

SURFACE VEHICLE RECOMMENDED PRACTICE

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Wheelchair Tiedown and Occupant Restraint Systems for Use in Motor Vehicles

Foreword—For people with disabilities who are unable to transfer from their wheelchairs when traveling in motor vehicles, the wheelchair must serve as the 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 must 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 a collision or sudden vehicle maneuver. Providing occupant protection for the wheelchair-seated occupant, therefore, requires that aftermarket equipment be installed to secure the wheelchair and restrain the wheelchair user.

This SAE Recommended Practice applies to the design and performance of motor-vehicle adaptive equipment referred to as wheelchair tiedown and occupant restraint systems or WTORS. It is the purpose of this document to encourage the design, testing, installation, and use of WTORS equipment that will provide effective wheelchair securement and occupant restraint in a frontal collision, and that will be comparable in crash performance to seat securement and occupant restraint systems provided by the vehicle manufacturer. While the primary concern is to reduce the potential for injury to wheelchair-seated occupants involved in a frontal vehicle crash, it is anticipated that achievement of improved occupant protection will also result in increased driver and passenger safety and comfort during normal travel. The provisions of this document should not be used to discourage people with disabilities from using motor vehicle transportation or to limit access to, and availability of, motor vehicle transportation to wheelchair users.

Since manufacturers of WTORS are generally not able to control or specify the end use of their products, the 48-km/h, 20-g sled impact test specified in Appendix A is intended to qualify WTORS for use in vehicles with a gross vehicle weight of less than 7000 kg. In larger vehicles, it may be possible to provide safe transportation using WTORS that do not comply with the level of crash severity used in this document.

As with any vehicle seat, the wheelchair is an important component of the occupant protection system, and also contributes significantly to the stability and comfort of the wheelchair-seated occupant during normal travel. Design and performance of wheelchairs used as seats in motor vehicles is addressed in a separate, but related, ANSI/RESNA Standard now under development.

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- 1. Scope**—This SAE Recommended Practice applies to WTORS comprised of a system or device for wheelchair tiedown and a system or device for restraining the wheelchair-seated occupant. It specifies design requirements, test methods, and performance requirements for WTORS, requirements for manufacturer's instructions to installers and users, and requirements for product marking and labeling. This document places particular emphasis on design requirements, test procedures, and performance requirements for the dynamic performance of WTORS in a 48-km/h, 20-g frontal impact. It also specifies test procedures and performance requirements for webbing slippage at adjustment devices of strap-type wheelchair tiedowns, and for partial but ineffective engagement of wheelchair tiedowns, and tiedown components that could be perceived to be effectively engaged. Appendix F includes additional recommendations for WTORS that will enhance the design, performance, installation, and use of WTORS, but which are not, at this time, required for compliance with this document.

The contents of this document apply to WTORS used with forward-facing wheelchair-seated children and adults, and apply to passengers and drivers of personally licensed motor vehicles as well as to passengers of motor vehicles used in public and school transportation. While much of the focus of this document is on WTORS that use four-point wheelchair tiedown systems, unless otherwise specified, the provisions of this document are applicable to all types of WTORS, including those that use docking-type wheelchair tiedowns.

While the primary focus of this document is a WTORS that is packaged by the manufacturer as a complete system or kit, it is recognized that a significant portion of the WTORS market consists of separate WTORS components and subassemblies, such as anchorage track that is sold to the bus manufacturer, or securement and restraint assemblies that are sold to the transit provider. Manufacturers of such WTORS components and subassemblies may certify their equipment as being in compliance with this document provided that:

- The subassemblies and components intended to be used together to create a WTORS meet all the appropriate requirements of this document, and
- The separately sold components and subassemblies are provided with instructions in accordance with 5.5, where the word "compatible" means tested together to comply with this document.

2. References

- 2.1 Applicable Publications**—This document contains provisions which reference the following documents. At the time of publication, the indicated editions of these references were valid. Since all publications are subject to revision or deletion, users of this document are encouraged to refer to the most recent published editions of these referenced documents.

