OVER-THE-ROAD BUSES & SYSTEMS

Technical Assistance Manual

March, 1999

Table of Contents

Introduction

This technical assistance document is one of a series provided to help in understanding the background and underlying rationale of the Americans with Disabilities Act Accessibility Guidelines for Transportation Vehicles (Vehicle Guidelines) and how the guidelines may apply in a particular case. The documents in this series are:

- Buses, Vans & Systems
- Rapid Rail Vehicles & Systems
- Light Rail Vehicles & Systems
- Commuter Rail Cars & Systems
- Intercity Rail Cars & Systems
- Over-the-Road Buses & Systems
- Automated Guideway Transit Vehicles & Systems
- High-Speed Rail Cars, Monorails & Systems
- Trams, Similar Vehicles & Systems

The information in this document is based on the preamble published with the Vehicle Guidelines, augmented with material developed in response to questions which have been posed to the Architectural and Transportation Barriers Compliance Board (Access Board) since publication of the guidelines. The Department of Transportation (DOT) has issued standards for vehicles based on the guidelines. The guidance in this document does not constitute a determination of compliance with the DOT standards or with your rights or responsibilities under the ADA and is not binding on DOT.

Background

The Americans with Disabilities Act (ADA) [P.L. 101-336, 42 U.S.C. 12101, *et seq*], signed into law by President Bush on July 26, 1990, is landmark legislation to extend civil rights protection to people with disabilities. The ADA prohibits discrimination on the basis of disability in employment, State and local government services, public transportation, public accommodations, commercial facilities, and telecommunications.

Title II of the ADA prohibits discrimination on the basis of disability in services, programs, and activities provided by public entities, including units of State and local government and the National Railroad Passenger Corporation (Amtrak). Title II addresses

public transportation and contains provisions specifically addressing the following types of transit systems: fixed route bus, rapid rail, light rail, commuter rail, and intercity rail. Under title II, transit systems of these types which are owned or operated by public entities, and persons under contract with such entities, must be made readily accessible to and useable by individuals with disabilities, including individuals who use wheelchairs. With respect to public entities, title II requires that:

New Vehicles. New vehicles purchased or leased after August 25, 1990, must be accessible.

Used Vehicles. If used vehicles are purchased or leased after August 25, 1990, good faith efforts must be made to obtain accessible vehicles.

Remanufactured Vehicles. If vehicles are remanufactured after August 25, 1990, to extend their useful life for 5 years or more in the case of buses and rapid and light rail vehicles, or for 10 years in the case of commuter and intercity rail cars, then the vehicles must be made accessible to the maximum extent feasible.

"One-Car-Per-Train" Rule. At least one vehicle or car in each train of two or more cars must be accessible no later than July 26, 1995, in the case of rapid, light, commuter, and intercity rail systems.

Demand Responsive Systems. New vehicles purchased or leased after August 25, 1990, for use in a demand responsive system operated by a public entity, or by a person under contract with such an entity, must be accessible unless the system, when viewed in its entirety, provides to individuals with disabilities a level of service equivalent to that provided to other members of the general public.

Title III of the ADA prohibits discrimination on the basis of disability in public accommodations and services provided by private entities. Under title III, public transportation services (other than by aircraft) provided by private entities must also be made readily accessible to and usable by individuals with disabilities, including individuals who use

wheelchairs. Under title III, the following requirements apply to private entities that are primarily engaged in the business of transporting people and whose operations affect commerce:

New Vehicles. New vehicles purchased or leased after October 6, 1991, must be accessible unless the vehicle is to be used solely in a demand responsive system that, when viewed in its entirety, provides to individuals with disabilities a level of service equivalent to that provided to other members of the general public. This requirement does not apply to automobiles, vans with a seating capacity of less than 8 passengers, or over-the-road buses. Over-the-road buses purchased or leased after October 30, 2000, for large operators, or after October 29, 2001, for small operators, must be accessible. In the meantime, over-the-road bus operators must provide boarding assistance and stow wheelchairs, including power wheelchairs and three-wheel mobility aids.

Vans. New vans with a seating capacity of less than 8 passengers purchased or leased after February 25, 1992, must be accessible, unless the system for which the van is being purchased or leased, when viewed in its entirety, provides to individuals with disabilities a level of service equivalent to that provided to other members of the general public.

Rail Cars. New rail passenger cars purchased or leased after February 25, 1992, must be accessible. Rail passenger cars remanufactured after February 25, 1992, to extend their useful life for 10 years or more must be made accessible to the maximum extent feasible.

For private entities not primarily engaged in the business of transporting people but whose operations affect commerce, such as hotels, shopping centers, and recreational facilities which operate shuttle service for customers or patrons, title III requires that:

New Vehicles for Fixed Route Systems. New vehicles with a seating capacity of more than 16 passengers purchased or leased after October 6, 1991, for use in fixed route systems must be accessible. This requirement does not apply to over-the-road buses until October, 2000, for large operators, and October, 2001, for small operators. New vehicles with a seating capacity of 16 passengers or less purchased or leased after October 6, 1991, for use in a fixed route

system must also be accessible unless the system, when viewed in its entirety, provides to individuals with disabilities a level of service equivalent to that provided to other members of the general public.

New Vehicles for Demand Responsive Systems. New vehicles with a seating capacity of more than 16 passengers, purchased or leased after October 6, 1991, for use in a demand responsive system must be accessible unless the system, when viewed in its entirety, provides to individuals with disabilities a level of service equivalent to that provided to other members of the general public.

Operation of Demand Responsive Systems. Demand responsive systems must be operated in such a manner that after July 26, 1990, the system, when viewed in its entirety, provides to individuals with disabilities a level of service equivalent to that provided to other members of the general public.

Regulations

The Department of Transportation is responsible for issuing regulations to implement the transportation provisions of the ADA, including accessibility standards for transportation vehicles. The ADA required the Access Board to develop guidelines to provide guidance to DOT on establishing the accessibility standards for transportation vehicles. DOT published interim standards on October 4, 1990 (55 FR 40762). Those standards apply to vehicles purchased after August 26, 1990, but before October 7, 1991.

The Access Board published its minimum guidelines, known as the ADA Accessibility Guidelines for Transportation Vehicles on September 6, 1991, in the Federal Register (56 FR 45530). The provisions for lifts, ramps, and securement devices were dawn primarily from a series of guidelines developed as part of a project sponsored by the Federal Transit Administration (FTA), formerly the Urban Mass Transportation Administration (UMTA), in 1986: Guideline Specifications for Passive Wheelchair Lifts, Guideline Specifications for Active Wheelchair Lifts, Guideline Specifications for Wheelchair Ramps and Guideline Specifications for Wheelchair Securement Devices. Provisions from the Guideline Specifications were supplemented with additional material derived from common accessibility standards, such as the Uniform Federal Accessibility Standards (UFAS) and the American National Standards

Institute (ANSI) A117.1-1980 specifications, research sponsored by the Access Board, and industry practice. Some provisions for Automated Guideway Transportation (AGT) "people movers" and rapid rail systems were derived from Los Angeles Downtown People Mover: Handbook on Accessibility for the Elderly and Handicapped (UMTA, November 1980). In addition, the guidelines incorporated provisions of 49 CFR Part 609 for buses, light rail and rapid rail systems published by UMTA in 1976.

These guidelines, codified at 36 CFR Part 1192, are not, in and of themselves, the standards for vehicles but rather form the minimum requirements for standards issued by DOT. DOT has adopted the substance of the guidelines (with minor editorial differences) as the accessibility standards for transportation vehicles. The final DOT regulation establishes effective dates for the accessibility standard and address when the standards are to be applied to vehicles for which a solicitation closes after October 6, 1991.[1] See 49 CFR 37.7. The Manuals in this series will deal only with the requirements for vehicles procured after this date.

Vehicles Covered

The Board's Vehicle Guidelines primarily address new, altered and remanufactured vehicles instead of existing vehicles since the ADA does not necessarily require vehicle retrofit. Existing buses, for example, are not required to be retrofitted to meet the standards of Part 38 of the DOT regulation. Even compliance with the "one-car-per-train rule" and the mobility aid seating requirements for intercity rail cars can be met by the purchase of new vehicles. However, some entities which do not plan to purchase a sufficient number of new vehicles before the compliance date for the "one-car-per-train" rule may choose to retrofit existing vehicles. For these entities, the Board has included provisions in the appropriate general sections concerning such retrofitted vehicles.

[1]The requirements for the size of platform lifts and minimum door height for buses over 22 feet in length apply to solicitations closing on or after January 26, 1992. See 49 CFR 37.13 and the December 9, 1991, Federal Register (56 FR 64214).

Operations

The Vehicle Guidelines cover the design, manufacture and alteration of vehicles, not their operation. Operational requirements are within the purview of DOT, not the Board, and are covered by Part 37 of the DOT rule, especially subparts B and G. Except for the possibility of operational procedures allowed under the equivalent facilitation provision, discussed below, the Board's statutory mandate is to ensure accessibility of the built environment, including instances in which operational procedures might fail. For example, the Board cannot assume that the strength, agility and attention of a driver will be sufficient to prevent a heavy wheelchair from rolling off a lift. Thus, the Board has included a requirement for lift platform barriers. Neither is it appropriate, as one transit operator suggested, to assume that fellow passengers will have the strength or skill to assist persons with disabilities to board vehicles. It is just as inappropriate to expect other passengers to lift a wheelchair user into a vehicle as it is to assume others should lift a wheelchair over a curb or carry someone up a flight of stairs to enter a building. Therefore, specific vertical and horizontal gaps for rail vehicles are specified.

Wheelchair and Mobility Aid Standards

Neither the ADA, nor any other statute, confers upon the Board the authority to set standards or minimum requirements for wheelchairs and mobility aids. The ADA does, however, provide a clear mandate to the Board to set the minimum requirements for vehicles. The Board has attempted to carry out this charge in the fairest, most cost effective manner possible consistent with the statute.

Minimum Requirements

It should be noted that these Vehicle Guidelines, and the DOT standards based on them, are minimum requirements. Standards or specifications which provide greater access are permitted. In addition, there are sections which expressly permit alternatives (e.g., rear-facing securement). The word "may" is used where alternatives are permitted and should not be construed as a requirement. Also, an appendix has been included in the guidelines which contains non-mandatory, advisory guidance to assist in applying the rule. The material from that appendix has been generally incorporated into the discussion material in this document.

Periodic Revisions

The Board intends to conduct periodic updates and revision of the Vehicle Guidelines so that future technologies and practices can be incorporated into them. As noted in the following discussions, the Board feels that additional data and study are needed in regard to certain issues and it intends to further revise and modify these guidelines based on its review of collected data and study results. Also, some variations determined to provide equivalent facilitation may be explicitly incorporated in future updates.

In addition, the Board plans to revise and update these technical manuals as new information or technology surfaces or as the Vehicle Guidelines themselves are changed. In some places in these manuals, notation is made of drafting errors or sections where the regulation itself is unclear. Changes in the regulation will be reflected in revised editions.

How These Manuals are Organized

Each of these manuals deals with a separate transportation mode or vehicle type, based on a particular subpart of the final regulation (e.g., subpart B - Buses, Vans and Systems; subpart C - Rapid Rail Vehicles and Systems; etc.). However, since subpart A applies to all vehicles, it is included at the beginning of each manual. Each manual is self-contained so that reference to other manuals is not necessary. Where the provisions of the Vehicle Guidelines refer to other modes, or where the DOT regulation requires one type of vehicle to comply with the requirements of another type, the relevant sections are repeated.

The portions of this document which appear in **bold** are the provisions as they appear in the final Vehicle Guidelines. The text immediately following is a discussion of the rationale. For purposes of this document, the section numbers correspond to the provisions as they appear in Title 36 of the Code of Federal Regulations. The numbering system of DOT's regulation follows the same format with the exception of the prefix number (i.e., §1192.23(b)(6) is substantively identical to §38.23(b)(6), etc.). Some of the provisions, particularly the requirements for horizontal gaps and vertical displacement between vehicles and platforms, must be read in conjunction with the station design requirements in 36 CFR Part 1191, which are included as Appendix A of the DOT regulation at 49 CFR Part 37.

