Mobility Device Access and Securement:
Standards and Wheelchair Marking & Tether Strap Programs

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A common problem for transit personnel is not being able to identify, or reach, where to attach tie-down straps on many wheelchairs and scooters. Newer wheelchair designs often do not have the type of frame joints that tie-down systems were originally designed for. Now there is a voluntary industry standard for specially designed attachment points, ANSI/RESNA "WC19", but wheelchairs complying with it are not yet in wide usage.

Some transit systems and disability organizations offer wheelchair marking and/or tether strap programs as a "best effort" approach to providing as much safety and comfort as possible. The objective is to make securement of mobility devices faster, easier, and safer to perform; to provide as stable and safe a tie-down as possible, and to make the process more consistent and convenient for transit customers who use mobility devices.

< Wheelchair with markings (rear) and tether straps (front)

BACKGROUND

Easter Seals Project ACTION published the *Status Report on the Current Use of Wheelchairs and other Mobility Devices on Public and Private Transportation* in 2008 (free as PDF, text file, or print copy at projectaction.easterseals.com > Store). The report investigated issues in several sectors:

- Transit vehicle and equipment design
- Transit operations and training
- Wheelchair design, purchasing, usage, and prescription
- Regulation and policy

Recommendations were made for improvements using best practices in the transit industry, based on a literature review and stakeholder interviews (in addition to recommendations for other sectors):

- Transit system policy statements and educational information (including information about the benefits of "transit-safe" mobility devices)
- Training program elements and service performance monitoring
- Auxiliary aids (such as marking/tether straps)
- Transit vehicle design and procurement; demonstration of new technologies

A more recent examination of the subject is *TCRP Report 171: Use of Mobility Devices on Paratransit Vehicles and Buses* (2014). This study describes current and emerging issues which limit the use of mobility devices in buses and paratransit vehicles, and includes a separate guidance document to assist transit systems, manufacturers, and transit users in the implementation of potential accessible design and accommodation solutions. The report also addresses potential safety improvements and ways to increase the level of service for larger and heavier mobility devices in buses and paratransit vehicles. (Available as a PDF at http://www.trb.org/Publications/Blurbs/171162.aspx)

ADA REQUIREMENTS FOR MOBILITY DEVICE ACCESS AND SECUREMENT

The Americans with Disabilities Act (ADA) requires vehicles to be accessible to mobility device users, and for service to ensure that passengers can take advantage of those features. The following are key provisions related to mobility device securement:

Vehicle Accessibility:

49 CFR PART 38: ADA Accessibility Specifications for Transportation Vehicles; Subpart B, Buses, Vans and Systems; Sec. 38.23 Mobility aid accessibility.

NOTE: The US Access Board is the agency responsible for developing these guidelines, as codified at 36 CFR Part 1192. Meanwhile, the implementing regulations of the US DOT are shown at 49 CFR Part 38, with the Access Board vehicle guidelines as an appendix – in effect, the US DOT adopts the Access Board guidelines as mandatory standards. The two CFR documents are identical, except for minor editorial differences and the number prefix, after which the numbering systems are parallel. For example, Section 1192.23 in the Access Board document corresponds to 38.23 in the DOT regulation.

The Access Board has been in the process of revising the bus and van guidelines since 2007, when the first of two draft guidelines were issued. Then a "notice of proposed rulemaking" (NPRM) was issued on July 26, 2010 (ADA anniversary date). Comments from the transit industry, disability community, and the public were due November 23, 2010. Review by the Access Board was postponed due to staff changeover and a combination of other issues, including a re-opening of the comment period for the topic of ramp slope, which closed in November 2012.

There new guidelines are finally expected to be issued as a final rule by 2016.

> See: http://www.access-board.gov/guidelines-and-standards/transportation/vehicles/update-of-the-guidelines-for-transportation-vehicles

The following is a review of the major changes being proposed. But until the final rule is actually issued, there is no way to know if the new elements will be issued as proposed, or if some will be modified based on comments received and internal deliberations over the five-year gestation period.

Wheelchair spaces

This will be split into 3 different required sizes, as compared to the existing single minimum of 30 x 48 inches:

- Unconstrained spaces: 30 x 48"
- Side entry ("parallel parking"): 30 x 54"
- Constrained front or rear entry: 31 x 48" (applicable to rear-ramp minivans)

The basic minimum wheelchair space size will remain 30 inches wide by 48 inches long (Fig. 1). However, in some vehicle layouts, two new requirements will come into play:

Side entry: Where the long side of the wheelchair space is entered from the side and the confined space is more than 15 inches deep (Fig. 2), the space must be at least 30 inches wide by 54 inches long (48 inches plus 6 inches for maneuvering space). "Confined space" is defined as confined on all or part of three sides, such as against a side wall and between a fold-up seat and wheel housing. This ostensibly means that in an open-floorplan vehicle (where most or all of the seats fold out of the way), the basic, or "unconstrained" minimum size of 30 x 48 will apply. The main vehicle types needing the larger space will be urban transit buses and body-on-chassis minibuses ("cutaways") that have fixed seating and/or wheel housings adjacent to wheelchair spaces.

