

LIGHT RAIL VEHICLES & SYSTEMS

Technical Assistance Manual

October, 1992

Table of Contents

Introduction	1
Background	1
Regulations	5
Vehicles Covered	5
Operations	6
Wheelchair and Mobility Aid Standards	6
Minimum Requirements	6
Periodic Revisions	7
How These Manuals are Organized	7
Other Publications	7
§1192.1 Purpose.	8
§1192.2 Equivalent facilitation.	8
§1192.3 Definitions.	9
§1192.4 Miscellaneous instructions.	12
§1192.71 General.	14
§1192.73 Doorways.	17
(a) Clear width.	17
(b) Signage.	18
(c) Signals.	19
(d) Coordination with boarding platform.	19
(1) Requirements.	19
(2) Exception.	20
(3) Exception.	21
(4) Exception.	21
§1192.75 Priority seating signs.	22
§1192.77 Interior circulation, handrails and stanchions.	23
§1192.79 Floors, steps and thresholds.	25
§1192.81 Lighting.	26
§1192.83 Mobility aid accessibility.	27
(a)(1) General.	27
(2) Exception.	28
(b) Vehicle lift.	29
(1) Design load.	29
(2) Controls.	29
(3) Emergency operation.	31
(4) Power or equipment failure.	32
(5) Platform barriers.	32
(6) Platform surface.	34
(7) Platform gaps.	35
(8) Platform entrance ramp.	35
(9) Platform deflection.	36
(10) Platform movement.	36
(11) Boarding direction.	37
(12) Use by standees.	37
(13) Handrails.	37
(c) Vehicle ramp or bridge plate.	39
(1) Design load.	39
(2) Ramp surface.	39
(3) Ramp threshold.	40
(4) Ramp barriers.	40
(5) Slope.	40
(6) Attachment.	42
(7) Stowage.	42
(8) Handrails.	42
§1192.85 Between-car barriers	43
§1192.87 Public information system.	44

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:

- o Buses, Vans & Systems
- o Rapid Rail Vehicles & Systems
- o Light Rail Vehicles & Systems
- o Commuter Rail Cars & Systems
- o Intercity Rail Cars & Systems
- o Over-the-Road Buses & Systems
- o Automated Guideway Transit Vehicles & Systems
- o High-Speed Rail Cars, Monorails & Systems
- o 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 as soon as practicable but in no event 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 August 25, 1990, 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.

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 manufactured 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 August 25, 1990, for use in fixed route systems must be accessible. This requirement does not apply to over-the-road buses. New vehicles with a seating capacity of 16 passengers or less purchased or leased after August 25, 1990, 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 August 25, 1990, 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.

Over-the-Road Buses. Title III specifically addresses over-the-road buses operated by private entities. The Office of Technology Assessment (OTA) is responsible under title III of the ADA for studying the access needs of individuals with disabilities to over-the-road buses and the most cost-effective methods for providing such access. In view of this mandated study, over-the-road buses covered by title III are not required to be accessible to wheelchair or mobility aid users until July 26, 1997, for small providers and July 26, 1996, for other providers. Over-the-road buses purchased or leased after January 26, 1992, but before July 26, 1996 or 1997 may be

required to include accessibility features which do not involve structural changes or use of boarding devices.

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 drawn 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 and remanufactured vehicles instead of existing vehicles since the ADA does not necessarily require vehicle retrofit. Existing

¹The 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).

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.

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. Several non-substantive changes in the regulation may be made in the future and these changes will be reflected in revised editions of these manuals.

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 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 could not 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 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.

The Board wishes to point out that 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 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 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 proposed regulation. 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 insure 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.

Subpart D -- Light Rail Vehicles and Systems

§1192.71 General.

(a) New, used and remanufactured light rail vehicles, to be considered accessible by regulations issued by the Department of Transportation in 49 CFR Part 37, shall comply with this subpart.

The Americans with Disabilities Act (ADA) requires new or used vehicles that are purchased or leased after August 25, 1990, to be accessible. A public entity may purchase or lease a used light rail vehicle for use on its system that is not readily accessible to and usable by individuals with disabilities, if after making demonstrated good faith efforts to obtain an accessible vehicle, it is unable to do so. See 49 CFR §37.87(c) for a description of what constitutes good faith efforts. Vehicles that are remanufactured after this date to extend their usable life for 5 years or more are also required to be accessible, to the extent it does not compromise the structural integrity of the vehicle. On October 4, 1990, the U.S. Department of Transportation (DOT) issued an interim set of requirements for such vehicles.

The guidelines discussed in this technical assistance document are substantively identical to standards issued by DOT on September 6, 1991, at 49 CFR Part 38 and replace the interim rules. The DOT rule at 49 CFR Part 37 further outlines the applicability and effective dates of these requirements. Questions as to whether certain vehicles are subject to these standards and specific effective dates should be directed to DOT.

(b)(1) Vehicles intended to be operated solely in light rail systems confined entirely to a dedicated right-of-way, and for which all stations or stops are designed and constructed for revenue service after the effective date of standards for design and construction issued pursuant to subpart C of 49 CFR Part 37, shall provide level boarding and shall comply with §§1192.73(d)(1) and 1192.85.

This provision requires that newly designed and constructed light rail systems operating on dedicated rights-of-way provide level boarding. Level boarding provides the most accessibility for the maximum number of people and is operationally superior to deploying boarding devices such as lifts, ramps, or bridge plates. It can significantly reduce station dwell times required for passenger boarding and alighting. In new construction, level boarding can be achieved in some cases when grading the site by piling the dirt fill next to the track and placing a concrete slab on top to coordinate with the level of the train floor. In other cases, it may be necessary to construct a high-level platform. The vehicles of such systems must be coordinated with the boarding platform as specified by section 1192.73(d)(1) and equipped

with between-car barriers that prevent or warn persons from accidentally stepping off the platform between cars according to section 1192.85.

It is important that operators review subpart C of DOT's rule for the effective date of standards for design and construction of transit facilities, including light rail stations. In its rule, DOT explains that the requirement that new facilities be accessible "is keyed to construction which 'begins' after January 25, 1992. The regulation defines 'begin' to mean when a notice to proceed has been issued. This term has a standard meaning in the construction industry as an instruction to the contractor to proceed with the work." Thus, regardless of the design work which preceded it, the issuance of a notice to proceed with construction on or after January 26, 1992, triggers the requirements for new stations. See also 49 CFR Part 37, Appendix A.