Other Publications

The Access Board has also made available a checklist based on its ADA Accessibility Guidelines (ADAAG) for Buildings and Facilities. ADAAG contains requirements for transit facilities, including bus stops and terminals, fixed facilities and stations, and airports. The Board also publishes technical bulletins on certain sections in ADAAG. These publications are available free from the Access Board.

Subpart A -- General

§1192.1 Purpose.

This part provides minimum guidelines and requirements for accessibility standards to be issued by the Department of Transportation in 49 CFR part 37 for transportation vehicles required to be accessible by the Americans with Disabilities Act (ADA) of 1990, 42 U.S.C. 12101 et seq.

This section merely sets forth the purpose of the guidelines which is to establish the minimum requirements for standards issued by DOT. Section 504 of the ADA requires the Access Board to issue minimum guidelines and requirements for vehicles and facilities. In turn, DOT must issue standards which are consistent with these guidelines. The DOT standards could be more strict than the guidelines but cannot provide a lesser degree of accessibility. This format is similar to that under the Architectural Barriers Act of 1968 in which the Board issued the Minimum Guidelines and Requirements for Accessible Design which sets the baseline for the Uniform Federal Accessibility Standards (UFAS). As discussed previously, the vehicle standards themselves have been issued by DOT and are codified at 49 CFR Part 38.

§1192.2 Equivalent facilitation.

Departures from particular technical and scoping requirements of these guidelines by use of other designs and technologies are permitted where the alternative designs and technologies used will provide substantially equivalent or greater access to and usability of the vehicle. Departures are to be considered on a case-by-case basis by the Department of Transportation under the procedure set forth in 49 CFR 37.7.

The Board and DOT agree that there is a need for some flexibility to address unique and special circumstances and to facilitate the application of new technologies. Therefore, an "equivalent facilitation" provision has been included that is similar to the provision in the buildings and facilities guidelines. DOT has established procedures under which an entity (e.g., transit agencies, providers, etc.) may pursue alternative means of providing accessibility with respect to specific requirements of the standard. The FTA or Federal Railroad Administration

(FRA) Administrator will determine on a case-by-case basis whether equivalent facilitation is provided. See 49 CFR 37.7 for the detailed procedures which must be followed as part of an application to the Administrator for an equivalent facilitation determination. DOT intends to consult with the Board in making determinations of equivalency.

Equivalent facilitation does not constitute a waiver from any accessibility requirement and is not a lesser standard of accessibility. Alternate designs and technologies may be used only where they will provide substantially equivalent or greater access to, and usability of, a vehicle. The Board encourages that, when considering alternative designs and technologies, entities consult with individuals with disabilities and their organizations at the earliest possible stage of the process. The Board is available to provide technical assistance regarding equivalent facilitation.

In developing an equivalent facilitation proposal, an entity should consider the intent of the guideline or standard requirement. For example, large buses, other than OTRBs, are required to have a doorway height of 5'8" from the raised lift platform. This height, although it accommodates only about 70% of the adult male population, is intended to provide some minimum head clearance for standees.

This clearance is especially important where a standee would be positioned outside the vehicle door when the lift is down but is moved up and through the door as the lift is raised. Other models of lifts do not move the standee through the door, but the individual would need to pass through the door after the lift is raised. While it is not practicable to provide clearance for the 90th percentile male standee, it is desirable to provide as much head room as possible, since ducking to clear the doorway may be more difficult for persons with ambulatory disabilities than for other members of the general population. A greater height was not specified because information supplied by vehicle manufacturers indicated that this height was consistent with that needed to accommodate overhead door opening mechanisms and roof lines.

However, some lifts are designed such that the motion is entirely vertical ("elevator" type lifts) and a standee is positioned at the full inboard edge and is raised fully within the vehicle, clear of the door lintel. In this case, the FTA Administrator has determined that the intent of the doorway height requirement is being met by the particular lift configuration, provided the location of the handrails is such that the full inboard standing position is viable.

§1192.3 Definitions.

Accessible **means, with respect to vehicles covered by this part, compliance with the provisions of this part.**

Automated guideway transit (AGT) **system means a fixed-guideway transportation system which operates with automated (driverless) individual vehicles or multi-car trains. Service may be on a fixed schedule or in response to a passenger-activated call button. Such systems using small, slow moving vehicles, often operated in airports and amusement parks, are sometimes called "people movers".**

Bus **means any of several types of self-propelled vehicles, other than an over-the-road bus, generally rubber tired, intended for use on city streets, highways, and busways, including but not limited to minibuses, forty- and thirty-foot transit buses, articulated buses, double-deck buses, and electric powered trolley buses, used to provide designated or specified public transportation services. Self-propelled, rubber tire vehicles designed to look like antique or vintage trolleys or street cars are considered buses.**

Common wheelchairs and mobility aids **means belonging to a class of three or four wheeled devices, usable indoors, designed for and used by persons with mobility impairments which do not exceed 30 inches in width and 48 inches in length, measured 2 inches above the ground, and do not weigh more than 600 pounds when occupied.**

Commuter rail car **means a rail passenger car obtained by a commuter authority (as defined by 49 CFR 37.3) for use in commuter rail transportation.**

Commuter rail transportation **means short-haul rail passenger service operating in metropolitan and suburban areas, operated by a commuter authority whether within or across the geographical boundaries of a state, usually characterized by reduced fare,**

multiple ride, and commutation tickets and by morning and evening peak period operations. This term does not include light or rapid rail transportation.

Demand responsive system **means any system of transporting individuals, including the provision of designated public transportation service by public entities and the provision of transportation service by private entities, including but not limited to specified public transportation service, which is not a fixed route system.**

Designated public transportation **means transportation provided by a public entity (other than public school transportation) by bus, rail, or other conveyance (other than transportation by aircraft or intercity or commuter rail transportation) that provides the general public with general or special service, including charter service, on a regular and continuing basis.**

Fixed route system **means a system of transporting individuals (other than by aircraft), including the provision of designated public transportation service by public entities and the provision of transportation service by private entities, including but not limited to specified public transportation service, on which a vehicle is operated along a prescribed route according to a fixed schedule.**

High speed rail **means an intercity-type rail service which operates primarily on a dedicated guideway or track not used, for the most part, by freight, including, but not limited to, trains on welded rail, magnetically levitated (maglev) vehicles on a special guideway, or other advanced technology vehicles, designed to travel at speeds in excess of those possible on other types of railroads.**

Intercity rail passenger car **means a rail car intended for use by revenue passengers obtained by the National Railroad Passenger Corporation (Amtrak) for use in intercity rail transportation.**

Intercity rail transportation **means transportation provided by Amtrak.**

Light rail **means a streetcar-type vehicle railway operated on city streets, semi-private rights-of-way, or exclusive private rights-of-way. Service may be provided by step-entry vehicles or by level-boarding.**

New vehicle **means a vehicle which is offered for sale or lease after manufacture without any prior use.**

Over-the-road bus **means a vehicle characterized by an elevated passenger deck located over a baggage compartment.**

Rapid rail **means a subway-type transit vehicle railway operated on exclusive private rights-of-way with high-level platform stations. Rapid rail may also operate on elevated or at-grade level track separated from other traffic.**

Remanufactured vehicle **means a vehicle which has been structurally restored and has had new or rebuilt major components installed to extend its service life.**

Specified public transportation **means transportation by bus, rail, or any other conveyance (other than aircraft) provided by a private entity to the general public, with general or special service (including charter service) on a regular and continuing basis.**

Tram **means any of several types of motor vehicles consisting of a tractor unit, with or without passenger accommodations, and one or more passenger trailer units, including but not limited to vehicles providing shuttle service to remote parking areas, between hotels and other public accommodations, and between and within amusement parks and other recreation areas.**

Used vehicle **means a vehicle with prior use.**

The definitions in this section are consistent with the definitions included in the DOT final rule. This set of definitions, however, does not include some terms which are included in the

DOT rule, primarily those which concern operational issues not addressed by the guidelines. Notice that the term "accessible" means compliance with the provisions of the guidelines (or the DOT standards in 49 CFR Part 38) which includes any determinations of equivalent facilitation.

§1192.4 Miscellaneous instructions.

(a) Dimensional conventions. Dimensions that are not noted as minimum or maximum are absolute.

(b) Dimensional tolerances. All dimensions are subject to conventional engineering tolerances for material properties and field conditions, including normal anticipated wear not exceeding accepted industry-wide standards and practices.

(c) Notes. The text of these guidelines does not contain notes or footnotes. Additional information, explanations, and advisory materials are located in the Appendix.

(d) General terminology. The terms used in this part shall have the following meanings:

(1) *Comply with* means meet one or more specification of these guidelines.

(2) *If*, or *if...then* denotes a specification that applies only when the conditions described are present.

(3) *May* denotes an option or alternative.

(4) *Shall* denotes a mandatory specification or requirement.

(5) *Should* denotes an advisory specification or recommendation and is used only in the appendix to this part.

This section contains several provisions designed to reduce some confusion which became evident in the responses to the original proposal. It contains miscellaneous instructions, including dimensional conventions and tolerances, and general terminology. An appendix was also added to the final guidelines that contains additional information, explanations, and advisory materials. That material is summarized in the discussion sections of this document, where appropriate.

With respect to dimensional tolerances, certain materials expand or contract due to variations in temperature or during the process of "curing" or drying. As a result, even close tolerances during construction or manufacture cannot ensure continued conformance to a given

standard. For example, a cable-driven historic inclined system has been modified to be generally accessible. However, the cable is subject to uncontrollable stretching during the day, especially in hot weather. The cars generally provide level entry in the morning, but may be significantly out of alignment by the end of the day. Such variation, even in a new system, resulting from material variations beyond the control of the operator would not be deemed in violation of the guidelines. Furthermore, unlike buildings and facilities which are essentially stationary objects, vehicles move and have dynamic as well as static "envelopes". Springs lose their elasticity, steel rails and wheels wear down, and supposedly "fixed" objects settle due to dynamic stress. The allowance for normal wear, however, is only to be applied in accordance with accepted industry standards and practices, not simply an agency policy. If the industry, including designers, engineers, manufacturers, operators, and recognized professional associations agree that a specific adherence can be achieved above that allowed by an agency policy or practice, it is the industry standard which is to be applied, not the agency policy.

Reliance on dimensional tolerances, however, is not an excuse for improper or deferred maintenance, or poor design or construction methods. For example, the claim of "dimensional tolerances" could not be made for a lift which fails to meet the vehicle floor within the limits specified in these guidelines, simply because an adjustment which could have been reasonably made to a control system or limit switch was not made. Neither could a rail operator be excused from compliance because it accepted vehicles from a manufacturer which did not meet the operator's bid specification. Nor could a group of manufacturers, operators or designers, for example, simply get together to adopt a lower "standard" solely for the purpose of relaxing compliance. Such a change would need to be acknowledged by a significant segment of the industry to constitute an "accepted industry standard or practice." Moreover, dimensional tolerances apply to the construction, manufacture or operation of a system, not to the design. An entity cannot issue vehicle specifications which are less stringent than those required by the guidelines; nor could it justify a wider horizontal gap as being within dimensional tolerances because it did not specify its vehicles to be within achievable limits for sway or stability.

Finally, dimensional tolerances takes into consideration "significant figures" and rounding conventions. For example, the door opening height mentioned above is only measured to two significant figures. Actual measurements should be rounded to two significant figures in accordance with the following conventions: if the digit following the significant digit is greater than five, round up; if the following digit is less than five, drop it; if the following digit is

five, round up if the significant digit is odd and down if it is even. Thus, 68.7 rounds to 69; 68.3 rounds to 68; 68.5 rounds to 68; 67.5 rounds to 68.

Subpart G -- Over-the-Road Buses and Systems

§1192.151 General.

(a) New, used and remanufactured over-the-road buses, to be considered accessible by regulations issued by the Department of Transportation in 49 CFR part 37, shall comply with this subpart.

