INTERNATIONAL STANDARD

ISO 7176-19

Second edition
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Wheelchairs —

Part 19: Wheeled mobility devices for use as seats in motor vehicles

Fauteuils roulants —

Partie 19: Dispositifs de mobilité montés sur roues et 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 7176-19 was prepared by Technical Committee ISO/TC 173, *Assistive products for persons with disability*, Subcommittee SC 1, *Wheelchairs*.

This second edition cancels and replaces the first edition (ISO 7176-19:2001), most clauses of which have been technically revised.

ISO 7176 consists of the following parts, under the general title *Wheelchairs*:

— *Part 1: Determination of static stability*

— *Part 2: Determination of dynamic stability of electric wheelchairs*

— *Part 3: Determination of effectiveness of brakes*

— *Part 4: Energy consumption of electric wheelchairs and scooters for determination of theoretical distance range*

— *Part 5: Determination of dimensions, mass and manoeuvring space*

— *Part 6: Determination of maximum speed, acceleration and deceleration of electric wheelchairs*

— *Part 7: Measurement of seating and wheel dimensions*

— *Part 8: Requirements and test methods for static, impact and fatigue strengths*

— *Part 9: Climatic tests for electric wheelchairs*

— *Part 10: Determination of obstacle-climbing ability of electrically powered wheelchairs*

— *Part 11: Test dummies*

— *Part 13: Determination of coefficient of friction of test surfaces*

— *Part 14: Power and control systems for electrically powered wheelchairs and scooters — Requirements and test methods*

— *Part 15: Requirements for information disclosure, documentation and labelling*

— *Part 16: Resistance to ignition of upholstered parts — Requirements and test methods*

— *Part 19: Wheeled mobility devices for use as seats in motor vehicles*

— *Part 21: Requirements and test methods for electromagnetic compatibility of electrically powered wheelchairs and scooters, and battery chargers*

— *Part 22: Set-up procedures*

— *Part 23: Requirements and test methods for attendant-operated stair-climbing devices*

— *Part 24: Requirements and test methods for user-operated stair-climbing devices*

— *Part 25: Requirements and test methods for batteries and their chargers for electrically powered wheelchairs and motorized scooters*

— *Part 26: Vocabulary*

A technical report, ISO/TR 13570-1, is also available, giving a simplified explanation of these parts of ISO 7176.

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 occupant loads 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 must 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 the manufacturer's literature requirements, and specifies associated test methods, for wheelchair tiedown and occupant-restraint systems (WTORS). This part of ISO 7176 addresses the seating part of wheelchair-user occupant-protection systems by establishing design, performance, labelling, and the manufacturer's literature requirements, as well as associated test methods, for wheelchairs that may be used as seats in motor vehicles.

Whilst wheelchairs may be secured by various types of tiedown and securement systems that were available throughout the world at the time this part of ISO 7176 was developed, effective wheelchair securement in the real world requires compatibility of the wheelchair tiedown system available in the vehicle and the method of securement provided on the wheelchair. At the time that this part of ISO 7176 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. For these reasons, this part of ISO 7176 requires that wheelchairs intended for use as seats in motor vehicles provide for securement using a four-point strap-type tiedown system by providing at least four designated securement points, with two in front and two in the back. However, this part of ISO 7176 also provides for evaluating wheelchairs that are also designed for securement by other methods, such as docking-type securement systems.

To evaluate the crashworthiness performance of a wheelchair, 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 and side impacts might be addressed in future International Standards.

This part of ISO 7176 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 the use of both pelvic-belt and shoulder-belt restraints. Therefore, the provisions and test methods of this part of ISO 7176 are based on the use of both pelvic- and shoulder-belt-type restraints.

Although the four-point strap-type tiedown system was considered to be the most common and universal method for effectively securing a wide range of wheelchairs at the time this part of ISO 7176 was developed, it is a method of wheelchair securement that requires 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 may travel in different public transportation and private vehicles. As a step toward this goal, this part of ISO 7176 includes a normative annex (Annex F) that 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.

Finally, this part of ISO 7176 can be viewed in the totality of daily wheelchair use and the range of standards to which all wheelchairs are expected to comply. Wheelchairs are designed primarily to serve as effective mobility devices and, in that respect, they must first conform to the applicable requirements set forth in other

parts of the ISO 7176 series. Transportation is only one of many daily activities that introduce unique circumstances and requirements that wheelchairs and wheelchair occupants may experience. Wheelchair products that comply with this part of ISO 7176 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 comply with this part of ISO 7176 cannot be used to limit access to, and availability of, motor vehicle transportation for wheelchair users.

