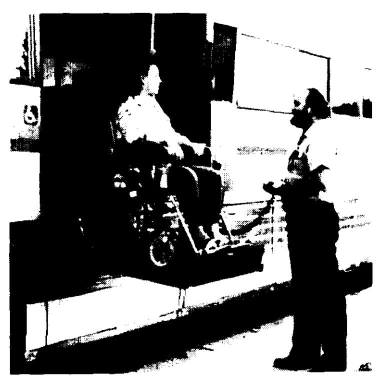
Accessibility Technologies for Over-the-Road Bus Service 4

FINDINGS

- Level-change devices can assist persons with mobility impairments in boarding and disembarking from over-the-road buses (OTRBs). As of late 1992, a number of vehicle-based lift technologies were available for OTRBs, and several such technologies were in the research and development phase. The capital costs for the available vehicle-based lifts range from $7,000 to $17,000. However, the Office of Technology Assessment (OTA) found only one station-based lift technology under development that appeared likely to meet Americans with Disabilities Act (ADA) standards (the cost estimate for this lift is $4,500). OTA found no ramp technology under development that would meet ADA standards.
- Bus modifications are necessary in conjunction with level-change devices to accommodate wheeled mobility aids onboard the bus. Modifications include wheeled mobility aid tie-down positions, folding seating units, movable arm rests, and an accessible door (modification costs are estimated at between $5,000 and $7,000).
- Currently several securement and restraint systems are available for persons using wheeled mobility aids on OTRBs. However, further review of the relevant movement standards is needed. In addition, OTA has not found any securement technology that prevents excessive movement by the wheeled mobility aid while also allowing the user to secure and release him or herself.



- OTRB manufacturers have developed two accessible restrooms, ranging in price from $5,000 **to $35,000.** Both result in a loss of seating capacity.
- At present, several technologies are available to assist persons with sensory and cognitive disabilities. The U.S. Department of Transportation (DOT) has issued lighting and contrast standards, but these do not fully address the communication needs of persons with sensory and cognitive disabilities. Most OTRBs have signage and public address systems; these and additional features could be used to meet the needs of persons with disabilities.
- Employee training is crucial for accessible OTRB service. While few programs are aimed at training OTRB company employees in the area of accessible service, several transit company training programs could be adapted for this purpose.

TECHNOLOGIES TO ASSIST PERSONS WITH MOBILITY IMPAIRMENTS

This chapter describes current and potential technologies to make OTRB service accessible. These technologies can be classified into two categories: 1) those that assist persons with mobility impairments, and 2) those that assist individuals with sensory or cognitive impairments. While sensory and cognitive disabilities are very different, some technologies designed for those with sensory impairments also serve people with cognitive impairments. The chapter also describes how employee training might improve intercity bus accessibility.

Persons with mobility impairments can encounter a number of difficulties when using current intercity bus service. These diffiiculties include getting on and off the bus and using onboard restrooms and terminal facilities, including ticket counters, boarding areas, and restrooms. Several technologies are currently available or proposed to address these problems. In addition to methods designed for persons who use wheeled mobility aids, other technologies assist people with different types of mobility impairments.

Carrying

Carrying is the primary method by which bus companies now assist travelers who cannot otherwise board an OTRB. One or more bus company employees hoist a person up the steps of an OTRB and into a passenger seat. Some bus companies use a boarding chair, a specially designed wheelchair narrow enough to be used onboard an OTRB. Passengers with disabilities are transferred on the ground from their personal wheeled mobility aids to a boarding chair, carried up the OTRB's steps in the boarding chair, wheeled down the aisle, and transferred again to a bus seat. The cost of a boarding chair is estimated at between $550 and $650.[1]

Most individuals who use wheeled mobility aids find that being lifted and carried for boarding or seat transfer is objectionable for reasons of safety, privacy, and dignity. Carrying might also be painful for people with certain disabilities, such as multiple sclerosis. In addition, there is risk of injury during the carrying process; bus employees might drop someone or strain themselves. Such accidents are likely to lead to increased workmen's compensation, litigation, and insurance costs. Since passengers must be separated from their wheeled mobility aids, there is also the possibility of damage to a wheelchair or scooter that is stowed. Indeed, some are so large and heavy that it is unclear where they might be kept.[2] If stored in the OTRB's baggage compartments, they might displace baggage or package express items.

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[1] Randy Isaac, Isaacs and Associates, Cottontown, TN, personal communication August 1992.

[2] Luggage compartments approximately 3 1/2 feet high are necessary to transport wheelchairs without folding or disassembling them. Scooters might require more space. Most luggage compartments are 33 1/2 inches high, or less than 3 feet.

Ramps

Ramps provide a smooth, gradual surface for travelers to get from the ground into an OTRB. The Architectural and Transportation Barriers Compliance Board (ATBCB) considers a ramp accessible if it has a slope no greater than 1 to 12, or 12 inches horizontal for every 1 inch vertical rise (see app. 4-A, which details current ATBCB guidelines). This ratio allows most individuals who can operate their own wheeled mobility aids to wheel themselves up the ramp, and reduces the danger that they will roll backwards. With sufficient vertical clearance at the bus entrance and adequate grab rails, the ramp can also be used by individuals with all sorts of mobility impairments, not just those using wheeled mobility aids. As there are no mechanical or motorized parts in a ramp, reliability primarily depends on the strength of initial construction. Maintenance requirements are negligible, consisting mainly of periodic inspections to make certain that all parts are secure.