Front or rear entry: Where the short side of the wheelchair space is entered from the front or rear and the confined space is more than 24 inches deep (Fig. 3), the space must be at least 31 inches wide (30 inches plus 1 inch for maneuvering space) by 48 inches long. The illustration provided by the Access Board (Fig. 3) shows a typical layout of a minivan with a ramp at the rear.

Figure 1 *(Basic)*

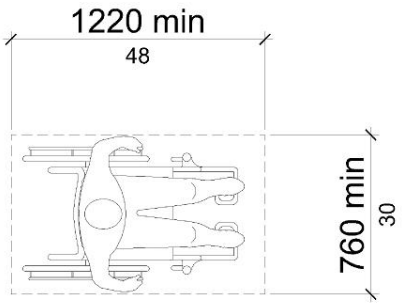


Figure 3 *(Front or rear entry)*

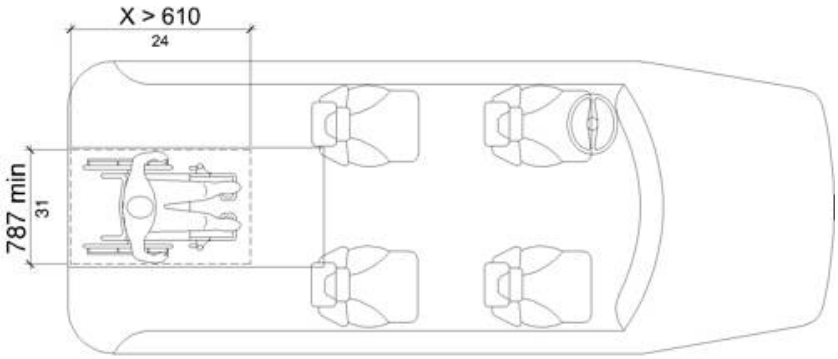
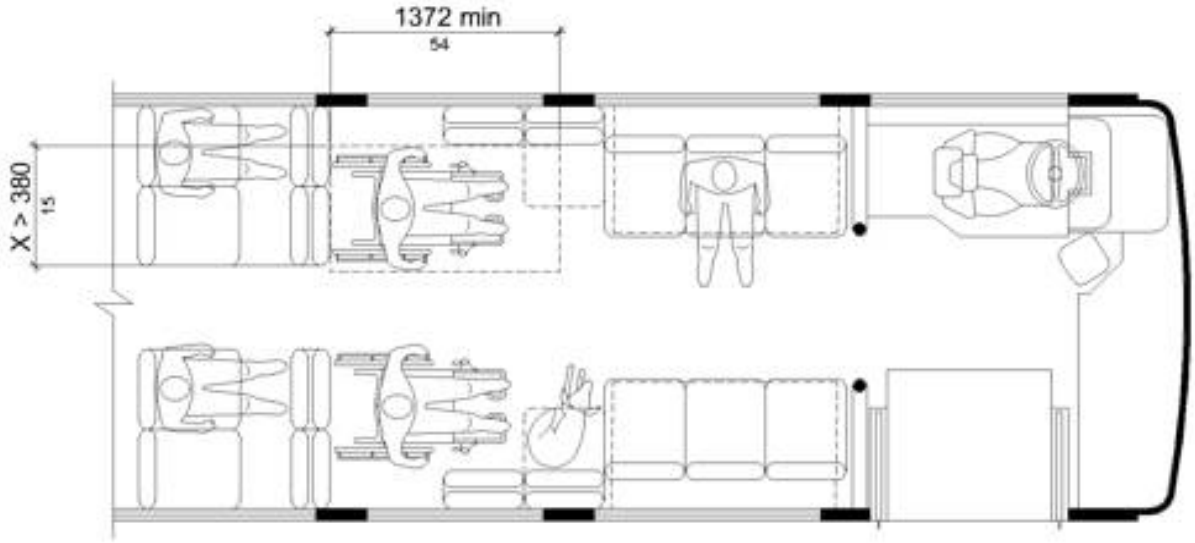


Figure 2 *(Side entry)*



Circulation path (aisle) width (now to be min. 34")

