-type tiedown, clamp-type securement, specific type of docking securement devices, etc.);
- c) a statement that ease of access to, and manoeuvrability in, motor vehicles can be significantly affected by wheelchair size and turning radius, and that smaller wheelchairs and/or wheelchairs with a shorter turning radius will generally provide greater ease of vehicle access and manoeuvrability to a forward-facing position;
- d) a statement of whether the wheelchair is capable of use with a form of wheelchair-mounted belt restraints;
- e) the ratings for wheelchair accommodation of vehicle-mounted three-point belt restraints, including
 - 1) the rating for ease of properly positioning a three-point belt restraint as required by [5.5 a\)](#), and
 - 2) the rating for the degree to which proper three-point belt-restraint positioning can be achieved as required by [5.5 b\)](#).

6.4 User and maintenance instructions

6.4.1 General

Instructions shall be provided with each wheelchair in at least one of the official languages of the country in which the wheelchair is marketed. These instructions shall include the following statements, descriptions, illustrations and warnings.

6.4.2 The user instructions shall include statements that

- a) people using wheelchairs should transfer to the vehicle seat and use the vehicle-manufacturer-installed restraint systems whenever it is feasible, and the unoccupied wheelchair should be stored in a cargo area or secured in the vehicle during travel,
- b) the wheelchair is designed to be forward-facing when used as a seat in a motor vehicle,

NOTE Conformance with this document does not preclude using the wheelchair facing rearward in ATV-SS equipped with rear-facing wheelchair passenger stations.

- c) the wheelchair conforms to the requirements of this document,
- d) only the designated securement points should be used to secure the wheelchair to the vehicle, and
- e) a statement of whether the wheelchair can be provided with and has been tested with any manufacturer-designated wheelchair-mounted belt restraints.

6.4.3 The user instructions shall include descriptions of

- a) the types of tiedown systems that are suitable for use with the wheelchair (i.e. four-point strap-type tiedown, clamp-type securement, specific type of docking securement devices, etc.),
- b) the locations of wheelchair securement points used in the frontal-impact tests of [Annex A](#) for each type of wheelchair securement for which the wheelchair was successfully tested, and the markings used to identify them,
- c) belt-restraint anchor-point locations, if any, and the specifications for anchorage hardware and fasteners that are compatible with the wheelchair's anchor points,
- d) the different ways that the wheelchair can be effectively secured in a vehicle, including if applicable the necessity for additional, or heavy duty tiedowns necessary to secure the wheelchair,

- e) the types and sizes of securement point end fittings that are compatible with the wheelchair securement points,
- f) the correct positioning of occupant belt restraints on the occupant, including statements that
 - 1) the pelvic-belt restraint should be in contact with and worn low across the front of the pelvis, so that the angle of the pelvic-belt restraint is within the zone of 30° to 75° to the horizontal, similar to that shown in [Figure J.1](#),
 - 2) a steeper (greater) pelvic belt angle between 45° to 75° to the horizontal is preferred,
 - 3) belt restraints should not be held away from the body by wheelchair components or parts, such as the wheelchair arm supports or wheels, together with an illustration similar to that of [Figure 5](#),
 - 4) shoulder-belt restraints should fit over the middle of the shoulders, as illustrated in [Figure 6](#),
 - 5) belt restraints should be adjusted as snugly as possible, consistent with occupant comfort, and
 - 6) belt webbing should not be twisted when in use.
- g) the recommended settings for any adjustable parts, including, where applicable, seat and back support positions and orientations, when the wheelchair is used in motor vehicles,
- h) the wheelchair mass, as measured in [ISO 7176-5](#),
- i) the maximum recommended occupant mass.

6.4.4 The user instructions shall include illustrations of

- a) the incorrect placement of belt restraints with the belts placed over the wheelchair arm supports, as shown in [Figure 5](#) as an example,
- b) the correct placement of belt restraints, using an illustration similar to [Figure 6](#),
- c) the locations of securement points for each type of tiedown method for which the wheelchair has been designed and successfully tested.