Ramps can be grouped into two categories: transferable and station-based ramps, Greyhound Lines, working with Handi-Ramp, Inc., of Mundelein, Illinois, has developed a transferable ramp (see photograph). The ramp has a slope of 1 to 8 (which does not meet current ADA standards) and is designed in five sections that can be disassembled and stored in the baggage compartment. The ramp parallels the side of the bus, and is 30-inches wide—too narrow to accommodate many wheeled mobility aids. A railing is provided on the side away from the bus, and the bus itself serves as a restraint on the inner side. At the door of the bus, the ramp is level with the passenger seating deck. A "bridge" platform spans the stairwell area entering the bus.[3] Ramp assembly time for two experienced operators could be less

Greyhound Lines, Inc.

Greyhound tested this ramp to board persons with disabilities. It does not meet current ADA standards.

than 5 minutes, though a single unpracticed operator might require as much as 20 minutes.[4] Cost estimates for the Greyhound ramp range from $3,500 to $4,500.[5] Since the ramp design does not call for modifying the bus to accommodate wheeled mobility aids, a boarding chair is necessary. Given the difficulties stated above and the requirement of a boarding chair, persons who use wheeled mobility aids might not readily accept such a ramp as a means of accessible service.[6]

Station-based ramps remain at the bus station. Prices for the several types of ramps proposed range from $4,000 to $7,500, depending on the construction materials. A problem with reliance on station-based level-change devices is that passengers with mobility impairments might be unable to disembark at an unscheduled stop. Although on-the-road breakdowns are not a

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[3] Econometrics, Inc., "Evaluation of Methods to Provide Accessibility to Over-the-Road Buses and Services," OTA contractor report, July 28, 1992, p. 58.

[4] Isaacs, op. cit., footnote 1.

[5] Randy Isaacs, director of State Government Affairs, Greyhound Lines Inc., personal communication, Nov. 5, 1991.

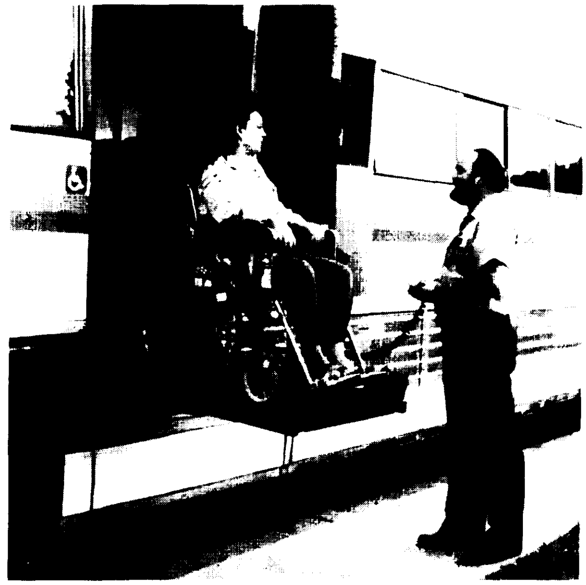
[6] Remarks at Office of Technology Assessment Workshop, "Intercity Bus Access for Individuals With Disabilities," Mar. 17, 1992.

regular occurrence, they are not uncommon. In an emergency situation, if the OTRB were equipped with a collapsible ramp and boarding chair, a person with mobility impairments could more easily and safely exit the bus or transfer to a replacement OTRB.

Lifts

OTA workshop participants have indicated that lifts in conjunction with bus modifications offer the highest degree of user acceptance. Several early generation lifts are currently used as boarding aids on intercity bus coaches. Lifts act as either manual or powered level-change devices. All lifts include a platform to raise and lower the occupant, a barrier to prevent the wheeled mobility aid from falling off the platform, and some form of side support for the user to grasp. However, lifts vary in operating costs, maintenance needs, and the degree to which other aspects of operation are automated (e.g., door closing and opening, barrier operation, and stowage). Lifts mounted inside the bus occupy space in the passenger area or the luggage compartment. In order to maintain adequate headroom at the door, some lifts displace overhead luggage space. Depending on the coach configuration, lift users may board the coach through separate entrances located along the side or at the back of the coach.[7]

With appropriate vehicle modifications, lifts allow individuals who use wheeled mobility aids to board, ride, and disembark from coaches without leaving their mobility aids. These bus modifications include tie-down positions (discussed below), foldup seating units, and an additional accessible door. Vehicle-mounted lifts, because they affect the structural integrity of the bus frame, can necessitate further structural modifications. It is estimated that these elements together constitute about $5,000 to $7,000 of the cost involved in the installation of a lift. In some cases, these bus modifications cause a loss of two



Stewart and Stevenson Power, Inc.

A passenger leaves an OTRB using an exterior-style lift.

to four passenger seats when persons using the tie-downs are onboard.

OTA has identified three types of lifts: vehicle-based, station-based, and transferable lifts. Vehicle-based lifts are the most common. OTA examined six different vehicle-based lifts designed in the United States and Canada and three from Europe. Vehicle-based lifts are part of the bus and therefore can be used at all stops. Some models take up baggage space when stored, while others reduce seating capacity. Electrical vehicle-based lifts rely on power from the coach, allowing operation only when the bus is running. However, many models have emergency, manual pumps that allow for independent operation. Cost estimates for powered vehicle-based lifts fall between $12,000 and $24,000, including vehicle modifications.

Vehicle-based lifts have two basic styles, “elevator” lifts and “exterior” lifts. Elevator lifts operate within the bus; users access the lifts

[7] Transit bus lifts are usually at the front or middle entrances, so persons with wheeled mobility aids use the same doors as other passengers. OTRB lifts often use separate entrances toward the rear of the bus.

through side doors near the baggage compartments of the bus. Exterior lifts operate outside the bus; users enter the lift outside the bus and are raised to a door at the OTRB's deck level.