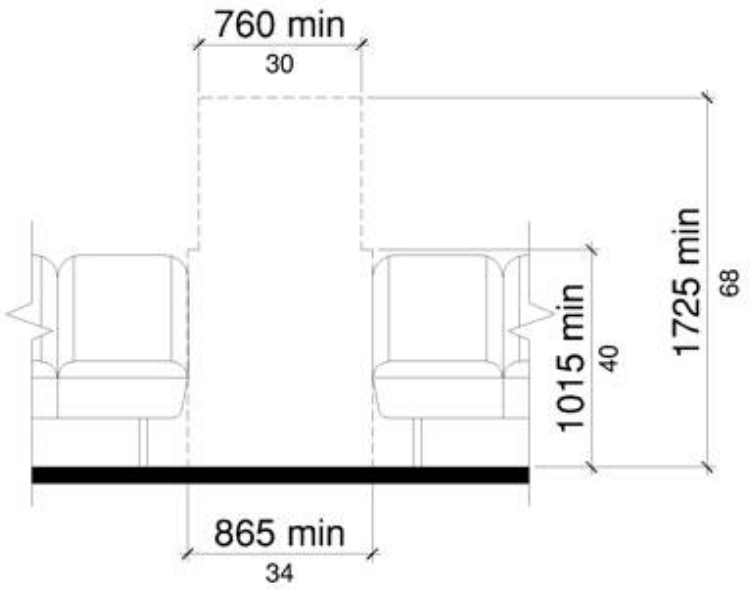
The existing ADA bus and van guidelines created a fair amount of confusion and uncertainty by not designating any particular dimensions for mobility devices to be able to access the wheelchair space. In an opening statement, completely separate from the wheelchair space section, it stated "All vehicles shall provide… sufficient clearances to permit a wheelchair or other mobility aid user to reach a securement location".

Since all vehicles had to accommodate mobility devices up to the 30 x 48 inch "common wheelchair" envelope, this meant that wheelchair spaces that were exactly 48 inches long (and sometimes slightly shorter) probably didn't provide "sufficient clearance" for some mobility devices. The analogy has been said that this was like trying to fit an 11-inch wide piece of paper into an 11-inch envelope.

The Access Board's new approach is to designate a minimum circulation width of 34 inches (Fig. 4). With the deletion of the "common wheelchair" definition in both the ADA provision of service regs (see "Service Accessibility" section below) and the proposed bus and van ADA accessibility guidelines ("ADAAG"; see below), vehicles must now accommodate mobility devices that can fit onto the lift or ramp and through the 34-inch (min.) wide pathways.

The 34-inch width must be maintained from the floor up to a height of 40 inches. Above 40 inches, the required minimum width decreases to 30 inches. In vehicles 22 feet long or less, the 30-inch width must be maintained to a height of at least 56 inches. In larger vehicles, it must be maintained up to at least 68 inches.

Figure 4 *(large vehicles)*



Deletion of "common wheelchair" definition

In keeping with the US DOT's deletion of the "common wheelchair" definition (see "Service Accessibility" section below), the Access Board is proposing to also eliminate this term in the section describing what securement devices must be able to secure:

Existing guidelines: "The securement system shall secure common wheelchairs and mobility aids…"

Proposal: "Wheelchair securement systems shall be capable of securing wheelchairs that can enter and maneuver within an accessible vehicle."

Ramp slope (now to be max. 1:6, or 17%)

The long-established maximum ramp slope of 1:4 (25%) to ground level was the best the vehicle industry could do in the earlier days of low-floor buses, but there was a lot of dissatisfaction with it. It usually worked well enough when the ramp was deployed to a normal-height curb, but traversing it from ground level ranged from difficult and scary to downright impossible. When at a curb, the vehicle would always be kneeled to allow the slope to be as gentle as possible.

The Access Board originally proposed an extreme change, to 1:8 (12.5%), but there were too many technical obstacles, so a compromise of 1:6 was settled upon for the NPRM. In fact, manufacturers began marketing ramps with slopes of 1:5-1:7 well in advance of the new rule, at least on big buses. However, there was a major catch – on large transit buses, part of the slope had to be within the bus vestibule, as opposed to entirely outside of the vehicle (folding section). This resulted in unanticipated usability and safety problems, due to the creation of a "dip" or "grade break" with the bus kneeled and the ramp deployed to a curb. Issues ranged from not being able to get up the steeper, inner section to tipping over backwards.