6.4.5 The user instructions shall include warnings, in 12-point or larger bold font, that

- a) the wheelchair conforms with the requirements of this document and, as such, has been designed and tested for use only as a forward-facing seat in a motor vehicle,

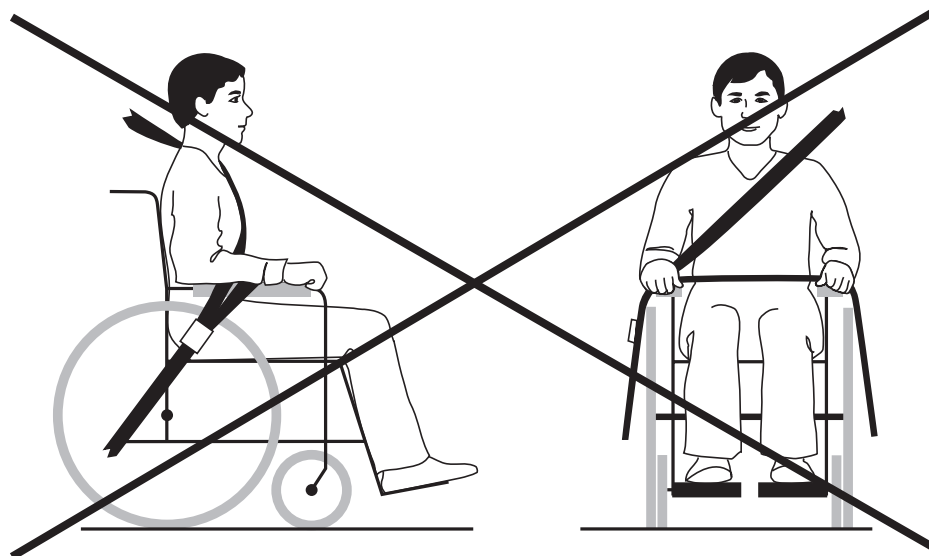
NOTE 1 Conformance with this document does not preclude using the wheelchair facing rearward in ATV-SS equipped with rear-facing wheelchair passenger stations.

- b) the wheelchair has been dynamically tested in a forward-facing orientation with the ATD restrained by a three-point belt restraint,
- c) both pelvic- and shoulder-belt restraints should be used to reduce the possibility of head and chest impacts with vehicle components,
- d) pelvic- and shoulder-belt restraints should be used together as designed for (i.e. do not connect a latch plate to a pin-bushing anchorage unless the system is designed to interface this way),
- e) in order to reduce the potential of injury to vehicle occupants, wheelchair-mounted trays not specifically designed for crash safety should
 - 1) be removed and secured separately in the vehicle, or

- 2) be secured to the wheelchair but positioned away from the occupant with energy-absorbing padding placed between the tray and the occupant,
- f) when possible, other auxiliary wheelchair equipment should be either secured to the wheelchair or removed from the wheelchair and secured in the vehicle during travel, so that it does not break free and cause injury to vehicle occupants in the event of a collision,
- g) postural supports should not be relied on for occupant restraint in a moving vehicle, unless they conform with the requirements specified in this document,

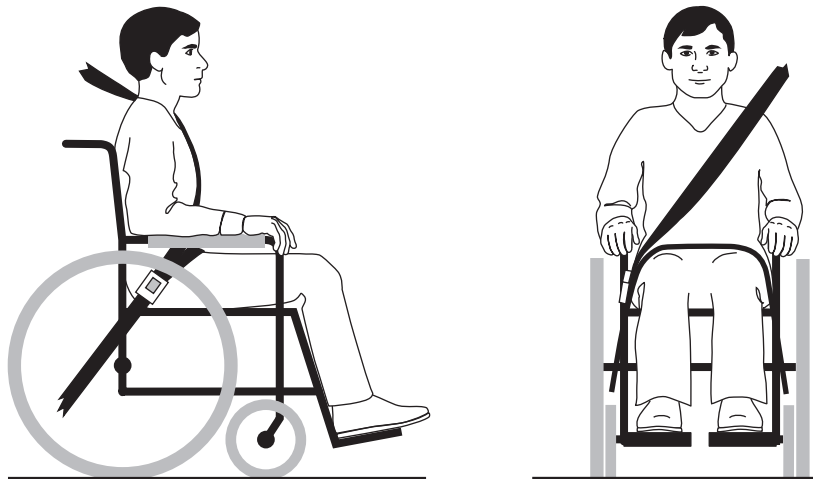
NOTE 2 Postural-support belts and harnesses that do not meet the requirements of a crashworthy occupant restraint can be helpful in retaining occupants in their wheelchairs during non-crash vehicle manoeuvres, such as sudden braking, and can help occupants maintain an upright seated posture that allows for good fit of the occupant restraints.