Station-based lifts are located at passenger terminals. OTA has found only one station-based lift, and it is currently in the development stage. Proposed by Adaptive Engineering Ltd. of Canada, the lift would be adapted from their Mobilift Model 4P(291 lift currently used by Amtrak (see photograph). The proposed lift is portable (although it currently cannot collapse to fit into a baggage compartment); one person can roll it to the side of the bus. It does not use either an electric motor or hydraulic devices to raise the lift platform, relying instead on a manual, hand-cranked cable lifting system. Maintenance requirements are minimal. Cost estimates for the manually powered lift range from $4,000 to $5,000, without bus modifications.[8]

Transferable lifts can be shifted from one bus to another, In 1992, no transferable lifts were in operation on OTRBs. The station-based lift discussed above could perhaps be adapted to fit in the baggage bay of an OTRB, although it would displace a considerable amount of baggage space. To deal with this problem, Adaptive Engineering has proposed a new type of transferable lift, referred to as the ''backpack" lift. The lift would be housed on the back of the bus, above the bus' rear bumper. When needed the backpack lift would slide along rails to the accessible side door. Before such a lift could be developed, however, several design problems must be solved, including: a method for negotiating the lift around the comer of the bus; a casing that protects the lift from harsh road and weather conditions; and a way to quickly and easily move the lift to allow engine maintenance. Because transferable lifts are still only a proposed technology, no reliable cost estimates exist.

Adaptive Engineering, Ltd.

This station-based lift, while designed for use on rail systems, may be adapted for OTRBs.

Some current lift designs pose problems for persons who use aids such as canes and crutches. Often, doorposts and other barriers are too low to allow these travelers to stand while exiting the lift, requiring them to crouch or duck in order to avoid bumping their heads, Therefore, the doorway must be high enough to accommodate these passengers. Some manufacturers have also added features to their lifts that would allow users to sit, rather than stand, during operation.

Data on the reliability of lifts is hard to come by, primarily because the technology has been employed in only 350 buses in the United States, most of which use early generation lifts.[9] However, some information is available from demon-

[8] Endre Pataky, export *manager,* Adaptive Engineering Ltd., personal communication, July 1992.

[9] Experience with lifts indicate that they are becoming more reliable with each successive generation. Manufacturers are ironing out problems, determining maintenance requirements, and standardizing the production process. In addition, bus drivers are learning better how to operate the lifts.

stration projects in Canada and experience in the United States (see ch. 3). Not surprisingly, different types of lifts have different reliability records. In general, the simpler the design, the less that goes wrong. Some lifts seem to be plagued by high maintenance costs and extended downtime, especially early generation elevator-style lifts. Others simply require routine checking of fluid levels. Reliability may be affected by exposure to road and harsh weather conditions.

Driver inexperience in operating the lifts can also lead to problems. The driver assumes several responsibilities, including communicating with individuals with a variety of impairments, operating the lift, and in some cases fastening the securement and restraint system once the passenger is inside the coach. (Related training is discussed later in this chapter). In some demonstration projects, drivers operated the lifts only a few times each year. Because of their limited experience with the lift, many drivers had difficulties recalling the correct procedures.

Securement, Restraint, and Other Issues

A requirement common to all accessible OTRBs is the provision of adequate space for wheeled mobility aids, and restraint of the mobility aid and passenger, inside the bus. Securement systems must restrain the wheeled mobility aid's movement so that it does not break free or collapse and injure someone or sustain damage itself.[10] Wheeled mobility aids that are not properly secured during an accident or even normal driving conditions (e.g., during fast turns or quick braking) pose serious risks to both the occupant and other passengers. The ATBCB Americans With Disabilities Act Accessibility Guidelines for Transportation Vehicles call for securement sys-


Project ACTION, National Easter Seals Society

Drivers must often assist passengers securing their wheelchairs.

terns on vans and transit buses to limit the movement of wheeled mobility aids to no more than 2 inches in any direction under normal vehicle operating conditions.[11] However, because intercity coaches often travel at faster speeds than transit buses and vans, a stricter standard might be necessary.

Securement system design is complicated because there are over 500 different types of wheeled mobility aids.[12] (For a drawing of a typical wheelchair, see figure 4-l.) Common issues facing designers include:

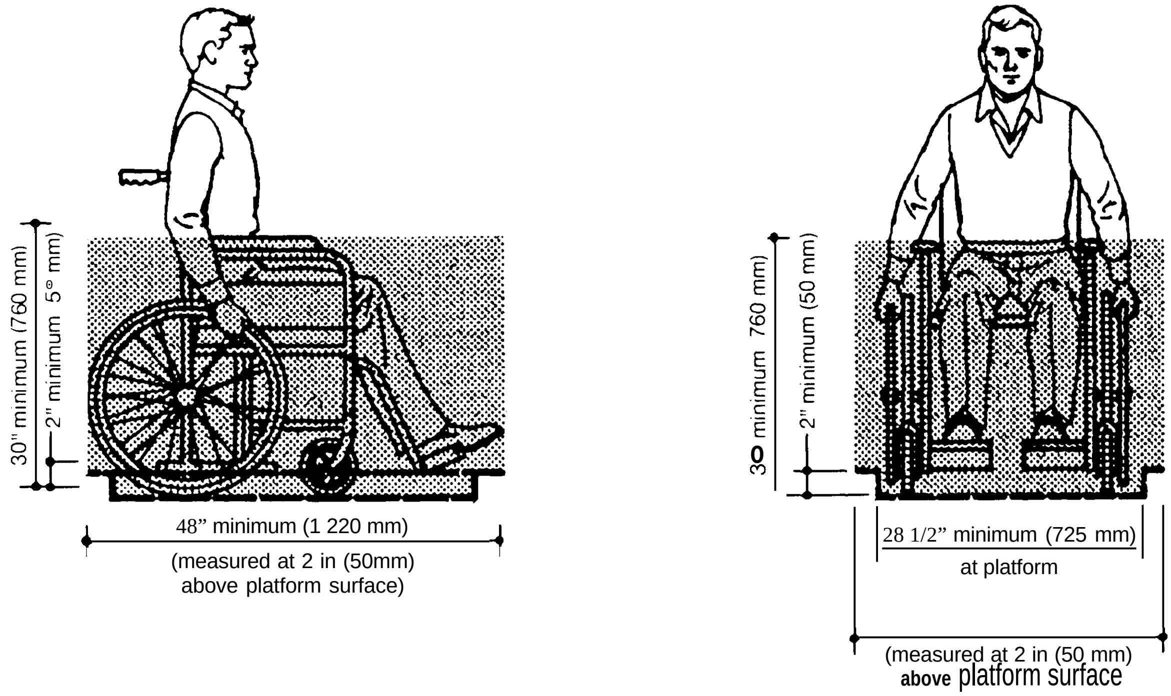
- Wheeled mobility aids are not meant to take stress from the directions that restraint systems might impose;
- Three-wheeled scooters have different stability characteristics from conventional four-wheel designs;
- Wheelchairs and scooters have a variety of wheel designs with differing thickness, diameter, and spoke characteristics, making it difficult to design a uniform wheel clamp;

