

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

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Regulations and standards regarding the accessibility of passenger transportation services have undergone a series of evolutionary changes over the past several years. This includes government standards related to the Americans with Disabilities Act (ADA) and voluntary industry standards for both wheelchairs and wheelchair securement equipment.

Meanwhile, 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.

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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

Among a broad variety of accessibility topics, the ADA requires vehicles to be accessible to mobility device users, and for services to ensure that passengers can take advantage of those features. The following are key provisions related to mobility device securement:

Vehicle Accessibility for Buses and Vans

The existing regulation is 49 CFR PART 38: ADA Accessibility Specifications for Transportation Vehicles; Subpart B, Buses, Vans and Systems. ([transit.dot.gov](http://www.transportation.gov) → Civil Rights → ADA → Regulations → Part 38)

Procedural note: The US Architectural and Transportation Barriers Compliance Board (“Access Board”) is the agency responsible for developing ADA Accessibility Guidelines (ADAAG), as codified at 36 CFR Part 1192. Meanwhile, the “implementing regulations” of the US DOT are shown at 49 CFR Part 38, with the essential content of the Access Board vehicle guidelines included as an appendix – in effect, the US DOT “adopts” the ADAAG as mandatory standards.

The older (pre--updated) Part 1192 (Access Board) document and the existing Part 38 (DOT) document were identical to each other, except for minor editorial differences and the number prefix, after which the numbering systems were parallel. This is no longer the case, as the ADAAG update (see below) was designed with a completely new numbering system.

Meanwhile, DOT has **not** yet adopted the new ADAAG, so the numbering systems are no longer parallel. Transit agencies, manufacturers, and dealers should always consult the Part 38



specifications for the current ADA requirements. But it is also a good idea to be aware of the updated ADAAG, which will become the enforceable requirement once it is adopted by DOT (however, there is no stated timeline for this adoption as a regulation). Some accessibility equipment and products, such as certain models of bus ramps, already comply with the new ADAAG.

The Access Board issued a final rule on the updated ADAAG for “non-rail vehicles” on December 14, 2016, and it was effective on January 13, 2017. “Non-rail vehicles” include buses, vans, and over-the-road-buses (OTRBs, also known as inter-city motor coaches). The ADAAG can be found at:

access-board.gov → *Transportation* → *Transportation vehicles* → *Updated Final (ADA Accessibility) Guidelines for Buses and Vans*

Important note: The Access Board website menu item called “ADAAG for Transportation Vehicles” is **not** a link to the actual ADAAG, but rather to the DOT Part 38 specifications, as described above.

The Access Board spent ten years working on the first-ever update to ADAAG for buses and vans. The process of revising the guidelines began in 2007, when the first of two “draft” guidelines were issued. Then a notice of proposed rulemaking (NPRM) was issued on July 26, 2010 (the ADA anniversary date). Comments from the transit industry, disability community, and the public were collected in late 2010. Issuance of the final rule, which then took six years, was delayed by a number of factors, including staff changeover at the Access Board, a re-opening of the comment period for the topic of ramp slope in 2012, and federal administrative oversight review.

The updated (2016) Non-Rail Vehicle Guidelines use a new organizational approach that is modelled after the Access Board’s accessibility guidelines for buildings and facilities in 36 CFR Part 1191. The new format organizes the revised scoping and technical guidelines for buses, OTRBs, and vans, into seven chapters. Most of the revisions in the final rule are “editorial” only, and restate current requirements in plain terms that are more clear and easier to understand.

The new ADAAG also coordinates more of the requirements across all types of vehicles (i.e., buses, OTRBs, and vans), so that requirements between different types of vehicles are generally similar. The aim is to make the guidelines easier to understand and apply, particularly for public transit agencies that frequently operate different types of non-rail vehicles.

The following is a review of the major changes made in the final rule, along with a listing of items that had been proposed, but were **not** adopted. Readers are encouraged to consult the updated ADAAG for specific details, as well as for some minor changes not covered here.