(2) Vehicles designed for, and operated on, pedestrian malls, city streets, or other areas where level boarding is not practicable shall provide wayside or car-borne lifts, mini-high platforms, or other means of access in compliance with §1192.83(b) or (c).

This provision takes into account that level boarding is not easily provided at stops along city streets or on pedestrian malls. Often, there is no space at such sites for platforms for level boarding. The "other areas where level boarding is not practicable" would include any other stop locations lacking space for platforms. It is important in the development of light rail systems that consideration be given to the selection of stop locations. A new system that operated on both a dedicated right-of-way and pedestrian malls or city streets would not be required to provide level boarding according to paragraph (b)(1) since that provision pertains to systems "confined entirely to a dedicated right-of-way." However, the Board recommends that, in such systems, level boarding be provided at all stops where it is feasible to do so.

(c) If portions of the vehicle are modified in a way that affects or could affect accessibility, each such portion shall comply, to the extent practicable, with the applicable provisions of this subpart. This provision does not require that inaccessible vehicles be retrofitted with lifts, ramps or other boarding devices.

This provision is similar to existing requirements of common accessibility codes and should be viewed as an "opportunity" clause. That is, when modifications are made for any reason, the opportunity must be explored to provide the maximum access feasible. When a vehicle is modified, each element that is part of the modification should be brought into compliance with the applicable sections of these requirements. For example, if a vehicle's floor is resurfaced and its electrical system rewired, the new floor surface must be slip resistant at aisles and areas used by standees and mobility aid users. If existing audible signals are

replaced or rewired, the installation of audible and visual alarms would also be required as part of the modification project. The intent of this provision is to ensure that elements of a vehicle will be made accessible when the opportunity to do so exists in the regular course of modifying or upgrading vehicles. However, those elements of the vehicle not affected by the modification plan would not have to be brought into conformance with these requirements. Under any modification plan, the installation of a lift, ramp, bridge plate or other boarding device is not required, even if the entrance of a vehicle is modified.

(d) Existing vehicles retrofitted to comply with the "one-car-per-train rule" at 49 CFR 37.93 shall comply with §§1192.75, 1192.77(c), 1192.79(a) and 1192.83(a) and shall have, in new and key stations, at least one door which complies with §1192.73(a)(1), (b) and (d). Vehicles previously designed and manufactured in accordance with the accessibility requirements of 49 CFR Part 609 or Department of Transportation regulations implementing section 504 of the Rehabilitation Act of 1973 that were in effect before October 7, 1991 and which can be entered and used from stations in which they are to be operated, may be used to satisfy the requirements of 49 CFR 37.93.

The ADA requires that at least one car in each train of two or more cars be accessible by 1995. Some operators will choose to make existing cars accessible in order to meet this requirement. In such situations, this provision requires only that vehicles conform to the following:

REQUIREMENTS FOR RETROFITTED CARS
Priority seating signs and signs designating wheelchair/ mobility aid locations (if such locations are provided)
Clear floor space (so that a route 32 inches wide leading to an area that can accommodate two wheelchair spaces each 30 by 48 inches in size is provided)
Slip resistant floor surfaces
Boarding devices (lift, ramp or bridge plate) where level entry is not provided
One accessible door that in new and key stations: <ul style="list-style-type: none"> - provides 32 inches of clear width; - is designated by the International Symbol of Accessibility; and - is coordinated with the platform so that the horizontal gap does not exceed 4 inches and the vehicle floor is within plus or minus 2 inches of the platform height when the vehicle is loaded to 50% of its capacity

Existing vehicles that meet previous accessibility standards can also be used to meet the "one-car-per-train" rule without any retrofit, provided they can be entered and used from the stations or stops at which they are to be used. Specifically, these standards include those issued by the FTA, vehicles obtained with FTA funds, and those issued by DOT under Section 504 of the Rehabilitation Act of 1973, which cover transit systems receiving Federal funds. Further information on these standards can be obtained from DOT.

§1192.73 Doorways.

(a) Clear width. (1) All passenger doorways on vehicle sides shall have minimum clear openings of 32 inches when open.

This provision for a clear opening width of 32 inches has been in effect since 1976 for FTA-funded vehicles and should be met easily. The door width specified is not designed solely to accommodate wheelchair users. Rather, the dimension is designed to provide space for crutch-tip-to-crutch-tip distance of a typical crutch user. Also, the requirement is for a "clear opening." The provision of a wide doorway with a vertical stanchion in the center does not meet the requirement.

(2) If doorways connecting adjoining cars in a multi-car train are provided, and if such doorway is connected by an aisle with a minimum clear width of 30 inches to one or more spaces where wheelchair or mobility aid users can be accommodated, then such doorway shall have a minimum clear opening of 30 inches to permit wheelchair and mobility aid users to be evacuated to an adjoining vehicle in an emergency.

This requirement applies only to new vehicles equipped with end doors that can be reached by a wheelchair or mobility aid user. This means that where there is a route at least 30 inches wide leading from the area containing accessible spaces to the end door, then the end doors must provide a minimum of 30 inches clear width. Since the clear area in which mobility aid users can position themselves is usually located at the ends of cars, the end doors will most likely be in close proximity to accessible spaces. This requirement does not apply to vehicles that are designed with a route leading to the end doors that is less than 30 inches wide at any point or that is inaccessible in any other aspect (e.g., steps). However, this provision should not be viewed as an excuse to arbitrarily place stanchions or arrange seats to preclude a 30-inch wide passage to avoid having to specify 30-inch wide end doors.

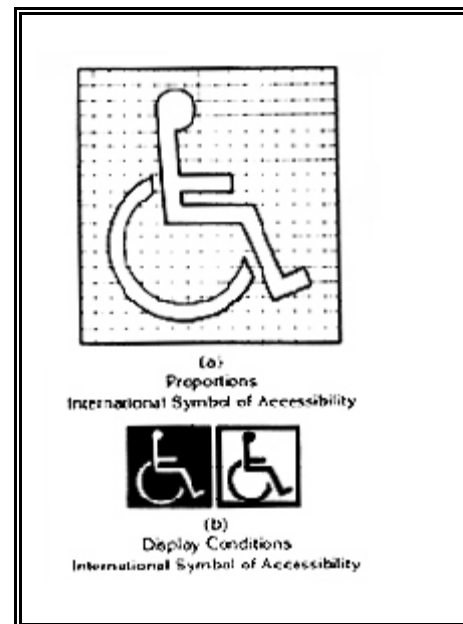
These guidelines do not address evacuation procedures or require that end doors be used in emergencies or that they be part of an evacuation route. For a variety of reasons, the end doors might not be used by a transit system's evacuation plan. In addition, a transit system's evacuation plan that requires the use of side doors would not be precluded by this

provision. Further, the evacuation route leading from the train itself is often inaccessible, especially in the case of rapid rail where narrow walkways, catwalks, and escape ladders are part of evacuation routes from tunnels. Nonetheless, the end doors of new vehicles can easily be designed to be functionally accessible (i.e., have 30 inches of clear width) and should be accessible in case they may serve as an accessible means of egress. In limited emergencies, such as when the side doors of a car fail, accessible end doors would be the only means of exit. Additionally, the Board recognizes that this provision does not guarantee access into adjoining cars since existing cars may not have end doors with 30 inches of clear width. However, as old cars are replaced over time and the number of accessible cars on each train increases, the chances of providing an accessible connection between cars will be greater.

