



WC18/WC19/WC20

WHITE PAPER

**Q'STRAIT
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Now is the Time to Plan Compliance with New WTORS Safety Standards

Manufacturers of wheelchair tiedown and occupant restraint systems (WTORS) need to be planning now for how they will increase the strength of their products to comply with a new requirement of a RESNA (Rehabilitation Engineering Assistive Technology Society of North American) wheelchair transportation safety standard, known as WC18, that takes effect in December 2015.

As with its predecessor standard, Society of Automotive Engineers (SAE) J2249, compliance with WC18 requires that wheelchair tiedown/securement systems of complete WTORS must be dynamically strength tested on an impact sled using a 30-mph/20-g crash pulse, a 187-pound (85 kg) surrogate wheelchair, and a 170-lb (76-kg) midsize adult male crash-test dummy. However, one of the most significant changes in WC18 is that by December 2015 (three years following the initial publication of WC18), wheelchair tiedown/securement systems must be able to withstand the increased forces generated in an additional test in which the 170-lb crash-test dummy is restrained by a lap belt that is anchored to the surrogate wheelchair rather than to the vehicle. The new WC19 wheelchair standard requires the availability of an optional wheelchair-anchored lap belt. The RESNA Committee on Wheelchairs and Transportation (COWHAT) developed the new WC18 standard to address the higher wheelchair forces that are transmitted to the tiedown/securement system when a person riding in a wheelchair is using that optional lap belt.

Industry Steps In Where Government Has Not Yet Acted

In the absence of federal standards for the use of wheelchairs as passenger seats in motor vehicles, key stakeholders involved in transportation for people who depend on wheelchairs for their mobility have assumed responsibility for improving transportation safety for these travelers through the development of voluntary industry standards. These stakeholders include WTORS manufacturers, wheelchair and wheelchair seating manufacturers, auto safety professionals, rehabilitation engineers, clinicians, transit providers, and consumers. While these industry standards are voluntary, their continuing revision, updating, and strengthening — as in the newest versions of WC18 and WC19 — demonstrate industry's ongoing and increasing commitment to the safety of travelers seated in wheelchairs.

Keeping the Wheelchair Secure

WC18 is the familiar name of *Wheelchair Tiedown and Occupant Restraint Systems for Use in Motor Vehicles*, which is Section 18 of Volume 4 of RESNA wheelchair standards (WC-4): *Wheelchairs and Transportation*. Section 19 (or WC19) is the companion standard for *Wheelchairs Used as Seats in Motor Vehicles*. These voluntary industry standards establish what are considered to be minimum design and

performance levels to provide a reasonable level of safe transportation and crash protection for people who use their wheelchairs as the vehicle seat when traveling in motor vehicles.

As noted above, WC18 is a revised and updated version of Society of Automotive Engineers (SAE) Recommended Practice J2249, which was first published in 1996 and last updated in 1999. WC19 was the first industry standard in the U.S to address the design and performance of wheelchairs used as seats in motor vehicles and was first published in 2000 as Section 19 of Volume 1 of RESNA wheelchair standards.

Both SAE J2249 and WC18 require that WTORS provide a method, independent of the occupant restraint system, for effectively securing wheelchairs in a 30-mph frontal crash. A three-point, lap-shoulder belt restraint system must also be provided to reduce occupant movement and prevent ejection from the vehicle, thereby reducing the chance of injury in a frontal crash from occupant contact with the vehicle interior, with other vehicle occupants, or with objects outside of the vehicle.

In *RESNA's Position on Wheelchairs Used as Seats in Motor Vehicles*,* RESNA says that wheelchairs used as passenger seats in motor vehicles should provide effective occupant support under the same frontal-impact test conditions as passenger car seats and child safety seats covered by federal motor vehicle safety standards. The wheelchairs should also facilitate proper placement of vehicle-anchored lap/shoulder-belt restraints. In addition, WC19-compliant wheelchairs are easier to correctly and effectively secured with a four-point, strap-type tiedown, which is today's universal method of wheelchair securement. RESNA also calls WC18-compliant WTORS "a critical part of a wheelchair transportation safety system as they anchor the wheelchair to the floor and keep passengers seated in their wheelchairs."