This is a general statement of the statutory requirement that all new, used and remanufactured vehicles must be accessible, if required by the DOT rule. In general, all new fixed-route vehicles must be accessible, while new vehicles used in demand responsive (e.g., advance reservation or paratransit) service must be accessible unless an entity has enough accessible vehicles to provide equivalent service, according to criteria set forth in the DOT rule. Vehicles which are remanufactured to extend their useful life for five years or more must meet the requirements for new vehicles if it is structurally feasible. See 49 CFR 37.75. Nothing in these guidelines or the DOT application rule requires existing vehicles purchased prior to October 7, 1991, to be retrofitted to meet these guidelines.

In general, private entities covered by Title III of the ADA are not required to purchase over-the-road buses which are accessible to wheelchair or mobility aid users until October, 2000 or 2001, depending on the size of the entity. In the meantime, such new, used and remanufactured buses must be accessible to persons with other disabilities, in accordance with the interim requirements contained in this subpart. In addition, the ADA mandated that the Office of Technology Assessment (OTA) conduct a study to determine how over-the-road buses can best be made accessible to persons who use wheelchairs and mobility aids. That study was published in May 1993. DOT published a final rule which became effective October 28, 1998.

(b) Over-the-road buses covered by 49 CFR 37.7(c) shall comply with §1192.23 and this subpart.

The final DOT regulations require that over-the-road buses acquired by public entities (or a contractor to a public entity under certain circumstances) must also provide a level change

mechanism or boarding device for wheelchair and other mobility aid users. Thus, OTRBs purchased by public transit agencies or with federal financial assistance are currently required to be accessible.

§1192.153 Doors, steps and thresholds.

(a) Floor surfaces on aisles, step treads and areas where wheelchair and mobility aid users are to be accommodated shall be slip-resistant.

The requirement for slip resistance is a general performance requirement. The Board had considered using a measure of the static coefficient of friction to determine slip resistance but the practical difficulties of defining an appropriate test procedure convinced the Board that a specific requirement should not be imposed.

Slip resistance is based on the frictional force necessary to keep a shoe heel or crutch tip from slipping on a walking surface under conditions likely to be found on the surface. While the dynamic coefficient of friction during walking varies in a complex and non-uniform way, the static coefficient of friction, which can be measured in several ways, provides a close approximation of the slip resistance of a surface. Contrary to popular belief, some slippage is necessary for walking, especially for persons with restricted gaits; a truly "non-slip" surface could not be negotiated.

The Occupational Safety and Health Administration recommends that walking surfaces have a static coefficient of friction of 0.5. A research project sponsored by the Board conducted tests with persons with disabilities and concluded that a higher coefficient of friction was needed by such persons. That report recommended a static coefficient of friction of 0.6 for steps, floors, and lift platforms and 0.8 for ramps. Those recommendations have not been adopted as requirements.

The coefficient of friction varies considerably due to the presence of contaminants, water, floor finishes, and other factors not under the control of transit providers and may be difficult to measure. Nevertheless, many common materials suitable for flooring or lift platform surfaces are now labeled with information on the static coefficient of friction. While it may not be possible to compare one product directly with another, or to guarantee a constant measure, vehicle operators or designers and manufacturers are encouraged to specify materials with

appropriate values. As more products include information on slip resistance, improved uniformity in measurement and specification is likely. The Access Board's advisory guidelines on Slip Resistant Surfaces, available from the Board at no cost, provides additional information on this subject. As further discussed under §1192.25, a contrast formula for step edges has been added to the appendix as advisory material.

The Board also considered specifying a maximum first step height from the ground and specific requirements for tread depth and riser height. Information supplied indicated that proposed requirements could not be met without major structural changes because the driver's floor is elevated to a greater height due to baggage compartment requirements and spare tire storage directly below the driver's position. If the driver's floor were lowered, it would also require providing an extra step for passengers. Some manufacturers offer a retractable step which decreases the height of the first step to 8 inches.

(b) All step edges shall have a band of color(s) running the full width of the step which contrasts from the step tread and riser, either dark-on-light or light-on-dark.

A specific formula for calculation of contrast has not been included in the requirement because of the difficulty in measuring reflectance, particularly in the field. However, a formula has been included in the appendix as advisory information. In general, it is recommended that the material used to provide contrast should contrast by at least 70%. Contrast in percent is determined by:

$$\text{Contrast} = [(B_1 - B_2)/B_1] \times 100$$

where B_1 = light reflectance value (LRV) of the lighter area
and B_2 = light reflectance value (LRV) of the darker area.

Note that in any application both white and black are never absolute; thus, B_1 never equals 100 and B_2 is always greater than 0.

(c) (1) Doors shall have a minimum clear width when open of 30 inches (760 mm), measured from the lowest step to a height of at least 48 inches (1220 mm), from which point they may taper to a minimum width of 18 inches (457 mm). The clear width may be reduced by a maximum of 4 inches (100 mm) by protrusions of hinges or other operating mechanisms.

(2) <u>Exception.</u> Where compliance with the door width requirement of paragraph (c)(1) of this section is not feasible, the minimum door width shall be 27 in (685 mm).

Although the lift is required to accommodate standees, the height of the lift in the raised position may make some persons uncomfortable. Therefore, the front door and steps must be as accessible as feasible to allow persons who use crutches and walkers, for example, to board and alight without using the lift.

The common accessible door width of 32 inches clear cannot be achieved without major structural changes to the vehicle forward section, suspension, and running gear components. Therefore, a clear width of 30 inches is specified for the lower portion of the door, where a person using crutches or who needs to swing his or her legs needs the maximum width. This width only applies to the doorway itself since, once inside, the person would normally use the handrails rather than the crutches or walker. The doorway can taper above 48 inches to allow for the slope of the front windshield. Minor intrusion into this opening by door hinges or operating mechanisms is permissible if the intrusions are not more than four inches and would not significantly interfere with crutches and walkers.

The exception allows a 27-inch wide door where achieving a 30-inch width is not feasible. An appendix note explains that achieving a 30-inch wide front door on an over-the-road bus is considered not feasible if doing so would necessitate reduction of the bus approach angle, relocating the front axle rearward, or increasing the bus overall length.

(d) The overhead clearance between the top of the lift door opening and the sill shall be the maximum practicable but not less than 65 inches (1651 mm).

The minimum door height opening for an urban transit bus is 68 inches. OTRBs have different design and operating characteristics which make this impractical in many instances.

For example, there are different models of OTRBs with characteristics designed to meet specific needs. The largest buses, used primarily for sightseeing tours, could almost meet the 68-inch minimum. However, there are other models designed to operate where overhead clearance is restricted by bridges, tunnels or other facilities. These vehicles must have a lower roof height and, therefore, could not achieve the 68-inch door height. Still other models are designed primarily for "line haul" transportation. These vehicles have a roof height nearly as high as the largest bus but a slightly higher floor to decrease the interior volume and increase luggage space. This reduces the space which must be air conditioned and, thus, improves fuel efficiency.

The measurement is from the sill, rather than the highest point of the lift as for urban transit buses, because the lift height will vary according to load. Generally, an OTRB lift is designed to be slightly higher than the sill when unloaded so that an exiting passenger doesn't experience a drop onto the lift platform. Even a slight drop might be disquieting, especially due to the height of the lift from the ground.

§1192.155 Interior circulation, handrails and stanchions.

(a) Handrails and stanchions shall be provided in the entrance to the vehicle in a configuration which allows passengers to grasp such assists from outside the vehicle while starting to board, and to continue using such handrails or stanchions throughout the boarding process. Handrails shall have a cross-sectional diameter between 1-1/4 inches and 1-1/2 inches or shall provide an equivalent grasping surface, and have eased edges with corner radii of not less than 1/8 inch. Handrails shall be placed to provide a minimum 1-1/2 inches knuckle clearance from the nearest adjacent surface. Where on-board fare collection devices are used, a horizontal passenger assist shall be located between boarding passengers and the fare collection device and shall prevent passengers from sustaining injuries on the fare collection device or windshield in the event of a sudden deceleration. Without restricting the vestibule space, the assist shall provide support for a boarding passenger from the door through the boarding procedure. Passengers shall be able to lean against the assist for security while paying fares.

This provision is essentially a restatement of the requirement for urban transit buses, which is, in turn, derived from the Baseline Specifications for Advance Design Buses (hereinafter referred to as the "White Book"). A manufacturer of over-the-road buses has indicated that the 1-1/2 inch clearance is the industry standard. The handrail across the fare box is currently required in urban transit buses by 49 CFR Part 609. The wording above has been taken from the White Book. Since the majority of over-the-road buses used in the private sector do not have fare boxes, this provision would generally only be applicable to such buses used in urban transit service.

(b) Where provided within passenger compartments, handrails or stanchions shall be sufficient to permit safe on-board circulation, seating and standing assistance, and alighting by persons with disabilities.

Except for buses used in urban transit service, the majority of over-the-road buses do not provide extensive interior stanchions and handrails. This section, which applies only where such handrails are normally provided, is a general performance requirement. Also, it is a requirement of FTA-funded buses by 49 CFR Part 609, in effect since 1976.

§1192.157 Lighting.

(a) Any stepwell or doorway immediately adjacent to the driver shall have, when the door is open, at least 2 foot-candles of illumination measured on the step tread.

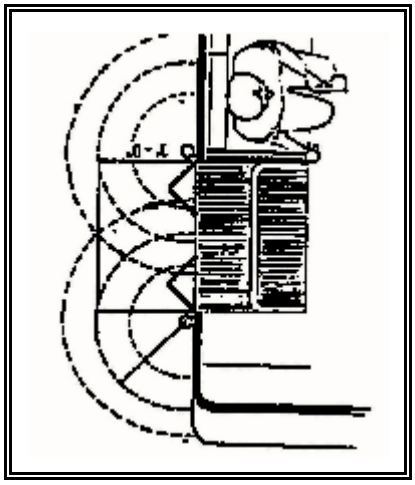
This section is identical to the provisions of §1192.31(a) for urban transit buses except for the reference in that section to lifts and ramps. Some responses to the original proposal recommended 5 footcandles for stepwells and doorways based on UFAS requirements for elevators.

The lighting provisions are based on the current requirements for transit buses in 49 CFR 609.15 for buses in excess of 22 feet in length. The higher illumination levels in UFAS apply to elevators inside buildings and facilities. Bright lighting in buses operating at night, however, might actually have the opposite effect intended. Lighting levels which are too high

inside or just outside the door could result in a disembarking passenger's eyes not adjusting to the darker surroundings and might actually create a more serious problem than it solves. Also, high lighting levels inside the vehicle cause reflections from windows and reduce the ability to see outside.

(b) The vehicle doorway shall have outside light(s) which, when the door is open, provide at least 1 foot-candle of illumination on the pathway to the door for a distance of 3 feet perpendicular to the bottom step tread or lift outer edge. Such light(s) shall be shielded to protect the eyes of entering and exiting passengers.

This provision is derived from the previous requirement for FTA-funded buses by 49 CFR 609.15.



The meaning of "3 feet perpendicular to the bottom step or lift tread outer edge" is to define a rectangle on the ground outside the bus door which is three feet deep and as wide as the door's lower step or lift outer edge. Of course, there are potions of this rectangle which may be in the shadow of the door, but the pathway to the door must be illuminated. In most cases, the actual area illuminated will be a semi-circular pattern. Such a pattern would meet the above requirement as long as the specified rectangle were illuminated. See Figure.

§1192.159 Mobility aid accessibility.

(a)(1) *General*. All vehicles covered by this subpart shall provide a level-change mechanism or boarding device (e.g., lift or ramp) complying with paragraph (b) or (c) of this section and sufficient clearances to permit a wheelchair or other mobility aid user to reach a securement location. At least two securement locations and devices, complying with paragraph (d) of this section, shall be provided.

(2) *Exception*. If portable or station-based lifts, ramps or bridge plates meeting the applicable requirements of this section are provided at stations or other stops required to be accessible under regulations issued by the Department of Transportation, the bus is not required to be equipped with a vehicle-borne device.

The number of spaces to be provided for wheelchair and mobility aid users is based on the number of such spaces required on urban transit buses greater than 22 feet in length. Since all OTRBs are larger than 22 feet in length, two spaces are required. Providing fold-down or removable seats over such spaces will minimize the impact of potential lost seating.

