INTERNATIONAL STANDARD

ISO 7176-19

Second edition
2008-07-15

AMENDMENT 1
2015-11-15

Wheelchairs —

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

AMENDMENT 1: Annex G

Fauteuils roulants —

Partie 19: Dispositifs de mobilité montés sur roues et destinés à être utilisés comme sièges dans des véhicules à moteur

AMENDEMENT 1: Annexe G

Reference number
ISO 7176-19:2008/Amd.1:2015(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

Amendment 1 to ISO 7176-19:2008 was prepared by ISO TC 173, *Assistive products for persons with disability*, Subcommittee SC 1, *Wheelchairs*.

Wheelchairs —

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

AMENDMENT 1: Annex G

Page vi, Introduction

Add the following paragraphs to the end of the 4th paragraph, just before the last sentence.

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 should use the test methods and performance measures in Annex G.

Page 9, 4.2.3

Add the following sentences to the last paragraph of 4.2.

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. These design guidelines are based on strategies used in designing conventional vehicle seats with the goal of reducing the risk of serious and fatal injuries to forward facing occupant seated in wheelchairs during rear-end impacts. In cases where these are incompatible with the person's medical/therapeutic needs, accommodation of the person's emergent healthcare needs should be given precedence.

Page 13, 5.4

Add new Note following 5.4.

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 set forth in Annex G

Annex G
(informative)

Wheelchair design, performance, and labelling recommendations for improved protection of occupants seated facing forward in wheelchairs during rear impacts

G.1 General

When people who remain seated in forward-facing wheelchairs riding in or driving motor vehicles are involved in rear-impact collisions, the wheelchair back support is the primary occupant restraint. As with vehicle seatbacks, wheelchair back supports must limit rearward movement of the occupant's torso relative to the vehicle interior to prevent occupant ejection from the wheelchair and/or the vehicle that will significantly increase the risk of serious injury due to contact with vehicle components, other occupants, or objects outside the vehicle.

At the current time, the only test of wheelchair back supports is rebound loading of the anthropomorphic test device (ATD), or crash-test dummy in the frontal impact test of Annex A. Wheelchair back supports are not tested to the same static and dynamic load levels used in performance testing of vehicles seatbacks in FMVSS 207, ECE R17, and other motor-vehicle safety standards, such as the rear-impact fuel-tank integrity test of FMVSS 301. Additionally, rear-impact sled tests of wheelchairs, including wheelchairs that comply with the performance criteria of ISO 7176-19:2008, 5.2, have shown that wheelchair back supports often do not provide effective occupant restraint in moderate-to-severe rear impacts, and may fail catastrophically in these tests.

Vehicle rear-head restraints are attached to, or integrated into, the vehicle seatback and are designed to limit the rearward movement of an occupant's head relative to the torso, and thus limit rearward rotation of the neck (i.e. neck extension) during rear impacts. When properly designed and positioned relative to the occupants head during normal vehicle travel, head restraints can further reduce the risk of serious head and neck injuries in rear-impact crashes. While all wheelchairs have back supports, some wheelchairs are also equipped with rear head supports that were designed to keep the head and neck upright during normal operation of the wheelchair, but were not designed to provide effective rear head restraint in rear-impact crashes. It is, however, possible to design wheelchair head supports, whether part of the original wheelchair equipment or added to the wheelchair as aftermarket components, so that they can serve a dual role of offering head support during normal wheelchair use and effective head restraint in vehicle rear impacts.

This Annex sets forth design guidelines, a rear-impact test method and associated performance criteria, and manufacturer product labelling and literature recommendations for wheelchair manufacturers who wish to design their products with back supports and head supports that will provide effective restraint for the torso and head of their occupants when seated in wheelchairs while facing forward in motor vehicle during rear-impact collisions. Wheelchairs that comply with these guidelines and performance rear-impact performance criteria will reduce the risk of serious head, neck, and torso injuries during rear-end crashes.

The severity of the rear-impact test in this Annex has been selected to be representative of the impact severity used to test vehicle seatbacks in the FMVSS 301 fuel-tank integrity test, and has been shown to also represent a moderate-to-severe real-world impact (about 80th percentile) based on analysis of representative crash-investigation databases, such as the National Automotive Sampling System (NASS) established and maintained by the National Highway Traffic Safety Administration (NHTSA).