- 2.1.1 SAE PUBLICATIONS**—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J211-2—Instrumentation for Impact Test
 SAE J850—Fixed Rigid Barrier Collision Tests
 SAE J1834—Seat Belt Comfort, Fit, and Convenience

2.1.2 FEDERAL PUBLICATIONS—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

FMVSS 209—Seat Belt Assemblies, Part 571.209

FMVSS 302—Flammability of Interior Materials, Part 571.302

2.2 Related Publications—The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J128—Occupant Restraint System Evaluation

SAE J140a—Seat Belt Hardware Test Procedure

SAE J141—Seat Belt Hardware Performance Requirements

SAE J383—Motor Vehicle Seat Belt Anchorage Design Modifications

SAE J2094—Terminology Report for Vehicle and Control Modifications for Drivers with Physical Disabilities

SAE J2252—Surrogate Wheelchair Drawing Package and Maintenance Manual

2.2.2 ADA PUBLICATION—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

PL 101-336—Americans with Disabilities Act, Part IV, Transportation for Individual with Disabilities, SN 869-010-0096-1, US Code Citation: 42 USC 12101

PL 101-476—Individuals with Disabilities Act (IDEA), 1990, US Code Citation: 20 USC 1400

2.2.3 AUSTRALIAN STANDARD—Available from Standards Association of Australia, Head Office: Standards House, 80 Arthur Street, North Sydney, P.O. Box 458, North Sydney, 2060 Australia.

AS 2942-1994—(Australian) Standard for Wheelchair Occupant Restraint Assemblies for Motor Vehicles, 2nd edition

2.2.4 CANADIAN STANDARDS ASSOCIATION PUBLICATIONS—Available from Canadian Standards Association, 178 Rexdale Boulevard, Etobicoke, Ontario, Canada M9W1R3.

CAN-D409-M84—Motor Vehicles for the Transportation of Physically Disabled Persons, ISSN 0317-5669, April 1994

CSA Z604—Transportable Mobility Aids for Occupancy in Moving Vehicles

CSA Z605—Mobility Aid Securement and Occupant Restraint Systems for Motor Vehicles

2.2.5 DIN PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

DIN 75 078 Teil 2—Motor Vehicles for Transportation of Handicapped Persons—Restraint Systems—Concepts, Requirements, Testing

2.2.6 FMVSS PUBLICATIONS—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

FMVSS 201—Occupant Protection in Interior Impacts, 49CFR Part 571.201 Amended August 18, 1995

FMVSS 222—School Bus Passenger Seating and Crash Protection, Federal Register, Vol 58, No. 10, January 15, 1993

2.2.7 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 7176/19—Requirements and test methods for transportation—Wheelchairs for use in motor vehicles

ISO 7193—Wheelchairs—Maximum overall dimensions, 1st edition, 1985-12-1

ISO 10542-1 and 2—Wheelchair tiedown and occupant restraint systems for use in motor vehicles

3. **Definitions**—For the purposes of this document, the following definitions apply:

3.1 **Anchorage**—An assembly of hardware 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 seat base.

3.2 **Anchor Point**—A point (area) on a vehicle, wheelchair, wheelchair tiedown, or vehicle seat base to which an anchorage is attached.

3.3 **ANSI**—Abbreviation for American National Standards Institute.

3.4 **Anthropomorphic Test Device (ATD)**—An articulated analog of the human body used to simulate a motor-vehicle occupant in a crash environment.

3.5 **Automatic-Locking Retractor**—A retractor incorporating adjustment by means of a positive self-locking mechanism which is capable, when locked, of withstanding restraint forces (from SAE J1834).

3.6 **Back Restraint**—A device or system intended to limit rearward movement of the occupant by providing support to the back of the torso.

3.7 **Belt**—A length of energy-absorbing webbing material used as part of an occupant restraint.

3.8 **Docking-Type Tiedown**—A wheelchair securement device whose engagement is initiated as a result of the wheelchair rolling into the proper position.

3.9 **Emergency-Locking Retractor**—A retractor incorporating adjustment hardware by means of a locking mechanism that is activated by vehicle acceleration, webbing movement relative to the vehicle, or automatic action during an emergency, and that is capable, when locked, of withstanding restraint forces (from SAE J1834).

3.10 **End Fitting**—Anchorage and securement hardware to which tiedown and occupant restraint webbing is fastened and which attaches directly to the anchor points and securement points on the wheelchair, tiedown system, or vehicle.

3.11 **Fasteners**—Devices used to secure, by mechanical means, other components or parts in place.

NOTE—These include, but are not limited to: bolts, nuts, screws, pins, rivets, and clamps.

3.12 **Forward Facing**—Orientation in which the wheelchair-seated occupant faces the front of the vehicle with the wheelchair reference plane within 10 degrees of the longitudinal axis of the vehicle.

3.13 **Four-Point Tiedown**—A wheelchair tiedown system that attaches to the wheelchair frame at four separate points and anchors to the vehicle at four separate anchor points.

NOTE—The typical four-point tiedown system uses four tiedown straps, with two attached to the front portion of the wheelchair and two attached to the rear portion.