WTORS can use different methods to secure the wheelchair and still be WC18-compliant. Typical securement systems include four-point, strap-type tiedowns and auto-engage docking devices. Future solutions yet to be designed are also allowed as long as they secure the wheelchair independent of the occupant to prevent the wheelchair from adding forces to the occupant during a crash event and comply with other design and performance requirements of WC18. Whatever the securement system, for WTORS equipment to be WC18 compliant, beginning in December 2015, it must be successfully tested with the crash-test dummy restrained by a lap belt anchored to the 187-lb surrogate wheelchair.

However, compliance with WC18 does require that WTORS include a belt-type occupant restraint system with both lower (lap or pelvic) and upper (shoulder) belt restraints. The most common of these is the three-point, lap-shoulder belt system similar to that installed as original equipment in motor vehicles.

Improved Safety When the Wheelchair Becomes the Passenger Seat

While WC18 addresses wheelchair securement and occupant restraint systems, the newly revised WC19 standard covers the design and performance testing of wheelchairs for use as seats in motor vehicles. Since the wheelchair becomes the vehicle seat for people with disabilities who cannot transfer from their wheelchairs to ride in a minivan, van, or bus, WC19 provides for the application of basic occupant-protection principles to wheelchair design. Key elements of WC19 compliance include:

- **Four easily accessible, permanently attached, and labeled securement points** with specific closed-loop geometry that allow one-hand attachment of tiedown-strap hooks. These must be able to withstand the forces of a 30-mph, 20-g frontal impact.
- **Successful crash testing with a commercially available wheelchair-anchored lap belt placed around the pelvis of the appropriate-size crash-test dummy.** A pin-bushing anchorage must be available on each half of the lap belt for attaching the lower end of a shoulder belt near the passenger's hip to comprise a three-point belt restraint system.
- **Testing to determine two ratings of the wheelchair's accommodation of vehicle-anchored lap/shoulder belt restraints:** one rating for the ease of proper seatbelt positioning and the other for the *degree* to which proper belt placement is achieved.

Because it is not practical to crash-test every possible combination of wheelchair seating systems and base frames, a new RESNA standard, Section 20 in Volume 4 of RESNA wheelchair standards, commonly referred to as WC20, allows for independent testing of wheelchair seating systems using a surrogate wheelchair frame or SWCF. As with WC18 and WC19, WC20 also specifies manufacturer requirements for product labeling and user instructions and warnings.

The Key Role of Third-Party Payers

Institutions such as private insurance companies that finance wheelchair users' mobility solutions can play a significant and important role in contributing to the success of these standards by agreeing to pay the small additional cost of standards-compliant wheelchairs, seating systems, and tiedowns.

Taking a step in that direction, the U.S. Department of Veterans Affairs recently required compliance with WC19 design, performance, and instruction requirements in its most recent solicitation for a select category of powered wheelchairs (VA-797-11-RP-0097; March 18, 2011). In responses to questions from prospective vendors who appeared to be unclear on this point, the VA confirmed and reiterated its requirement for WC19 compliance.

In Amendment 7 to the solicitation (June 16, 2011), the VA wrote:

“All submissions must be tested to WC-19 standards as indicated in the solicitation...”

In Amendment 9 to the solicitation (July 8, 2011), the VA wrote:

“... the power wheelchair **MUST BE TESTED** to all identified RESNA standards in the standard configuration as prior clarified, including the wheelchair anchored pelvic belt.”

While this requirement of standards compliance currently applies only to a specific category of powered wheelchairs, Dr. Larry Schneider, Research Professor and Associate Director of the University of Michigan Transportation Research Institute (UMTRI), and Chair of the RESNA Committee on Wheelchairs and Transportation from 2000 to 2013, says that RESNA remains hopeful that the VA will issue a similar requirement for manual wheelchairs and tiedown systems.