When the Access Board learned of this, it put the update on hold and re-opened the public comment period for this issue only. Meanwhile, manufacturers sought solutions, one of which was the creation of a moveable inner section so that the bus floor could be kept flat when deployed to curb level. Currently, there are three basic scenarios in use by manufacturers and transit agencies for large urban transit buses:

- Stay with the original, single-slope section (1:4 to ground) design (This will no longer be allowable after the proposed revision is adopted)
- Employ one of the new articulated interior slope models to allow selecting ramp configuration dependent on curb situation ("up" for curbs, "down" for going to roadway)
- Use a fixed-slope 1:6 ramp (newer ones have re-designed inner sections that alleviate some of the problems), and take care not to kneel when at a curb

Transit providers should be careful to understand the differences between the two types of 1:6 ramps (fixed-slope and moveable-slope) before ordering transit coaches with one or the other. This also applies to low-floor, body-on-chassis "cutaway" vehicles, which are increasingly being marketed as an alternative to traditional, lift-equipped vehicles (most low-floor cutaways and minivans are already offered with 1:6 ramps).

(Note that the design load requirement for lifts and ramps is not being changed, and will remain 600 lbs.)

Bridgeplates or ramps at station platforms (1:8, or 12.5%)

To address the emergence of mobility devices boarding buses from station platforms, as with Bus Rapid Transit (BRT), a new category is being added to the ADAAG. Ramps and bridgeplates shall have slopes not steeper than 1:8 (12.5%) when deployed to station platforms ("bridgeplates" are short ramps designed to bridge the gap between station platforms and vehicle entrances in more-or-less "level boarding" situations).

Wheelchair securement orientation

The proposal essentially keeps the elements of the existing guideline:

Proposal: "Wheelchair securement systems shall secure the wheelchair so that the occupant faces the front or rear of the vehicle. On vehicles more than 22 feet in length, at least one wheelchair securement system shall be front facing."

This is an item that could potentially be changed in the final rule, because a number of comments were received from wheelchair transportation safety researchers that only forward-facing securement should be allowed in smaller vehicles. This is based on the crash forces that can be expected in vehicles such as vans traveling at highway speeds.

Except for the new "passive compartmentalization" approach to rear facing securement (see section on rear facing below), securement manufacturers require their equipment to be used forward facing, and lap/shoulder belts are designed to function in that direction. But even though the guidelines have allowed rear facing in small vehicles, it has not been used other than in large urban transit buses, especially BRT vehicles (see section on rear facing below).

The proposal adds an "Advisory" that ***side facing securement is not permitted.*** This had to be inferred from the existing guideline, which said only that securement could be facing toward the front of the vehicle or toward the rear. The advisory fits with manufacturers' instructions, and responds to situations in which either passengers or vehicle operators were trying have mobility devices face sideways, including some where a long scooter would be secured sideways and the seat pivoted to have the occupant sit facing the front of the vehicle – not a good idea!

Revision of dimensions for rear-facing wheelchair spaces

The existing guideline is a curious one. It essentially requires a "head stop", which is a padded barrier, extending from 38 to 56 inches above the vehicle floor, 18 inches wide, laterally centered in back of the seated individual. This approach, which still requires the use of tie-downs and seat belts, has never really been used in the U.S. transit or paratransit industries. The Access Board apparently did some research, which it does not explain, to come up with a different version of this approach. The proposal contains these elements:

A ***forward excursion barrier*** shall be provided to prevent an occupied wheelchair from moving toward the front of the vehicle. The barrier, which is located at the back of the wheelchair, shall extend from the floor to a height of 24 inches minimum for the full width of the wheelchair space (Fig. 5).

The ***padded head rest*** is intended to reduce the possibility of whiplash in a sudden stop. It is positioned approximately in line with the plane of the wheelchair backrest, and the bottom edge of the head rest is positioned to be above the approximate height of the backrest. Many wheelchair users have backpacks on their wheelchairs. If the bottom edge of the padded head rest is below the top of the backrest, the head rest may encounter the backpack and prevent the wheelchair from being positioned close to the head rest.

The padded head rest (Fig. 6) shall be 10 inches wide minimum, and shall be centered on the wheelchair space. The lower edge shall be 38 inches minimum and 40 inches maximum above the vehicle floor, and the top edge shall be 56 inches minimum above the vehicle floor. The plane of the face of the padded head rest shall protrude into the wheelchair space 9 inches minimum and 12 inches maximum measured from the plane of the forward excursion barrier.

