

V. Guidelines for Users of WTORS

The following guidelines are intended as a reference by users and prescribers of wheelchairs, as well as for attendants and operators who are responsible for the appropriate use of securement and restraint devices in motor vehicles used to transport wheelchairs. The guidelines are based on existing US laws and regulations, as well as on the biomechanical principles outlined in Section III above. In addition, experiences gained over the past 20 years in wheelchair and securement device crash testing under laboratory conditions has yielded valuable performance information regarding actual products in the marketplace. Finally, the preparation of both national and international standards, as referenced in Appendix A, has created excellent opportunities for information sharing of experiences on a world wide scale. Many of these sharing experiences have also influenced the following guidelines (part 3).

1) *The key provisions in existing US laws*a) Transit vehicles (ADA)

- all " common " wheelchairs shall be transported
- clear floor space of at least " 30"x48" for at least two forward-facing wheelchair stations must be provided near vehicle entrance
- transit entity may require use of securement devices
- access cannot be denied on basis of an unsecureable wheelchair
- transit entity may request transfer to regular seat, but can not require it
- tiedowns and occupant restraints shall be provided for each wheelchair station
- use of occupant restraints optional
- securement devices must meet a stated minimum static strength requirement
- movement of wheelchair must not exceed 2" during normal driving

b) School buses (FMVSS-222)

- wheelchairs must be forward facing
- both wheelchair securement and occupant restraint devices must be provided
- each wheelchair station must have at least four securement anchorage's
- each tiedown anchorage must meet a stated minimum static strength requirement
- each restraint anchorage must meet a stated minimum static strength requirement.
- securement straps must have a means for minimizing slack

c) Private vehicles

The provisions of several Federal Motor Vehicle Safety Standards that apply to manufacturers of passenger vehicles have been used as a basis for many of the provisions of SAE j2249. These include:

- FMVSS 208 – Occupant Crash Protection
- FMVSS 209 – Seat Belt Assemblies
- FMVSS 210 - Seat Belt Assembly Anchorages
- FMVSS 213 – Child Restraint Systems Seat Belt Assemblies and Anchorages

2) The key provisions (requirements) for products to conform to US voluntary industry standards and recommended practice

a) Wheelchair securement products (J2249)

- designed for use by forward-facing children and adult wheelchair occupants
- not depend on the wheelchair brakes to conform with this recommended practice
- designed for use in both private and public vehicles
- capable of withstanding a 20g, 30 mph simulated frontal crash
- end fittings compatible with transit wheelchairs that conform to ANSI/RESNA, WC-19⁸
- function without any component of the tiedown passing through the wheels of the wheelchair
- allow for routine release of the wheelchair within 60 seconds without the use of special tools
- designed to prevent unintentional loosening of any threaded fasteners
- include a manual override for any power operated systems in the event of a power failure
- designed to eliminate free movement without the use of tools
- allow for the adjustments of tiedown strap lengths without the use of tools
- have specified labelling and identification
- be marketed with specified presale information, installation guidelines and user instructions.

b) Occupant restraint products (J2249)

- designed to be used by both passengers and drivers
- include both pelvic and upper torso restraints
- lengths be manually adjustable to accommodate a wide range of body sizes without the use of tools
- not depend on an airbag to conform to this recommended practice

⁸ see Appendix A

- be marketed with specified labeling, permanent identification markings, installation guidelines and user instructions.

c) Transit wheelchairs (ANSI/RESNA, WC/19)⁹

- designed to be secured as a forward-facing seat for use in both public and private motor vehicles
- four clearly identified securement points (2 front, 2 rear) that will accept tiedown end fittings that conform to J2249
- permit a vehicle-anchored pelvic restraint to cross the pelvis to anchor points within the specified 30-75° angle range
- provide a clear path for fastening pelvic restraint straps to anchor points on the tiedown or vehicle floor
- if wheelchair anchored, provide a pelvic restraint angle within the specified range of 30-75°.
- if postural supports are provided, they be designed to break away at low forces or comply with J2249
- meet the requirements of the specified 30mph/20 g sled impact
- be marketed with specified presale information, installation guidelines and user instructions
- have specified labelling and permanent markings .

