

## **IX. Appendices**

### ***Appendix A-Reference Standards, Laws and Regulations***

#### **1) Authorizing Federal Laws and Regulations**

- FMVSS 222- School Bus Passenger Seating and Crash Protection, Federal Register, Vol.58, No. 10, January 15, 1993.
- ADA- Americans with Disabilities Act, 42 U.S.C. 12101, 1990

#### **2) US National Voluntary Industry Standards**

- SAE J2249- Wheelchair Tiedown and Occupant Restraints (Status 1/98-Ver.1-completed February, 1997)
- SAE J2252- Surrogate Wheelchair Drawing Package and Maintenance Manual (Status 1/98-under revision)
- ANSI/RESNA WC-19 Standards for wheelchairs used as Seats in Motor Vehicles (Status: target completion Spring, 1999)

#### **3) Comparable Canadian National Standards**

- CSA Z604 - Transportable Mobility Aids for Occupancy in Moving Vehicles (Status: completed February, 1997)
- CSA Z605 - Mobility Aid Securement and Occupant Restraint Systems for Motor Vehicles (Status: completed, February, 1997)
- CAN-D409-M84-Motor Vehicles for the Transportation of Physically Disabled Persons, ISSN 0317-5669, April 1994, Canadian Standards Association (Status: completed, October, 1992)

#### **4) Comparable International Standards**

- ISO 7176/19 Requirements and Test Methods for Transportation Wheelchairs for Use in Motor Vehicles (Status: target completion, Spring, 1999)
- ISO 10542-1&2 Wheelchair Tiedown and Occupant Restraint Systems for Use in Motor Vehicles (Status: completion, Spring, 1998)
- ISO 10542-3 Docking Systems (Status: target completion, Spring, 2000)
- ISO 10542-4 Clamping systems (Status: target completion, Spring, 2001)
- ISO 10542-5 Systems for Specific Wheelchairs (Status: target completion, Spring, 1999)

## ***Appendix B-Glossary of Terms***

Definitions of terms used throughout J2249:

**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.

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

**ANSI:** Abbreviation for American National Standards Institute.

**Anthropomorphic test device (ATD):** An articulated analog of the human body used to simulate a motor-vehicle occupant in a crash environment.

**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 J1834).

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

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

**Docking-type tiedown:** A wheelchair securement device whose engagement is initiated as a result of the wheelchair rolling into the proper position.

**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 J1834).

**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.

**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.

**Forward facing:** Orientation in which the wheelchair-seated occupant faces the front of the vehicle with the wheelchair reference plane within ten degrees of the longitudinal axis of the vehicle.

**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 of the wheelchair and two attached to the back.

**Harness:** A restraint assembly consisting of at least one belt designed to provide pelvic restraint and two shoulder or torso belts that apply forces to both shoulders.

**Head restraint:** A device intended to limit rearward displacement of the occupant's head.

**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 J850).

**Impact sled:** That part of an impact simulator on which components can be mounted for impact testing.

**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.

**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.

**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.

**Occupant restraint:** A system or device for restraining the occupant in a vehicle to prevent or minimize contact with the vehicle interior components and prevent ejection during a crash (from J2094).

**OEM:** Abbreviation for Original Equipment Manufacturer.

**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.

**Point P:** A reference point that lies at the cross-sectional center of a 100-mm-diameter cylinder positioned with the longitudinal axis perpendicular to the wheelchair reference plane such that the curved surface of the cylinder contacts with the backrest and the upper surface of the seat (see Figure 15).

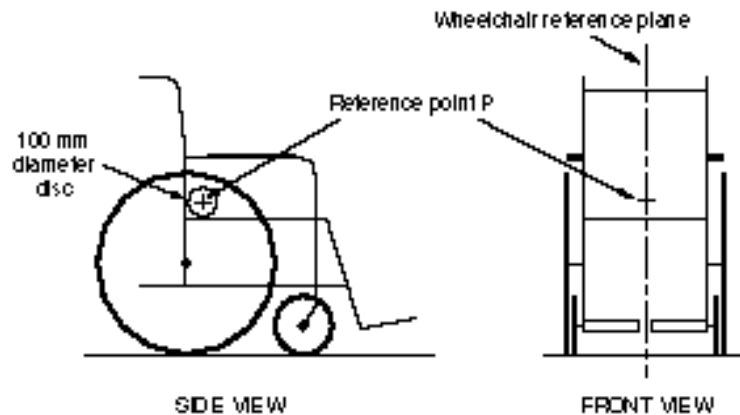


Figure 15 - Wheelchair reference point P and wheelchair reference plane.

**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.

**Securement hardware:** End fittings of a wheelchair tiedown system that connect to the wheelchair.

**Securement point:** Location on the wheelchair frame to which a wheelchair tiedown end fitting connects.

**Strap:** A length of webbing material used as a part of a wheelchair tiedown.

**Surrogate wheelchair:** A rigid, reusable device used to simulate a wheelchair for the purpose of testing a WTORS.

**SWC:** Abbreviation for surrogate wheelchair.

**Test wheelchair:** A production, prototype, or surrogate wheelchair used to conduct tests specified in this recommended practice.