Figure 5 *(forward excursion barrier)*

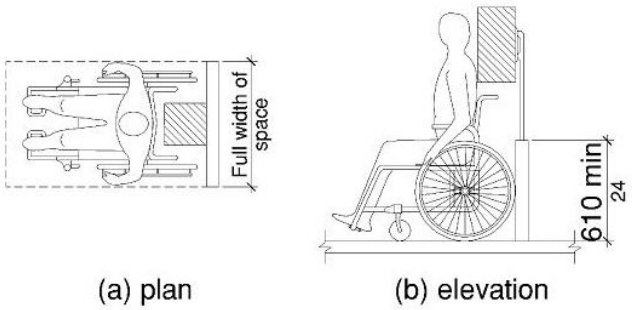
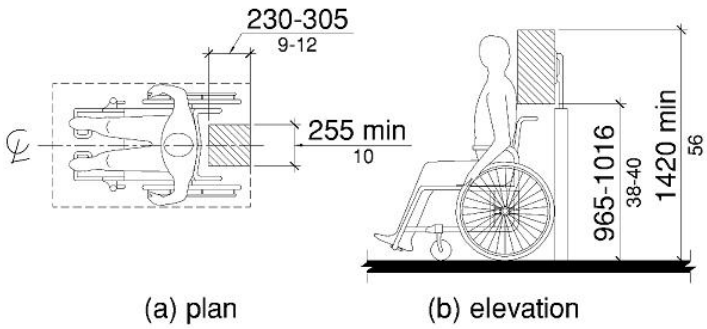


Figure 6 *(padded headrest)*



There is a possibility that this section could change in the final rule, because a number of comments were received that urged the Access Board to instead adopt the design commonly used in European and Canadian transit vehicles, which was recently codified into an international standard, ISO 10865-1 (supported in the U.S. by ANSI/RESNA, the committee for which, COWHAT, the author sits on).

In fact, several implementations of rear facing in the U.S. (mainly in BRT vehicles) have followed this approach, at least to more of an extent than they resemble the Access Board's proposal. The goal of the ISO model is to eliminate the need for traditional tie-downs and seat belts, with the structures surrounding the passenger providing protection from movement (although the best method of sideways tipping protection is yet to be determined – some designs use folding armrests, some use vertical stanchions, and a new automated product squeezes the sides of the mobility device). The concept is to give more independence to passengers and to speed boarding times.

Illustrations of the ISO model

Automated stop and route announcement systems (for 100 or more buses)

While not related to mobility device access, the other important change in the bus & van ADAAG is the requirement for automated stop and route announcement systems. The proposal states:

> "Public entities that operate 100 or more buses in annual maximum service in fixed route systems, as reported in the National Transit Database, shall provide automated stop and route announcements on buses that are more than 22 feet in length.
>
> **Automated stop announcements** shall be audible and visible within the vehicle. Visible announcements shall be a sign (complying with technical requirements) at the front of the vehicle. Where rear facing wheelchair securement systems are provided, an additional sign shall be located within view of passengers facing the rear of the vehicle. **Automated route announcements** shall be audible at boarding and alighting areas."

The Access Board found that only seven transit systems operating 100 or more buses did not already have automated announcements.

Service Accessibility:

- 49 CFR Sec. 37.165: Lift and securement use; and Sec. 37.173: Training requirements
- "Interpretive" Appendix D to Part 37 - Background as to purpose of the regulations
- US DOT Disability Law Guidance "Questions and Answers Concerning Wheelchairs and Bus and Rail Service" *(www.FTA.gov/ Civil Rights & Accessibility →Americans with Disabilities Act →ADA Technical Assistance → DOT Disability Law Guidance)*
- 49 CFR Parts 37 and 38: Transportation for Individuals With Disabilities at Intercity, Commuter, and High Speed Passenger Railroad Station Platforms; **Miscellaneous Amendments** (final rule issued September 19, 2011)

The September 2011 ADA amendments make some significant changes in definitions and procedural requirements related to accommodating wheelchair users. The previous concept of the *"common wheelchair"* size and weight envelope (30 x 48 inches, 600 lbs. occupied) was eliminated. Instead, the requirement is now to accommodate all wheelchairs at weights up to the vehicle's lift or ramp rating (at minimum) and that can maneuver into the vehicle and wheelchair securement area. The concept of safety is also now addressed with a new definition of *"direct threat"*, which means "a significant risk to the health or safety of others that cannot be eliminated by a modification of policies, practices, procedures, or by the provision of auxiliary aids or services".

Note: The ADA does NOT require specific performance, such as a minimum number of tie-down points. Nor does it specify a particular level of safety for wheelchair users. Rather, the guidelines are intended to make wheelchairs comparable to regular vehicle seats, which are solidly attached to the floor. The principle is stated as a "securement system to ensure that the wheelchair remains within the securement area." However, beyond the civil rights perspective of ADA, there are many safety and liability issues to be concerned about.

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INDUSTRY STANDARDS

Standards for Transportable Wheelchairs

Programs such as wheelchair markings and tether straps are increasingly used by transit agencies to deal with difficult-to-secure wheelchairs. Recent improvements in tie-down products have also helped. However, markings and tether straps are not nearly as good as having proper tie-down points built in or attached to wheelchairs. The use of tether straps should be considered a "stopgap" measure, until users are able to obtain wheelchairs and scooters with integral (or manufacturer-installed) tie-down points.