Wheelchairs —

Part 19:
Wheeled mobility devices for use as seats in motor vehicles

1 Scope

This part of ISO 7176 applies 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 22 kg. This part of ISO 7176 specifies wheelchair design requirements, performance requirements and associated test methods, and requirements for wheelchair labelling, presale literature, user instructions and user warnings. It applies to complete wheelchairs, including a base frame and seating system, as well as to wheelchairs equipped with add-on adaptive components designed to facilitate compliance with one or more of the requirements.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 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*

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

ISO 7176-15:1996, *Wheelchairs — Part 15: Requirements for information disclosure, documentation and labelling*

ISO 7176-22:2000, *Wheelchairs — Part 22: Set-up procedures*

ISO 7176-26:2007, *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 10542-2, *Technical systems and aids for disabled or handicapped persons — Wheelchair tiedown and occupant-restraint systems — Part 2: Four-point strap-type tiedown systems*

FMVSS 209:2004, Standard No. 209, *Seat belt assemblies.* Federal Motor Vehicle Safety Standards, 49 CFR 571.209, 1 October, 2004

ECE Regulation 16, *Uniform provisions concerning the approval of safety belts and restraint systems for adult occupants of power-driven vehicles*, Revision 3, Amendment 2, 16 August 1993

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
add-on components
hardware that is attached to the wheelchair frame subsequent to sale by the wheelchair manufacturer, in a manner that requires the use of tools for removal, in order to enhance design and/or performance of the wheelchair

3.2
adult
person having a mass equal to or greater than 43 kg

3.3
anchor point
location on a vehicle interior component, floor, 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 the human body used to represent a wheelchair occupant in a test

3.6
belt
length of webbing material used as part of an occupant restraint or postural support device

3.7
child
person having a mass equal to or greater than 22 kg and less than 43 kg

3.8
clamp-type tiedown
method of wheelchair tiedown or securement that uses only mechanical linkages and/or grips requiring manual positioning and tensioning of the end fittings to the wheelchair

3.9
docking-type tiedown
docking-type securement
method of wheelchair tiedown by which portions of the wheelchair structure, or add-on components fastened to the wheelchair, align, mate and engage with a docking tiedown device fastened to the vehicle, upon manoeuvring the wheelchair into position in the vehicle

NOTE Securement of the wheelchair may occur automatically during wheelchair engagement, or could require manual intervention through operation of a mechanical lever or electrical switch. Release of the wheelchair will usually require operation of a mechanical lever or electrical switch.

3.10
docking tiedown device
docking securement device
assembly of fixtures and components designed for installation in motor vehicles for the purpose of securing a wheelchair by engaging with, and locking onto, securement points on the wheelchair frame or on wheelchair securement adaptors attached to the wheelchair frame

3.11
excursion
horizontal movement of an ATD or wheelchair during a test relative to its initial position on an impact sled

3.12
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

3.13
four-point tiedown
wheelchair tiedown that attaches to the wheelchair frame at four separate securement points and also attaches to the vehicle at four separate anchor points

3.14
four-point strap-type tiedown
four-point tiedown that uses four strap assemblies to secure the wheelchair in the vehicle

3.15
H-point
one of a pair of points located on the left and right sides of the pelvic region of an anthropomorphic test device (ATD) that represent the approximate locations of the human hip joint centre in the side views, as specified by the ATD manufacturer

3.16
head restraint

device intended to limit rearward excursion of the wheelchair occupant's head in a vehicle impact

3.17
impact simulator

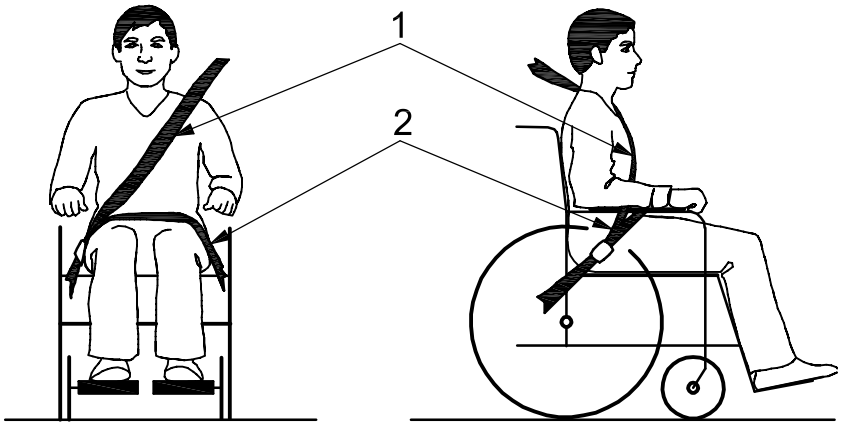
device for accelerating, decelerating, or a combination of decelerating and accelerating, a section of a vehicle or simulated vehicle structures, including instrumentation for measuring data required by this standard