3) What can be considered "best practice" today?

The following are recommendations that are possible with today's technology, however they may not be feasible in every case due to the existence of products that were marketed prior to the formal issuance of the above standards and recommended practice guidelines.

a) General Principles

It must be recognized that wheelchair-occupant protection while seated on a moving motor vehicle is a systems issue. That is, effective occupant protection can only occur when the wheelchair, the wheelchair securement, the occupant restraint and the vehicle are viewed as a complete protection system. The effectiveness of the system will only be as good as the weakest component in the system. For example, if a wheelchair passenger is secured in a motor vehicle meeting all the ADA and FMVSS requirements, but the attachment location to the wheelchair, or the wheelchair itself does not meet specifications, this creates a system deficiency that, although certainly better than no securement, is less than adequate given what is possible using today's knowledge and technology. Again, sometimes these "best practice" arrangements are unachievable due to technical, financial or other constraints. However, when selecting new products, wheelchair users and prescribers should include these transport safety principles in their decision-making process. Given the passage of the related federal laws and regulations, combined with the increasing adoption of voluntary industry standards, new opportunities are

⁹ see Appendix A for status information

rapidly emerging to make product selections that can vastly improve the transport safety of wheelchair users.

Standards are always a moving target, In fact, all standards setting organizations mandate a review and if necessary, revision every five years. Therefore, it is essential for those seeking current information that they make sure that they have access to the most current versions.

Wheelchair occupants in motor vehicles are generally not the only passengers needing occupant protection. Therefore, J2249 and its other related standards, have attempted to maintain the safety of others passengers while introducing the requirements specific to the wheelchair and its occupant.

Four-point strap-type securement devices are by far the most commonly used securement technology in North America. For this reason, the evolving industry standards and the Federal regulations are to a large extent based on these technologies. This is also the case for these guidelines and the following recommendations.

In addition, the following " best practices" recommendations are extractions from the principles and standards discussed above that are particularly pertinent to wheelchair users, prescribers and those that assist directly with the transport of persons using wheelchairs.

b) Wheelchair selection for transit use

When selecting a wheelchair that is also intended for use as a seat in a motor vehicle, the following principles or features should be fully considered:

- very few wheelchairs, as of 1/98, have designed for use as a seat in a motor vehicle
- the availability of structurally adequate securement points (2 front, 2 rear) that are compatible with tiedown end fittings specified in J2249
- the presence of rigid components in the occupant compartment that could present injurious contact areas in the event of a crash
- unobstructed pathways that will allow for vehicle-anchored restraints straps to pass closely across the body at the appropriate anatomical locations, and most preferably
- evidence, through permanent labeling or presale literature, that the wheelchair has been tested to ANSI/RESNA, WC-19 or a comparable standard¹⁰.

c) Wheelchair securement

- most commercially available strap-type securement devices have been tested to J2249 and should be advertised accordingly.

¹⁰ see Appendix A--Wheelchairs

- insist on transporters using a forward facing wheelchair orientation in the vehicle.
- assuming a four point strap tiedown system, use all four straps to secure the wheelchair.
- assuming no designated securement points, attach tiedowns only on structural members and as close to the center of gravity (CG) of the W/C as possible. A good estimate of the vertical location of the CG for most wheelchairs is in a zone ranging from 9-12" above the floor.
- assuming they are available, use only the four designated wheelchair securement points, and
- take time to remove the slack using the adjustable mechanisms on the tiedown straps.

d) Occupant restraint

- use both the pelvic and shoulder belts.
- locate the pelvic restraint low over the bony structures of the pelvis (range 45-75° angle from horizontal (see figure 5)).
- if adjustable, locate the upper trunk restraint belt anchor point so that the belt crosses the chest at the mid clavicle (collar bone) region (approximate angle-55° to horizontal).
- distribute restraint forces to as large an area as possible, but avoid soft tissue areas such as the abdomen and neck.
- do not confuse the use of postural belts with occupant restraint belts. If necessary, the former should be labeled as inadequate for such use unless it conforms to the strength requirements of J2249, and
- during application insure a snug fit of occupant restraints by removing unnecessary belt slack, as is comfortably possible.