Existing cars or cars retrofitted under the "one-car-per-train" rule are not subject to this requirement.

(b) Signage. The International Symbol of Accessibility shall be displayed on the exterior of each vehicle operating on an accessible light rail system unless all vehicles are accessible and are not marked by the access symbol. (See Fig. 6)

Under this requirement, all new vehicles must be designated by the International Symbol of Accessibility (access symbol) shown in Figure 6 below. However, new vehicles acquired for a light rail system in which all vehicles are accessible and which are not designated by the symbol do not have to be designated. In fully accessible systems, consistency is important, so that if existing accessible vehicles are designated, new vehicles should be designated as well. Still, the Board considers the access symbol to be at times subject to over-use and thus recommends that transit operators remove symbols when all cars are accessible. Since cars are usually designated by decals, which eventually wear and must be replaced, operators may opt to simply not replace them.



The placement of the access symbol is not specified by these guidelines. It is recommended that the symbol be placed at each accessible passenger door of an accessible vehicle. However, if the clear floor area for wheelchair or mobility aid users is provided at only one end of a car, then only those passenger doors at that location should be designated.

(c) Signals. Auditory and visual warning signals shall be provided to alert passengers of closing doors.

Audible signals are required by existing FTA regulations, in effect since 1976. Audible signals usually activate before the doors begin to close and thus provide advance warning that the doors are about to close. Without visual signals, persons with hearing impairments are not afforded any equivalent advance warning and can only detect closings as the doors actually begin to close. According to information received during the development of these guidelines, the addition of audible and visual warning signals for automatically-operated doors of new vehicles is feasible and represents only a modest cost increase for a chime, light, and associated electrical controls at each doorway. These signals are not required to be provided on existing vehicles or those that are retrofitted. Since proposed requirements for door closing force and speed have been removed, the Board considers the provision of audible and visual indicators to be of even greater importance.

The term "passengers" means persons within the transit system including those who are on the train and those waiting to board. Therefore, warning signals should be visible from both inside and outside the vehicle. This can be achieved by equipping the entrances of new vehicles with both an interior and exterior light indicator. Also, it is conceivable that a single light indicator, by either its illumination level, design, or placement may be specified so that it is visible both inside and outside the vehicle. Either method of addressing this requirement is acceptable so long as it provides a visual warning that doors are about to close. Further, visual indicators should be synchronized with audible signals so that equivalent advance notification of door closure is provided to all persons, including those with hearing or visual impairments.

(d) Coordination with boarding platform. - (1) Requirements. The design of level-entry vehicles shall be coordinated with the boarding platform or mini-high platform design so that the horizontal gap between a vehicle at rest and the platform shall be no greater than 3 inches and the height of the vehicle floor shall be within plus or minus 5/8 inch of the platform height. Vertical alignment may be accomplished by vehicle air suspension, automatic ramps or lifts, or any combination.

This provision and the exceptions that follow outline the maximum horizontal gap and vertical tolerance allowed. However, vehicles should be specified to be level with the platform edge and as close to it horizontally as possible, so that under normal passenger conditions these maximum levels are not exceeded. These tolerances, even when specified in the acquisition of new vehicles, may not be achieved under all conditions throughout the vehicle lifetime. The requirements are based on normal passenger conditions. It is incumbent on the operator not only to specify the correct floor height when ordering vehicles (and to accept them only if they

meet the specification) but also to correctly specify the rail-to-platform height for new stations. Thus, it is important to keep in mind that the horizontal gap and vertical tolerance are dependent not only on the vehicle specifications but also the design and construction of station platforms. Those requirements, including gap requirements and the rail-to-platform height, are provided at 49 CFR Part 37, Appendix A.

In those instances where a new light rail system could not meet these gap requirements, the operator would be able to pursue alternative means of reducing gaps under the procedure for equivalent facilitation contained in DOT's rule (see 49 CFR 37.7). Also, the Board recognizes that close tolerances during construction or manufacture cannot insure continued conformance to a given standard. Variations, such as those resulting from normal wear or material variations would not be deemed violations of the guidelines. However, only those variations within the limits of accepted industry practices or tolerances are allowed. (See Subpart A at the beginning of this manual for further discussion of dimensional tolerances.) Adequate maintenance must be performed to ensure the vehicles remain within acceptable tolerances.

(2) Exception. New vehicles operating in existing stations may have a floor height within plus or minus 1-1/2 inches of the platform height. At key stations, the horizontal gap between at least one door of each such vehicle and the platform shall be no greater than 3 inches.

The ability to closely align new vehicles with existing station platforms is limited by the rail-to-platform height and the vertical distance between the track and the platform. Existing stations are not required to be altered under the ADA, unless they are a "key" station. This provision allows new vehicles serving existing stations, including key stations, a greater vertical tolerance since the existing platform height may make the 5/8 inch tolerance infeasible. Nevertheless, the goal is for the vehicle floor and platform to be at the same height. The greater allowance under this provision is not an excuse to create unnecessary barriers.

A consistent horizontal gap along all vehicles of a train may not be feasible due to the design of existing stations, such as those that have curved platforms. (This, however, is more pertinent to commuter and rapid rail stations). In view of this, the three-inch horizontal gap requirement has been limited only to key stations, which are required to be made accessible under the ADA, and does not apply to other existing stations. Further, only one door of a new vehicle is required to meet the 3 inch gap requirement since, in the case of curved stations, a uniform gap cannot be achieved along the entire side a vehicle. A transit system could, as one transit operator has suggested, designate one location where such tolerances are achieved along a portion of a curved station platform. New vehicles could be ordered with a slight sill protrusion to reduce the horizontal gap in stations where a wider gap currently exists.