10 Because wheeled mobility aids are not designed to be used as intercity coach seats, they are susceptible to damage during severe driving conditions. Norman Littler, coordinator for Regulatory Relations, MCI, personal communication Aug. 19, 1992.

I 1 56 *Federal Register* 45540 (Sept. 6, 1991), Architectural and Transportation Barriers Compliance Board, Americans With Disabilities Act Accessibility Guidelines for Transportation Vehicles; Final Guidelines, 36 CFR Part 1192, Sub Part B, 1192.23 (5).

12 Katherine Hunter-Zaworski, assistant professor, Transportation Institute, Oregon State University, personal communication, Dec. 14, 1991.

Figure 4-l—Typical Wheelchair Dimensions



SOURCE: 56 ***Federal Register 45576*** (Sept. 6,1991), Architectural and Transpiration Barriers Compliance Board, Americans With Disabilities Act Accessibility Guidelines for Transportation Vehicles; Final Guidelines, 36 CFR Part 1192.

- Opinion is split on whether the person should be secured as well as the wheeled mobility aid and whether they should be secured together or separately;
- The ideal securement system would allow for quick entry and exit, preferably allowing the user to operate the system without assistance;
- Some travelers with disabilities cannot secure themselves, regardless of system design; and,
- Passengers and drivers are sensitive about violations of their personal space, as might occur when the driver must assist in the securement procedure.

Thus, it is difficult to develop a securement system that can adapt to all types of wheelchairs and scooters and is acceptable to all users and drivers. OTA has not found any securement systems that both adequately limit wheeled mobility aid movement and enable the user to restrain and release him or herself.

Currently, there are two main types of securement devices: the belt design and clamp design. In 1992, urban transit service and accessible OTRBs used both systems. Belt systems are usable on the majority of wheelchairs and have proven crashworthy. Crash tests conducted on the Q-Straint belt design securement system have shown that in crashes of up to 20gs, wheelchairs moved less than 4 inches .13 However, drivers who are not properly trained or do not use the system routinely might require as much as 15 minutes to secure a wheeled mobility aid and still might not

[13] In addition, the Q-Straint system meets the ATBCB requirement that chairs not move more than 2 inches under normal driving conditions.

secure it properly.[14] *The Q-Straint* belt securement system costs approximately $400 per unit.[15]

The clamp securement system uses a clamp that locks onto the rear wheels of the mobility aid; the front is fastened with straps. The advantage of the clamp system is the ease of attachment, allowing some persons with mobility impairments to secure themselves.[16] Clamp systems do not work on all types of wheeled mobility aids, however, because of the varied widths of wheels. In addition, mobility aid wheels are not as strong as the frames, and therefore run a higher risk of collapsing during a crash.

One proposed solution to the problem of diversity among wheeled mobility aids is the use of a uniform attachment device. The device could be fastened to a wheeled mobility aid in order to make it compatible with a standard securement device inside the bus,[17] reducing the time needed for securement.[18] To maximize user acceptance, any add-on feature should be inconspicuous, simple, and inexpensive.[19]

A separate but related issue is the securing of the passenger. Many wheeled mobility aids do not offer as much back, neck, or head support as intercity bus seats, which are taller and provide headrests. In an accident in which an individual's head is snapped backward, people seated in wheeled mobility aids might be more likely to sustain neck or head injuries. Furthermore, some people with disabilities might not be able to use their arms to protect themselves in a crash.[20] All securement systems examined by OTA provide optional restraint devices, such as lap and shoulder belts, but no means of supporting the occupant's head and neck.

Technologies for Persons Not Using Wheeled Mobility Aides

There are several coach enhancements that can improve the accessibility of OTRBs for persons who have mobility impairments but do not use a wheeled mobility aid. Many of these enhancements are already required by DOT.[21] (For an overview of current accessibility regulations, see box 4-A.) These include slip resistance standards for aisles, steps, and floors; knuckle clearances for hand rails; lighting and contrast standards; and minimum door widths. The 32-inch-wide door allows a male at the 95th percentile in height using two crutches to enter.[22]

Another necessary modification would be the installation of foldup arm rests, allowing people with mobility impairments who do not use wheeled mobility aids easier access to OTRB seats. Other modifications currently offered on OTRBs include retractable first step and kneeling features. A retractable first step reduces the step's

14 William Bauer, executive director, Cleveland, Ohio Services for Independent Living, personal communication, Aug. 18, 1992.