3.18
impact sled
part of an impact simulator on which components can be mounted for impact testing

3.19
occupant restraint
system or device intended to restrain a motor-vehicle occupant during an impact in order to prevent ejection, and prevent or minimise contact with the vehicle interior components and other occupants

3.20
pelvic-belt restraint
lap-belt restraint
assembly of webbing and hardware intended to maintain an occupant in a seat during a crash

NOTE See Figure 1.



Key

1 shoulder-belt restraint

2 pelvic-belt restraint

NOTE The use of a pelvic-belt restraint only is not recommended.

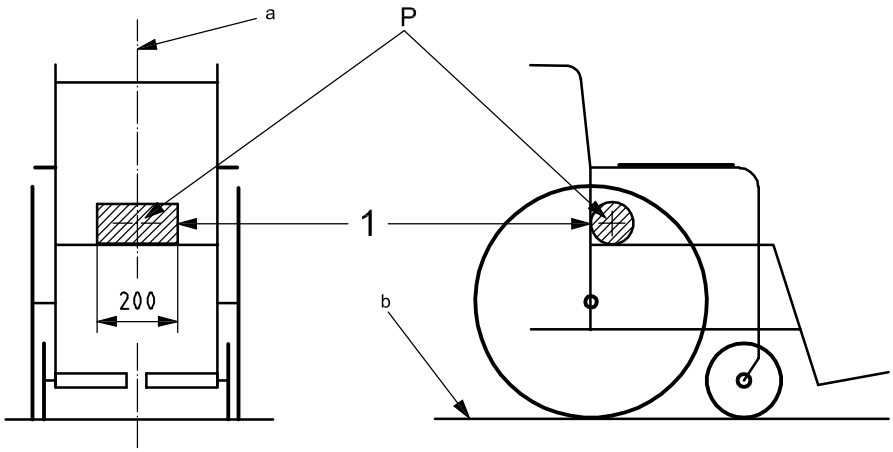
Figure 1 — Three-point-belt restraint comprising a pelvic-belt restraint and a shoulder-belt restraint that connect together near the hip of the occupant

3.21
point P

side-view projection of a point that lies at the cross-sectional centre of a 100 mm diameter, 200 mm long, lightweight (max. 0,5 kg) cylinder positioned with the longitudinal axis perpendicular to the wheelchair reference plane, such that the curved surface of the cylinder contacts the back support and the upper surface of the seat

NOTE See Figure 2.

Dimensions in millimetres



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

3.22
postural support device
component and/or belt used to support a person in a desired seated position during normal wheelchair use

NOTE Postural support devices are not designed or intended to provide occupant restraint in a vehicle impact

3.23
power(ed)
systems which are operated by means of an energy source other than manual effort

3.24
securement points
points on the wheelchair to which wheelchair tiedowns are connected

3.25
shoulder-belt restraint
upper torso restraint
portion of the occupant restraint intended to limit movement of the head and chest by application of restraint forces to either or both clavicles

NOTE See Figure 1.

3.26
strap
length of webbing material used in a wheelchair tiedown

3.27
surrogate tiedown
wheelchair securement system used during wheelchair testing to simulate commercial tiedown systems

NOTE Guidelines for designing surrogate tiedowns are provided in Annex E.

3.28
three-point belt restraint
three-point restraint (deprecated)
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 See Figure 1.

3.29
tilt seating
type of wheelchair seat design that allows the complete seat structure to rotate in the wheelchair reference plane relative to and about an axis located on the wheelchair base

3.30
universal docking interface geometry
UDIG
specifications for the size, shape, and location of wheelchair securement points, including surrounding clear zones, intended for use with a variety of docking tiedown devices installed in a wide range of vehicles

3.31
UDIG adaptor
wheelchair tiedown adaptor that conforms to the UDIG specification in Annex F

3.32
wheelchair footprint
space outlined on the horizontal wheelchair ground plane by projecting vertically down from the outermost edges of the structural members that comprise the mobile base and seat of the wheelchair

3.33
wheelchair ground plane
plane representing the surface on which the wheelchair rests

NOTE See Figure 2.