(3) Exception. Retrofitted vehicles shall be coordinated with the platform in new and key stations such that the horizontal gap shall be no greater than 4 inches and the height of the vehicle floor, under 50% passenger load, shall be within plus or minus 2 inches of the platform height.

This exception pertains to existing vehicles that are made accessible under the "one-car-per-train" rule. Generally, existing vehicles cannot be coordinated with the platform to the degree that new vehicles can. Even if feasible, retrofitting existing vehicles to meet the requirements for new vehicles, could be very expensive. Consequently, this exception allows a greater and more easily achievable horizontal gap and vertical tolerance. These vehicles need to be aligned with the platform at new stations or key stations so that the horizontal gap does not exceed 4 inches and the vertical tolerance is less than 2 inches. While the Board does not consider such a gap to be independently negotiable by many wheelchair users, such vehicles will eventually be phased out as new vehicles are added to the system.

HORIZONTAL AND VERTICAL TOLERANCES

	NEW STATIONS	KEY (EXISTING) STATIONS
NEW VEHICLES	3" horizontal gap 5/ 8" vertical tolerance	3" horizontal gap (1 door) 1-1/ 2" vertical tolerance*
RETROFITTED VEHICLES	4" horizontal gap 2" vertical tolerance	4" horizontal gap (1 door) 2" vertical tolerance

* Also applies to new vehicles operating at existing stations, not only key stations.

(4) Exception. Where it is not operationally or structurally practicable to meet the horizontal or vertical requirements of paragraphs (d)(1), (2) or (3) of this section, platform or vehicle devices complying with §1192.83(b) or platform or vehicle mounted ramps or bridge plates complying with §1192.83(c) shall be provided.

This exception acknowledges that, in many systems, high platforms are not operationally feasible and pertains to those systems that are not required to provide level boarding. Such systems are required to provide access from low platforms with car-borne, platform-mounted, or portable lifts in accordance with the specifications for lifts. Access may also be provided by ramps or bridge plates meeting the applicable requirements. Such ramps or bridge plates may be automatically or manually deployed.

§1192.75 Priority seating signs.

(a) Each vehicle shall contain sign(s) which indicate that certain seats are priority seats for persons with disabilities, and that other passengers should make such seats available to those who wish to use them.

The content of signs is not specified by this requirement and is left up to the discretion of transit operators. At a minimum, the sign should indicate which seats are intended for use by persons with disabilities.

(b) Where designated wheelchair or mobility aid seating locations are provided, signs shall indicate the location and advise other passengers of the need to permit wheelchair and mobility aid users to occupy them.

This requirement pertains to vehicles that provide specific locations for wheelchair or mobility aid users. Sometimes, these areas are accessed by folding up a regular seat. Operators should take into account how one accesses and uses such locations in determining the content of signs. This provision is not intended to suggest that specified areas or "bays" be provided.

(c) Characters on signs required by paragraphs (a) or (b) of this section shall have a width-to-height ratio between 3:5 and 1:1 and a stroke width-to-height ratio between 1:5 and 1:10, with a minimum character height (using an upper case "X") of 5/8 inch, with "wide" spacing (generally, the space between letters shall be 1/16 the height of upper case letters), and shall contrast with the background, either light-on-dark or dark-on-light.

These requirements for the character height and proportion are based on existing Federal requirements for building and facility signage, augmented by the results of research sponsored by the Board. Contrast can be provided either with light characters on a dark background or dark characters on a light background. However, light-colored characters against a dark background are preferred since studies have shown that this type of contrast is more readable for persons with low vision. A minimum level or percentage of contrast between characters and the background of the sign is not specified. Research, however, indicates that signs are more legible for persons with low vision when characters contrast with their background by at least 70 percent. 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.

Although not required, it is also recommended that the characters and background of signs should be eggshell, matte, or other non-glare finish. An eggshell finish (11 to 19 degree gloss on 60 degree glossimeter) is preferred.

§1192.77 Interior circulation, hand rails and stanchions.

(a) Handrails and stanchions shall be sufficient to permit safe boarding, on-board circulation, seating and standing assistance, and alighting by persons with disabilities.

This provision is written as a general performance requirement in order to allow as many options as possible in the design of accessible vehicles. Handrails and stanchions must be placed near the doors and along the path of entrance into the vehicle for those using crutches or walkers, among others. However, they should not interfere or restrict the necessary clearance at doors or along an accessible route leading to accessible spaces as required by the following provision.

(b) At entrances equipped with steps, 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.

Stepped entrances are required to be equipped with handrails and stanchions that can be reached by the passenger from the outside before actually stepping into the vehicle. Such handrails and stanchions must be placed so that passengers can use them at all stages of the boarding pathway. This part of the requirement is derived from 49 CFR Part 609, in effect since 1976. This would include a horizontal rail in front of any fare collection device, which not only provides support while paying fares but can help prevent someone from falling against the fare box or windshield during a sudden stop.

Most car 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 hand rails have not posed any known problem. Thus, the 1-1/2 inch diameter requirement can result in a hand rail of approximately 2 inches under current building industry practices.

(c) At all doors on level-entry vehicles, and at each entrance accessible by lift, ramp, bridge plate or other suitable means, handrails, stanchions, passenger seats, vehicle driver seat platforms, and fare boxes, if applicable, shall be located so as to allow a route at least 32 inches wide so that at least two wheelchair or mobility aid users can enter the vehicle and position the wheelchairs or mobility aids in areas, each having a minimum clear space of 48 inches by 30 inches, which do not unduly restrict movement of other passengers. Space to accommodate wheelchairs and mobility aids may be provided within the normal area used by standees and designation of specific spaces is not required. Particular attention shall be given to ensuring maximum maneuverability immediately inside doors. Ample vertical stanchions from ceiling to seat-back rails shall be provided. Vertical stanchions from ceiling to floor shall not interfere with wheelchair or mobility aid circulation and shall be kept to a minimum in the vicinity of accessible doors.

Designating accessible spaces for wheelchair or mobility aid users is not required. During the development of these guidelines, it was apparent that some transit operators assumed that "bays" or "berths" would have to be provided in order to meet this requirement. Such accommodations are not required or recommended. All that must be provided is enough clear floor space so that two wheelchair or mobility aid users can board and position themselves on the vehicle. The 30 by 48 inch dimension is based on the standard space allowance for a person in a wheelchair. The clear floor area where persons with disabilities can position themselves must be connected to the doors by a route with at least 32 inches of clear width. The clear floor space that is typically provided for standees is usually large enough to meet this requirement.

