RAPID RAIL VEHICLES & SYSTEMS

Technical Assistance Manual

October, 1992

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Introduction

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

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

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

Background

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

Title II of the ADA prohibits discrimination on the basis of disability in services, programs, and activities provided by public entities, including units of State and local government and the National Railroad Passenger Corporation (Amtrak). Title II addresses public transportation and contains provisions specifically addressing the following types of transit systems: fixed route bus, rapid rail, light rail, commuter rail, and intercity rail. Under title II, transit systems of these types which are owned or operated by public entities, and persons under contract with such entities, must be made readily accessible to and useable by individuals with disabilities, including individuals who use wheelchairs. With respect to public entities, title II requires that:

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

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

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

"One-Car-Per-Train" Rule. At least one vehicle or car in each train of two or more cars must be accessible 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 remanufactured after February 25, 1992, to extend their useful life for 10 years or more must be made accessible to the maximum extent feasible.

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

New Vehicles for Fixed Route Systems. New vehicles with a seating capacity of more than 16 passengers purchased or leased after 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 dawn primarily from a series of guidelines developed as part of a project sponsored by the Federal Transit Administration (FTA), formerly the Urban Mass Transportation Administration (UMTA), in 1986: Guideline Specifications for Passive Wheelchair Lifts, Guideline Specifications for Active Wheelchair Lifts, Guideline Specifications for Wheelchair Ramps and Guideline Specifications for Wheelchair Securement Devices. Provisions from the Guideline Specifications were supplemented with additional material derived from common accessibility standards, such as the Uniform Federal Accessibility Standards (UFAS) and the American National Standards Institute (ANSI) A117.1-1980 specifications, research sponsored by the Access Board, and industry practice. Some provisions for Automated Guideway Transportation (AGT) "people movers" and rapid rail systems were derived from Los Angeles Downtown People Mover: Handbook on Accessibility for the Elderly and Handicapped (UMTA, November 1980). In addition, the guidelines incorporated provisions of 49 CFR Part 609 for buses, light rail and rapid rail systems published by UMTA in 1976.

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

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

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 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 regarding 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 proposal. It contains miscellaneous instructions, including dimensional conventions and tolerances, and general terminology. An appendix was also added to the final guidelines that contains additional information, explanations, and advisory materials. That material is summarized in the discussion sections of this document, where appropriate.

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

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

Subpart C -- Rapid Rail Vehicles and Systems

§1192.51 General.

(a) New, used and remanufactured rapid 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 rapid rail vehicle for use on its rapid rail 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 §37.81(c) for the criteria for good faith efforts. Vehicles that are remanufactured after this date to extend their usable life for 10 years or more are also required to be accessible, to the extent that it does not compromise the structural integrity of the vehicle. On October 4, 1990, 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) 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 door signals 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 bridge plate or other boarding device is not required, even if the entrance of a vehicle is modified.

(c) Existing vehicles which are retrofitted to comply with the "one-car-per-train rule" of 49 CFR 37.93 shall comply with §§1192.55, 1192.57(b), 1192.59 and shall have, in new and key stations, at least one door complying with §1192.53(a)(1), (b) and (d). Removal of seats is not required. 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 having 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 listed in the chart below.

The requirement for "at least one door" is designed to accommodate curved platforms in existing stations where not all vehicle doors can attain the same horizontal gap. Notice also that the gap requirements pertain only to existing stations which have been designated as key stations. The horizontal gap requirements can be met by installing a protruding sill at some doors or adding material to the platform edge face. However, information supplied to the Board suggests most existing vehicles will meet these requirements without modification.

Existing vehicles that meet previous accessibility standards can also be used to meet the "one-car-per-train" rule without any retrofit. Specifically, these standards include those issued by FTA for 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.

REQUIREMENTS FOR RETROFITTED VEHICLES
Priority seating signs
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

One accessible door that in new and key stations:

- 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.

§1192.53 Doorways.

(a) Clear width. - (1) Passenger doorways on vehicle sides shall have clear openings at least 32 inches wide when open.

The 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 the crutch-tip-to-crutch-tip distance of a typical crutch user. Also, the requirement is for a "clear opening." Providing a wide doorway with a vertical stanchion in the center does not meet this 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.

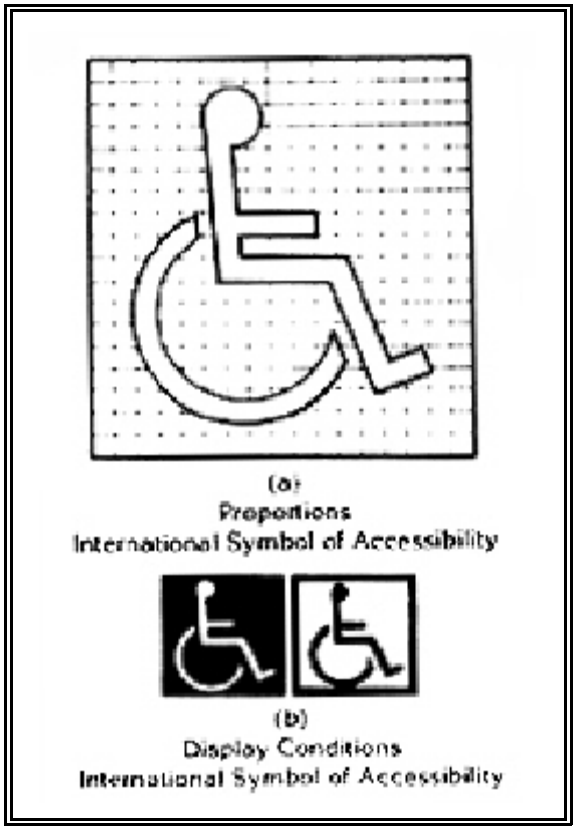
These guidelines do not address evacuation procedures or require that end doors be used in emergencies or that they be part of an evacuation route. For a variety of reasons, the end doors might not be used by a transit system's evacuation plan. In addition, a transit

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 tunnels, because of narrow walkways, catwalks, and escape ladders that are part of evacuation routes. Nevertheless, 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 accessible vehicles operating on an accessible rapid rail system unless all vehicles are accessible and are not marked by the access symbol.