- 3.14 Harness**—An occupant restraint consisting of at least one belt designed to provide pelvic restraint and two shoulder or torso belts that apply forces to both shoulders.
- 3.15 Head Restraint**—A device intended to limit rearward displacement of the occupant's head.
- 3.16 Impact Simulator**—A device for accelerating, decelerating, or a combination of decelerating and accelerating, a section of a vehicle or simulated vehicle structures, including instrumentation for measuring pertinent data (from SAE J850).
- 3.17 Impact Sled**—That part of an impact simulator on which components can be mounted for impact testing.
- 3.18 Independent Occupant Restraint**—An occupant restraint that anchors directly to the vehicle or vehicle anchored components that are separate from the wheelchair and wheelchair tiedown.
- NOTE—This is also known as a parallel restraint system.
- 3.19 Integrated Occupant Restraint**—An occupant restraint for which the anchor points for the pelvic-restraint, or both pelvic- and shoulder-restraints, are located on the wheelchair, or on tiedown components not fastened to the vehicle.
- 3.20 Occupant Restraint Anchorage**—An assembly of hardware and fittings by which loads are transferred directly from the occupant restraint to the vehicle, wheelchair, wheelchair tiedown, or vehicle seat base.
- 3.21 Occupant Restraint**—A system or device for restraining the occupant in a vehicle to prevent or minimize contact with the vehicle interior components, and to prevent ejection during a crash (from SAE J2094).
- 3.22 OEM**—Abbreviation for Original Equipment Manufacturer.
- 3.23 Pelvic Restraint**—That portion of a seat-belt assembly intended to limit movement of the pelvis.
- NOTE—Other terms with similar meaning are lap belt, lap restraint, and lower torso restraint.
- 3.24 Point P**—A reference point that lies at the cross-sectional center of a 100 mm diameter disc positioned with the longitudinal axis perpendicular to the wheelchair reference plane, such that the curved surface of the disc contacts with the backrest and the upper surface of the seat (see Figure 1).

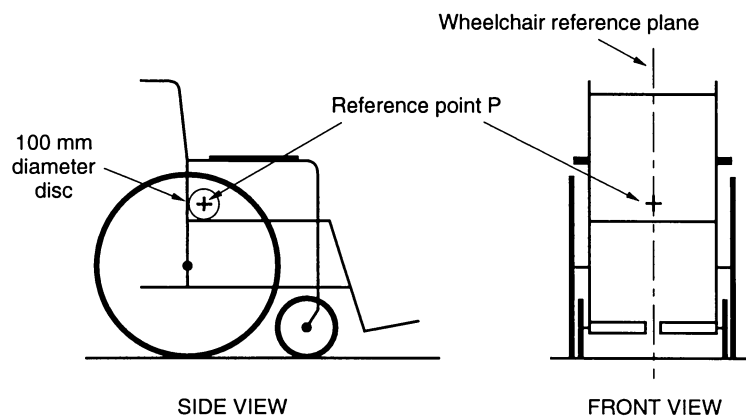


FIGURE 1—WHEELCHAIR REFERENCE POINT P AND WHEELCHAIR REFERENCE PLANE

- 3.25 Postural Support**—A component used to support a person in a desired position, but that is not usually intended to provide occupant restraint in a vehicle impact.
- 3.26 Securement Hardware**—End fittings of a wheelchair tiedown system that connect to the wheelchair.
- 3.27 Securement Point**—Location on the wheelchair frame to which a wheelchair tiedown end fitting connects.
- 3.28 Strap**—A length of webbing material used as a part of a wheelchair tiedown.
- 3.29 Surrogate Wheelchair**—A rigid, reusable device used to simulate a wheelchair for the purpose of testing a WTORS.
- 3.30 SWC**—Abbreviation for surrogate wheelchair.
- 3.31 Test Wheelchair**—A production, prototype, or surrogate wheelchair used to conduct tests specified in this document.
- 3.32 Three-Point Restraint**—An occupant restraint assembly combining both a pelvic belt and diagonal shoulder belt that connect near the hip of the user (see Figure 2).