Hand rails or stanchions must be placed so that the required clear floor spaces and routes are not obstructed. It is also recommended, but not required, that consideration be given to the proximity of handrails or stanchions to the area in which wheelchair or mobility aid users may position themselves. When identifying the clear floor space where a wheelchair or mobility aid user can be accommodated, it is suggested that at least one such area be adjacent to, or in close proximity to a hand rail or stanchion. Of course, such a hand rail or stanchion cannot encroach upon the required 32 inch width required for the doorway or the route leading to the clear floor space which must be at least 30 by 48 inches in size. This recommendation should not be interpreted as a requirement that the area where wheelchair or mobility aid users can position themselves be designated at a specific location. It is important that wheelchair and

mobility aid users have as many options as possible in positioning themselves in view of the crowding that can take place and the limited time allowed to enter or exit the vehicle.

There is no requirement for securement systems or tie-down devices. Previous research conducted for DOT and comments received during the development of these guidelines indicate that such devices are not needed on light rail vehicles because of the low acceleration and deceleration forces.

§1192.79 Floors, steps and thresholds.

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

A specific measure, or static coefficient of friction, has not been specified for slip-resistance. 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 common 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. A static coefficient of friction of 0.6 is recommended for steps, floors, and lift platforms and 0.8 for ramps.

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 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 to develop. The Board has published a brochure, "Slip Resistant Surfaces," available at no cost, which provides additional information and advisory guidelines on slip resistant surfaces.

A variety of common materials used on transit vehicle floors can provide adequate slip resistance. Common rubberized matting may be slip resistant depending on the orientation of

the grooves. Carpet is more variable depending on pile and weave and should probably be tested before it is specified.

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

The band of contrasting color required by this provision must span the full width of the threshold and steps along the nosing. However, a minimum width for the band itself is not specified. The Board recommends a minimum of three inches, although the actual size is left to the discretion of operators. Although a minimum level of contrast for this band is not specified, it is recommended that the following formula be used in determining the contrast level:

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

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.

§1192.81 Lighting.

(a) Any stepwell or doorway with a lift, ramp or bridge plate immediately adjacent to the driver shall have, when the door is open, at least 2 footcandles of illumination measured on the step tread or lift platform.

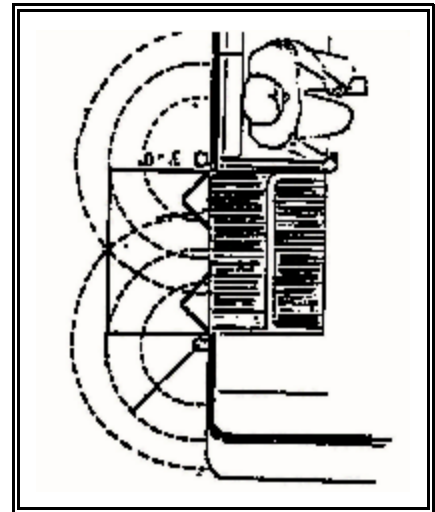
This requirement is based on existing FTA requirements for light rail vehicles and pertains only to the interior lighting provided at entrances equipped with boarding devices. The requirement only pertains to open doors so that the light will not reflect off the windshield while the vehicle is moving. The measurement pertains to all step treads of the entrance or to the lift platform at floor level. While a maximum lighting level is not specified, high levels may increase the time necessary for the vision of exiting passengers to adjust to a darker, nighttime environment.

(b) Other stepwells, and doorways with lifts, ramps or bridge plates, shall have, at all times, at least 2 footcandles of illumination measured on the step tread or lift or ramp, when deployed at the vehicle floor level.

This provision requires the same level of lighting in other doorways with boarding devices and stepwells of the vehicle. Since such stepwell lighting would not interfere with the operator's visibility, the minimum level is required at all times.

(c) The doorways of vehicles not operating at lighted station platforms shall have outside lights which provide at least 1 footcandle of illumination on the station platform or street surface for a distance of 3 feet perpendicular to all points on the bottom step tread. Such lights shall be located below window level and shielded to protect the eyes of entering and exiting passengers.

This provision is also based on an existing FTA requirements and specifies that the 3 foot distance is to be measured perpendicularly from the step tread, as shown in the figure. The meaning of "3 feet perpendicular to all points on the bottom step tread outer edge" is to define a rectangle on the ground outside the vehicle door which is three feet deep and as wide as the door lower step. 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.



This requirement pertains only to vehicles that serve unlighted stations. While these guidelines pertain only to vehicles, not stations, it is recommended that stations be lighted to serve both those passengers waiting at stations and those passengers entering or exiting vehicles. If stations are lighted, vehicle doorways do not have to be illuminated.

§1192.83 Mobility aid accessibility.

(a)(1) General. All new light rail vehicles, other than level entry vehicles, covered by this subpart shall provide a level-change mechanism or boarding device (e.g., lift, ramp or bridge plate) complying with either paragraph (b) or (c) of this section and sufficient clearances to permit at least two wheelchair or mobility aid users to reach areas, each with a minimum clear floor space of 48 inches by 30 inches, which do not unduly restrict passenger flow. Space to accommodate wheelchairs and mobility aids may be provided within the normal area used by standees and designation of specific spaces is not required.

This requirement for boarding devices applies only to light rail systems that do not provide level boarding. This would apply to the vehicles of new systems where level boarding is provided at some but not all stops. The clearances required for access to seating locations would include those for doorways (section 1192.73) and for interior circulation (section 1192.77).

(2) Exception. If lifts, ramps or bridge plates meeting the requirements of this section are provided on station platforms or other stops, or mini-high platforms complying with §1192.73(d) are provided, at stations or stops required to be accessible by 49 CFR Part 37, the vehicle is not required to be equipped with a car-borne device. Where each new vehicle is compatible with a single platform-mounted access system or device, additional systems or devices are not required for each vehicle provided that the single device could be used to provide access to each new vehicle if passengers using wheelchairs or mobility aids could not be accommodated on a single vehicle.

New, non-level entry cars are not required to be equipped with boarding devices if such devices are provided at station platforms or mini-high platforms are provided. To meet this exception, boarding devices or mini-high platforms would have to be provided at all stations and stops required to be accessible. However, transit operators should consider which option (boarding devices on cars or at stations) offers the most accessibility in determining their course of action.