- h) the wheelchair should be evaluated by a manufacturer's representative for determination whether the wheelchair is suitable for reuse after involvement in any type of vehicle collision,
- i) alterations or substitutions should not be made to the wheelchair securement points or to structural and frame parts or components since this can affect the crashworthiness of the wheelchair, and it can also change the performance of the wheelchair in normal use. If it is considered necessary to make these kinds of alterations, the wheelchair manufacturer shall be consulted,
- j) spill-proof sealed batteries, such as gelled electrolyte, should be installed on powered wheelchairs when used in a motor vehicle, and
- k) care should be taken when applying the occupant restraint to position the seatbelt buckle so that the release button will not be contacted by wheelchair components during a crash.



Belt restraints shall not be held away from the body by wheelchair components such as arm supports or wheels.

Figure 5 — Illustration of improper belt-restraint fit



Belt restraints should make full contact with the shoulder, chest, and pelvis and pelvic belts should be positioned low on the pelvis near the thigh-abdominal junction.

Figure 6 — Illustration of proper belt-restraint fit

7 Documentation of conformance

7.1 General

7.1.1 The wheelchair manufacturer shall maintain documentation, including test reports, that provide evidence of conformance to the design and performance requirements of this document. This documentation shall include the information listed in [7.1.2](#), [7.2](#) and [7.3](#), and if applicable [K.6](#).

7.1.2 The following shall be included in the report of each test conducted in accordance with this document:

- a) a reference to this document, i.e. ISO 7176-19:2022;
- b) the name and address of the testing institution;
- c) the date that the test occurred, as well as the date of issue of the test report;
- d) a unique test report number shown on each numbered page;
- e) the name of the manufacturer, the product type and designation, and the serial number of the test wheelchair, the mass of the ATD, and the WTORS used and conformance of WTORS with [ISO 10542-1](#);
- f) a photograph of the complete test set-up.

7.2 Frontal impact test

The test report for the frontal impact shall also include

- a) the measured or calculated value of the test velocity change,
- b) descriptions and photographs of the WTORS and wheelchair as set up prior to the test,
- c) if appropriate, indicate that the wheelchair was tested with a wheelchair-mounted pelvic-belt restraint and/or a wheelchair-mounted shoulder-belt restraint,

- d) settings used for adjustable components, including seat and back support angles and locations,
- e) a graph of the impact sled deceleration/acceleration plotted against time superimposed on the shaded area of [Figure A.1](#),
- f) the test results as specified in [5.2](#), including photographs of the wheelchair post-test and any separated and/or broken components, and
- g) a statement as to whether or not the wheelchair met the criteria of [5.2](#) and any other relevant observations.

7.3 Design, labelling, and literature requirements

The wheelchair manufacturer shall maintain statements and evidence on file as to

- a) whether securement points intended for use with four-point strap-type tiedowns are in conformance with the design requirements in [4.2.1 a\)](#) and [Annex B](#),
- b) whether securement points intended for attachment of four-point strap-type tiedowns are in conformance with the accessibility and clear path requirements of [5.3](#) and [5.4](#) when tested in accordance with [Annex C](#),
- c) if applicable, whether the wheelchair-mounted five-point harness restraint conforms with the requirements in [4.3.2 a\)](#), [5.6 a\)](#) and [Annex H](#),
- d) if applicable, whether the wheelchair-mounted belt restraints conform with the requirements in [4.3.2 b\)](#), [5.6 b\)](#) and [Annex I](#),
- e) whether the ratings for accommodation of vehicle-mounted occupant belts are in conformance with the requirements in [5.5](#) when tested in accordance with [Annex D](#), and
- f) whether the identification and labelling of the wheelchair and its components, and the manufacturer's literature conform with all the requirements in [Clause 6](#).

Annex A (normative)

Method for frontal impact test

A.1 General principle

The wheelchair is placed facing forward on an impact sled and loaded with an appropriate-size ATD. The wheelchair is secured in place and the ATD is restrained by a WTORS that conforms to the crashworthiness performance requirements of [ISO 10542-1](#). The impact sled is subjected to a deceleration/acceleration pulse that falls within a specified *g*-level-versus-time envelope to achieve a longitudinal velocity change of 48 km/h. Observations and measurements are made during and after the test to assess the performance of the wheelchair and any wheelchair-mounted belt restraints under these dynamic loading conditions.