During the rulemaking for urban transit buses, the Board was persuaded by the virtually unanimous concurrence of the responses to the proposed rule that only one space for wheelchair and mobility aid users is inadequate, especially in light of the significant number of reported instances of individuals with disabilities being denied service because only one space was provided and it was occupied. Some reports indicated that individuals with disabilities have been denied service even where two spaces were provided. For typical OTRB service applications, the problem is exacerbated by the limited service frequency compared to urban transit operations.

The section also requires sufficient clearance to be provided to permit a wheelchair or other mobility aid user to reach a securement location. While providing additional specificity of maneuvering space may be desirable, insufficient guidance is available on what dimensions should be, how they should be measured and between what points. The provisions of accessibility codes for buildings cannot be strictly applied to vehicles which are restricted by such things as the roadway width, vehicle code width requirements, and wheelwell intrusion into aisles. Since the lift on an accessible OTRB is placed in a separate door in the vehicle side, rather than in the front door, most of the maneuvering problems are eliminated.

With respect to an anticipated decrease in seating, this section only requires "sufficient" clearance to enter the vehicle and reach a securement location. Nothing in the guidelines specify a turning radius or any of the maneuvering requirements some operators and manufacturers have claimed. In addition, the 30 inch by 48 inch clear floor space is allowed to overlap or share an adjoining access aisle.

The exception allows a station-based lift that meets the same requirements as would apply to a lift mounted on the vehicle. This means that such a lift must transport a passenger

onto the OTRB in his or her own wheelchair or mobility aid, not a "boarding chair" that would require the passenger to transfer out of a personal wheelchair or mobility aid. This exception is expected to be of limited use. It would only apply to the case in which an OTRB traveled solely between specific stations where the station-based lifts were deployed. This might occur, for example, where a bus provides a scenic trip through a park area and only picks up and discharges passengers at a visitors' center, scenic overlook, restaurant or similar locations, but does not operate outside the park. The Board expects this situation to be rare but the option of a station-based lift may provide some cost saving in some cases.

(b) *Vehicle lift*. - (1) *Design load*. The design load of the lift shall be at least 600 pounds. Working parts, such as cables, pulleys, and shafts, which can be expected to wear, and upon which the lift depends for support of the load, shall have a safety factor of at least six, based on the ultimate strength of the material. Nonworking parts, such as platform, frame, and attachment hardware which would not be expected to wear, shall have a safety factor of at least three, based on the ultimate strength of the material.

Most lift manufacturers and transit agencies have been using the design load of 600 pounds specified in §1192.23(b)(1) for some time. It is the same as the California specification and the FTA-sponsored Guidelines Specifications issued in 1986.

While some responses to the proposed guidelines suggested increasing the design load, it should be pointed out that the design load does not represent the maximum load the lift is capable of supporting. The safety factors for the support components mean the lift cables, pulleys and shaft will support 3600 pounds and the platform, frame and attachment hardware must support 1800 pounds. Except for a suggestion that a 700 pound design load be required to accommodate persons with service animals, no real justification has been provided for increasing the load. This design load is consistent with the definition of a "common wheelchair or mobility aid" which weighs 600 pounds or less when occupied.

Both the FTA-sponsored Guideline Specifications and some state codes specify a detailed test and certification procedure to help ensure reliability, maintainability and durability, including hydraulic hose burst pressure. The Board does not view these issues as directly related to accessibility design but rather operational considerations. The DOT rule requires

accessibility equipment to be maintained and those factors which could affect maintainability should generally be included in bid specifications. Furthermore, the National Highway Traffic Safety Administration (NHTSA) may issue a regulation on several safety aspects of accessibility equipment which may include some specific testing requirements. The Board views NHTSA as the more appropriate agency to deal with these issues and has not dealt with them in the guidelines.

(2) *Controls*. - (i) *Requirements*. The controls shall be interlocked with the vehicle brakes, transmission, or door, or shall provide other appropriate mechanisms or systems, to ensure that the vehicle cannot be moved when the lift is not stowed and so the lift cannot be deployed unless the interlocks or systems are engaged. The lift shall deploy to all levels (i.e., ground, curb, and intermediate positions) normally encountered in the operating environment. Where provided, each control for deploying, lowering, raising, and stowing the lift and lowering the roll-off barrier shall be of a momentary contact type requiring continuous manual pressure by the operator and shall not allow improper lift sequencing when the lift platform is occupied. The controls shall allow reversal of the lift operation sequence, such as raising or lowering a platform that is part way down, without allowing an occupied platform to fold or retract into the stowed position.

This provision is adapted from the FTA-sponsored Guideline Specification. Most large vehicles are specified with door interlocks which prevent the bus from moving when the door is open. Since the door must be open to operate the lift, the above provision would be satisfied. If an auxiliary door is provided exclusively for a lift or ramp, that door would also need to be interlocked. Alternatively, the lift or ramp itself could be provided with its own interlock system.

For vehicles without brake or transmission interlocks, the situation may be less straight forward. The "appropriate mechanisms or systems" might include some relatively simple electrical interlocks to prevent the lift from being deployed unless the interlock is engaged. For a manual ramp which has no electrical function, a door switch may be appropriate if the vehicle electrical system is tied to the door switch in some fashion that would not allow the vehicle to be moved unless the ramp were stowed. A flashing light or buzzer which is activated by the lift or

open door is not sufficient since it could be ignored. The key operational criterion is that the vehicle cannot be moved while the lift or ramp is deployed or in use. The interlock mechanism or circuit may not be activated until the lift or ramp has moved some slight distance from its stowed position provided the interlock engages before any gaps occur which could pose a hazard. Generally, gaps between the platform and vehicle floor, for example, should not exceed 5/8 inch before the interlock engages.

Furthermore, the lift must be designed to deploy to all levels expected to be encountered in the operating environment. While generally not a problem with today's equipment, some older devices would not deploy to ground level unless the vehicle were first "kneeled". There are a few cases, however, where the device might not need to reach the ground. If, for example, the vehide operates only along a restricted right-of-way such as a specially designed pedestrian mall where all of the stops are at raised curbs, or only stops at designated stations with raised platforms, then all stops encountered in the operating environment are above ground level.

Finally, the controls must be of the momentary contact type, requiring continuous pressure to activate and must be interlocked in such a way as to preclude the possibility of folding or stowing the lift when the platform is occupied (except as provided below). Some lifts currently in service can be folded or stowed simply because the operator presses the wrong button at the wrong time. The regulatory provision is intended to preclude this possibility. Some lifts accomplish this function by incorporating a pressure sensitive switch in the platform to sense when it is occupied. Others incorporate a slip-clutch mechanism on the folding motor such that it is not capable of folding anything heavier than an empty platform. Photocells or proximity switches might also be employed to detect the presence of a lift user on the platform. Some lifts also employ pressure switches at pinch points to stop the lift operation if a passenger's foot is caught between opposing members. Whatever system is used, it should be designed so that, if the pressure switch, photocell or proximity switch is not operating, the lift will not operate. The lift must be capable of reversal, but without folding or stowing. For example, if the platform is raised to the bus floor but the inner barrier fails to retract to allow the user to board, then the controls must allow the lift to be returned to the ground level for deboarding. In this case, the fold or stow function must still be precluded until the platform is empty.

(ii) *Exception*. Where the lift is designed to deploy with its long dimension parallel to the vehicle axis and which pivots into or out of the vehicle while occupied (i.e., "rotary lift"), the requirements of this paragraph prohibiting the lift from being stowed while occupied shall not apply if the stowed position is within the passenger compartment and the lift is intended to be stowed while occupied.

This provision simply permits the use of a certain type of lift which would be precluded by the above requirement that the lift cannot be stowed when occupied. The particular type of device, a rotary lift, intended to be covered by this exception is one in which the platform rotates into the vehicle and this is the stowed position. In this case, the lift is intended to be stowed while occupied, which would otherwise be prohibited by strict application of the previous paragraph. It should be noted, however, that another type of rotary lift in which the platform is intended to be raised to a vertical position for stowage, is not covered by this exception. Such a design is not precluded, since the rotation of the platform while occupied is not prohibited, but the actual raising of the platform into the vertical stowed position must still be prevented when the platform is occupied.

(3) *Emergency operation*. The lift shall incorporate an emergency method of deploying, lowering to ground level with a lift occupant, and raising and stowing the empty lift if the power to the lift fails. No emergency method, manual or otherwise, shall be capable of being operated in a manner that could be hazardous to the lift occupant or to the operator when operated according to manufacturer's instructions, and shall not permit the platform to be stowed or folded when occupied, unless the lift is a rotary lift and is intended to be stowed while occupied.

This provision is intended to allow persons who need the lift to deboard, to do so even if the lift or bus power fails. Typically, this operation is performed by a hand operated crank or pump, although some devices incorporate a back-up power system. The emergency system is only intended to allow the lift to be deployed and lowered to the ground with an occupant, not to allow the passenger to board. Whatever method is used for emergency operation, it must continue to operate safely, when operated according to manufacturer's instructions.

Notwithstanding the cautionary note about manufacturer's instructions, the emergency system must not permit the lift to be stowed or folded when occupied. This could be accomplished with a pressure valve in the hand pump system which would not allow sufficient pressure to fold a lift platform which had some specific weight on it. Also, if two separate control systems were provided, one for raising and lowering and one for stowing, which required a hand lever, for example, to be removed from one valve and placed in another could provide safety. This could be especially effective if the stowage control access point were physically blocked by a lift occupant.

(4) *Power or equipment failure*. Platforms stowed in a vertical position, and deployed platforms when occupied, shall have provisions to prevent their deploying, falling, or folding any faster than 12 inches/second or their dropping of an occupant in the event of a single failure of any load carrying component.

This provision requires some sort of "braking" or "damping" mechanism, similar to those provided on elevators, to prevent "free fall" of an occupied platform in the event of a power failure or single failure of any load carrying component. The fall rate is substantively the same as the FTA-sponsored Guideline Specifications. The provision applies to the fall rate of the deployment cycle as well as an occupied lift platform because it is also intended to protect a person with a disability who might be waiting close to the vehicle for the lift to deploy when the power fails. This is not a "planned" event which can be anticipated and the slow rate might provide enough time to move out of the way. This provision applies only to those lifts which are stowed in a vertical position, generally the so-called "active" lifts, which could fall outward (i.e., unfold) when someone is waiting outside the vehicle. Most such lifts with a powered deploy cycle simply stop when the power fails. Preventing rapid deployment in the event of a single failure of a load carrying component, such as a chain or cable breakage, will require more ingenuity.

(5) *Platform barriers*. The lift platform shall be equipped with barriers to prevent any of the wheels of a wheelchair or mobility aid from rolling off the platform during its

operation. A movable barrier or inherent design feature shall prevent a wheelchair or mobility aid from rolling off the edge closest to the vehicle until the platform is in its fully raised position. Each side of the lift platform which extends beyond the vehicle in its raised position shall have a barrier a minimum 1-1/2 inches high. Such barriers shall not interfere with maneuvering into or out of the aisle. The loading-edge barrier (outer barrier) which functions as a loading ramp when the lift is at ground level, shall be sufficient when raised or closed, or a supplementary system shall be provided, to prevent a power wheelchair or mobility aid from riding over or defeating it. The outer barrier of the lift shall automatically raise or close, or a supplementary system shall automatically engage, and remain raised, closed, or engaged at all times that the platform is more than 3 inches above the roadway or sidewalk and the platform is occupied. Alternatively, a barrier or system may be raised, lowered, opened, closed, engaged, or disengaged by the lift operator, provided an interlock or inherent design feature prevents the lift from rising unless the barrier is raised or closed or the supplementary system is engaged.

The first part of this provision covers the barrier (often called a "roll stop") which is intended to prevent the lift user from rolling or stepping off the platform edge closest to the vehicle. Some lifts have a flap which rises when the lift is deployed and lowers when the platform reaches the vehicle floor level. Other designs depend on the structure of the vehicle itself or a "close-out panel" to prevent falling off the inner edge. This feature is particularly important in some applications where a persons' toes can be trapped between the rising lift platform and the underside of the door sill (as explained later, the lift must be designed to accommodate both inward and outward facing of wheelchair and mobility aid users).