**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 16).

**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 17 for examples).

**Upper torso restraint:** A portion of a seat-belt assembly intended to restrain movement of the chest and shoulder regions (J140 and J141).

**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.

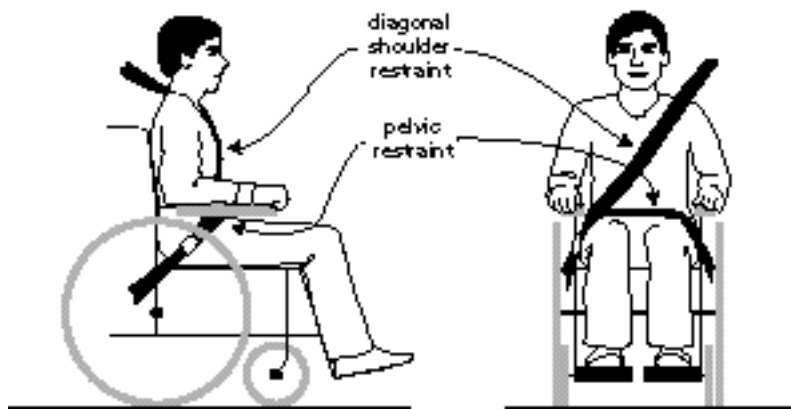


Figure 16 – Three-point occupant restraint. Wheelchair tiedown is also required but is not shown.

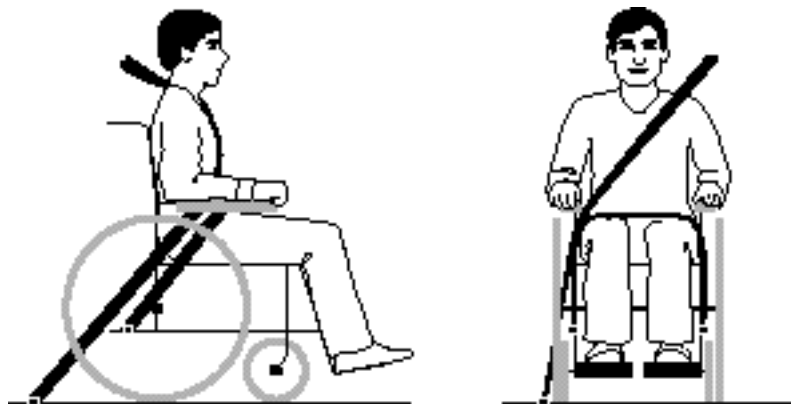


Figure 17 - Two-point vehicle-anchored shoulder restraint with two-point wheelchair-anchored pelvic restraint. Wheelchair tiedown is also required but is not shown.

**Wheelchair reference plane:** The vertical plane of symmetry in the longitudinal centerline of the wheelchair (see Figure 15).

**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.

**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.

**Wheelchair tiedown anchorage:** An assembly of hardware and fittings by which loads are transferred directly from the wheelchair tiedown to the vehicle.

**Appendix C -List of Participant Organizations, Companies and Individuals:**

**1) Organizations**

Paralyzed Veterans of America--Jeff D.  
NHTSA--Charles Hott, Gayle Dalrymple  
SAE-Adaptive Devices subCommittee (ADSC)-Phil Doolittle -Chair  
SAE- ADC-Task Group on Wheelchair Securement-Douglas Hobson  
-Chair  
Transport Canada-Roy Nishizaki, Barbara Smith  
University of Michigan (UMTRI)--Lawrence Schneider, Miriam Manary  
University of Middlesex (UK)--Peter Roy, Edward Stait  
University of Pittsburgh (RERC)--Douglas Hobson, Gina Bertocci,  
Kennerly Digges and Jean Webb  
University of Virginia--Greg Shaw, John Thacker  
Veterans Administration--Lou Molino,

**2) Companies**

ANCRA International--Ralph Abato  
Division Industries--Scott Boldoc  
Everest and Jennings Inc--Robert Clarke  
EZ Lock Inc--Bruce Constantin  
Indiana Mills Inc. James Johnson  
Invacare Inc--Gil Haury  
Kinedyne Inc--Joe Takacs  
New Haven Equipment--Ray Lee  
Ortho Safe Systems--Winifred Kraft  
Q' Straint--Jean-Marc Girardin  
Tie Tech Inc--Jack McIntyre  
GESAC--N. Rangarajan

**3) Additional Individuals** (incomplete)

SAE Task Group participants:

Tom Adams	Roger Koppa
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Jeff Dolozal	Greg Shaw
Phil Doolittle	Lyle Stevens
Laurin Garland	Joe Takacs
Peter Grandolfo	John Thacker
Charles Fitzsimmons	Margaret Young
Douglas Hobson-(Chair)	Winifred Kraft
Charles Hott	Carmella Starno
Patricia Karg	Gary Sherman