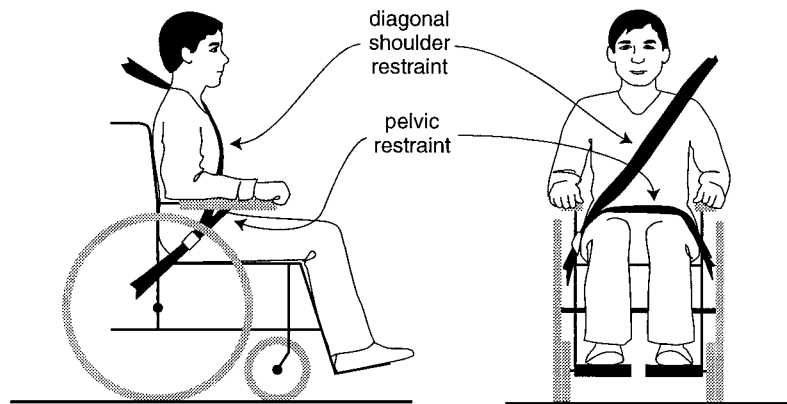


FIGURE 2—THREE-POINT OCCUPANT RESTRAINT. A WHEELCHAIR TIEDOWN IS ALSO REQUIRED BUT IS NOT SHOWN

3.33 Two-Point Restraint—An occupant restraint assembly consisting of a single length of webbing and related components that anchors at two separate points (see Figure 3 for examples).

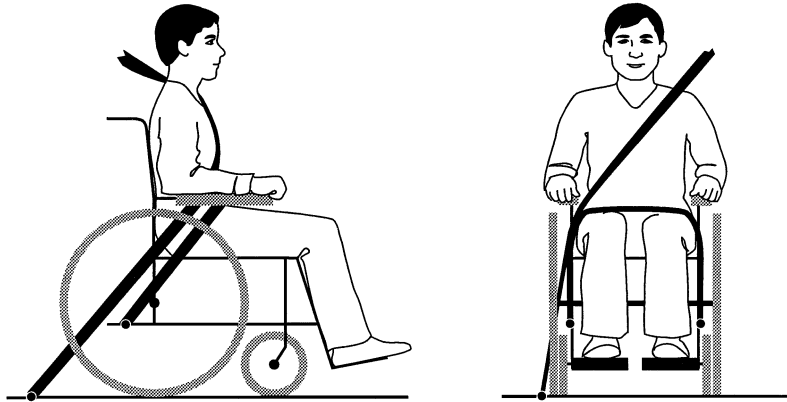


FIGURE 3—TWO-POINT VEHICLE-ANCHORED SHOULDER RESTRAINT WITH TWO-POINT WHEELCHAIR-ANCHORED PELVIC RESTRAINT. WHEELCHAIR TIEDOWN IS ALSO REQUIRED BUT IS NOT SHOWN

3.34 Upper Torso Restraint—A portion of a seat-belt assembly intended to restrain movement of the chest and shoulder regions (SAE J140 and J141).

3.35 Wheelchair—A seating system comprised of a frame, a seat, and wheels that is designed to provide support and mobility for persons with physical disabilities.

NOTE—The term encompasses standard manual wheelchairs, powered wheelchairs, power-based wheelchairs, three-wheel scooter-type wheelchairs, and specialized seating bases.

3.36 Wheelchair Reference Plane—The vertical plane of symmetry in the longitudinal centerline of the wheelchair (see Figure 1).

3.37 Wheelchair Tiedown and Occupant Restraint System (WTORS)—A complete restraint system for wheelchair-seated occupants comprised of a system or device for wheelchair tiedown as well as a system for restraining the occupant.

NOTE—A complete WTORS includes all anchorage hardware and anchorage fasteners, or specifications for anchorage fasteners, required for installing and using the system in a vehicle. Complete WTORS may be designed with the intention of using the vehicle OEM occupant restraint system.

3.38 Wheelchair Tiedown—A device or system designed to secure a wheelchair in place in a motor vehicle.

NOTE—Synonymous terms include wheelchair hold-down, wheelchair lock-down, wheelchair restraint, and wheelchair securement.

3.39 Wheelchair Tiedown Anchorage—An assembly of hardware and fittings by which loads are transferred directly from the wheelchair tieddown to the vehicle.

3.40 WTORS—Abbreviation for wheelchair tieddown and occupant restraint system.

4. Design Requirements

4.1 Complete WTORS—WTORS shall:

- a. Be for use with only one wheelchair and one occupant at a time.
- b. Not require components of wheelchair tiedowns and occupant restraints to pass through the wheels of a wheelchair.
- c. Provide for release of both the wheelchair and the occupant within 60 s by a single attendant or wheelchair user without the use of tools.
- d. Not require removal of wheelchair frame material, drilling into the wheelchair frame, deformation of the wheelchair, welding, or the use of an adhesive process, during installation, unless the WTORS is intended for a specific wheelchair and the modifications are approved by the wheelchair manufacturer.
- e. Once installed, be operable without tools.
- f. Include only hardware and fittings that are permanently connected to the WTORS or a WTORS subassembly.
- g. Be designed to prevent unintentional loosening of all threaded fasteners.
- h. Include a manual override in case of power failure for any power-operated mechanisms of tiedowns or restraints.
- i. Include anchorage fasteners and hardware, and/or specifications for such hardware, that are based on the material, size, and quantity of anchorage fasteners used in the simulated frontal impact test of Appendix A.

