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

Part 1: Requirements and test methods for all systems

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

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

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Page

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 10542-1 was prepared by Technical Committee ISO/TC 173, *Assistive products for persons with disability*, Subcommittee SC 1, *Wheelchairs*.

This second edition of ISO 10542-1 cancels and replaces ISO 10542-1:2001, ISO 10542-2:2001, ISO 10542-3:2005, ISO 10542-4:2004 and ISO 10542-5:2004, which have been consolidated into one part.

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

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

Introduction

Many wheelchair users remain in their wheelchairs during motor-vehicle transport and hence their wheelchair serves as a vehicle seat. This usually means that the occupant restraint system installed by the vehicle manufacturer cannot be used to provide protection in a crash. In addition, the wheelchair needs to be secured to the vehicle so that it does not impose forces on its occupant and/or become a hazard to other vehicle occupants in collisions or sudden vehicle manoeuvres. Providing safe transportation for wheelchair-seated occupants therefore requires that equipment be used to provide effective wheelchair securement and occupant restraint.

This part of ISO 10542 applies to the design, testing, installation and use of wheelchair tiedown and occupant restraint systems (WTORS) used by forward-facing wheelchair-seated occupants. Transportation-related requirements for wheelchairs that are suitable for forward-facing occupant seating during motor vehicle transportation are specified in ISO 7176-19.

The primary purpose of this part of ISO 10542 is to reduce the risk of serious injuries to wheelchair-seated occupants involved in frontal collisions and it is anticipated that additional parts of ISO 10542 will be developed to address different impact conditions and directions. However, it can be expected that the proper use of equipment that complies with this part of ISO 10542 will also reduce the risk of injury in other types of crashes, as well as in vehicle rollovers, emergency vehicle manoeuvres, and normal operating conditions.

The provisions of this part of ISO 10542 are based on the premise that WTORS manufacturers are generally not able to control the end use of their products. This part of ISO 10542 therefore requires that WTORS intended for general use in all types and sizes of motor vehicles are dynamically tested for crashworthiness performance in a nominally worst-case 48 km/h, 20 g frontal sled impact test using an 85 kg surrogate wheelchair (SWC) and a midsize adult male anthropomorphic test device (ATD) to dynamically load the WTORS.

Although the forces on WTORS components in a small percentage of real-world crash events may exceed those produced in the nominally worst-case frontal-impact test in this part of ISO 10542 due to a number of factors, including higher crash severities, angled frontal impacts, a higher wheelchair mass, and a higher occupant mass, there is currently no evidence of any WTORS system or component failing in a real-world crash. Thus, while the performance of WTORS in real-world crash events needs to be carefully and continuously monitored, at this time there is no basis for increasing the mass of the surrogate wheelchair, the crash-test dummy, or the crash severity used in the frontal-impact test of WTORS intended for general use in this part of ISO 10542. However, in addition to testing to the conditions set forth in this part of ISO 10542, WTORS manufacturers can also test their equipment to higher test conditions than those required by this part of ISO 10542.

This part of ISO 10542 requires that every WTORS include a belt-type occupant restraint since this approach to occupant protection has been shown to be the most effective in frontal crashes, vehicle rollovers, and a large percentage of side impacts, and can be implemented relatively straightforwardly in forward-facing seating positions of passenger vehicles. Since the use of only a pelvic belt restraint will not provide the same level of crash protection and safety as the use of both a pelvic belt restraint and an upper-torso belt restraint, this part of ISO 10542 requires, and only specifies test methods for, WTORS that include both pelvic and upper-torso belt restraint systems.

In this regard, while ISO 7176-19 does not require wheelchairs to be crash-tested with a wheelchair-anchored pelvic-belt restraint, it does allow for this restraint condition, which can offer benefits to wheelchair passengers in terms of improved belt-restraint fit to their lower pelvic region and reduced interference with their personal space by drivers or attendants. In this situation, the tiedown portion of a WTORS will be subjected to higher loading conditions than with vehicle-anchored pelvic belts since a portion of the occupant restraint loads will be transferred through the wheelchair to the wheelchair tiedown/securement system. Thus, WTORS manufacturers may also wish to crash-test their tiedown/securement systems with a pelvic-belt restraint anchored to the surrogate wheelchair.

For accessible transport vehicles intended for use by both sitting and standing passengers (ATV-SS) for which crash events of any significance are rare events, it is generally sufficient to provide equipment and/or systems that provide for effective wheelchair containment and retention of the wheelchair-seated passenger in their wheelchair seating system. Such systems can be evaluated using simulated non-crash vehicle accelerations and decelerations that are less than 1g that are generated in emergency vehicle manoeuvres. For this reason, the use of rearward-facing wheelchair passenger spaces (RF-WPS) can provide a reasonably safe approach

to transporting wheelchair-seated passengers in a manner that is more acceptable to the operational needs of the transportation system. Performance of RF-WPSs is therefore addressed by ISO 10865-1.

At the time this part of ISO 10542 was developed, the four-point strap-type tiedown system was considered to be the most effective and universal method for securing a wide range of wheelchairs occupied by passengers travelling in public, school, and private vehicles. For this reason, ISO 7176-19 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 at the front and two at the back. However, wheelchairs can also be secured in motor vehicles using docking-type tiedown devices, such that the wheelchair is automatically secured when the wheelchair user moves his/her wheelchair into the designated wheelchair space. Currently, use of these types of securement systems is primarily limited to private vehicles where docking securement components added to the wheelchair are matched to the securement device in the vehicle. Annex F provides specifications for a universal docking interface geometry (UDIG), which, when implemented into the securement components of wheelchairs, either by wheelchair manufacturers or by after-market wheelchair adaptors, will allow wheelchair users increased independence and reduce the time required for loading and unloading wheelchair passengers in public vehicle environments.

This part of ISO 10542 establishes additional requirements for WTORS that are intended to be used with specific makes and models of wheelchairs. The belt-type occupant restraints may attach to the wheelchair such that occupant-restraint loads will be transferred through the wheelchair. As such, the performance of both the WTORS and wheelchair are evaluated as a total system.

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

Part 1: Requirements and test methods for all systems

1 Scope

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

This part of ISO 10542 is applicable to WTORS intended for use with all types of manual and powered wheelchairs, including three- and four-wheeled scooters, used by children and adults with a body mass equal to or greater than 22 kg. It is applicable also to WTORS designed for limited use with a particular make or model of wheelchair.

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

2 Normative references

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

ISO 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 7176-19:2008, *Wheelchairs — Part 19: Wheeled mobility devices for use as seat in motor vehicles*

ECE R 16:2009, *Uniform provisions concerning the approval of safety belts, restraint systems, child restraint systems and isofix child restraint systems for occupants of power-driven vehicles,* Revision 6, 19 May 2009

FMVSS 209, *Seat belt assemblies,* Federal Motor Vehicle Safety Standards, 49 CFR part 571.209, 1 October 2004

3 Terms and definitions

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

3.1
adult
person having a mass equal to or greater than 43 kg

3.2
airbag
device installed to supplement occupant restraint systems in power-driven vehicles, i.e. system which, in the event of a severe impact affecting the vehicle, automatically deploys a flexible structure intended to limit, by compression of the gas contained within it, the gravity of the contacts of one or more parts of the body of an occupant of the vehicle with the interior of the passenger compartment