15 Dave Kessler, manager of Bus Bidding, Flxible Corp., personal communication% Aug. 18, 1992.

16 The individual can back the wheeled mobility aid into the clamp, which automatically locks, and then fasten the front straps.

17 Katherine M. Hunter-Zaworski, Transportation Institute, Oregon State University, "OSU Offers 'Trailer-Hitch' Approach to Solve Securement Problems, " Project ACTION Update, National Easter Seals Society, fall 1991, pp. 4-5.

18 A uniform attachment can be used in conjunction with both the belt and clamp securement systems. The Services for Independent Living in Cleveland is developing a clamp-style securement system that uses a universal attachment. The system has held a wheelchair to within 1 1/2 inches in a 20g test collision.

19 William Bauer, executive director, Services for Independent LivingCleveland, OH, ''Project Develops Prototypes of Self-Securement Systems, " Project ACTION Update, National Easter Seals Society, fall 1991, p. 6.

20 Bauer, op. cit., footnote 14.

21 56 *Federal Register* 45771 (Sept. 6, 1991), Part 38, Subpart G, Sec. 151-157.

22 It is Motor Coach Industries Limited's position that accommodating the 32-inch standard could require moving the pillar behind the door rearward, forcing the front axle rearward, displacing air conditioning equipment, and forcing reconfiguration of the front third of the bus in order to maintain proper axle loading, pavement wear, and other operating characteristics. Joseph M. Dabrowski, vice president for Engineering, Transportation Manufacturing Corp., personal communication Mar. 17, 1992.

Box 4-A-Current Bus Accessibility Regulations

In 1991, the U.S. Department of Transportation (DOT) issued rules under the Americans with Disabilities Act (ADA) regulating accessibility standards for publicly owned and operated transit buses, privately owned and operated over-the-road buses (OTRBs), and privately owned OTRBs operated under public contract.

The regulations governing transit buses cover:

- doors, steps, and thresholds,
- priority seating signs,
- interior circulatiion, handrails, and stanchions,
- lighting,
- fare boxes,
- public information systems,
- stop requests, and
- destination and route signs.[1]

In addition, the regulations included a mobility aid accessibility section, mandating that transit buses provide a' 'level-change mechanism or boarding device. " The regulations state:

> All vehicles covered by the subpart shall provide a level-change mechanism or boarding device (e.g., lift or ramp) complying with paragraph (b) or (c) of this section and sufficient clearances to permit a wheelchair or mobility aid user to reach a securement location. At least two securement locations and devices, complying with paragraph (d) of this section, shall be provided on vehicles in excess of 22 feet in length.[2]

Regulations controlling privately owned and operated OTRBs took effect in 1991. These regulations apply to doors, steps, and thresholds; interior passenger circulation, handrails, and stanchions; and lighting.[3] In addition, they mandate that OTRB operators provide accessible service and arrange for a passenger with disabilities to be carried aboard if no other type of boarding aid is available. OTRB operators may require up to 48 hours advance notice for providing boarding assistance.[4] These regulations maybe augmented after DOT review of this study. Regulations governing boarding aids have yet to be formulated. DOT will issue boarding aid regulations after review of this study, and these regulations will take effect in 1996 for large bus companies and 1997 for small bus companies.[5]

One exception to the regulations covering OTRBs applies to publicly owned OTRBs and privately owned OTRBs under contract to a public entity. These OTRBs must comply not only with the regulations governing privately owned and operated OTRBs, but also with the mobility aid accessibility rules regulating transit buses, i.e. they must provide a boarding aid such as a vehicle-based lift or rarnp.[6]

1 56 *Federal Register* 45757-45760 (Sept. 6, 1991), U.S. Department of Transportation, Transportation for Individuals with Disabilities; Final Rule, Part 38, Subpart B.

2 Ibid., Sec. 38.23, paragraph (a).

3 56 *Federal Register* 45771 (Sept. 6, 1991), U.S. Department of Transportation, Transportation for Individual with Disabilities; Final Rule, Part 38, Subpart G.

4 56 *Federal Register* 4564045641 (Sept. 6, 1991), U.S. Department of Transportation, Transportation for Individuals with Disabilities; Final Rule, Part 37, Subpart G, Sec. 37.169.

5 *Federal Register*, op. cit., footnote 3. The President can delay implementation of each set of final regulations for 1 year.

656 *Federal Register* 45626 (Sept. 6, 1991), U.S. Department of Transportation, Transportation for Individuals with Disabilities; Final Rule, Part 37, Subpart A, Sec. 37.23, paragraph a; and 56 *Federal Register 45625* (Sept. 6, 1991), U.S. Department of Transportation, Transportation for Individuals with Disabilities; Final Rule, Part 37, Subpart A, Sec. 37.7, paragraph c.

height to approximately 8 inches, down from 16 or 17 inches.[23] Kneeling options reduce the frost step height by 3 to 5 inches. In addition, some OTRBs carry a step box, which adds an additional step. Without reductions in step height, many persons who could otherwise climb steps cannot board.

Aisle width is another possible obstacle. The standard 14-inch aisle width accommodates only certain boarding chairs and imposes severe restrictions on users of walkers, crutches, or canes. Given exterior coach width limitations of 96 or 102 inches, however, increasing aisle widths along the entire length of the coach would almost certainly reduce seating capacity.


Motor Coach Industries

As of early 1993, all accessible OTRB restrooms displace passenger seating.

Accessible Restrooms

The authors of the ADA were uncertain about the availability of accessible OTRB restrooms or the feasibility of designing one without incurring a significant loss of seating capacity. Restroom access will be necessary if OTRB service is to be truly accessible, and some manufacturers have begun designing onboard accessible restrooms.