“These kinds of things are slow in coming, but they can have a significant impact on improving transportation safety for occupants who must remain seated in their wheelchairs when traveling in motor vehicles,” he says.

With the publication of the newest WTORS and wheelchair transportation standards in December of 2012, and the increased strength requirement for wheelchair tiedown and securement systems beginning year-end 2015, now is the time for transportation providers to be discussing compliance roadmaps with WTORS manufacturers and developing strategies for providing improved safety for passengers seated in wheelchairs who are using crashworthy wheelchair-anchored lap belts.

New Wheelchair and WTORS Standards at a Glance

- RESNA's WC18 standard for *Wheelchair Tiedowns and Occupant Restraint Systems for Use in Motor Vehicles* updates, enhances, and replaces SAE Recommended Practice J2249.
- RESNA's WC19 standard for *Wheelchairs Used as Seats in Motor Vehicles* updates and expands on RESNA WC19 published in April 2000.
- RESNA's WC20 for *Seating Systems for Use in Motor Vehicles* provides a new set of design and performance requirements for wheelchair seating systems comprised of a seat, a back support, and attachment hardware.
- All three standards are included in the new Volume 4 of RESNA Wheelchair Standards, *Wheelchairs and Transportation*, which went into effect in December 2012
- In December 2015, WC18 will require that wheelchair tiedown/securement systems be tested to a higher level with a surrogate lap-belt restraint anchored to the 187-lb surrogate wheelchair restraining the crash-test dummy's pelvis. This addresses the passenger in a wheelchair who chooses to use a crashworthy wheelchair-anchored lap belt required in wheelchair crash testing by WC19.
- To fail the frontal crash test under the new standards, there must be a "complete failure" of primary load-carrying components as opposed to the previous performance criteria where "sign of failure" resulted in failure of the test. However, "signs of failure" must still be noted in the test report.
- The new WTORS standard (WC18) requires that WTORS designed with three-point lap/shoulder belt restraints with vehicle-anchored pelvic/lap belts must either:
 - provide a way to disconnect the shoulder belt from the pelvic belt using the standard connector-to-pin-bushing anchorage, and/or
 - feature anchorage ends that can be easily threaded through openings in wheelchairs and manually attached to the floor anchorages, such as the housings of tiedown-strap retractors.
- If the shoulder belt of a three-point belt restraint with vehicle-anchored lap belt provided by the WTORS manufacturer doesn't disconnect from the lap belt, there must be a way to use only the shoulder portion of the belt restraint to connect to one of the pin-bushing anchorages on a wheelchair-anchored crashworthy lap belt.
- The minimum lateral distance between securement points on wheelchairs was increased from 100 mm to 200 mm (3.94 to 7.87 inches).
- In the new WC19 standard, the test for wheelchair accommodation of vehicle-anchored belt restraints has been changed. Previously manufacturers were required to "measure and disclose" the rating in the wheelchair presale literature but now this is a "pass/fail" performance requirement with two ratings, one each for:
 - the ease of achieving proper positioning of the vehicle-anchored lap/shoulder belts on passengers seated in the wheelchair, and
 - the degree to which proper belt positioning is achieved.

To comply with WC19, a wheelchair model must be rated as "acceptable" or higher for each rating.

Information adapted from *Wheelchair Transportation Safety Standards (An update on WC18, WC19, and WC20)*, presented by Dr. Larry Schneider of the University of Michigan Transportation Research Institute at the 2011 STN Annual Conference, July 27, 2011.

*Mary Ellen Buning PhDOTR/LATP/SMS, Gina Bertocci PhDPE, Lawrence W. Schneider PhD, Miriam Manary MSBE, Patricia Karg MSE, Dalthea Brown PTMS & Sue Johnson (2012): RESNA's Position on Wheelchairs Used as Seats in Motor Vehicles, *Assistive Technology: The Official Journal of RESNA*, 24:2, 132-141. <http://dx.doi.org/10.1080/10400435.2012.659328>