Items changed or newly adopted

- Maximum ramp slope
- Deletion of “common wheelchair” terminology
- Wheelchair spaces must now be identified with the International Symbol of Accessibility (ISA)
- Vehicle doorways with ramps or lifts must be identified with the ISA, on the exterior
- Wheelchair securement systems – reduced the minimum “design load” (strength) in large vehicles
- New accessibility requirements for OTRBs
- Rear-facing wheelchair spaces may be used only in large vehicles, not in vans or mini-buses
- Design of padded barrier in rear-facing wheelchair spaces
- New accessibility requirements for “level boarding” bus systems (operation at BRT-style station platforms, with “bridgeplates” instead of ramps)



- New requirement for automated announcement systems on large fixed route buses
- Change in definition of “large” vehicles – from 22+ ft. to 25+ ft. “Small” vehicles are 25 ft. or less (But note that in some instances, the ADAAG uses gross vehicle weight rating – GVWR – to differentiate between larger and smaller vehicles.)
- New definition of “operable part”
- Changes in locational spacing requirements for operable parts

Proposed items NOT adopted

- New minimum clear width for accessible circulation paths
- New maneuvering clearances at wheelchair spaces
- “Advisory” statement that side-facing use of wheelchair securement spaces is not permitted

Discussion of Items changed or newly adopted in 2016 ADAAG update

Ramp slope

Under the new (2016) ADAAG, the maximum slope allowed for vehicle ramps, when deployed to ground level, is now 1:6, or 17%. The previous, 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 a more 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 in 2012, it put the update of the ADAAG 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 (under the original, 1991 ADAAG), 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 updated ADAAG is adopted by FTA as a regulation)
- 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 was not changed, and remains 600 lbs.)

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 eliminated this term from the non-rail vehicle guidelines. The following is a review of the evolution of this concept within the non-rail vehicle ADAAG:

- *Original (1991) ADAAG:* “The securement system shall secure **common wheelchairs** and mobility aids...”
- *2010 NPRM proposal:* “Wheelchair securement systems shall be capable of securing wheelchairs that can enter and maneuver within an accessible vehicle.”
- *Updated (2016) ADAAG:* No mention is made of what securement systems must secure; the use of securement equipment is evidently assumed to be self-explanatory

Wheelchair securement systems

In larger buses (GVWR of 30,000 lbs. or more), the new rule reduces from 4,000 lbs. to 2,000 lbs. the minimum force that wheelchair securement systems must be designed to restrain in the forward longitudinal direction. This revision was made in light of research showing that a lower design force would be sufficient to accommodate force generated on wheelchairs and their occupants under common conditions (e.g., maximum braking, maximum acceleration, frontal collision).

This change does not necessarily impact the sale and use of existing styles of wheelchair tie-downs, which by their nature are designed to be “universal”, meaning that they can be used in any size vehicle. The revised design force would potentially spur greater innovation in wheelchair securement systems (which is an area in need of new approaches), but without sacrificing safety, given that the 2,000-pound specification is based on findings from scientific transportation studies. Potential new approaches to securement will likely be of types other than the traditional, cargo hold-down-type “tie-down”.

The existing standard for smaller vehicles was not affected (5,000 lbs. of securement system strength).

Identification of wheelchair spaces

This has impact primarily on purpose-built fixed-route buses. The new requirement to use the International Symbol of Accessibility (ISA – see note below for details) to designate wheelchair spaces is a part-way solution to better ensure that wheelchair users will be able to board crowded buses.

Previously, the standard was merely that “Each securement location shall have a sign designating it as such”. Many such signs were text only. The old rule was under the heading “Priority Seating”. The combination of this placement in the text and generally vague wording meant that wheelchair spaces and “priority” seating for disabled (and senior) passengers were often lumped together, in practice.

This situation was exacerbated with the advent of low-floor buses, since the once-separate aisle-facing seating over the front wheel housings was no longer available as the most likely place for disabled and senior “priority” seats. The problem created was that wheelchair spaces and priority seating now occupied the same location, with folding seats (usually aisle-facing) over the wheelchair spaces being the closest seats to the front door of the vehicle. The rules, old and new, also required priority seating signs at the forward-



facing seat nearest the doorway. In some bus seating layouts, the first forward-facing seats were folding seats over the wheelchair space.