Standard No. WC19: "Wheelchairs Used as Seats in Motor Vehicles" was approved by the American National Standards Institute (ANSI) in 2000, as a voluntary U.S. national standard. It specifies strength and geometric requirements for at least 4 securement points and seat/shoulder belt anchorage points that can withstand crash forces, as well as accessible geometry that can receive a securement hook or buckle. A brochure describing the standard and securement principles, entitled "RideSafe", is available at www.travelsafer.org or http://wc-transportation-safety.umtri.umich.edu > Ride Safe Brochure.

< Modern power chair with WC19 attachment points

Detail of WC-19 "Transit Option" loop and labeling >

So far, only a limited number of wheelchair models are available with the securement "loops" specified by WC19, dubbed the "Transit Option" by some wheelchair manufacturers. A listing of wheelchair models that have been designed and tested to meet WC-19 is available at http://wc-transportation-safety.umtri.umich.edu > WC19.

< WC 18 & 19 promotional logo

A slight majority of WC19-compliant models are lightweight or specialized manual chairs. A smaller proportion is high-end power "rehab" types that are quite expensive. Meanwhile, traditional "standard" manual wheelchairs, scooters, and "consumer" power models (with "van" type seats) are not being designed and equipped to meet WC19.

As of April 2011, a total of 148 wheelchair models were listed with WC19 available, usually as an extra-cost option of $200-$450 (retail). 113 models were either pediatric (manual & power) or lightweight "transport" manual models, the latter having four small wheels that require pushing by an attendant. WC19 was available on 24 adult self-propelled manual models, from 10 manufacturers. 16 adult power wheelchairs are offered with it, all from the three major US wheelchair manufacturers. This means there are several hundred, and possibly over 1,000 non-WC19 wheelchair and scooter models being sold of the type most likely to be used on public transportation. Adding this to the number of older, non-Wc19 wheelchairs in already in use illustrates the reason for the small number of "transit safe" wheelchairs on the road.

Acceptance of WC19 in the marketplace has been slow, due to the voluntary nature of the standard, the cost of development and testing (crashworthiness is an important factor), and lack of awareness and therefore demand from consumers. Another issue is the lack of awareness and acceptance by health care prescribers and funders. An example is the Medicare funding limitation for wheelchairs as "primarily for in-home" use only. In general, the federal government has shied away from this issue, and meaningful regulation does not seem to be forthcoming anytime soon.

Standards for Vehicle Securement Equipment

In addition to the ADA vehicle specifications, since 1996 there has been a voluntary industry standard for vehicle-mounted securement systems: Society of Automotive Engineers (SAE) Recommended Practice J2249: Wheelchair Tie-down and Occupant Restraints (WTORS). This existing standard was recently incorporated as **Part 18** of ANSI/RESNA Volume 4: Wheelchairs and Transportation, which will locate it adjacent to WC19 (Part 19) and related wheelchair standards. (See http://wc-transportation-safety.umtri.umich.edu > WC18).

SAE J2249 (WC18) covers WTORS sold as after-market equipment, since WTORS are not covered by OEM safety requirements of the Federal Motor Vehicle Safety Standards (FMVSS). A few sections of WC18 apply to specific types of tie-downs, such as docking devices or four-point strap systems only, but most of it applies to systems that use all types of tie-down devices, as long as they are used with forward-facing wheelchairs. Note that it does NOT allow attachment to mobility device WHEELS -- therefore, compliant equipment tends to be strap- and docking-types, not the older wheel clamp styles, which are technically still allowable under the ADA.

Based on WC19-compliant wheelchairs with an optional wheelchair-anchored pelvic-belt, WTORS must now withstand the additional occupant restraint loads. Beginning December 2015, impact tests must be conducted for tie-downs with both vehicle-anchored and wheelchair-mounted pelvic-belts. Wheelchair-mounted belts offer the promise of better fit and less personal contact/intrusion by vehicle operators.

A stronger tie-down is needed to meet the crash test with wheelchair-mounted pelvic belt (which must connect with vehicle-mounted shoulder belt). The new, stronger tie-downs are now being marketed by manufacturers, alongside tie-downs meeting the older standard. However, the adoption of wheelchair-mounted lap belts is still optional to wheelchair buyers (on WC19 chairs), and it remains to be seen how it will be accepted in the wheelchair marketplace. Meanwhile, vehicle-mounted lap belts are still required on all vehicles.