Clarifying language has also been added to the provision with regard to the meaning of "entering the vehicle" and the need for side barriers on the portion of the lift which is outside the vehicle when the platform is raised. That is, the portion of the lift platform which remains outside the vehicle when the lift is in the raised position must have side barriers. The portion which is inside the vehicle envelope does not need side barriers, since such barriers could restrict the ability of a wheelchair or mobility aid user in turning into the vehicle. In addition, a specific prohibition makes it clear that the side barriers cannot interfere with maneuvering. Care must be taken in this design because there is often a gap between the side of the lift

platform and the bus floor when the lift is fully raised. Several lift manufacturers and transit operators use various "close-out" gaskets and devices to eliminate or reduce such gaps so that the wheel of a wheelchair or mobility aid will not be trapped when it crosses such gaps. The height requirement for side barriers has been chosen to accommodate some rims on the cambered wheels of sport wheelchairs which may need space to clear the barriers. Higher barriers might interfere with such chairs unless the platform is wider.

With respect to the requirement for the loading edge (outer) barrier, consideration was given to both a general performance requirement and a more specific requirement for application of a specified force at a specified height. Many transit agencies and lift manufacturers had suggested that the test procedure for outer edge barriers in the FTA-sponsored Guideline Specifications be included in §1192.23(b)(5). This test procedure involved the use of actual wheelchairs being driven against outer barriers in order to determine the minimum height and strength for a barrier which would prevent a wheelchair from rolling off the lift platform. The Board also considered suggestions to set a maximum barrier height ranging from 2 inches to 6 inches and to require that the barrier angle outward at 45 degrees to accommodate larger wheelchairs.

The Board has not specified a safety test for the loading edge (outer) barrier in the final guidelines because the NHTSA may issue proposed safety standards for lifts. The Board feels that NHTSA is the appropriate agency to define safety tests. In the meantime, §1192.23(b)(5) includes only a performance requirement. The detailed force test in the original proposal could have been interpreted as meaning that a 3-inch high barrier was sufficient to prevent a power wheelchair from rolling off a platform. This is not the case, since some common power wheelchairs can easily ride over a 3-inch barrier, even if it is firmly locked in its raised position. A barrier with a height greater than 3 inches may be adequate, depending on the angle of the barrier and its rigidity, but a specific test has not been performed to determine what the appropriate height should be. Further, the proposed test seemed to ignore other potential solutions such as a reported Canadian standard which would address the issue of preventing the occupant of a wheelchair or mobility aid from falling from the platform in addition to restraining the chair. Accordingly, the final provision permits a supplementary system as an alternative to a high barrier.

Finally, whatever barrier or supplemental system is used, it must either rise or engage automatically when the lift is raised more than three inches off the ground, or there must be an interlock which prevents the lift from rising more than three inches off the ground unless the

barrier or supplementary system is engaged. Thus, the barrier or system could be engaged manually, provided the lift could not rise unless it were properly engaged. Systems could employ an electrical switch which interrupts power to the lift unless the barrier is engaged or might use a mechanical slip-clutch or gear and sprocket arrangement which is engaged only when the barrier is raised or the supplemental system is engaged.

(6) *Platform surface*. The platform surface shall be free of any protrusions over 1/4 inch high and shall be slip resistant. The platform shall have a minimum clear width of 28-1/2 inches at the platform, a minimum clear width of 30 inches measured from 2 inches above the platform surface to 30 inches above the platform, and a minimum clear length of 48 inches measured from 2 inches above the surface of the platform to 30 inches above the surface of the platform. (See Fig. 1)

The 30 inch by 48 inch platform is consistent with accessibility requirements which have been in effect since 1980. The Board acknowledges that some power wheelchairs cannot be accommodated on such a platform but does not have sufficient data on which to base a requirement for a larger platform although some manufacturers and transit operators had suggested that the platform length be 50 inches. Lift platforms which exceed the minimum requirements of this section are desirable to accommodate a larger proportion of the potential population. Such lifts are, in fact, commercially available.

The FTA-sponsored Guideline Specifications called for a platform length of only 44 inches, 2-1/2 inches above the platform, although 48 inches was recommended. This shorter length included in the FTA-sponsored Guideline Specifications was based on incomplete data and would not accommodate larger power wheelchairs and three wheeled scooters which are used by many individuals with disabilities who ride public transportation. These data were derived from the length of the wheelchair itself rather than the length of a wheelchair and its user.

On the other hand, UFAS and the ANSI A117.1-1980 standards specify a 48 inch length for an occupied wheelchair and require a space of 48 inches by 30 inches for the clear floor space required to accommodate a single stationary wheelchair and for a platform lift. A diagram in the appendix of the 1980 ANSI standard clearly shows that the toes of a wheelchair

occupant extend four to six inches beyond the footplates. Furthermore, power wheelchairs usually have "anti-tip bars" behind and below the curve of the rear wheels and smaller rear wheels that are set further back than manual wheelchairs and which limit the location of lift safety barriers. This information has been readily available for some time, and was discussed at length in the Board's technical publication Lifts and Wheelchair Securement published in 1987. Most lift manufacturers have responded to this information and have designed their lifts accordingly.

Section 1192.23(b)(6) is consistent with the definition of common wheelchairs and mobility aids and provides that the 48-inch length and 30-inch width are to be measured 2 inches above the platform. The reason for the length measurement to be taken at the 2-inch height is to allow for certain elements such as barrier hinges or control rods to impinge on the 48-inch envelope only if they do not interfere with anti-tip bars and other parts of the wheelchair or mobility aid. While a minimum length at the platform surface is not specified (unlike the width requirement) obviously the platform surface cannot be less than the wheelbase of the mobility aid.

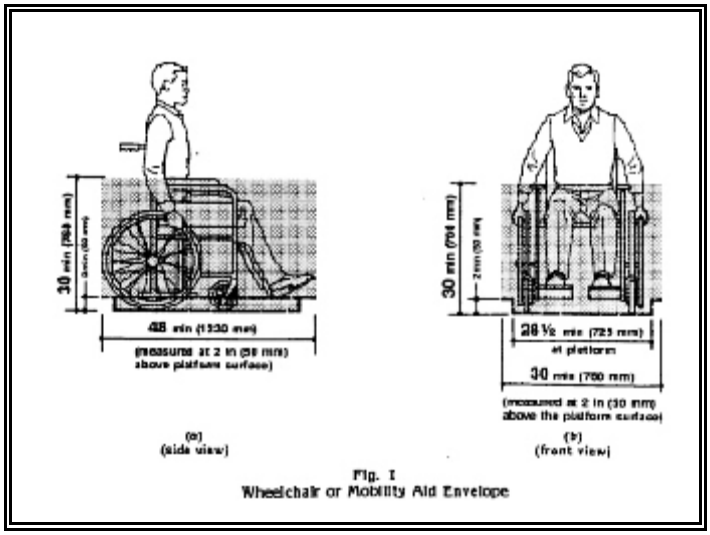


Fig. 1
Wheelchair or Mobility Aid Envelope

The width measurement position was originally intended to acknowledge that the door structure of some urban transit buses would not permit a 30-inch wide platform unless the frame were modified. This section allows the width to be measured 2 inches above the platform to allow a narrower platform at the bottom only, thus permitting wider lifts to be incorporated without the need to modify the door frame. While this restriction does not really apply to OTRBs which mount the lift in a separate door, it has been retained to allow manufacturers to

produce a single lift model rather than a separate one for urban transit buses and OTRBs. Also, since many transit operators use both OTRBs and standard transit buses, it would not be advisable for a passenger to be accommodated on one bus only to discover that he or she could not access another bus at a transfer point. In addition, the lift handrails are often attached to the platform at the bottom and the structural material takes up some portion of the usable surface. In order to achieve a platform with a clear width of 30 inches at the surface would require a lift with a much wider overall width. Measuring the width above the handrail anchor points allows a lift which does not affect door structure but still allows a clear 30 inches between handrails. The clear space is measured to the height of 30 inches to clear the armrests of most wheelchairs and mobility aids. The clear space required is shown as the shaded portion of Figure 1. In effect, a box of the indicated dimensions must be accommodated on the platform. The barriers must not intrude into this area when raised. Thus, the inner roll stop and outer barriers must be vertical or, preferably slant outward, to provide the clear area. Under no circumstances may the barriers slant inward into the required clear space.

The requirement for the 1/4-inch maximum protrusion is consistent with common accessibility standards, such as UFAS and ANSI, and is intended to reduce tripping hazards for standees.

The requirement for slip resistance is a general performance requirement. The Board had considered using a measure of the static coefficient of friction to determine slip resistance but the practical difficulties of defining an appropriate test procedure convinced the Board that a specific requirement should not be imposed.

The appendix notes that slip resistance is based on the frictional force necessary to keep a shoe heel or crutch tip from slipping on a walking surface under conditions likely to be found on the surface. While the dynamic coefficient of friction during walking varies in a complex and non-uniform way, the static coefficient of friction, which can be measured in several ways, provides a close approximation of the slip resistance of a surface. Contrary to popular belief, some slippage is necessary for walking, especially for persons with restricted gaits; a truly "non-slip" surface could not be negotiated.

The Occupational Safety and Health Administration recommends that walking surfaces have a static coefficient of friction of 0.5. A research project sponsored by the Board conducted tests with persons with disabilities and concluded that a higher coefficient of friction was needed by such persons. The study recommended a static coefficient of friction of 0.6 for steps, floors,

and lift platforms and 0.8 for ramps. However, in the absence of a specified test or measurement protocol, these values can only serve as approximate guidelines and should **not** be interpreted as requirements.

The coefficient of friction varies considerably due to the presence of contaminants, water, floor finishes, and other factors not under the control of transit providers and may be difficult to measure. Nevertheless, many common materials suitable for flooring or lift platform surfaces are now labeled with information on the static coefficient of friction. While it may not be possible to compare one product directly with another, or to guarantee a constant measure, transit operators or vehicle designers and manufacturers are encouraged to specify materials with appropriate values. As more products include information on slip resistance, improved uniformity in measurement and specification is likely. The Access Board's advisory guidelines on Slip Resistant Surfaces, available from the Board at no cost, provides additional information on this subject.

(7) *Platform gaps*. Any openings between the platform surface and the raised barriers shall not exceed 5/8 inch in width. When the platform is at vehicle floor height with the inner barrier (if applicable) down or retracted, gaps between the forward lift platform edge and the vehicle floor shall not exceed 1/2 inch horizontally and 5/8 inch vertically. Platforms on semi-automatic lifts may have a hand hold not exceeding 1-1/2 inches by 4-1/2 inches located between the edge barriers.

This section is intended to prevent the front caster of a wheelchair from turning sideways and dropping through the gap between the raised barrier and the platform. It is the quantification of a performance criterion because 5/8 inch is the approximate width of a wheelchair caster wheel. It should also be small enough to prevent a service dog paw from falling through. The provision applies only to the gap between the platform and the raised barrier and does not preclude the use of expanded metal platforms.

(8) *Platform entrance ramp*. The entrance ramp, or loading-edge barrier used as a ramp, shall not exceed a slope of 1:8, measured on level ground, for a maximum rise of 3

inches, and the transition from roadway or sidewalk to ramp may be vertical without edge treatment up to 1/4 inch. Thresholds between 1/4 inch and 1/2 inch high shall be beveled with a slope no greater than 1:2.

In most lift designs, the outer barrier folds down to form a ramp up onto the platform. The ramp slope in this section is based on common accessibility standards. The Board is inclined to relax certain slope standards where there is reason to do so, based on physical constraints. However, in view of the availability of equipment which meets the requirements of this section, and the lack of convincing evidence that the slope should be changed, the requirement has been retained. A suggestion to define the slope as being measured on level ground has been incorporated.

In general, the leading edge of the ramp must be tapered. A maximum vertical edge of 1/4 inch is permitted but, if the lip is 1/4 inch to 1/2 inch, the edge must be beveled to a slope of 1:2. In no case may the lip be greater than 1/2 inch high.

(9) *Platform deflection*. The lift platform (not including the entrance ramp) shall not deflect more than 3 degrees (exclusive of vehicle roll or pitch) in any direction between its unloaded position and its position when loaded with 600 pounds applied through a 26 inch by 26 inch test pallet at the centroid of the platform.