The significance of all this is that more and more conflicts began to arise on urban transit buses, over who had the right to the wheelchair spaces. Passengers with disabilities who took a seat in the wheelchair area would sometimes balk at moving from them, insisting that they had the right to stay there, even when a wheelchair user attempted to board (which is technically true, under the ADA “ask, don’t tell” convention of vehicle operators asking passengers to make way for wheelchair users).

Ostensibly, the new requirement for the ISA at wheelchair spaces is meant to better differentiate such locations from “priority” seating. However, the new ADAAG does not say that the ISA **shouldn’t** also be used at “regular” priority seating, which some transit agencies actually do.

Some large transit agencies, such as in Los Angeles and San Francisco, have responded by doing three things:

- Using different pictograms in conjunction with priority seating “reserved” signs. Items variously depicted are canes, crutches, and service animals, either in combination with the ISA or by themselves. These pictograms are placed directly on the seats or woven into the upholstery material, and are complements to the text signage that instructs passengers to yield the seats to those who need them due to disability, age, pregnancy, medical condition, etc.



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- Completely separating priority seating from wheelchair spaces. In this case, the ISA is NOT used at the priority seating. Note that this approach can result in most, if not all, of the seating spaces ahead of the second door of a bus being reserved for either wheelchair users or other passengers with disabilities (and seniors, where local practice dictates).
- Designating certain folding seats as places for walkers, shopping carts, and/or baby strollers. The newer style of individual folding seats makes this more feasible and convenient.

LA Metro →



Note on International Symbol of Accessibility (ISA)

There has been a controversy about the use of a new symbol in place of the long-standing “stick figure seated in a wheelchair” ISA pictogram. The new version is described as being “dynamic”, in that its angled representation imparts motion, and therefore more independent ability on the part of people with disabilities. It may be a worthy goal, but it has engendered passionate opposition from some sectors of the disabled community and related parties. Since actual use of the new symbol has gone so far as some state and local governments officially adopting it, the controversy has become something of a federal issue.

In response, the Access Board issued special guidance on March 27, 2017. The guidance says, in summary:

“Use of a symbol other than the ISA is permitted under the ADA standards only if it satisfies the equivalent facilitation provision and under the Architectural Barriers Act (ABA) standards only if a waiver or modification is issued. Otherwise, where the ADA or ABA Standards require accessible spaces or elements to be identified by the ISA, the ISA must be used even where a state or local code or regulation specifies a different symbol.”

Reading between the lines, a transit agency or bus manufacturer would have to apply to the FTA for “equivalent facilitation”; and the FTA, along with other federal agencies, is not likely to grant it.



YES



NO

Rear-facing wheelchair spaces prohibited in small vehicles

The original (1991) guideline required that at least one wheelchair location be forward-facing. Additional spaces could be either forward or rearward facing, with a padded barrier, in all types of vehicles. Based on comments from wheelchair transportation safety researchers, the new rule now allows rear-facing spaces only on large buses designed for use by both seated and standing passengers, provided that at least one wheelchair securement system is front facing.

Rear-facing wheelchair space components

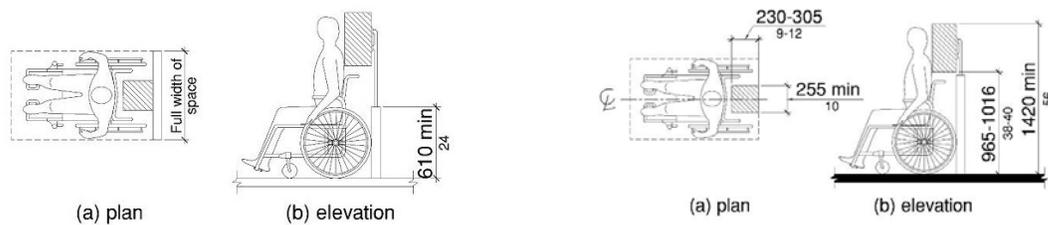
The Access Board retained the original requirement for “forward excursion barriers” (FEBs) for rear-facing wheelchair securement systems, but modified the technical requirements for such barriers in response to commenters’ concerns about the new, untested specifications in the proposed rule. The commenters were wheelchair transportation safety researchers and transit industry professionals who interface with them.