3.34
wheelchair reference plane
vertical plane in the longitudinal centreline of the wheelchair

NOTE See Figure 2.

3.35
wheelchair tiedown
wheelchair securement
device or system designed to secure a forward-facing wheelchair in place in a motor vehicle

NOTE The vehicle-anchored tiedown component may be installed using either permanent fasteners or by using a mechanical coupling that allows for position adjustment for different wheelchairs.

3.36
wheelchair tiedown adaptor
wheelchair securement adaptor
hardware that is attached temporarily or permanently to the wheelchair frame to accommodate wheelchair securement by a wheelchair tiedown device

3.37
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

4 Design requirements

4.1 Wheelchair securement

4.1.1 The wheelchair shall be designed to provide for forward-facing securement in a motor vehicle using a four-point strap-type tiedown system that complies with ISO 10542-2 using a minimum of four securement points, two at the front and two at the rear, that conform to the geometric specifications set forth in Annex B and the performance requirements in Clause 5.

NOTE In addition to complying with this subclause, the wheelchair can be designed for forward-facing securement using other methods of wheelchair securement, including docking-type securement devices.

4.1.2 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, the securement points on the wheelchair and/or of the wheelchair tiedown adaptors shall conform to the specifications set forth in Annex F and the performance requirements in Clause 5.

4.2 Occupant restraints

4.2.1 Wheelchair-anchored pelvic-belt restraint

If a wheelchair-anchored pelvic-belt intended for use as an occupant restraint in a vehicle is provided as part of the wheelchair, when placed on the ATD in accordance with the set-up procedures for the frontal-impact test of Annex A, it shall

a) have its anchor points located so that the projected side-view angle of the belt is between 30° and 75° to the horizontal, as indicated in Figure 3, and

b) provide for adjustment of the pelvic-belt restraint that allows for increasing the length and decreasing the length as specified in Table 1.

NOTE 1 A steeper (larger) pelvic-belt restraint angle within the preferred zone shown in Figure 3 is desirable.

NOTE 2 At least 25 mm of webbing must extend through any fitting where adjustment takes place at all times during testing.

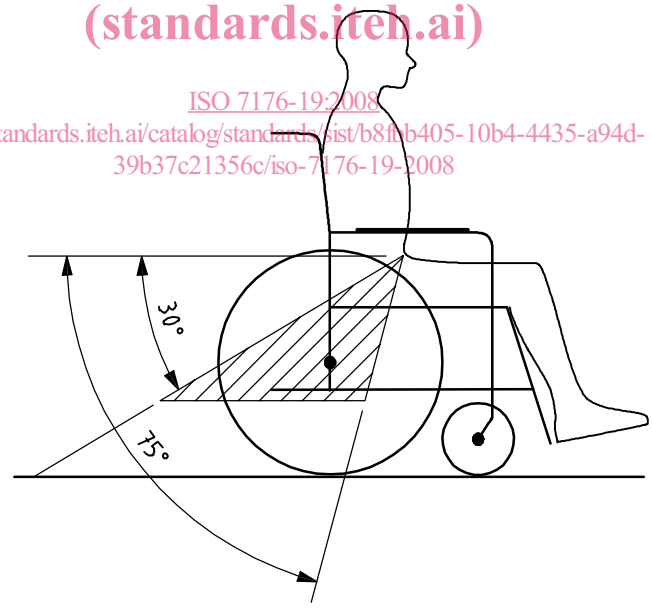
Table 1 — Requirements for pelvic-belt-restraint shortening and lengthening

Dimensions in millimetres

ATD size [a]	Required belt shortening [b]	Required belt lengthening [b]
6-year-old child	100	100
10-year-old child	100	100
small adult female	100	100
midsize adult male	200	200
large adult male	200	200

[a] See Table A.1.

[b] At least 25 mm of webbing must extend through any fitting where adjustment takes place at all times during testing.



NOTE The angles indicated are obtained by projecting the angle of the pelvic-belt restraint onto a vertical plane that is parallel to the wheelchair reference plane.

Figure 3 — Range of required angles of wheelchair-anchored pelvic-belt restraint when installed on the appropriate-size ATD used in the test of Annex A