G.2 Design recommendations for back supports and head support/restraints

G.2.1 Principle

A head restraint is a device intended to limit the rearward displacement of an occupant's head during crash events, and when properly designed and positioned, a head restraint can reduce the incidence of head and neck injuries in rear-impact crashes. Many wheelchairs are equipped with back supports or head supports that were not designed to provide crash protection and whose effect on injury outcomes is unknown. In some cases, head supports and head restraints are added to a wheelchair as aftermarket items and these would need to be tested per the dynamic test protocols in Annex A and Annex G with

a commercial wheelchair to ensure that the attachment hardware is sufficient for the transportation environment. This subclause provides specifications for head supports that can function as head restraints and are consistent with the goal of reducing injury.

G.2.2 General specifications

All wheelchair posterior back and head supports that are also intended to also perform as back and head restraints should

a) have head supports/restraints that are attached to the back support and not detach from the wheelchair when tested to the dynamic test requirements of Annex A or Annex G,

b) have head supports/restraints that are recommended for use with a back support for the wheelchair occupant with sufficient height so that the top of the back support is at or above the height of the centre of rotation of the shoulder joint for the ATD selected for testing in G.3.2,

c) provide a padded head support/restraint contact surface that has energy absorbing properties that meet FMVSS 201 and/or ECE Reg 17,

d) provide a padded head support/restraint surface of width ≥ 170 mm,

e) allow the head support/restraint to adjust so that the top-edge height equal to that of the most rearward point on the head of the ATD selected for testing in sections G.3.2, and

f) be able to adjust and fix the fore/aft position of the head support/restraint so that the smallest gap between the horizontal distance of front surface is no further than 55 mm from the most rearward point on the ATD's head when the ATD is set up for testing in accordance with G.3.2

NOTE The 170 mm minimum width of the head support/restraint and the 55 mm backset are drawn from the requirements for automotive head restraints.

G.3 Rear-impact test

To simulate a typical moderate-to-severe rear-impact event to an occupied wheelchair, the wheelchair is placed on the test platform of an impact sled facing rearward to the direction of sled acceleration and/or deceleration. The wheelchair is loaded with an appropriate-size ATD and is secured by a four-point, strap-type tiedown system, and the ATD is restrained by a three-point vehicle or wheelchair-anchored belt restraint. The sled is subjected to an acceleration/deceleration-time pulse that falls within a specified corridor to achieve the required horizontal change in velocity, or delta V. Observations and measurements are made during and after the test to determine if the wheelchair was effectively secured throughout the test, and if the back support and head support/restraint provided effective restraint for the ATD during rear-impact loading."

G.3.1 Test sample

An unused, complete production or prototype wheelchair should be used for each test.

NOTE 1 The wheelchair may include a head support/restraint or an aftermarket head support/restraint may be added to the wheelchair.

NOTE 2 Wheelchairs that have back supports and head supports/restraints that meet the design guidelines of G.2.2 are more likely to meet the performance criteria of this rear-impact test.

G.3.2 Test equipment

G.3.2.1 Impact simulator and surrogate tiedown/restraint equipment

An impact simulator should be used that includes

a) an impact sled equipped with a flat, horizontal, structurally rigid platform on which the wheelchair can be placed and to which anchorages of a WTORS with a four-point, strap-type tiedown and three-point lap/shoulder belt restraint can be fastened,

b) a rigid structure for attaching the upper shoulder-belt anchorage with adjustability in anchor-point location to achieve the desired shoulder-belt angles specified in Annex A,

c) a means to accelerate and/or decelerate the impact sled such that the processed acceleration and/or deceleration-time pulse falls within the shaded area of Figure G.1 and to achieve a change in sled velocity of 25 km/h to 0,2 km/h,

d) a surrogate four-point strap-type tiedown and complete upper and lower belt restraint system, as defined in this International Standard that conforms to ISO 10542-1, and

e) a Hybrid III ATD selected from Table G.1 based on wheelchair manufacturer's recommended occupant mass capacity.