The key concern was that the proposed design requirement would conflict with the already-adopted international standard (rear-facing systems are very common in Canada and Europe). In recognition of this, the updated ADAAG requires rear-facing FEBs to comply with the applicable standard by the International Organization for Standardization (ISO).



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 anti-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.

The ISO standard is basically supported in the U.S. by RESNA (standards body for wheelchairs under ANSI), the advisory body for which, the Committee on Wheelchairs and Transportation (COWHAT), the author sits on. (However, there is a possibility that the now-proposed parallel US standard will have some slight technical differences with the ISO standard.)



2010 ADAAG NPRM design requirements



ISO-style rear-facing FEBs

New accessibility requirements for over-the-road-buses (OTRBs)

Under the new (2016) Non-Rail Vehicle Guidelines, OTRBs operating in fixed route service will be newly required to satisfy the following accessibility requirements:

- Signs for accessible seating and doorways
- Public address systems
- Stop request systems
- Provision of exterior destination or route signs on both the front and boarding sides of vehicles, when exterior signage is provided (this means it can't be front-only)

These requirements are new only as applied to OTRBs; buses and vans have been covered by similar requirements since 1991. Note that the US DOT ADA regulations require that purchases of ALL fixed-route



buses, including OTRBs, to be for accessible vehicles, whether they be new, re-manufactured, or used (the regulations do not require retrofitting of vehicles already in a fleet). The only exceptions are for:

- Used vehicles, provided that the buyer has made a “demonstrated” (i.e. well-documented) good-faith effort to obtain an accessible vehicle, and is unable to do so
- Remanufacture of existing vehicles, when an engineering analysis demonstrates that including the required accessibility features would have a significant adverse effect on the structural integrity of the vehicle
- OTRBs, under the current DOT regulations, must meet only certain ADAAG requirements, including mobility aid (wheelchair) accessibility comparable to the regular bus and van requirements. This means that when the DOT adopts the new ADAAG as a regulation, all OTRBs will also have to include the four items listed above in order to be considered accessible.

Bridgeplates or ramps at station platforms

To address the emergence of mobility devices boarding buses from station platforms, as with Bus Rapid Transit (BRT), a new category was 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). Bridgeplates are **required** anytime the gap between the platform and vehicle floor is greater than 2 inches horizontally, or 5/8 inch vertically.

Automated announcement systems

“Large transit entities” (100 or more peak fixed route vehicles) are now required to provide automated stop and route announcement systems on all large vehicles (over 25 ft.) operating in fixed route bus service that stop at multiple designated stops. Automated announcement systems must have both audible and visible components.

Operable parts

The new definition describes these as any component of a device or system used to insert or withdraw objects, or to activate, deactivate, adjust, or connect to the device or system. Operable parts include, but are not limited to, buttons, levers, knobs, smart card targets, coin and card slots, pull-cords, jacks, data ports, electrical outlets, and touchscreens.

Any and all operable parts are now to be located between 24 and 48 inches above the vehicle floor. The original (1991) ADAAG had specified that the stop request control in wheelchair spaces must be at least 15 inches above the floor, which was effectively an unusable location for many passengers with wheelchairs. The updated guidelines also add a new requirement that wheelchair space controls are to be located from 24 to 36 inches from the back of the space, measured horizontally.

Items proposed in 2010 NPRM that were NOT adopted

Wheelchair space minimum size

Since all vehicles, under the original (1991) ADAAG, 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) sometimes didn’t provide “sufficient clearance” (see next section) 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.

Over the course of developing the update to the ADAAG, the Access Board attempted to clarify the meaning of “sufficient clearances” by proposing specific dimensions for the clear width of circulation paths and maneuvering clearances at wheelchair spaces, as well as more clearly specifying the obligation to ensure that features along circulation paths—particularly in the front vestibule of buses (where stanchions or fare collection devices tend to be located)—do not interfere with the maneuvering of wheelchairs or other mobility devices.