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WHEELCHAIR MARKING AND TETHER STRAPS

The first component is "markings" for appropriate attachment points on customers' chairs -- with color-coded tape, stickers, wire ties, or some other identifier. If there is no good place for attaching tie-down belts or hooks, a nylon or polyester webbing "tether strap" can be installed on the mobility device. The following steps can be useful in developing a comprehensive approach:

Program Components and Responsibilities

The first task is to define objectives and get buy-in from staff and customers, especially wheelchair users and disability advisory or advocacy groups. Having everyone understand the reasons for the program will help keep it on track. Local consumers can help pilot the program and evaluate choices that must be made.

A consideration is whether to offer the program free of charge, or to require a fee. Systems that offer it at no charge have found that customers are more eager to participate, and that the cost is minimal compared to the many benefits:

- Customer comfort
- Speedier boarding
- Operating personnel safety and convenience
- Minimization of accidents

Venues for installing markings and straps

A key decision is where, and by whom, markings and straps will be installed. The best choice is usually to offer markings and tether straps as a "permanent", one-time installation by trained staff in an unhurried environment. This approach can be called the "centralized" method, and allows time for evaluating the best tie-down attachment points. It also allows for determining whether markings, straps, or both, are needed on individual mobility devices. It is helped by "trying on" the actual tie-down equipment used in transit and paratransit fleets. In some cases, markings may be needed on one end of the wheelchair, and straps on the other end.

The centralized method also enhances working with customers to identify any problems with their mobility device being accommodated on vehicles. It also gives a chance to identify any issues that may need to be addressed by qualified mobility device technicians before markings or straps can be safely installed. Another benefit is the ability to record and document what is installed, and to interact with customers regarding their general riding experiences.

Offering convenient locations for customers to visit for installations is important. Some customers can't or won't travel far to participate. Transit agencies may offer the program via appointments throughout the community, at either their offices or at transit centers, as well as at public facilities like community centers or disability service organizations. In some cases, a local disability-oriented organization may wish to actually perform installations, either as a public service, or as a contractor to the transit system. However, liability concerns can deter agencies or firms other than the transit system from wanting to be responsible.

Alternatives to the centralized model are: a) installation by customers themselves, or b) by vehicle operators. Some transit agencies distribute marking media and/or tether straps to customers for self-installation. Others provide straps as equipment for vehicle operators to carry. While these approaches may require less staff and facility commitment, they do not allow for as much control and documentation, and consumers are often not familiar enough with proper securement mechanics.

The "onboard" method typically uses only tether straps, on an as-needed basis. It precludes the "pre-marking" approach, which is often preferable to using tether straps, since direct attachment of tie-downs is always best. This is because adding to the effective securement length of wheelchairs and introducing more flexibility when it's not necessary can result in less-than-desirable tie-down mechanics, and excess movement. It also can be time-consuming and/or physically difficult to install straps properly, which defeats the purpose of making securement faster and easier for vehicle operators.

On-board deployment may be more feasible in smaller bus systems and on paratransit, where customers and their mobility devices are well known to vehicle operators. It is also sometimes used as a back-up, where a centralized program is the primary mode.

Oversight and coordination

Whichever approach is selected, it's important for legal and risk management staff to understand the program and give their blessing prior to implementation. Key to discuss is the overall liability the agency will have with the program, as compared to without it.

The purpose of such a program is to reduce the number of incidents and accidents that may occur with unsecured or under-secured mobility devices. Tip-overs and other hazardous movement by wheelchairs (especially scooters, either 3- or 4-wheeled) during normal operations are the most common types of incidents. Tether straps can also reduce injuries to vehicle operators by minimizing the physical difficulty of attaching tie-downs.

The benefit of preventing catastrophic accidents almost always outweighs perceived liability created by the application of markings or tether straps (CAVEAT: as long as installation is done CORRECTLY, and vehicle variations are taken into account.) The fact that tie-down manufacturers offer tether straps as aids in using their products is one argument in favor of adopting a strong program. Another argument is very successful implementation in various locations throughout the country. Agencies contemplating their own program can easily learn from others that have already done it.

Taking the liability aspect to its logical conclusion, the implementing agency should maintain as much control and oversight as possible. Installation of markings and straps should be done by qualified staff who understand both wheelchairs and how tie-downs work (in "real world" vehicles, not just the classroom). Also key are establishing consistent training and procedures, documentation of what is installed, and communication of rules and responsibilities to customers (such as notifying the agency when markings/straps are damaged or lost), along with testing sample installations on actual vehicles.