4.2 Wheelchair Tiedowns—Wheelchair tiedowns and tiedown components shall:

- a. Not depend on the wheelchair brakes.
- b. Be designed so that securement of the wheelchair is accomplished by the tiedown only and not by the occupant restraints.
- c. Provide a means to eliminate free movement of the wheelchair without the use of tools.
- d. If the WTORS includes a four-point strap-type tiedown, each strap assembly shall provide for manual adjustment in length without the use of tools, such that the adjustment ranges of front and rear straps enable achieving the minimum and maximum lengths indicated in Table 1, with at least 25 mm of webbing extending from the adjustment mechanisms.

TABLE 1—MINIMUM ADJUSTMENT RANGES FOR FOUR-POINT TIEDOWN STRAPS⁽¹⁾

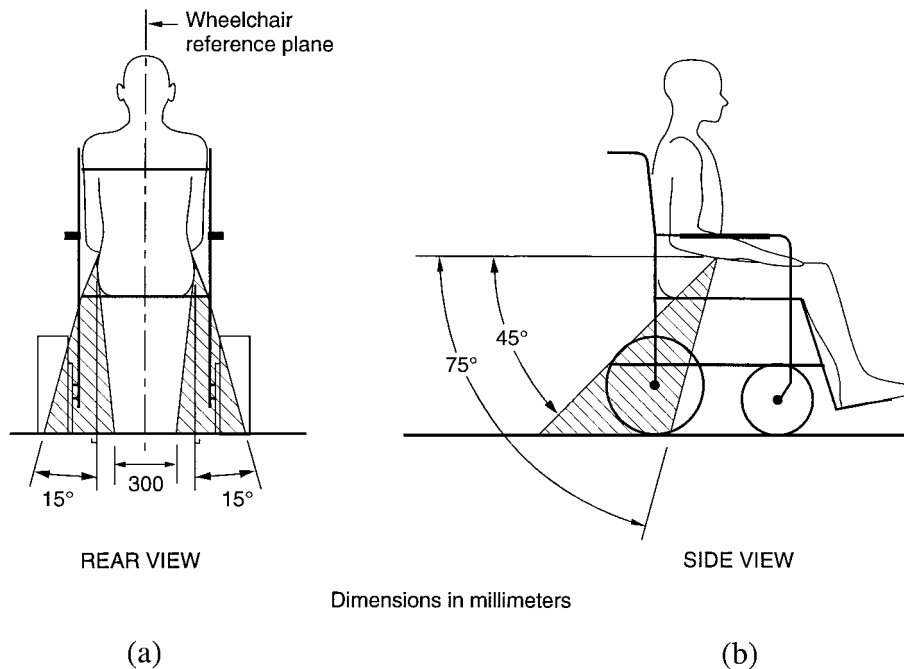
Strap Assembly Location	Minimum Length ⁽²⁾ mm (in)	Maximum Length mm (in)
Rear	485 (19)	740 (29)
Front	410 (16)	710 (28)

1. See F.1.14 and Figure F5 of Appendix F for rationale.
2. Length is defined as the straight-line distance from the point of intersection of the tiedown end fitting with the wheelchair securement point, to the point at which a straight line along the length of the strap assembly intersects with the wheelchair ground plane when set up as specified in A.6.4.

- e. Have securement-point end fittings of four-point tiedowns that are compatible with the securement-point opening geometry and the cross section of the securement-point structural member of the surrogate wheelchair illustrated in Figure E4.
- f. Include a device to indicate, by visual or auditory means, when a docking-type tiedown is properly engaged.

4.3 Occupant Restraints—WTORS shall either be designed to use the vehicle OEM passenger or driver restraint, or shall include an occupant restraint that complies with the following requirements:

- 4.3.1 The occupant restraint portion of the WTORS shall include both pelvic and upper torso restraints.
- 4.3.2 Occupant restraints may be designed to anchor directly to the vehicle, to components of the wheelchair tiedown, or to tiedown components fastened to the wheelchair. Occupant restraints shall not be designed with anchorages that rely on the transmission of restraint loads through the wheelchair structure unless the WTORS is designed for a specific wheelchair and the WTORS meets the requirements of 6.2 when the combination of wheelchair and WTORS is tested according to Appendix A.
- 4.3.3 The lengths of pelvic and upper torso restraints shall be manually adjustable without the use of tools.
- 4.3.4 When the WTORS is set up and measured as specified in Appendix B, pelvic restraints and, if applicable, their anchor points or guide points, shall:
 - a. Achieve side-view projected angles that fall within the zone shown in Figure 4b.
 - b. Achieve projected rear-view angles and locations within the zones shown in Figure 4a.
 - c. Provide sufficient length adjustment to allow the pelvic restraint, measured from anchor point to anchor point, to be both increased and decreased by 200 mm with at least 25 mm of webbing extending through the restraint end fittings at all times.