The 2010 ADAAG proposal split the guideline into 3 different required sizes, as compared to the existing single minimum of 30 x 48 inches. Two new sets of dimensions were based on the orientation of the wheelchair space in relation to other interior features of the vehicle:

- Unconstrained spaces: 30 x 48”
- Side entry (“parallel parking” common on large fixed-route buses): 30 x 54” (6 additional inches of length clearance space)
- Constrained front or rear entry (applicable to rear-ramp minivans): 31 x 48” (1 additional inch of width clearance space)

After careful consideration of commenters’ views on the NPRM, the Access Board determined that **adopting specific measurements for additional clearances at wheelchair spaces was not advisable for the updated ADAAG**. Therefore, the original (1991) measurements of minimum 30 x 48 inches remain in effect in the adopted new (2016) ADAAG. The Board looks to ongoing research to help inform future rulemaking efforts.

This does not mean, however, that transit agencies should look merely to purchase vehicles with 30 x 48” wheelchair spaces. The conundrum with this, vis-à-vis larger and larger wheelchairs and scooters, is that besides wheelchair structures themselves, the biggest challenge to vehicle operators in securing them is lack of adequate space. Remember that, under DOT’s rules for accessible service, any mobility device that can fit on the lift or ramp and maneuver into the wheelchair space must be allowed to board.

Spaces of approximately 48 inches in length are clearly inadequate in many instances. A good rule of thumb is to start with 52 to 54 inches as the minimum length – the longer, the better, up to a maximum of about 60 inches. There should be enough room for the wheelchair user to stop partway into the space, so the vehicle operator can attach the rear tie-downs before the wheelchair is backed all the way into the space. Otherwise, the operator may have to bend and reach in an unsafe and uncomfortable way to attach rear tie-downs.

Where “horizontal” floor tracks (perpendicular to vehicle side walls) are used, as is typical in body-on-chassis minibuses (“cutaways”), the best approach is to provide an extra track at the front of the space (for a total of three). This gives flexibility in properly accommodating the range of possible mobility devices, from small to large.

Horizontal tracks that are too close together can result in improper tie-down geometry, and sometimes, in inability to tension the tie-downs adequately. Transit agencies should not fall prey to vehicle floorplans that offer the maximum number of wheelchair spaces, which may look good on paper, but which in practice can be quite problematic when dealing with multiple wheelchairs at the same time. The best approach is often to get “longitudinal” (running front-to-rear) sets of floor tracks, which give unlimited flexibility in fore-and-aft placement of tie-downs.

Circulation path (aisle) width measurement

The original (1991) ADAAG 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 states “All vehicles shall provide... sufficient clearances to permit a wheelchair or other mobility aid user to reach a securement location”.

Over the course of developing the update to the ADAAG, the Access Board attempted to clarify the meaning of “sufficient clearances” by proposing specific dimensions for the clear width of circulation paths and maneuvering clearances at wheelchair spaces, as well as more clearly specifying the obligation to ensure that features along circulation paths—particularly in the front vestibule of buses (where stanchions or fare collection devices tend to be located)—do not interfere with the maneuvering of wheelchairs or other mobility devices.

In the 2007 Draft Revised Guidelines, the Board proposed a minimum clear width of circulation paths of 36 inches, as well as additional maneuvering clearances of 6 inches (for front or rear entry wheelchair spaces) or 12 inches (for side entry wheelchair spaces) when wheelchair spaces are confined on three sides. The 2007 draft also proposed guidelines for clearances at turns (such as the turn needed at the front of a bus) along circulation paths.

Many commenters to the 2007 Draft were critical of these new proposals. Accordingly, the 2008 Draft Revised Guidelines modified these requirements to be 34 inches for pathway width, and 1 additional inch for front or rear entry wheelchair spaces, or 6 inches for side entry. The 2008 Draft also did not retain the proposal for maneuvering clearances at turns; instead, it proposed a more general requirement that features on circulation paths should not interfere with the maneuvering of wheelchairs.