Another important issue is coordination with adjacent agencies (or professionals) serving customers who receive markings or tether straps. Travel trainers, either in-house or at outside agencies, should be aware of and support the program. If a fixed-route transit system or department sponsors the program, it should coordinate with paratransit providers that may serve the same customers. Likewise, nearby transit systems should be aware of how to treat wheelchairs with the "home" system's markings and tethers. Nearby transit agencies should also be encouraged to coordinate features of markings and tether straps they may implement themselves (colors, marking materials, etc.)

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Program Materials and Resources

Marking and tether strap choices

The first choices to be made are for the style, sizes, and colors of markings and straps to be used. Marking can be done with color-coded tape, stickers, plastic wire ties, or paint. Considerations include ease of installation and removal, acceptance by customers, and durability. Vinyl tape is available in various colors, is easy to apply, and does not damage the surface of the wheelchair.

Two colors of markings can be used, the first being for the basic marking that is coordinated with the color of tether straps. The second marking color can be used for placing underneath where "permanent" type tether straps are installed. This enables tethers to be re-installed properly when removed for cleaning or replacement, and so that locations marked thusly are not confused with the basic markings for "where to attach tie-downs".

Tether straps are marketed by most of the major vehicle securement equipment manufacturers. They are sold with names such as "Webbing Loop" (www.qstraint.com), "Secure Loop" (www.safehaven-usa.com), and "Quick Strap" (www.sure-lok.com). Another generic name is "safety strap", and the straps are also sometimes called "Stokes Straps", after Bill Stokes, a disability advocate and consultant who helped popularize the concept in the Phoenix area. Multiple lengths of tether straps are often needed, due to wide variations in wheelchair frame sizes and configurations. This is especially important when the straps will be left on wheelchairs "permanently".

The protruding loop of the strap should be kept as short as needed to allow for attaching tie-downs. This is important for a number of reasons. First, excess length and flexibility can contribute to less secure tie-downs (for this same reason, markings should always be tried first, and tether straps used only when markings aren't feasible). Second, straps that are too long can get caught on other parts of the wheelchair or other objects, or can drag on the ground and become damaged.

For comparison, attachment points on WC19 compliant wheelchairs are about 2.5 inches long and 1 inch wide. This size allows for both hooks and the types of buckles used on older tie-down systems. Tether straps are usually best kept to a usable length of around 3 inches (except for sometimes on central seat pillars, which may require slightly longer ones to facilitate access).

Some styles of straps have features that help keep them in place when used on a "permanent" basis. Colors can be chosen to promote visibility, and lighter/brighter colors can make them easier to see and use. The straps sold by tie-down manufacturers are tested to appropriate standards, specifically SAE J2249. Using traps that are not certified could create additional liability.

< Variety of tether strap styles, lengths, and colors

Other tools and aids

In addition to a supply of marking materials and tether straps, installers should have examples of each of the major types of tie-downs used in local fleets (or at least the smallest, "most restrictive" example). These are used to determine if the mobility device can accept tie-downs. If they can, markings can be applied. This includes marking any WC19-style attachment loops that may be built into the wheelchair. The reason for this is so markings are consistent on all wheelchairs, and so they're easily visible (WC19-compliant labeling is often small, and not visible from various angles in actual on-board environments).

< Older power wheelchair with markings only (yellow tape)

If tie-downs cannot be properly attached to the mobility device, tether straps can be used. It's important to test the various types and models of tie-downs customers may encounter, because small variations in hook/buckle shapes or sizes can affect attachment capabilities.

< Wheelchair with tether straps installed

A digital camera can be used to take photos of the final installation for filing. Standardized forms should be developed for recording all pertinent information. Other useful items are scissors, cleaning supplies for preparing marking locations, a kneeling pad or cushion (*this is a physically demanding job - installation can require getting down on the floor!*), a tape measure for checking securement dimensions, flashlight, and small hand tools for working tethers into tight spaces.

Training and Education

Training is vitally important for any staff members who will perform installation of markings or tether straps. Staff selected should have familiarity with vehicle operations and accessibility, and should have good customer service skills. Staff should be assigned to this task on an ongoing basis, since the "experience base" of working with the variety of mobility devices will build CUMULATIVELY. It is best to have the job

done by a small number of people who can confer with each other, for consistency and identifying issues.

Training can be done with the same wheelchairs used for securement training for vehicle operators (as long as at least three or four of the basic types are included). Even better is a visit to a local wheelchair dealer for practicing with the wide variety of wheelchair shapes and sizes available today. This approach also allows the dealer to explain wheelchair and scooter construction features, while at the same time themselves learning about the transit agency's program and overall accessibility.

Education can be done via brochures, flyers, posters, press releases, website information, and vehicle postings. Promotional and educational materials can be targeted to various audiences, such as customers, vehicle operators and supervisors, and community agencies.