Under this requirement, all new vehicles must be designated by the International Symbol of Accessibility (access symbol). However, new vehicles acquired for a rapid 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. 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 have been required by existing FTA regulations 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 closing 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.

Visual warning signals should be visible from both inside and outside the car. This can be achieved by equipping the entrances of new cars 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 car. Either method of addressing this requirement is acceptable so long as it provides a visual warning that doors are about to close to persons who are entering or exiting the car. 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. Where new vehicles will operate in new stations, the design of vehicles shall be coordinated with the boarding platform design such that the horizontal gap between each vehicle door 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 under all normal passenger load conditions. Vertical alignment may be accomplished by vehicle air suspension or other suitable means of meeting the requirement.

These specifications for vehicle coordination with the platform pertain to new vehicles operating at new stations. This provision, and the exceptions that follow, outline the maximum

horizontal gap and vertical tolerance allowed under these guidelines. However, the goal is that vehicles 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. It is understood that these tolerances, even when specified in the acquisition of new vehicles, may not be achieved under all conditions. These 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 accepting 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 and track specifications. Those requirements, including gap tolerances and the rail-to-platform height, are provided at 49 CFR Part 37, Appendix A.

In those unique instances where a new rapid rail system cannot 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 ensure 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 of the beginning of this manual for further discussion of dimensional tolerances.) When the variation exceeds these limits, adjustments would be required to bring the vehicle back into alignment.

(2) <u>Exception</u>. 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 tracks 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. The design of existing platforms, such as those that are curved, can make the provision of the same horizontal gap infeasible at all doors. 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 side of a vehicle. A 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 just key stations.

§1192.55 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) Characters on signs required by paragraph (a) 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. In general, the requirement is designed to eliminate type faces with letters which are short and fat or tall and thin. Also, the individual stroke lines should not be especially thin or thick. Many common type faces fit within these aspect ratios. If the specifications are included in bid documents, signage manufacturers should have little difficulty supplying appropriate type styles.

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.

§1192.57 Interior circulation, handrails and stanchions.

(a) Handrails and stanchions shall be provided to assist 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. 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) Handrails, stanchions, and seats shall 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 user circulation and shall be kept to a minimum in the vicinity of 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.

Handrails 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 handrail or stanchion. Of course, such a handrail or stanchion cannot encroach upon the required 32 inch width required for the doorway or the route leading to the clear floor space. 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 rapid rail vehicles because of the low acceleration and deceleration forces.

(c) The diameter or width of the gripping surface of handrails and stanchions shall be 1-1/4 inches to 1-1/2 inches or provide an equivalent gripping surface and shall provide a minimum 1-1/2 inches knuckle clearance from the nearest adjacent surface.

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.

§1192.59 Floor surfaces.

Floor surfaces on aisles, 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.

§1192.61 Public information system.

(a)(1) Requirements. Each vehicle shall be equipped with a 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. Each vehicle operating in stations having more than one line or route shall have an external public address system to permit transportation system personnel, or recorded or digitized human speech messages, to announce train, route, or line identification information.

(2) Exception. Where station announcement systems provide information on arriving trains, an external train speaker is not required.

This provision requires cars 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 recorded 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.

It is also required that rapid rail vehicles be equipped with an external speaker. This does not apply to vehicles operating on only one line or route since the destinations announced would be the same for all vehicles. The Board is aware of the concern about the use of external speakers on vehicles that operate in quiet residential areas and notes that transit operators have

full discretion over the volume of external announcements and that a minimum decibel level is not specified by this provision.

(b) [Reserved]

These guidelines do not currently contain technical specifications for the provision of public information in a format that is accessible to persons with hearing impairments. Such a technical 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. Nevertheless, general prohibitions of discrimination in the ADA itself and the "provision of service" requirements of the DOT rule require, in esssence, that information necessary for the operation or use of a transit system be made available to persons with hearing impairments. See 49 CFR 37.167(f). 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 general 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. Announcements of elevator outage, for example, could be easily conveyed on a simple chalkboard in the station kiosk.

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. At least two such systems have been installed at no cost to the transit agency since the company providing the equipment is seeking paid advertisements to support the installation and operation. Such visual displays can supplement audio announcements and are useful to all passengers where the noise level or reverberation is high. 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 technical assistance manual, "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.

§1192.63 Between-car barriers.

(a) Requirement. Suitable devices or systems shall be provided to prevent, deter or warn individuals from inadvertently stepping off the platform between cars. Acceptable solutions include, but are not limited to, pantograph gates, chains, motion detectors or similar devices.

(b) Exception. Between-car barriers are not required where platform screens are provided which close off the platform edge and open only when trains are correctly aligned with the doors.

A serious danger posed to passengers, particularly those with visual impairments, is stepping in-between cars and falling onto the tracks. The light from end windows can sometimes cause persons with visual impairments to mistake the gap between vehicles as an entrance. This provision mentions some possible solutions to prevent accidents of this nature.

Other available solutions are acceptable so long as they serve to "prevent, deter, or warn" individuals of the gap.

Although the Board does not require or recommend one device or solution over another, 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 persons with visual impairments who use 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.