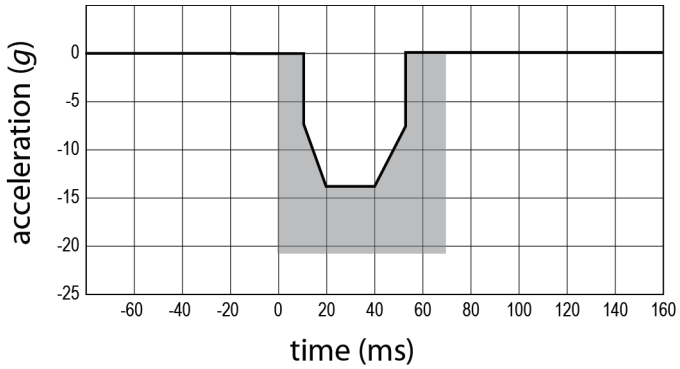

Figure G.1 — 25 km/h acceleration corridor for rear impact test

Table G.1 — Available ATD for wheelchair rear-impact testing

Occupant mass range kg (lb)	ATD size	Approximate mass of ATD kg (lb)
>18 to 27 (>40–60)	6 year-old child	23,4 (52)
>27 to 43 (>60–95)	10 year-old child	35,2 (78)
>43 to 57 (>95–125)	Small adult female	49,0 (108)
>57 to 75 (>125–165)	Small adult female weighted to 59 kg	59,0 (130)
52 to 95 (>165–300)	Midsize adult male	77,1 (170)
95 to 125 (>300)	Large adult male	101,2 (223)
NOTE The ATD mass may be increased by attaching weighted material, such as lead, to the exterior of the ATD.		

G.3.2.2 Test instrumentation and data collection

A means should be provided to

a) measure the ATD and wheelchair horizontal excursions specified in G.3.5.1 with a precision and accuracy of ±5 mm,

NOTE A side-view high-speed camera or video system with a frame rate of 500 frames per second is required.

b) measure the horizontal acceleration and/or deceleration of the impact sled in the direction of travel, at a sampling rate in accordance with ISO 6487, and with a precision of +0.5 *g*,

c) measure the horizontal velocity change (delta-V) of the impact sled during the impact with a precision of +0,5 km/h, and

d) filter transducer signals using a low-pass filter in accordance with ISO 6487, including:

1) pre-filtering of all transducer signals to Channel Class 1000 (−4 dB at 1650 Hz) prior to digitizing at 10,000 Hz, and

2) filtering of the digitized accelerometer and load-cell signals to Channel Class 60 (−4 dB at 100 Hz).

G.3.3 Test preparation and procedure

G.3.3.1 Perform the following prior to initiating the test.

a) Adjust the ATD to achieve a static resistance of 1 *g* at each joint indicated by just noticeable movement from the weight of the distal body segment as specified by the ATD manufacturer.

b) Place snug-fitting cotton clothing on the pelvis, thighs, and torso of the ATD.

c) Prepare the wheelchair for use in a motor vehicle as specified by the manufacturer's user instructions.

NOTE If a range is specified for any adjustments then the midpoint of the range should be used, when possible.

d) Equip the wheelchair with any required add-on components as specified by the manufacturer.

e) If a pelvic belt intended for use as an occupant restraint is provided as a component of the wheelchair, attach it to the wheelchair according to the manufacturer's instructions.

f) If the wheelchair is equipped with non-impact worthy batteries they should be replaced by the nearest equivalent gel, sealed or a surrogate battery. Supplemental weights, if used, must provide equivalent mass distribution to the original batteries.

g) Inflate any pneumatic tyres to the pressure recommended by the wheelchair manufacturer.

h) Turn the wheelchair power off, if applicable.

G.3.3.2 Install the wheelchair tiedown anchorages on the sled platform in accordance with the WTORS instructions as found in Annex E and the tiedown spacing and installation procedures of ISO 10542-1, Annex A.

G.3.3.3 Position the wheelchair on the sled in the orientation appropriate for representing vehicle accelerations during rear-impact event and with the wheelchair reference plane parallel to the direction of sled travel ±3°.

G.3.3.4 Secure the wheelchair with the surrogate wheelchair tiedown according to the instructions in Annex E. Follow the tiedown spacing and installation procedures in of ISO 10542-1.

G.3.3.5 If applicable, apply wheelchair brakes.

G.3.3.6 If applicable, adjust the seat, back support, and head support/restraint per the instructions in A.4.5 and also adjust the rear head support/restraint so that its centre is vertically aligned with the most prominent point on the back of the ATD's head and so that the gap between head and head restraint is minimized.

G.3.3.7 Position the ATD in the wheelchair as described in A.4.6.

G.3.3.8 If the wheelchair is provided with postural belts, install and fasten the belts on the ATD as recommended by the manufacturer.

G.3.3.9 If the wheelchair is provided with a pelvic belt intended to provide protection in a crash, fasten the belt on the ATD as recommended by the manufacturer and then complete the three-point occupant restraint with a vehicle-mounted shoulder belt. If the wheelchair does not provide a wheelchair-anchored pelvic belt, then apply the vehicle-anchored three-point belt restraint of the surrogate WTORS to the ATD.