OTA has identified two accessible restroom designs. One design is currently available as an option on some Neoplan coaches.[24] Like most conventional restrooms, it is on the same level as the passenger deck, in the back of the bus. The Neoplan design differs from a conventional restroom in that the dimensions are slightly larger. The accessible restroom permanently displaces three seats and requires the narrowing of one seat by 3 inches. The location of the lift entrance is a few feet forward of the restroom, so that persons who use wheeled mobility aids need only back a short distance to the restroom entrance. The Neoplan's dimensions provide just enough clearance to allow a wheeled mobility aid to enter, and use of the toilet requires a relatively agile passenger. The estimated cost for Neoplan's accessible restroom is roughly $5,000, which can be compared with the price of a nonaccessible restroom at $3,300.[25]

The other accessible restroom is a prototype developed by MCI and installed on its 45-foot demonstration coach. Developed in conjunction with MCI's 4-Link lift, the restroom and the lift are fully integrated. A movable partition separates the two so that the space needed for entering the coach from the lift is borrowed from the restroom as needed. The lift entrance is located behind the rear axle. The restroom takes up the entire width of the coach and is quite spacious compared to the Neoplan design. Ample room, handles, and grasps inside the restroom provide for maximum maneuverability and a wide range of agility. Seven seats are lost with the lift and accessible restroom. A potential operational problem is that the toilet is mounted on the left side of

23 In Massachusetts, State utility regulators ordered the retractable first steps on State-assisted buses deactivated because the additional width of the deployed step caused the bus width to exceed the State regulations. As of early 1993, it was unclear whether these regulations are still were in effect for OTRBs.

24 Neoplan is a German manufacturer of OTRBs, with facilities in Colorado.

25 Interview with Harvey F. Dick, senior vice president of Operations, Neoplan USA Corp., Nov. 21, 1991, in Ecosometrics, Inc., op. cit., footnote 3.

the coach, rather than the right, as is customary. Many dumping stations can accommodate only the conventional right rear restroom location.[26] MCI has estimated that a 45-foot coach with the lift and restroom package would cost $50,000 more than a standard 40-foot coach,[27]

One problem with accessible restrooms is that the person using the wheeled mobility aid must release the tie-down restraints, either back up or turn to gain entrance to the restroom, and open the door. Undoing the restraints might be impossible for the passenger, requiring the aid of the driver or an attendant. If the driver is called on, the bus must be stopped.

Reservation Systems

One approach to ensuring accessible service is to have persons with special needs notify bus companies in advance of their desire to travel. Technologies that could be helpful include:[28]

- 24-hour telephone or modem lines for reservations and information;
- automatic vehicle location systems to provide bus location information to fleet management;
- electronic databases for geographical, scheduling, and fare information;
- computerized methods for fleet routing and dispatch; and
- two-way voice or data communications between vehicles and the dispatch center.

As of early 1993, few intercity bus companies had reservation systems. In 1991, Greyhound began the first stage of a computerized fleet allocation, passenger reservation, and yield management system.[29] The new system will allow customers to call the 200 largest Greyhound stations to reserve tickets for specific times and dates, and to receive fare and schedule information for Greyhound and all interlining carriers. In addition, customers will be able to pick up tickets at non-Greyhound locations, such as convenience stores, or receive tickets through the mail.

Other intercity bus companies use less sophisticated reservation systems. Martz Trailways in Pennsylvania, for instance, maintains a noncomputerized reservation system. Users telephone one of six locations to reserve bus seats. Bus employees record their name and bus seat on a standardized form. Approximately 80 percent of the company's regular riders use the reservation system .30

Reservation systems could be used by individuals with disabilities to alert bus companies that accessible service will be necessary. However, under the ADA, bus companies cannot require

[26] Ibid., p. 145.

27 Ibid., p. 145.

28 Paratransit operators and public and private transportation fleets already use many of these technologies, but they have not yet spread to intercity bus service.

[29] The fleet allocation portion of the system allowed Greyhound to more efficiently schedule its bus fleet through an increased use of 'hubs and spokes' and the identification and elimination of unprofitable routes and schedules. Greyhound targeted the passenger reservation and yield management portion of the system to be implemented by mid-1993. Greyhound Lines, Inc., *Greyhound Company Newspaper*, January/February 1993. The yield management portion of the system should enable Greyhound to monitor reservation levels on a real-time basis and, depending on those levels, increase or decrease the number of discount and full fares available on specific schedules in order to maximize revenues, re-route passengers when seat availability is restricted, and generate logs that list inbound and outbound passengers by name.

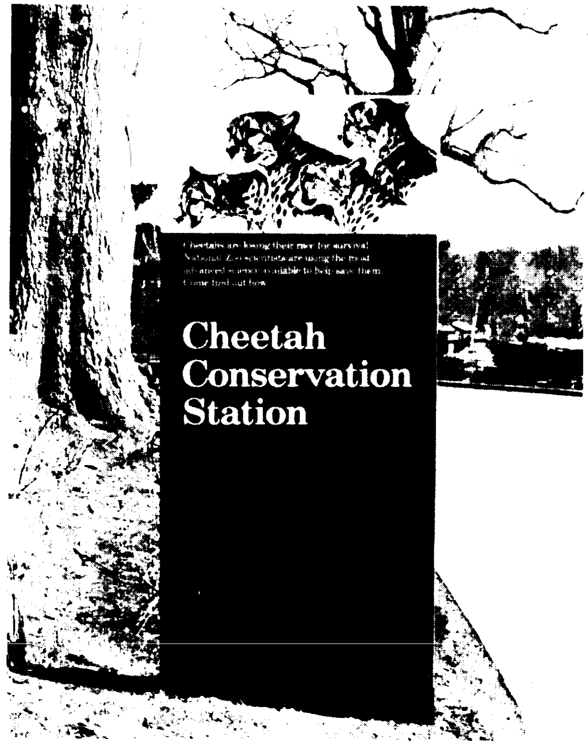
313 Frank Henry, president, Frank Martz Coach Co., personal communication, June 1992.

persons with disabilities to use a reservation system if persons without disabilities are not also required to do so[31] (see ch. 1). In addition, if and when reservation systems are widely used, fleet personnel must be carefully trained to ensure proper coordination of equipment and schedules, particularly when more than one carrier is involved.