The specified platform deflection is exclusive of vehicle roll or pitch. In practice, the Board expects that the deflection would not be measured on the vehicle but would be measured by the manufacturer on a "test rig" in the factory. The manufacturer would then certify the lift as meeting the requirement. The same is also anticipated for other measures, such as acceleration and barrier resistance.

Since the vehicle will normally tilt when the lift is loaded, due to the weight of the wheelchair or mobility aid and the user, there will be a slope away from the vehicle toward the barrier. The reason for limiting the deflection of the lift platform is to minimize the contribution to this slope by the platform itself. The specified deflection load is consistent with the definition of a common wheelchair or mobility aid which is defined as weighing as much as 600 pounds when occupied. To increase the angle would allow the platform to slope more with a heavy

wheelchair, a situation which is potentially the most dangerous and the most likely to result in a wheelchair or mobility aid overriding or defeating the outer barrier.

The test pallet defined is approximately the width of a typical wheelchair or mobility aid wheelbase and the length is the average between a common three-wheel scooter and a common power wheelchair. The platform centroid, or center of mass, will usually be close to the geometric center of the platform.

(10) *Platform movement*. No part of the platform shall move at a rate exceeding 6 inches/second during lowering and lifting an occupant, and shall not exceed 12 inches/second during deploying or stowing. This requirement does not apply to the deployment or stowage cycles of lifts that are manually deployed or stowed. The maximum platform horizontal and vertical acceleration when occupied shall be 0.3g.

The requirements in this section are taken directly from the FTA-sponsored Guideline Specifications which adopted a speed slower than some other specifications for reasons of safety and comfort. The slower speed is even more important for use by standees. However, the slower speed is primarily relevant to the raising and lowering of an occupied lift. The Board is concerned about unnecessarily increasing dwell time. Nevertheless, the speed with which the lift deploys or stows is not unrelated to safety. A potential user waiting outside the vehicle might not be able to get out of the way of a rapidly deploying lift. Similarly, some lifts which fold up into the passenger compartment could pose a hazard to a person inside the vehicle near the lift if the platform is stowed too fast. Accordingly, the provision specifies the 6 inch per second speed only for the raising and lowering of an occupied lift and a 12 inch per second speed for the deploy and stow portion of the cycle.

The FTA-sponsored Guideline Specifications specify an acceleration rate of 0.3g for active lifts and 0.2g for passive lifts. A lower rate was specified for passive lifts for reasons of comfort, even though an earlier report on lift safety had recommended a rate of 0.3g. The Advisory Panel which developed the FTA-sponsored Guideline Specifications did not examine, nor is the Board aware of, any evidence that the higher acceleration rate permitted for active lifts is unsafe or uncomfortable for passive lifts. Therefore, the 0.3g acceleration rate is specified.

(11) *Boarding direction*. The lift shall permit both inboard and outboard facing of wheelchair and mobility aid users.

This provision is taken directly from the Guideline Specifications and is straightforward. While some operators advise wheelchair or mobility aid users to back onto the lift, it is difficult for some to do so. Therefore, the lift must permit persons to board and alight facing either in toward the vehicle or out toward the sidewalk or boarding area. This requirement should be considered in conjunction with the barrier or supplemental system designed to retain the wheelchair or mobility aid on the platform. For example, some barriers have been designed to rise under the curve of the rear wheel or under the front footrests of a wheelchair. Some designs may be usable only if the occupant is facing a particular direction. This is not permitted. Similarly, at least one supplementary lift restraint system used in Canada involves a belt connected between handrails. In some configurations, the belt is intended to be fastened around the front of the wheelchair when the wheelchair is facing outward. Since the lift must accommodate both inward and outward facing wheelchairs and mobility aids, the belt would need to be long enough to go around the back of the wheelchair or mobility aid if the person is facing inward.

(12) *Use by standees*. Lifts shall accommodate persons using walkers, crutches, canes or braces or who otherwise have difficulty using steps. The platform may be marked to indicate a preferred standing position.

The legislative history of the ADA clearly states that Congress intended lifts to accommodate standees. See H. Rept. 101-485, pt. 2, at 89. In view of the wide support for this provision, including transit operators and transit associations, the Board has retained the requirement in the final guidelines. The DOT rule requires that operators accommodate standees on lifts which meet the design requirements of part 38. Some current lifts already meet those standards with respect to standees, providing handrails which move in tandem with the lift, and several transit systems have accommodated standees on lifts for several years with no reported problems. See 49 CFR 37.165(g).

There has been some consideration to providing contrasting marking around the perimeter of the platform. Some standards do specify such marking. In light of the other requirements for lighting on the platform, a contrasting edge, side barriers, and handrails, the Board does not believe that a perimeter marking should be required.

(13) *Handrails*. Platforms on lifts shall be equipped with handrails on two sides, which move in tandem with the lift, and which shall be graspable and provide support to standees throughout the entire lift operation. Handrails shall have a usable component at least 8 inches long with the lowest portion a minimum 30 inches above the platform and the highest portion a maximum 38 inches above the platform. The handrails shall be capable of withstanding a force of 100 pounds concentrated at any point on the handrail without permanent deformation of the rail or its supporting structure. The handrail shall have a cross-sectional diameter between 1-1/4 inches and 1-1/2 inches or shall provide an equivalent grasping surface, and have eased edges with corner radii of not less than 1/8 inch. Handrails shall be placed to provide a minimum 1-1/2 inches knuckle clearance from the nearest adjacent surface. Handrails shall not interfere with wheelchair or mobility aid maneuverability when entering or leaving the vehicle.

The 100 pound force requirement for lift handrails is derived from the Canadian and the California standards. Handrails and grab bars in buildings and facilities are required to withstand a force of 250 pounds and the White Book generally requires bus handrails to meet a 300 pound test. However, the Canadian standard is well established and the Board believes it should not be changed without evidence that it is inadequate.

With respect to the force requirements, handrails in buildings and facilities are required to withstand much higher forces because they are intended to provide support for rising from a sitting position, maneuvering into and out of a wheelchair or mobility aid, or walking up or down stairs or ramps. The handrails on a lift are intended only to provide stability as opposed to major support. Lift handrails meeting the 100 pound force requirement have been in service for many years with no known problem. Moreover, handrails mounted on walls, are subject to torques which are very different from those on lift handrails attached only to the platform. To withstand equivalent forces would require substantial reinforcement of the lift handrail

attachment points, with corresponding increases in weight, and a potential decrease in the platform width. In the absence of information that the 100 pound force requirement is inadequate, it has not been changed.

As for handrail shape, the configuration is related to mounting height. For example, the FTA-sponsored Guideline Specifications specify mounting between 25 inches and 34 inches. Considerable research has been conducted in the past on the height of a handrail which can be used by persons with a disability. Until recently, the accepted height has been a minimum 30 inches and a maximum 34 inches above the platform. More recent research on handrail height has suggested that a height from 34 inches to 38 inches is better and these dimensions have been accepted by the model building codes and incorporated in the Board's final guidelines for buildings and facilities. Because of design constraints imposed by the vehicle, the Board is not inclined to fully impose these new dimensions on lift handrails. However, some entities have suggested a higher upper limit than the original proposal, so the Board has incorporated the 38 inch maximum but retained the 30 inch minimum height in this section. Consideration was given to establishing a performance criterion instead of height requirements, but the existence of such criteria currently has resulted in the placement of handrails which are too low, according to research. Clearly, specific guidance is needed to correct this situation.

With respect to handrail shape or configuration, the Board is not aware of any problems with either curved or vertical handrails, provided they move in tandem with the platform. Therefore, the provision contains no explicit reference to diagonal or horizontal configuration.

The usable length is specified as 8 inches so that a vertical handrail between the mounting height limits would not be precluded. Handrails which extend above or below the limits are permitted, provided a usable segment is within the limits.

As for handrail diameter, the requirements in this section are consistent with the White Book. Also, the Board-sponsored Hand Anthropometrics research project tested gripping by persons with various hand disabilities and confirmed the appropriateness of the specified dimensions. A 1-inch diameter handrail would not be usable. The Board notes that most vehicle handrails are made of pipe. In the building industry, pipe size typically specifies inside diameter so that a 1-1/2 inch pipe handrail actually has a larger outside diameter, sometimes up to 2 inches. Such handrails have not posed any known problem. Thus, the 1-1/2 inch diameter requirement can result in a handrail of almost 2 inches under current building industry practices. The 1-1/2 inch clearance also received general support and has been included.

It is critical that more than one handrail be provided if standees are to be able to use the lift. The presence of two handrails is also critical for rotary lifts. However, because of the design of rotary lifts, it may be that a suitable configuration can be achieved with handrails that are not necessarily on opposite sides of the platform, but might be on two adjacent sides. Accordingly, this section specifies handrails on "two sides" rather than "both sides" of the platform. The performance criterion that the handrails be usable throughout the entire lift cycle still applies.

(c) *Vehicle ramp*. - (1) *Design load*. Ramps 30 inches or longer shall support a load of 600 pounds, placed at the centroid of the ramp distributed over an area of 26 inches by 26 inches, with a safety factor of at least 3 based on the ultimate strength of the material. Ramps shorter than 30 inches shall support a load of 300 pounds.

The Guideline Specifications, from which most of the technical requirements for ramps were drawn, focused on urban transit and small buses where ramps may be practical for low floors. While it is not practical to provide ramp access to the high floor of an OTRB, there may be some cases where the vehicle loads and unloads from a high platform, using a bridge plate or short ramp, where permitted under section 1192.159(a)(2).

The Guideline Specifications require only a 400 pound design load for ramps, based primarily on the small market identified at the time those guidelines were developed. However, since ramps are permitted in some cases instead of lifts, it is essential that they be designed to accommodate the same range of common wheelchairs and mobility aids. Therefore, the 600 pound design load has been specified for ramps of 30 inches or longer.

For ramps or bridge plates which are approximately the length of the test pallet, placing a loaded pallet on the ramp would not test the strength of the ramp but would instead merely rest on the vehicle and platform or curb. Furthermore, ramps shorter than 30 inches need support only about half the weight of a wheelchair or other mobility aid at a given point: when the front wheels are on the ramp, the rear wheels are still on the sidewalk or boarding area, and when the rear wheels move onto the ramp, the front wheels will be inside the vehicle. Therefore, a 300 pound design load is specified for shorter ramps. The provision does not specify a test pallet for making this measurement, but manufacturers should use a method

which approximates the loading that would be expected from either the front or rear wheels of a wheelchair or mobility aid, applied at enough points along the ramp length to ensure that it will support a common wheelchair or mobility aid user without significant deflection.

(2) *Ramp surface*. The ramp surface shall be continuous and slip resistant; shall not have protrusions from the surface greater than 1/4 inch high; shall have a clear width of 30 inches; and shall accommodate both four-wheel and three-wheel mobility aids.

The term "continuous surface" is used instead of "solid surface" to mean a single, uninterrupted surface from edge to edge as opposed to a platform with a gap in the middle that may incorporate steps. It is also intended to preclude the use of two separate ramps placed some distance apart. Those configurations can accommodate four wheeled devices but cannot accommodate three wheeled scooters. Ramps having two parts are permitted, provided they are designed to be deployed together to provide a uniform, uninterrupted surface. The term is not intended to preclude expanded metal ramps which are often much lighter than solid platforms of the same strength.

While lift platforms are permitted to be 28-1/2 inches wide, ramps must have a clear width at the surface of 30 inches. This is because ramps are designed to be traversed, while a wheelchair or mobility aid user essentially remains stationary on a lift platform while it is in operation. For this reason, a wheelchair or mobility aid user needs more clearance on a ramp for maneuvering than on a lift platform. The restriction on 1/4 inch high protrusions is taken from common accessibility standards for accessible surfaces.

(3) *Ramp threshold*. The transition from roadway or sidewalk and the transition from vehicle floor to the ramp may be vertical without edge treatment up to 1/4 inch. Changes in level between 1/4 inch and 1/2 inch shall be beveled with a slope no greater than 1:2.