NOTE See [Annex M](#) to get an indication of the values of some key dimensions in this annex expressed in imperial units.

A.2 Test sample

An unused complete wheelchair is required for each test conducted, along with any wheelchair-mounted belt restraints, when applicable.

A.3 Test methods

A.3.1 Test equipment

The test equipment and facility shall include

- a) an impact sled equipped with a flat, horizontal, structurally rigid platform on which the wheelchair can be mounted, and to which the WTORS can be fastened,
- b) a horizontal track or guide path to provide unidirectional movement of the sled during the impact event,
- c) a means to drive the impact sled through a change in velocity of 48 km/h (+2 -0) km/h using an acceleration/deceleration pulse that
 - 1) falls within the shaded area of [Figure A.1](#),
 - 2) exceeds 20 *g* for a cumulative time period of at least 15 ms,
 - 3) exceeds 15 *g* for a cumulative continuous time period of at least 40 ms, and
 - 4) has a duration of at least 75 ms from t_0 to t_f , where t_0 is the start time and t_f is the stop time, as seen in [Figure A.1](#).
- d) a rigid structure attached to the impact sled to which the shoulder-belt restraint can be mounted in the manner, and to the geometry, specified by the WTORS manufacturer,
- e) an ATD selected from [Table A.1](#) that is representative of the size range of occupants for which the wheelchair is designed. For testing a wheelchair with a five-point harness restraint, select an ATD with mass below 23 kg (i.e. 3-year-old or 6-year-old ATD),

- f) a means to position and tension a length of 25 mm wide webbing laterally in front of the ATD at specified distances forward and above the selected ATD's knee-joint centres as shown in [Figure A.3](#) and [Table A.2](#), to restrict upward movement of the ATD's legs and feet during frontal impact loading and rebound,
- g) a length of 25 mm wide webbing with an anchoring mechanism at one end and a tensioning/anchoring mechanism at the other end for use in [A.4.14](#),
- h) a four- or multiple-point tiedown that conforms to ISO 10542-1. ISO 10542-1 uses an 85 kg surrogate wheelchair for testing. For testing a wheelchair above 85 kg, it is recommended to check the specifications of the WTORS to ensure it can be used as test equipment,

NOTE 1 Use of a strap type surrogate tiedown for testing wheelchairs will increase the repeatability as well as reproducibility of the results.

- i) if an additional test is to be performed using a different type of wheelchair securement, the securement device (as appropriate for use with the test wheelchair mass) that conforms to the dynamic performance criteria specified in [ISO 10542-1](#),

NOTE 2 In [ISO 10542-1:2012](#) the dynamic performance criteria are given in 5.2.1 b).

- j) a vehicle-mounted three-point-belt restraint, or a two-point shoulder-belt restraint as required to supplement the pelvic belt restraint provided with the wheelchair, that conforms to [ISO 10542-1](#) and is appropriate for the mass of the ATD selected in accordance with [Table A.1](#). [ISO 10542-1](#) requires occupant restraints be tested with a midsize-adult male ATD. For testing with a large adult male ATD, it is recommended to check the specifications of the occupant restraint to ensure it can be used as test equipment.

NOTE 3 The surrogate occupant restraint as specified in [Annex E](#) can be used for testing with a large adult male ATD.

Table A.1 — Available ATDs for wheelchair testing

Occupant mass range kg	ATD size ^a	Approximate mass of ATD kg
12 to ≤18	3-year-old child	15
>18 to ≤27	6-year-old child	22
>27 to ≤43	10-year-old child	35
>43 to ≤57	small adult female	47
>57 to ≤75	small adult female, weighted ^b	59
>75 to ≤136	midsize adult male	77
>136	large adult male	102

^a The midsize male ATD shall be a Hybrid II or Hybrid III type. The other sizes of ATDs may be Hybrid II, Hybrid III, VIP, P series, or Q series types.

^b The ATD mass can be increased by attaching weighted material, such as lead sheeting, to the exterior of the ATD.

NOTE The ATD masses representing wheelchair occupants are based on precedents established in existing global automotive safety provisions.