The Board received some comments from operators of light rail systems who currently use platform-mounted (wayside) lifts or mini-high platforms with which the operator aligns one door of the vehicle. The operators suggested that the second vehicle should not be required to be accessible so that a second lift or mini-high platform would not be needed to serve the second vehicle in the train. The ADA, however, is explicit that, except for specific provisions for intercity rail cars, all new vehicles must be accessible. Therefore, the final guidelines require that every new vehicle be able to be entered and used and accommodate at least two wheelchair or mobility aid users. The current requirement does not require the provision of additional lifts or platforms at a station if other vehicles of the train which are required to be accessible are compatible with, and can be served by, the lift or platform if positioned properly.

In practical terms, the driver would align the door of the first car with the lift or mini-high platform and allow all passengers using wheelchairs or mobility aids to board. If all the waiting passengers who need the lift or platform can be accommodated on the first car, the train would not need to move to allow boarding of the second car. The transit agency should, therefore, carefully assess the interior layout of its cars to ensure that sufficient clear floor area is provided to accommodate all the anticipated wheelchair and mobility aid users for a trip. If a larger number of such passengers presented themselves at a stop, and a second car were not

full, it may be discriminatory under the DOT rule not to move the train to allow those passengers to board the second car. This potential situation is one of the reasons why the Board strongly urges planners and designers to provide level boarding from full length high platforms wherever practicable.

(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.

The specified design load is consistent with the definition of a "common wheelchair or mobility aid" which weighs 600 pounds or less when occupied. However, 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.

Previous FTA-sponsored guidelines for lifts and some state codes specify a detailed test and certification procedure to help ensure reliability, maintainability and durability. 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 on buses which may include some specific testing requirements, and which may be applicable to rail car lifts. 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, propulsion system, 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.

Most large vehicles are specified with door interlocks which prevent movement when the door is open. Since the door must be open to operate the lift, this 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. In some cases, meeting this requirement may involve other solutions, especially for rail cars where door interlocks are not normally provided or where a portable lift may have no direct connection to the car. The "appropriate mechanisms or systems" might include some relatively simple electrical interlocks. However, the system or mechanism cannot work only as a warning to the driver, such as a flashing light or buzzer, which can be inadvertently overlooked. The key operational criterion is that the car cannot be moved while the lift or ramp is in use.

Furthermore, the lift must be designed to deploy to all levels expected to be encountered in the operating environment. In some systems where all of the stops are at raised platforms, then the lift would only be required to deploy to platform level.

Finally, if the lift is electrically operated, 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. This 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. 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 car 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 platform level for deboarding. In this case, the fold or stow function must still be precluded until the platform is empty.

(ii) Exception. Where physical or safety constraints prevent the deployment at some stops of a lift having its long dimension perpendicular to the vehicle axis, the transportation entity may specify a lift which 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 paragraph (b)(2)(i) of this section prohibiting the lift from being stowed

while occupied shall not apply to a lift design of this type 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 previous 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 car 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.

Since rotary lifts deploy with the long dimension of the lift platform parallel to the vehicle, and the user enters and exits parallel to the vehicle, they can be deployed in relatively narrow spaces. Such a lift could be deployed into a narrow island between traffic lanes on a street, for example. This would allow street stops to be accessible where a light rail system operates on city streets along with automobiles.

(iii) Exception. The brake or propulsion system interlocks requirement does not apply to a station platform mounted lift provided that a mechanical, electrical or other system operates to ensure that vehicles do not move when the lift is in use.

This exception for platform-mounted or portable lifts allows use of a "mechanical, electrical, or other system" in lieu of an interlock system, to ensure that the car does not move while the lift is in use. This provision is intended to cover situations in which the lift is not electrically or mechanically connected to the vehicle. Under this exception, devices may be installed that do not function as an interlock but, at a minimum, as a warning that a lift is in use or that a door is open. Some mechanical or electrical device must be provided in addition to any operational methods in order to limit the possibility of human error. This provision is written as a performance requirement so that transit operators and manufacturers have as much flexibility as possible in providing such a system. If this requirement cannot be met, operators can develop and propose alternative methods under the procedures for equivalent facilitation.

(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 intended to be stowed while occupied.

This provision is intended to allow persons who need the lift to disembark if the lift 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 platform level 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, providing two separate control systems, 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. Lift 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 also applies to the deployment cycle in order to protect any persons waiting close to the car 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 car. 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 likely 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 lift 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 lift 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 rise or close, or a supplementary system shall automatically engage, and remain raised, closed, or engaged at all times that the lift is more than 3 inches above the station platform or roadway and the lift 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 car. Some lifts have a flap which rises when the lift is deployed and lowers when the platform reaches the car floor level. Other designs depend on the structure of the car itself or a "close-out panel" to prevent falling off the inner edge.

In addition, side barriers must be provided along those portions of the platform that remain outside the car when the lift is in the raised position. The portion which is inside the car envelope does not need side barriers as such barriers could restrict the ability of a wheelchair or mobility aid user in turning into the aisle. 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 car floor when the lift is fully raised. In regard to bus lifts, several lift manufacturers and transit operators have indicated that they 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 turns into the aisle. 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.

Previous FTA-sponsored guidelines for lifts specified a safety test for the loading edge (outer) barrier. The Board has not required such a test in these guidelines because NHTSA is planning to issue proposed safety standards for bus lifts which may be suitable for application here. The Board feels that NHTSA is the appropriate agency to define safety tests. In the meantime, this provision includes only a performance requirement.

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 platform or ground, or there must be an interlock which prevents the lift from rising more than three inches off the platform or 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, for example, 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 lift platform surface shall be free of any protrusions over 1/4 inch high and shall be slip resistant. The lift 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 lift platform surface to 30 inches above the surface, and a minimum clear length of 48 inches measured from 2 inches above the surface of the platform to 30 inches above the surface. (See Fig. 1)

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

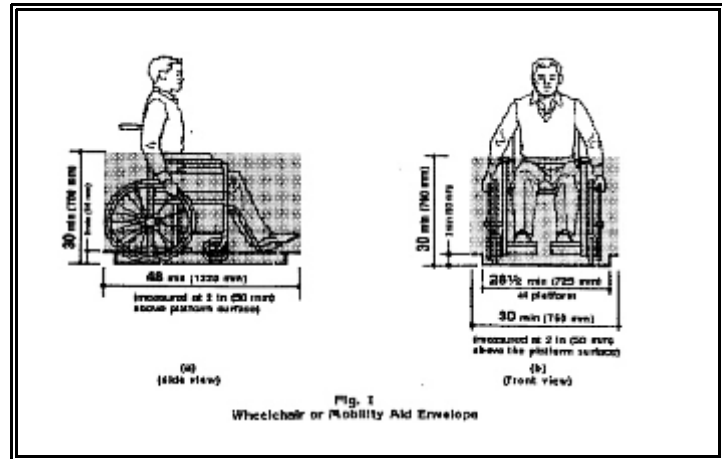
The requirement for slip resistance is a general performance requirement. As discussed under floor surfaces, there are difficulties in defining an appropriate test procedure for determining the level of slip resistance or the static coefficient of friction. However, a static coefficient of friction of 0.6 is recommended for platform surfaces.