This provision is drawn from common accessibility requirements for accessible ground and floor surfaces. The ends of the ramp, both where it meets the roadway, sidewalk or

boarding area, and the transition to vehicle floor, must be tapered to 1/4 inch vertical lip or up to 1/2 inch, beveled to a slope of 1:2. In no case may the lip exceed 1/2 inch. Since the requirement is based on common accessibility standards and ramp manufacturers said that it was easily achievable, the Board has not changed the provision. Operators who suggested a 5/8 inch threshold seemed to have been concerned about existing equipment which is not affected by these guidelines.

(4) *Ramp barriers*. Each side of the ramp shall have barriers at least 2 inches high to prevent mobility aid wheels from slipping off.

Some responses to the original proposal suggested that the height of side barriers should depend on the length of the ramp. One operator uses a short bridge plate placed between door posts which, in its view limits lateral movement of a wheelchair or mobility aid to the extent that side barriers are unnecessary.

The Board has no information which provides a rationale on how the barriers should vary according to ramp length. While short ramps or bridge plates that are placed between door posts limit the likelihood of a wheelchair or mobility aid rolling off, the Board believes there is still sufficient danger in many situations to require edge barriers. In the absence of any data on what the cutoff point should be, and in view of limited opposition to the provision, the Board has decided not to change this requirement until further study is completed or additional information is obtained. The Board will consider adding additional requirements during future revisions and updates of the guidelines.

The height requirement for side barriers on ramps is derived from common accessibility requirements for ramps. The height differs from that for lift platform side barriers because wheelchairs and mobility aids move along the ramp during boarding and alighting and there is substantially more opportunity for wheels to ride over the barriers than for lift platforms.

(5) *Slope*. Ramps shall have the least slope practicable and shall not exceed 1:4 when deployed to ground level. If the height of the vehicle floor from which the ramp is deployed is 3 inches or less above a 6-inch curb, a maximum slope of 1:4 is permitted; if

the height of the vehicle floor from which the ramp is deployed is 6 inches or less, but greater than 3 inches, above a 6-inch curb, a maximum slope of 1:6 is permitted; if the height of the vehicle floor from which the ramp is deployed is 9 inches or less, but greater than 6 inches, above a 6-inch curb, a maximum slope of 1:8 is permitted; if the height of the vehicle floor from which the ramp is deployed is greater than 9 inches above a 6-inch curb, a slope of 1:12 shall be achieved. Folding or telescoping ramps are permitted provided they meet all structural requirements of this section.

Tests of ramps on buses were conducted as part of the Transbus program. Those tests showed that a slope of 1:6 was generally the maximum slope which could be negotiated but that short ramps of 1:4 slope could be used by some persons under some circumstances. While the high floor of an OTRB will make ramps impractical in most cases, there may be some situations where vehicles operate only between designated stops where a high level boarding platform is available.

This provision requires that, in general, the least slope practicable be obtained, and may not exceed 1:4 when deployed to the boarding platform. A slope of 1:4 is permitted if the vertical floor height is 3 inches or less above the platform. This would require a ramp approximately 1 foot long and would be short enough to be negotiable by many people. If the floor height does not exceed 6 inches above the platform, a slope of 1:6 would be permitted. A slope of 1:8 would be permitted if the floor height does not exceed 9 inches above the platform. A slope of 1:12 would be required for greater rises.

Height of Vehicle Floor Above Platform	Maximum Ramp Slope
3 in. or less	1:4
6 in. or less but more than 3 in.	1:6
9 in. or less but more than 6 in.	1:8
more than 9 in.	1:12

(6) *Attachment*. When in use for boarding or alighting, the ramp shall be firmly attached to the vehicle so that it is not subject to displacement when loading or

unloading a heavy power mobility aid and that no gap between vehicle and ramp exceeds 5/8 inch.

The 5/8 inch gap specified is based on the width of a wheelchair front caster. In this case, the Board believes simplicity should be the rule. The specified dimension is easy to measure whereas specifying a performance criterion would require the ramp manufacturer to first make an independent determination of what constitutes an appropriate gap for a variety of mobility aids. The measurement does not appear to be burdensome.

With respect to portable ramps, the ADA legislative history specifically mentions portable ramps as a viable option for some vehicles. The principal complaint about portable ramps has usually been the possibility of slipping which the Board believes is adequately addressed by the requirement that the ramp be attached to the vehicle when in use for boarding and alighting. Several commercially available portable ramps have brackets which are attached to the vehicle and which permit quick connect and disconnect. Others have a hole-and-pin arrangement which allows for firm attachment while in use. The definition of "firmly attached" in this case means that the ramp does not move enough to allow a gap between vehicle and ramp greater than 5/8 inch under any conditions, not necessary that the ramp be rigidly or permanently attached.

(7) *Stowage*. A compartment, securement system, or other appropriate method shall be provided to ensure that stowed ramps, including portable ramps stowed in the passenger area, do not impinge on a passenger's wheelchair or mobility aid or pose any hazard to passengers in the event of a sudden stop or maneuver.

This section of the final guidelines addresses the provision of a stowage compartment, securement system, or other means of ensuring that the ramp does not pose a hazard. In many situations where portable ramps are currently used, the ramp is simply set inside the passenger compartment, sometimes leaning against the passenger's mobility aid, where it could cause injury in a sudden stop or maneuver. Some ramps automatically stow in a pocket under the floor or are folded back over the step. At least one manufacturer provides a storage area immediately inside the door as part of the handrail configuration.

(8) *Handrails*. If provided, handrails shall allow persons with disabilities to grasp them from outside the vehicle while starting to board, and to continue to use them throughout the boarding process, and shall have the top between 30 inches and 38 inches above the ramp surface. The handrails shall be capable of withstanding a force of 100 pounds concentrated at any point on the handrail without permanent deformation of the rail or its supporting structure. The handrail shall have a cross-sectional diameter between 1-1/4 inches and 1-1/2 inches or shall provide an equivalent grasping surface, and have eased edges with corner radii of not less than 1/8 inch. Handrails shall not interfere with wheelchair or mobility aid maneuverability when entering or leaving the vehicle.

During the original 1991 rulemaking process, the Board solicited input on whether ramps should be required to have handrails. Opinion was divided. One suggestion was to require handrails on ramps with a slope greater than 1:12 or longer than 6 feet but other entities were concerned that handrails would interfere with maneuverability of wheelchair and mobility aid users.

The Board generally agrees that "short" ramps and bridge plates do not need handrails. Unfortunately, there is no general agreement on the definition of "short". Since most ramps and bridge plates will probably be "short" in some sense, the Board has not made the provision for handrails on ramps mandatory. However, where they are provided, they must meet structural requirements and not interfere with maneuverability. The Board will further review this issue when the guidelines are revised and updated.

(d) *Securement devices*. - (1) *Design load*. Securement systems and their attachments to such vehicles, shall restrain a force in the forward longitudinal direction of up to 2,000 pounds (8,880 N) per securement leg or clamping mechanism and a minimum of 4,000 pounds (17,760 N) for each mobility aid.

These requirements are taken directly from the Guideline Specifications. The purpose of the securement requirement is to restrain the wheelchair or mobility aid consistent with the

requirements that apply to all other passenger seats on the vehicle, since the wheelchair or mobility aid replaces one of those seats. The specified force was derived from research on the g-forces experienced by vehicles of various sizes and weights and their crash profiles. In general, the larger or heavier the vehicle, the lower the g-forces experienced on a collision or sudden braking. Some comments to the proposed rule suggested that this requirement, currently applicable to urban transit buses, is inadequate for OTRBs that may travel at high speeds. Despite high speed travel, comments indicated that OTRB seats are not subject to any greater requirements than those imposed on urban transit buses. Therefore, the Board has no reason to believe that the requirement is inadequate.

The significant forces during collision are imposed primarily on the rear securement legs (for a forward-facing securement). Four-point securement systems are common in demand responsive and some fixed route operations but the two forward straps are primarily designed to provide containment and reduce or prevent rebound. Therefore, the front straps are not subjected to the same forces. This section is not intended to suggest a two-point securement system. However, most securement devices consist of two rear straps or clamping devices, one attached to each side of the wheelchair or mobility aid frame. As such, each leg accounts for about half of the force of restraint. At least one device in current use has a metal bracket which has a hook on each side that attaches to the wheel axles, both of which are secured to the vehicle floor through a single belt. In this case, the single belt must accommodate all of the 4,000 pounds of force. The more securement straps or devices used for each wheelchair or mobility aid, the less force each one must accommodate individually. To be effective, the securement devices must be attached to the wheelchair or mobility aid frame, not the wheels.

There are several securement devices which have been used successfully in a variety of situations which are described in the Board's technical assistance brochure "Securement of Wheelchairs and Other Mobility Aids on Transit Vehicles." This brochure, available free from the Board, provides detailed technical specifications for securement devices and lists available resources. Such devices, properly installed, should meet these guidelines. In addition, there are several new and on-going projects designed to produce better securement devices.

(2) *Location and size*. The securement system shall be placed as near to the accessible entrance as practicable and shall have a clear floor area of 30 inches by 48

inches. Such space shall adjoin, and may overlap, an access path. Not more than 6 inches of the required clear floor space may be accommodated for footrests under another seat provided there is a minimum of 9 inches from the floor to the lowest part of the seat overhanging the space. Securement areas may have fold-down seats to accommodate other passengers when a wheelchair or mobility aid is not occupying the area, provided the seats, when folded up, do not obstruct the clear floor space required. (See Fig. 2)

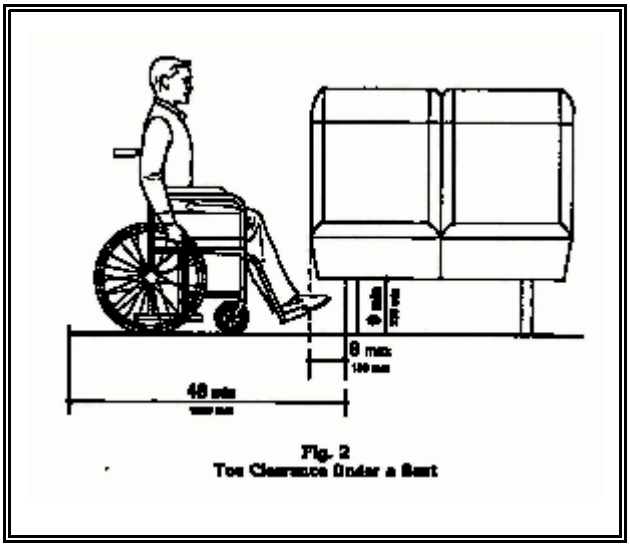


Fig. 2
Toe Clearance Under a Seat

The clear floor area is consistent with the definition of a common wheelchair or mobility aid. Service animals should be able to be accommodated in an area adjacent to the space specified, not necessarily within it. Notice that the area may overlap an adjacent access aisle. However, there is no requirement that the access aisle remain clear and unobstructed by another wheelchair or mobility aid. The Board strongly recommends against interior designs which create "first-on-last-off" situations because such designs impose severe operational constraints on system operators.

Figure 3 (Figure 2 in the Vehicle Guidelines themselves) shows the amount of the required space which can be accommodated under a seat, provided there is a minimum clearance of 9 inches under the seat or object. The requirement, however, is not intended to be construed as pertaining only to seats. That is, a modesty panel or other fixture could also overhang the space, provided the same clearances are adhered to. Since a common wheelchair or mobility aid cannot achieve the required minimum clearance, two wheelchair or mobility aid spaces cannot overlap.

Fold-down seats may be placed in the securement area provided they do not reduce the required area when folded. Quick-release seats could also be placed in the securement area if they can be removed without affecting the provision of service. For example, if the seat on a fixed-route vehicle can be quickly and easily removed by the driver, it could be used. Seats

which are bolted down would not generally provide equivalent service even in a demand responsive system if the time needed to remove seats caused a delay in the provision of service which was greater than that allowed for others. On the other hand, if all trips on a demand responsive system required advance notice so that the time needed to remove the seats did not affect response time, bolt-in seats would not be precluded.

(3) *Mobility aids accommodated*. The securement system shall secure common wheelchairs and mobility aids and shall either be automatic or easily attached by a person familiar with the system and mobility aid and having average dexterity.