NOTE—Note that angles indicated are obtained by projecting the angle of the pelvic restraint onto a vertical plane parallel to the wheelchair reference plane (side view), or onto a vertical plane that is perpendicular to the wheelchair reference plane (rear view).

FIGURE 4—RANGES OF REQUIRED ANGLES AND LOCATIONS FOR PELVIC RESTRAINTS AND PELVIC-RESTRAINT ANCHOR POINTS

4.3.5 When the WTORS is set up and measured as specified in Appendix B, upper torso restraints shall provide for sufficient length adjustment to extend an additional 200 mm, and shorten by 300 mm, with at least 25 mm of webbing extending through the restraint end fittings at all times.

4.3.6 For WTORS that include upper-anchor points or upper-guide support structures for shoulder or harness restraints, the locations of these anchor points or supporting structures shall:

- a. Be sufficiently adjustable in height to be located at or above the shoulder levels of the intended users, or
- b. Be located at least 1100 mm above the wheelchair ground plane so as to be near or above the shoulder height of wheelchair seated occupants.

NOTE 1—The anchor point may be located below 1100 mm if an upper-guide support is located at or above 1100 mm.

NOTE 2—Although FMVSS 210 allows for the upper torso restraint anchor points to be located a significant distance below the occupant's shoulder level, such locations are considered to be undersirable and not in compliance with this document since they could result in downward loading on the occupant that can produce spinal injuries.

4.3.7 The junction of the shoulder and pelvic restraints of three-point restraints shall be located not less than 150 mm from the ATD centerline when installed as specified in Appendix B.

4.3.8 An airbag shall be used only as a supplementary occupant restraint in conjunction with a wheelchair tiedown and belt-type occupant restraint that comply with the requirements of this document.

4.3.9 Performance of the WTORS shall not depend on an airbag to comply with this document.

5. Identification, Labeling, and Instruction Requirements

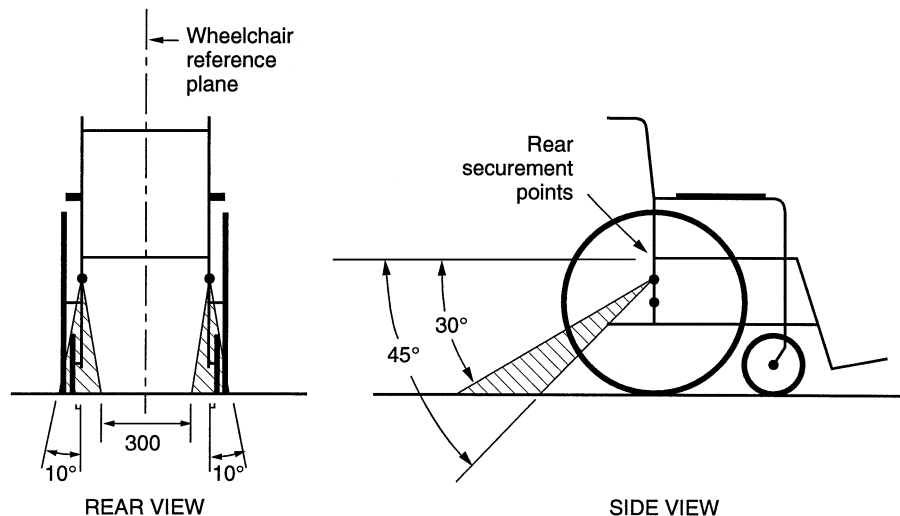
5.1 Identification and Labeling—Primary WTORS components and subassemblies shall be permanently and legibly marked with:

- a. Manufacturer's name or trademark
- b. Month and year of manufacture, with the month indicated by the name or a recognized abbreviation, and the year indicated by at least the last two digits
- c. Manufacturer's model and part number or an equivalent identification code
- d. Other information that may be necessary to identify a particular product in the event that a recall or special inspection becomes necessary
- e. The name and location of each detachable WTORS component (e.g., right-rear tiedown, shoulder restraint, pelvic restraint, etc.)
- f. The notation that the WTORS complies with SAE J2249, and for WTORS impact tested according to Appendix A with a specific production or prototype wheelchair rather than the 85-kg surrogate wheelchair, the make, model, and name of the specific wheelchair, along with the mass of the wheelchair and ATD used in the test

NOTE—The information of 5.1.f shall also be included in the manufacturer's presale literature.