Reaction to the 2008 draft from the public transit community, including bus manufacturers, was solidly opposed to the proposed new clearance specifications. The Access Board’s proposed solution for the 2010 NPRM was to require only the minimum circulation width of 34 inches. With this new requirement and the deletion of the “common wheelchair” definition, vehicles would have had to accommodate mobility devices that could fit onto the lift or ramp and through the 34-inch (min.) wide pathways.

Industry comments on this aspect of the 2010 NPRM were likewise negative, and university researchers advised that:

- The current state of information does not provide a sufficient basis for development of performance standards.
- In-depth study is needed to better understand multiple inter-related factors, before any particular measurements are adopted as standards

In response, the 2016 ADAAG final rule retains the original (1991) requirement that contains only the general statement that “the clear width of accessible circulation paths must be sufficient to permit passengers using wheelchairs to move between accessible doorways and wheelchair spaces, and to enter and exit wheelchair spaces”. The Access Board will be looking to ongoing research efforts to inform future rulemaking efforts.

Wheelchair securement orientation

The 2010 NPRM proposal kept 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.”

But, The 2010 NPRM added an “Advisory” that **side facing securement is not permitted**. This had to be inferred from the original (1991) guideline, which said only that securement could be facing toward the front of the vehicle or toward the rear. The planned advisory fit with manufacturers’ instructions, and responded 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.

Also, comments on the NPRM 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 sections on rear-facing, above), securement manufacturers require their equipment to be used only forward facing, based on the US standard, WC18 (see section below: “Standards for Vehicle Securement Equipment”). In addition, lap/shoulder belts are designed to function only in the forward direction. But note that even though the original ADAAG had allowed rear facing in small vehicles, it has not actually been used other than in large urban transit buses, especially BRT vehicles (see sections on rear-facing above).

Ultimately, the suggested “advisory” statement was not included in the updated guidelines. This leaves the issue somewhat open to interpretation of the requirements that securement design be for forward facing, except in the case of appropriate rear-facing spaces in large vehicles.

Service Accessibility:

- 49 CFR Part 37: Transportation Services for Individuals with Disabilities (transit.dot.gov → *Civil Rights* → *ADA* → *Regulations* → *Part 37*)
- “Interpretive” Appendix D to Part 37 - Background as to purpose of the regulations
- US DOT Disability Law Guidance “Accommodating Wheelchairs on Bus and Rail Service (Q&A)” (www.FTA.gov → *Civil Rights* → *Americans with Disabilities Act* → *Guidance* → *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; and **Miscellaneous Amendments** (final rule issued September 19, 2011, the latter of which are incorporated into the online version of Part 37)
- Circular FTA C 4710.1 “AMERICANS WITH DISABILITIES ACT (ADA): GUIDANCE”, November 4, 2015 (www.FTA.gov → *Civil Rights* → *Americans with Disabilities Act* → *Guidance* → *Americans with Disabilities Act Circular – PDF or Word*)

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.

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/crash-tested-product-lists> (or travelsafer.org)

WC 18 & 19 promotional logo →



As of April 2017, approximately 68 adult wheelchair models were listed with WC19 available, usually as an extra-cost option of \$250-\$500 (retail). Another 100+ WC19-compliant models were either pediatric (manual & power) or lightweight “transport” manual models, the latter having four small wheels that require pushing by an attendant. Overall, this means that 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 already in use illustrates the reason for the small number of “transit safe” wheelchairs on the road.

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, NO traditional “standard” manual wheelchairs, scooters, or “consumer” power models (with “van” type seats) are being designed and equipped to meet WC19. Most (58) of the crash-tested wheelchairs (see above) are “fully compliant”, in that they can be ordered with the optional wheelchair-mounted crashworthy lap belt that was mandated in late 2015 for WC19 crash testing. The other ten models also have the securement attachment points and lap belt, but are not fully compliant with one or more engineering and design requirements for crash-worthiness.

WC19 applies only to mobility devices manufactured in the U.S. There are also a number of wheelchair models from other countries that are designed and tested to meet the similar “ISO” standard. The difference is that ISO does not require the wheelchair-mounted, crashworthy lap belt.

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.

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.)

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.

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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.