The critical part of the above performance requirement is that the system, whatever its design, accommodate common wheelchairs and mobility aids, as defined in §1192.3, including power wheelchairs and three-wheel scooters. Thus, a system consisting only of wheel clamps or "rim pins", which can be attached only to chairs of a particular design (i.e., large rear wheels with open spokes), clearly does not meet the requirement. Wheel clamps and rim pins do not accommodate many power wheelchairs, particularly the so-called power base chairs, or three-wheel mobility aids.

While there is no requirement to retrofit existing vehicles, the DOT regulation does not permit a transit operator to deny service to persons with disabilities even if its current securement device does not fit the particular wheelchair or mobility aid. See 49 CFR 37.165(d). The operator is required to do the best he or she can with the existing system or device. Since securement devices exist which can secure common wheelchairs and mobility devices at moderate cost, operators may wish to consider installing new devices.

Some entities have suggested that standards for wheelchairs and mobility aids be developed which would require the provision of a common securement point. Neither the ADA nor any other statute confers upon the Board the authority to set standards or guidelines for wheelchairs and mobility aids. However, the development of some standards is currently under way through the International Standards Organization (ISO) and RESNA, a professional society of experts in rehabilitation technology. Furthermore, operators may want to get in touch with their local Independent Living Center to investigate whether there are wheelchair or mobility aid dealers or service and repair shops which have devised, or can devise, attachments or

modifications to some types of wheelchair or mobility aid to make them compatible with a particular securement device or system.

(4) *Orientation*. In vehicles in excess of 22 feet in length, at least one securement device or system required by paragraph (a) of this section shall secure the wheelchair or mobility aid facing toward the front of the vehicle. In vehicles 22 feet in length or less, the required securement device may secure the wheelchair or mobility aid either facing toward the front of the vehicle or rearward. Additional securement devices or systems shall secure the wheelchair or mobility aid facing forward or rearward. Where the wheelchair or mobility aid is secured facing the rear of the vehicle, a padded barrier shall be provided. The padded barrier shall extend from a height of 38 inches from the vehicle floor to a height of 56 inches from the vehicle floor with a width of 18 inches, laterally centered immediately in back of the seated individual. Such barriers need not be solid provided equivalent protection is afforded.

In the original proposal, the Board pointed out that all available research data indicate that forward or rear-facing securement is the safest configuration and asked whether rear facing securement should be permitted. In light of the strong support for permitting rearward facing systems, the Board has included provisions for them in the final guidelines. Also, there was overwhelming support for permitting only forward or rearward facing securement. Several responses explicitly affirmed the conclusions of the research and none offered any evidence to suggest that the data were incorrect. The only objections arose from a concern for space limitations.

The section requires at least one forward facing system, with any additional positions permitted to be either rearward or forward facing. A requirement has also been added for a padded barrier for rearward facing systems, analogous to the headrests provided on many automobile seats. The padded barrier does not have to be solid. Barriers provided on some vehicles have consisted of a series of padded bars with spaces between, specifically for driver vision. It is also possible that the barrier could be removed or folded when the space is not occupied. It is critical, however, that the barrier be provided for rearward facing systems to

prevent severe, possibly fatal, whiplash. The Board also notes that rearward facing systems are optional and operators can provide only forward facing systems.

The wording of this provision above is as it appears in the final guidelines issued by the Board. It contains an editorial revision, to clarify some confusion about the padded barrier, not included in 49 CFR 38.23(d)(4). The DOT provision is intended to be consistent with the Board's final guidelines which requires that the padded barrier pertain only to the securement locations and devices which are rear facing.

Side-facing securement is not permitted under any circumstances. This prohibition is not only based on the results of crash tests but is also related to the dynamics under ordinary sudden stop conditions. That is, during a sudden or panic stop, the wheels of a side-facing manual wheelchair in contact with the vehicle floor experience a force perpendicular to the plane of the wheel. However, the wheels are only intended to support forces radially from the axle. Engineers investigating the dynamics of wheelchairs in accordance with the new ISO standards have reported that wheels subjected to a perpendicular force will typically "dish" and fail under a force of 250 pounds, one tenth the force required to be sustained by the securement system itself. Power-base wheelchairs, some electric wheelchairs with "mag" wheels, and three-wheel mobility aids may fair somewhat better but three-wheel scooters have a higher center of gravity and will tend to tip under sideward forces. Since the DOT rule no longer permits operators to require the users of such devices to transfer to a fixed seat, the securement system must be capable of securing the mobility aid while occupied.

It also appears as if the concern for space is based on a misunderstanding of the requirements of this guideline as well as the dynamics of securement. First, this section does not apply to fixed seats provided for ambulatory passengers, as they are already covered by Federal Motor Vehicle Safety Standards for seat attachment and can face in any direction consistent with those standards. Second, some operators appear to believe that space can be conserved by placing two side-facing wheelchairs or mobility aids immediately adjacent to each other. These suggested configurations seem to assume wall-mounted rim-pins, which do not meet the requirements for securement of all common wheelchairs and mobility aids. In order to provide adequate securement for a side-facing wheelchair or mobility aid, only belts are currently available and they would need to be mounted in such a way that at least two feet would be required between wheelchairs or mobility aids to achieve the appropriate belt angle.

With respect to lap and shoulder belts, all but two responses to the original proposal supported a requirement for them. Again, from the available crash test data, lap and shoulder

belts are more important on small vehicles, where the g-forces are greater. A requirement has been included in section 1192.23(d)(7) to require a lap and shoulder belt system at each securement location on vehicles of any length.

(5) *Movement*. When the wheelchair or mobility aid is secured in accordance with manufacturer's instructions, the securement system shall limit the movement of an occupied wheelchair or mobility aid to no more than 2 inches in any direction under normal vehicle operating conditions.

The majority of responses to the original proposal supported this requirement, although a few said it was too stringent while others said it was too liberal. It was pointed out that the requirement for a 2 inch movement could be met only under normal operating conditions, not in a crash, and the final provision limits the application to normal operating conditions. In fact, some elasticity is desirable to absorb shock from collisions or even emergency stops. Note also that the provision applies to systems attached in accordance with the manufacturer's instructions.

(6) *Stowage*. When not being used for securement, or when the securement area can be used by standees, the securement system shall not interfere with passenger movement, shall not present any hazardous condition, shall be reasonably protected from vandalism, and shall be readily accessed when needed for use.

This section requires that securement devices not pose a hazard when stowed properly. Some entities contend that the area over the securement device have fold down seats and not be used by standees when not occupied by a wheelchair or mobility aid user. Whether standees are permitted to occupy the area over the securement device when not occupied by a wheelchair or mobility aid user is an operating decision to be made by the operator. The guidelines are intended to provide accessibility in a safe manner.

(7) *Seat belt and shoulder harness*. For each wheelchair or mobility aid securement device provided, a passenger seat belt and shoulder harness, complying with all applicable provisions of 49 CFR part 571, shall also be provided for use by wheelchair or mobility aid users. Such seat belts and shoulder harnesses shall not be used in lieu of a device which secures the wheelchair or mobility aid itself.

As discussed above under orientation, there was significant support for the provision of a seat (lap) and shoulder belt at each securement position. Whether a true "harness" or a conventional diagonal shoulder belt is provided, it must meet all applicable provisions of Federal Motor Vehicle Safety Standards (FMVSS) at 49 CFR part 571. In an automobile, a conventional diagonal shoulder belt is anchored to the frame above the door and connects to the lap belt on the opposite side. However, the same point on a bus, above the side window, may not have the required structural strength. Attaching the belt with screws is not adequate to meet the FMVSS requirements. A true harness, connected to an anchor point on the floor, provides better stability for the passenger (the diagonal belt causes some pivoting of the torso) but may be more difficult to install and use. Because of the g-forces involved, this arrangement may be more suited to vans and small vehicles. Diagonal shoulder belts can work, if installed properly.

The seat and shoulder belt are in addition to the wheelchair or mobility aid securement device. The aid must be secured independent of the passenger belt system. Under no conditions is the passenger seat and shoulder belt to be used to secure both simultaneously. In the event of a crash or sudden stop, the wheelchair or mobility aid would move forward, squeezing the passenger between the chair and the belt, possibly causing serious injury. Also, the lap belt must cross a passenger's pelvic region, not the abdomen or chest. Belts placed around the wheelchair backrest and a passenger's chest or abdomen should never be used.

§1192.161 Moveable aisle armrests

A minimum of 50% of aisle seats, including all moveable or removable seats at wheelchair or mobility aid securement locations, shall have an armrest on the aisle side which can be raised, removed, or retracted to permit easy entry or exit.

Moveable aisle armrests are designed to allow persons with disabilities to enter and exit seat rows more easily. This is especially beneficial to those who may walk with difficultly and who would not be using a wheelchair or mobility aid in a securement location. The requirement also applies to aisle seats which are removable or retractable at securement locations. Generally, two sets of retractable or removable seats are provided across the aisle from each other. When only one wheelchair or mobility aid is present, the seats across the aisle from the lift will remain in place. A moveable aisle armrest on these seats would allow the wheelchair or mobility aid user to transfer to one of the regular seats adjacent to this location.

Appendix to Part 1192

The appendix to Part 1192 provides additional material of an advisory, non-mandatory nature to assist covered entities understand and comply with the rule. Sections IV, reprinted here, pertains to OTRBs. For example, information is included on what factors the Board considers relevant to claiming the door width exception contained in section 1192.153(c)(2). It also contains recommended specifications for on-board restrooms which an entity may wish to provide.

VI. Over-the-Road Buses

A. Door Width

Achieving a 30 inch wide front door on an over-the-road bus is considered not feasible if doing so would necessitate reduction of the bus approach angle, relocating the front axle rearward, or increasing the bus overall length.

B. Restrooms

The following is provided to assist manufacturers and designers to create restrooms which can be used by people with disabilities. These specifications are derived from requirements for rail vehicles and represent compromises between space needed for use and constraints imposed by vehicle dimensions. As a result, some persons with disabilities cannot use a restroom which meets these specifications and operators who do provide such restrooms should provide passengers with disabilities sufficient advance information about design so that those passengers can assess their ability to use them. Designers should provide additional space beyond these minimum specifications whenever possible.

(1) If an accessible restroom is provided, it should be designed so as to allow a person using a wheelchair or mobility aid to enter and use such restroom as specified in paragraphs (1)(a) through (e) of section VI.B of this appendix.

(a) The minimum clear floor area should be 35 inches (890 mm) by 60 inches (1525 mm). Permanently installed fixtures may overlap this area a maximum of 6 inches (150 mm), if the lowest portion of the fixture is a minimum of 9 inches (230 mm) above the floor, and may overlap a maximum of 19 inches (485 mm), if the lowest portion of the fixture is a minimum of 29 inches (740 mm) above the floor, provided such fixtures do not interfere with access to the water closet. Fold-down or retractable seats or shelves may overlap the clear floor space at a lower height provided they can be easily folded up or moved out of the way.

(b) The height of the water closet should be 17 inches (430 mm) to 19 inches (485 mm) measured to the top of the toilet seat. Seats should not be sprung to return to a lifted position.

(c) A grab bar at least 24 inches (610 mm) long should be mounted behind the water closet, and a horizontal grab bar at least 40 inches (1015 mm) long should be mounted on at least one side wall, with one end not more than 12 inches (305 mm) from the back wall, at a height between 33 inches (840 mm) and 36 inches (915 mm) above the floor.

(d) Faucets and flush controls should be operable with one hand and should not require tight grasping, pinching, or twisting of the wrist. The force required to activate controls should be no greater than 5 lbs (22.2 N). Controls for flush valves should be mounted no more than 44 inches (1120 mm) above the floor.

(e) Doorways on the end of the enclosure, opposite the water closet, should have a minimum clear opening width of 32 inches (815 mm). Door latches and hardware should be operable with one hand and should not require tight grasping, pinching, or twisting of the wrist.

(2) Accessible restrooms should be in close proximity to at least one seating location for persons using mobility aids and should be connected to such a space by an unobstructed path having a minimum width of 32 inches (815 mm).

C. Visibility through a Window

Care should be taken so that the lift does not obscure the vision of the person occupying the securement position.