TECHNOLOGIES TO ASSIST PERSONS WITH SENSORY AND COGNITIVE DISABILITIES

Technologies for people with sensory and cognitive disabilities are aimed at delivering information to people who otherwise might have difficulty receiving it. People with vision or hearing impairments might have trouble reading signs or hearing instructions. People with cognitive impairments might have difficulty making decisions about which bus to board or where to get off. Several of these technologies serve individuals from both groups.

OTA has found that relatively little technology is being developed specifically to assist persons with sensory and cognitive disabilities to use OTRBs. A wide range of specialized equipment is under development for urban transit operation, and much of it could be applied to OTRBs. However, urban and intercity bus service differ in many ways, so all technologies might not apply equally. Some advantages for intercity service are that freed-route intercity bus tickets are always bought from a ticket agent or driver rather than through a machine, tickets are printed with origins and destination, and these tickets are collected and examined by the bus driver. These



Stephen Garcia

This sign at the National Zoo in Washington, DC combines large graphics, color-coding, and pictures to direct visitors to the exhibit.

practices provide a check to ensure that individuals with sensory or cognitive impairments get on the proper bus, and get off at their destination.[32]

Signage

DOT requires the use of accessible signage in buildings and facilities, including bus stops and terminals (see figure 4-2).[33] Signage, both on the bus and within stations, can help people with sight, hearing, and cognitive impairments. Large

31 Specifically, Section 302(b)(1)A of the ADA prohibits denial of full and equal enjoyment of goods, Sink% facilities and privileges, advantages, or accommodations. This section is made applicable to OTRB operations by Section 304(b)(2). In addition, Section (304)(b)(l) prohibits a private entity that is primarily engaged in transporting people from discriminating, including establishing eligibility criteria that screens out persons with disabilities from full enjoyment of the transportation service. Thus, if the reservation system is the sole means for a disabled passenger obtaining transportation, it would not be permitted under the ADA.

32 Ecosometrics, Inc., op. cit., footnote 3, p. 33.

33 DOT regulations include rules on character proportion, character height, raised and braille characters and pictorial symbols signs, finish and contrast, mounting location and height, and symbols of accessibility. 56 *Federal Register* (Sept. 6, 1991), Department of Transportation Transportation for Individuals With Disabilities; Final Rule, Appendix A to Part 37—Standards for Accessible Transportation Facilities, p. 53,4.30.04.30.7.

and more extensive signs, high contrast signs, and tactile maps (i.e., maps that can be read like braille) can present information to people with disabilities. Placement of braille signs in uniform locations within stations might make it easier for individuals with vision impairments to locate them. Simplifying signs, and using pictures and symbols where feasible, might specifically aid people with cognitive disabilities.[34] In addition, color coding signs, maps, tickets, buses, and stations might make it easier for all people, but especially those with certain cognitive impairments, to follow instructions.

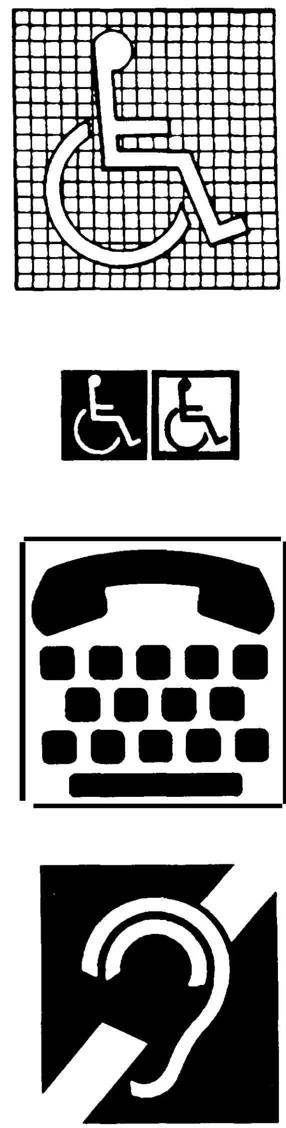
Public Address Systems

DOT requires that transit buses in excess of 22 feet be equipped with either a driver-operated public address system or recorded or digitized human speech messages, to announce stops and provide other passenger information within the vehicle.[35] People with vision and cognitive disabilities might benefit from this technology, as well as individuals with limited hearing impairments. Public address systems could be used both onboard the OTRB and within bus stations. OTRBs generally include public address systems as standard equipment, so a new requirement would not necessarily result in increased costs. An external speaker would require modifications, but the costs would be minimal.[36]

Telecommunications Devices for the Deaf (TDD)

TDDs serve as telephones for individuals with hearing impairments by allowing users to send and receive written messages. Presently, ATBCB guidelines for new stations mandate that if bus stations house interior pay phones, there must

Figure 4-2—Symbols of Accessibility y



Proportions for International symbol of accessibility

Display conditions International symbol of accessibility

International TDD symbol

International symbol of access for hearing loss

KEY: TDD - telecommunication device for the deaf.