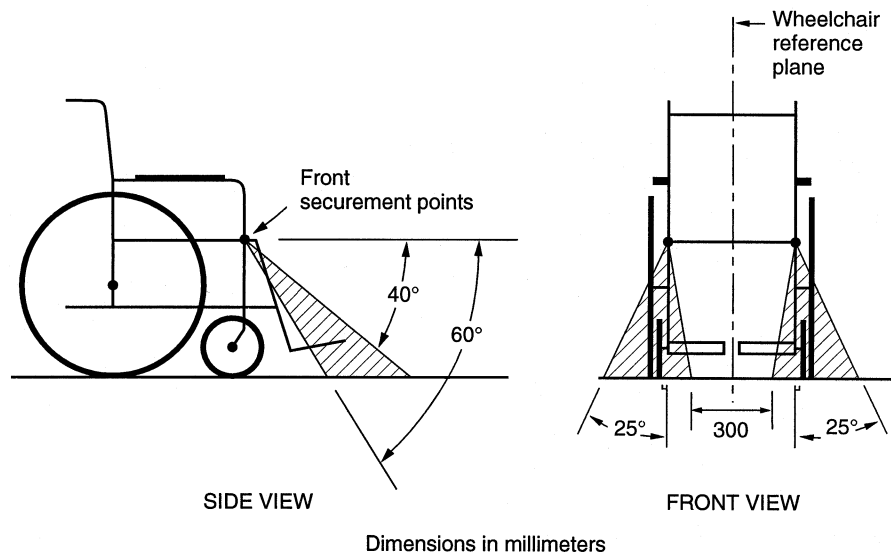
5.2 Instructions for Installation—Manufacturers of WTORS shall provide written instructions for the installer that include:

- a. Diagrams showing acceptable methods for fastening WTORS anchorages to the vehicle.
- b. A description of how the WTORS is to be used so that the installer may be fully informed regarding the purpose and function of all components and how they should be installed.
- c. A statement that if a head restraint is anchored to the vehicle, a vehicle-anchored back restraint must be provided to minimize rearward deflection of the wheelchair seatback and thereby prevent neck injury.
- d. An exploded-view drawing, parts list, or receiving inspection checklist for all components required in the installation.
- e. If fasteners are not supplied as part of the WTORS assembly, the minimum specifications for all wheelchair tiedown and occupant restraint anchorage fasteners and related components. The specifications shall be based on the material, size, and quantity of anchorage fasteners used in the simulated frontal impact test of Appendix A.
- f. A statement that vehicle anchor points may require reinforcement, along with a minimum strength recommendation for the vehicle at all WTORS anchor points.
- g. Identification of any components to be permanently fastened to the wheelchair and a description of procedures for attachment.
- h. A statement of the number of separate packages containing WTORS components.
- i. A description of the types of anchorage fittings that are suitable for use with the vehicle-installed anchorages.
- j. Recommended distances between anchor points of four-point wheelchair tiedowns, along with Figures 5 and 6.



NOTE—Note that angles indicated are obtained by projecting the angle of each tiedown strap onto a vertical plane parallel to the wheelchair reference plane (side view) or onto a vertical plane that is perpendicular to the wheelchair reference plane (rear view).

FIGURE 5—PREFERRED ANGLES AND LOCATIONS OF REAR WHEELCHAIR TIEDOWN STRAPS AND VEHICLE ANCHOR POINTS



NOTE—Front tiedowns should be angled out for lateral stability when possible. Note that all angles indicated are obtained by projecting the angle of each tiedown strap onto a vertical plane parallel to the wheelchair reference plane (side view) or onto a vertical plane that is perpendicular to the wheelchair reference plane (front view).

FIGURE 6—PREFERRED ANGLES AND LOCATIONS OF FRONT TIEDOWN STRAPS AND VEHICLE ANCHOR POINTS

- k. Recommended locations, relative to wheelchair tiedown anchor points, for anchor points of pelvic restraints that are intended to anchor directly to the floor of the vehicle, and an explanation that pelvic-restraint anchor points should be selected to achieve side-view projected restraint angles of 30 degrees or greater, and preferably between 45 or 75 degrees, to the horizontal, as shown in Figure 7, in order to reduce the possibility of the pelvic restraint loading the occupant's abdomen.