The specified platform surface dimensions are consistent with the definition of "common wheelchairs and mobility aids" in requiring a 30 inch width and 48 inch length 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.

The width measurement position acknowledges that the door structure of some cars may not permit a 30 inch wide platform unless the door frame is modified. The width is 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 modifying the door frame. Also, the lift handrails are often attached to the platform at the bottom and the structural material takes up some portion of the usable surface. To have 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.



(7) Platform gaps. Any openings between the lift platform surface and the raised barriers shall not exceed 5/8 inch wide. When the lift is at vehicle floor height with the inner barrier (if applicable) down or retracted, gaps between the forward lift platform edge and 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 applies only to the gap between the platform and the raised barrier and does not preclude the use of expanded metal platforms. A handhold hole is permitted in the platform for lifts which are manually deployed.

(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 the station platform or roadway 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.

This required slope is based on common accessibility standards which allow steeper slopes for short distances where a slope of 1:12 cannot be provided due to existing constraints. A slope of 1:8 is permitted for a maximum rise of 3 inches. If the rise is greater, the slope must be less.

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) 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 lift platform.

The provision has been clarified so that the platform deflection is exclusive of vehicle roll. In practice, however, 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 standard. 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 deflection load is based on the term "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, this situation is potentially the most dangerous and the most likely to result in a wheelchair or mobility aid overriding or defeating the outer barrier.

(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 specified maximum speeds are provided not only for the safety of persons, including standees, occupying the lift, but also of any persons waiting near the lift. The deployment and stowage rate, although allowed a greater speed, may also affect passenger safety. A potential user waiting outside the car 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,

particularly active lifts, could pose a hazard to a person inside the car near the lift if the platform stowed too quickly. Accordingly, the final rule 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 Board considered a requirement for the maximum rate of change of acceleration (jerk) but did not do so because it is difficult to measure and can be easily affected by other variables not directly related to the rate of change of acceleration of the lift platform itself. Also, there is no research which identifies acceptable rates for persons with disabilities.

(11) Boarding direction. The lift shall permit both inboard and outboard facing of wheelchairs and mobility aids.

While some operators advise wheelchair or mobility aid users to back onto the lift, it is difficult for some people to do so. Therefore, the lift must permit persons to board and alight facing either in toward the vehicle or out toward the platform 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 hand rails. This belt must be long enough to go around the back of the wheelchair or mobility aid if the person were facing inward, not just across the armrests for a person facing outward.

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

The DOT rule requires that operators accommodate standees on lifts which meet the design requirements of Part 38. Some current lifts already meet these standards with respect to standees while others do not. According to DOT, it is not the intent of the DOT rule to require that standees be accommodated on lifts which do not meet those standards. See 49 CFR 37.165(g).

(13) Handrails. Platforms on lifts shall be equipped with handrails, on two sides, which move in tandem with the lift 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. 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. Handrails shall not interfere with wheelchair or mobility aid maneuverability when entering or leaving the vehicle.

Considerable research has been conducted in the past on the height of a handrail which can be used by persons with disabilities. 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 a vehicle, the Board is not inclined to fully impose these new dimensions on handrails.

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.

In regard 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. As for handrail diameter, the requirements in this section are consistent with the Board sponsored hand anthropometrics research project which 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. Most car 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 approximately 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 hand rails 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.

(c) Vehicle ramp or bridge plate. - (1) Design load. Ramps or bridge plates 30 inches or longer shall support a load of 600 pounds, placed at the centroid of the ramp or bridge plate 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 or bridge plates shorter than 30 inches shall support a load of 300 pounds.

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. Consequently, the design load specified for lifts is also required for ramps or bridge plates 30 inches or longer. Ramps or bridge plates under 30 inches must have a design load of 300 pounds; such ramps or bridge plates are approximately the length of a test pallet and placement of a loaded pallet on the ramp would not test the strength of the ramp but would instead merely rest on the car 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 boarding area, and when the rear wheels move onto the ramp, the front wheels will be inside the car. 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 or bridge plate surface shall be continuous and slip resistant, shall not have protrusions from the surface greater than 1/4 inch, shall have a clear width of 30 inches, and shall accommodate both four-wheel and three-wheel mobility aids.

The term "continuous surface" means 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 was 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.

A minimum value or coefficient of friction is not specified for slip resistance due to practical difficulties in measuring such a value. However, the Board has conducted research on slip resistance and recommends a static coefficient of friction of 0.8 for ramp surfaces.

(3) Ramp threshold. The transition from roadway or station platform and the transition from vehicle floor to the ramp or bridge plate 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 paths. The ends of the ramp, both where it meets the platform, and the transition to car 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.

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

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 barriers on ramps than for lift platforms.

Although 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.

(5) Slope. Ramps or bridge plates shall have the least slope practicable. If the height of the vehicle floor, under 50% passenger load, from which the ramp is deployed is 3 inches or less above the station platform a maximum slope of 1:4 is permitted; if the height of the vehicle floor, under 50% passenger load, from which the ramp is deployed is 6 inches or less, but more than 3 inches, above the station platform a maximum slope of 1:6 is permitted; if

the height of the vehicle floor, under 50% passenger load, from which the ramp is deployed is 9 inches or less, but more than 6 inches, above the station platform a maximum slope of 1:8 is permitted; if the height of the vehicle floor, under 50% passenger load, from which the ramp is deployed is greater than 9 inches above the station platform a slope of 1:12 shall be achieved. Folding or telescoping ramps are permitted provided they meet all structural requirements of this section.

Previous tests of ramps on buses have shown that a slope of 1:6 is 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. The Board recognizes that there are practical difficulties in meeting common accessibility standards in vehicles which are constrained by other factors, such as maximum width. In view of these factors, this section requires that, in general, the least slope practicable be obtained. A slope of 1:4 is permitted if the vertical floor height is 3 inches or less above the station 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. - (i) Requirement. When in use for boarding or alighting, the ramp or bridge plate shall be attached to the vehicle, or otherwise prevented from moving such that it is not subject to displacement when loading or unloading a heavy power mobility aid and that any gaps between vehicle and ramp or bridge plate, and station platform and ramp or bridge plate, shall not exceed 5/8 inch.

The 5/8 inch gap specified is based on the width of a wheelchair front caster.

(ii) Exception. Ramps or bridge plates which are attached to, and deployed from, station platforms are permitted in lieu of vehicle devices provided they meet the displacement requirements of paragraph (c)(6)(i) of this section.

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 firmly attached to the car or platform when in use for boarding and alighting. Several commercially available portable ramps have brackets which are attached to the car 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 car and ramp greater than 5/8 inch under any conditions, not necessarily that the ramp be rigidly attached.

(7) Stowage. A compartment, securement system, or other appropriate method shall be provided to ensure that stowed ramps or bridge plates, including portable ramps or bridge plates 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.

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. 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 hand rail 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. Hand rails shall not interfere with wheelchair or mobility aid maneuverability when entering or leaving the vehicle.

These hand rail specifications are similar to those required on lifts (see previous discussion).

The Board generally recognizes that "short" ramps and bridge plates do not need handrails while "long" ones may. Unfortunately, there is no general agreement on the definition of "short" or "long." Since most ramps and bridge plates will probably be "short" in some sense, the Board has not made the provision of hand rails on ramps or bridge plates mandatory. The Board will further review this issue when the guidelines are revised and updated.

§192.85 Between-car barriers

Where vehicles operate in a high-platform, level-boarding mode, devices or systems shall be provided to prevent, deter or warn individuals from inadvertently stepping off the platform between cars. Appropriate devices include, but are not limited to, pantograph gates, chains, motion detectors or other suitable devices.

At high platforms providing level boarding, a serious danger to passengers, particularly those with visual impairments, is stepping in-between cars and falling on to the tracks. The light from end windows on some car designs can sometimes cause persons with visual impairments to mistake the gap between cars as an entrance. There are several possible solutions to prevent accidents of this nature noted in the provision. Other available solutions not mentioned in the provision are acceptable so long as they serve to "prevent, deter, or warn" individuals of the gap. The typical bellows provided between many commuter and intercity rail cars serves this same purpose and no additional device is needed. One light rail system is considering installing barriers on the platform which would correspond to the gap between cars when the train stops.

Although the Board does not require or recommend one device or solution over another, it is known that spring or pantograph gates are more effective than chains or motion detectors in stopping a person from stepping over the platform edge and falling between cars. Chains, if mounted high enough, may actually prevent falls, but if mounted at a low height may serve only as a warning to visually-impaired persons using canes. Motion detectors are

strictly a warning device and will not physically restrict someone from falling between cars. Operators concerned about the manual connection and disconnection of spring gates or chains can specify pantograph gates, motion detectors, or other devices.

§1192.87 Public information system.

(a) Each vehicle shall be equipped with an interior public address system permitting transportation system personnel, or recorded or digitized human speech messages, to announce stations and provide other passenger information. Alternative systems or devices which provide equivalent access are also permitted.

This provision requires vehicles to be equipped with a public address system that provides either recorded or digitized human speech messages or announcements made by drivers or other transit personnel. Digitized human speech uses spoken sounds and words arranged digitally and rearranged for customized messages. While other systems that provide equivalent access to information are permitted, the use of synthetic speech is not recommended. According to Board-sponsored research, synthetic speech, which is generated electronically, has not yet been proven to be as easily recognized or understood as recorded or digitized human speech. Information received by the Board during the development of these guidelines did not contradict this assessment.

(b) [Reserved]

These guidelines do not currently contain requirements or specifications for the provision of public information in a form that is accessible to persons with hearing impairments. Such a requirement has been reserved pending further study of the options that are available in making such information fully accessible; the Board expects to include some requirements in the future. However, general prohibitions of discrimination in the DOT rule require, in essence, that information necessary for the operation or use of a transit system be made available to persons with hearing impairments. Thus, it is recommended that the information for passengers contained in audible announcements also be made available to persons with hearing loss or who are deaf. Of course, announcements intended only for system personnel are not part of the information needed by passengers. DOT is assessing available and soon-to-be available technology in a study to be conducted during Fiscal Year 1992. Entities are encouraged to employ whatever services, signage or alternative systems or devices that are available and that provide equivalent access.

Information can be provided in different ways, some of which are relatively simple and inexpensive. For example, one transit system has a policy of flashing interior train lights to indicate to passengers who are deaf that the train is malfunctioning and that all passengers must exit the train at the next station. Of course, the meaning of this signal must be conveyed

in advance to potentially affected passengers for it to be useful and may not be useful to persons unfamiliar with the system, such as tourists. A prominent sign in the vehicle also would be useful. In general, such information should be included in the brochures and guides available to the public rather than only in a "special services" brochure intended for persons with disabilities. Access to some information may also be conveyed by a system of signage providing information routinely provided in announcements (e.g., no smoking, fares, hours of operation) while information provided in special announcements (e.g., changes in schedule, elevators not in service) could be posted in strategic areas, such as at entrances to the station or at information kiosks.

More sophisticated solutions could include visual display systems and electronic message boards. Visual display systems provide information through electronic message boards or video monitors and can accommodate persons who are deaf as well as those with hearing loss. Electronic message boards using a light emitting diode (LED) or "flip-dot" display are currently provided in some transit stations and terminals and may be usable in cars. One transit system is testing the feasibility of on-board visual displays for next-station announcements and even points of interest, news headlines and weather reports. Paid advertisements may be used to support the system. Such visual displays can supplement audio announcements. These devices may be used to provide real time or pre-programmed messages. However, real time message displays require the availability of an employee for keyboard entry of the information to be announced.

Video monitor systems, such as visual paging systems provided in some airports (e.g., Baltimore-Washington International Airport), are another alternative. The Board can provide technical assistance and information on these systems, including a free pamphlet, "Airport TDD Access: Two Case Studies."

Assistive listening systems (ALS) may possibly provide another alternative although they benefit a narrower population of people with hearing loss. These types of systems are intended to augment standard public address and audio systems by providing signals which can be received directly by persons with special receivers or their own hearing aids and which eliminate or filter background noise. Magnetic induction loops, infra-red and radio frequency systems are types of listening systems which are appropriate for various applications. These systems, however, are not usable by persons who are deaf. Further, the feasibility and cost of installing such devices on cars remain uncertain. The Board has published a pamphlet, "Assistive Listening Systems," available at no cost, which lists demonstration centers across the country where technical assistance can be obtained in selecting and installing appropriate systems. The state of New York has also adopted a detailed technical specification which may be useful.