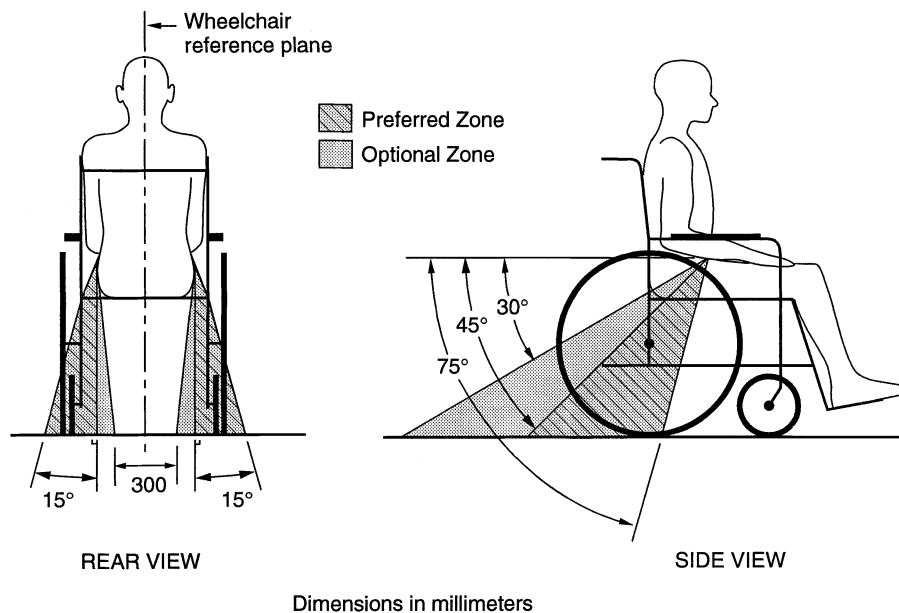


FIGURE 7—PREFERRED AND OPTIONAL ANGLES FOR PELVIC RESTRAINTS

- l. Recommended locations for upper-anchor or upper-guide support points of shoulder and harness restraints, and an explanation that these points should be positioned so that the belt webbing passes over the midpoint of the occupant's shoulder and at a height that is at or above the level of occupant's shoulders so as not to impose downward loads on the spine.

NOTE—See Tables and Figures in Appendix F for more information on torso belt fit.

- m. A diagram indicating recommended distances between WTORS anchor points and vehicle interior components along with the illustration of Figure 8, indicating that the distances are based upon the desire to maintain clear zones for potential head excursions of occupants provided with both upper and lower torso restraint, or with only a pelvic restraint, as applicable to the particular transportation situation.
- n. An instruction that, to reduce the possibility of head injury to wheelchair-seated passengers, vehicle components that are inside of the clear zones of Figure 8 should comply with the impact performance requirements of FMVSS 201.
- o. An instruction that all vehicle padding should comply with the flammability requirements of FMVSS 302.
- p. A statement that an airbag shall be used only as a supplementary occupant restraint in combination with a wheelchair tiedown and belt-type occupant restraint system that comply with the requirements of this document.
- q. A statement that cautions installers that airbags can cause serious injury if a wheelchair-seated occupant sits too close, and to contact the vehicle manufacturer or the National Highway Traffic Safety Administration for advice about disabling the airbag.

5.3 Advice and Warnings for Installers—The WTORS manufacturer shall also provide written advice and warnings to the installer that include:

- a. A statement that the WTORS complies with all applicable requirements of SAE J2249, including a 48-km/h, 20-g frontal impact test using either:
 - 1. A forward-facing surrogate wheelchair with a mass of 85 kg and an ATD with a mass of 76.3 kg, or
 - 2. A specific production wheelchair and an appropriate size ATD, along with the mass of the test wheelchair and ATD
- b. A statement that the WTORS should only be installed for forward-facing seating.
- c. Advice to have the WTORS installed by an experienced technician.
- d. Descriptions of any wheelchair features that are required to allow correct fitting of WTORS components that are to be permanently fastened to the wheelchair.
- e. A general warning to consult the WTORS manufacturer in case of questions as to the method of installation on the wheelchair and/or in the vehicle.
- f. A warning that anchorages should not be installed into unsound materials such as corroded metal, wood, plastic, and fiberglass panels, without additional and suitable reinforcement.
- g. A warning against making alterations or substitutions to the WTORS parts or components without consulting the WTORS manufacturer.
- h. A warning that the equipment has been tested in a configuration similar to that recommended by the manufacturer, and that any deviation from the manufacturer's recommendations is the responsibility of the installer.
- i. A warning to protect webbing from contacting sharp corners and edges.