SOURCE: 56 FederalRegister45697 (Sept. 6, 1991), U.S.Department of Transportation, Transportation for Individuals With Disabilities: Final Rule, 49CFR Part 37, Appendix A to Part 37—Standards for Accessible Transportation Facilities.

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34 Shari Gelman, headmaster, Ivymount School, personal communication, Aug. 5, 1992.

35 56 *Federal Register* 45760 (Sept. 6, 1991), U.S. Department of Transportation, Transportation for Individuals with Disabilities; Final Rule, Part 38, Sub Part B-Buses, Vans and Systems, Sec. 38.35, Public Information System.

36 Cost estimates for an onboard public address system range from between $150 to $300, not including installation. Mary Fran Kelly, executive specialist, Midwest Electronic Industries, Inc., personal communication, Aug. 28, 1992.

National Easter Seals Society

TDD equipment enables persons with hearing impairments to use the telephone.

also be at least one interior public TDD.[37] Furthermore, the ADA requires telecommunications companies to provide telecommunications relay services for persons with hearing and speech impairments.[38] Individuals with hearing and speech impairments will therefore be able to call bus companies for information on services.

Crawling Messages and Video Monitors

Crawling messages-electronic signs that scroll information across a screen-and video monitors, similar to those currently used in airports, might also display messages or scheduling information within bus terminals. ATBCB's guidelines mandate that if public address systems are offered to convey information, a means of conveying the same information to persons with hearing impairments must be provided.[39] This provision could be satisfied at least partially through employees who are trained to communicate with persons with disabilities.

Other Technologies

Closed circuit television (CCTV) and computer magnification systems enlarge printed information so that it can be read more easily. These systems might be employed in bus stations to magnify system maps or other schedule information. Cost estimates range for CCTV from $2,300 to $3500. Computer magnification systems, which consist of hardware and software to magnify information on computers, add approximately $3,000 to the price of a personal computer. However, in the use of computer magnification systems, the user still must ask an agent for information, wait while it is called up, and remember it. As long as ticket agents are available to provide this kind of verbal or written information, the advantages of CCTV/computer magnification appear limited.[40]

Assistive listening devices (ALDs) help individuals hear speech in group situations, where the combination of background noise, distance, and poor acoustics make it difficult to distinguish or understand speech. ALDs consist of a transmitter carried by the driver and a receiver carried by the user. There are basically three types of ALDs: induction loop systems, narrow-band FM sys-

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37 56 *Federal Register* (Sept. 6, 1991), U.S. Department of Transportation Transportation for Individuals With Disabilities; Final Rule, Part 37, Sec. 10.3 (12)(a).

38 Telecommunications relay services are telephone transmission services that enable individuals with hearing or speech impairments to communicate by wire or radio in a manner that is functionally equivalent to communications by an individual who does not have a hearing or speech impairment. Public Law 101-336, Sec. (401)a.

39 56 Federal Register (Sept. 6, 1991), U.S. Department of Transportation Transportation for Individuals With Disabilities; Final Rule, Part 37, Sec. 10.3 (14).

40 Ecosometrics, Inc., op. Cit., footnote 3, p. 35.

terns, and infrared.[41] Cost estimates for ALDs range from $300 to $5,000, depending on the type of technology used and the number of receivers carried on the bus. A potential operational problem involves issuing, retrieving, and electrically charging the receivers.[42]

TRAINING TO FACILITATE ACCESSIBLE SERVICE

Proper training of bus company employees is an essential part of accessible service, and is already required by DOT. Employees must be able to interact with passengers and operate accessibility equipment.

The OTRB industry thus far has directed little effort toward creating accessibility training techniques or materials.[43] It is quite possible, however, that the industry could adapt the experiences and programs of the public transit industry in developing their own accessibility training courses.[44] Many urban transit systems use training programs that include information on facilitating accessible service. These programs instruct drivers and other employees on ADA requirements, passenger assistance methods, lift operation, and sensitivity training. The Denver Rapid Transit District, for example, has a full day of training on these issues, as does Seattle Metro.

Plymouth & Brockton is one of the few private OTRB firms with an accessibility training program, partly funded by the State government. Plymouth & Brockton is a private firm located in Plymouth, Massachusetts, operating intercity, commuter, airport, and charter and tour services. Their accessibility training program lasts 7 to 8 hours and is one component of a larger employee training course that takes 40 to 60 hours. The training includes classroom, video, role playing, and hands-on instruction in operation of the vehicle-based MCI lift and separate securement system, as well as some sensitivity training. All employees who might come into contact ***with*** either lifts or persons with disabilities take the course. It seldom takes more than 20 to 30 minutes to teach a bus driver how to operate a given lift and securement system.[45] In addition, bus drivers carry their own resource manual, with sections on lift trouble-shooting, operation of the lift, lift load limits, emergency situations, safety, and sensitivity.[46]

Although it falls on the transit authorities and bus companies to develop their courses,[47] most lift manufacturers supply operating instructions in the form of written or video materials to bus companies, and some lift manufacturers train bus company mechanics. For example, Lift-U conducts 8-hour training sessions to teach bus company mechanics lift terminology theory of lift operation, and how to use the manual.[48]

Sensitivity training teaches operators to help individuals with disabilities in a way that affirms the dignity of the person being assisted.[49] Train-

41 The only known installation of an assistive listening device onboard an OTRB was by MCI. In 1986, MCI installed a FM system, purchased from Telex Communications, Inc., on two MCI MC 102A3 coaches for Charterways, Inc. MCI found that the technology worked well.

42 Econometrics, Inc., op. cit., footnote 3, pp. 38-41.

43 Ibid., p. 161.

44 However, special attention must be paid to the differences between transit and OTRB company employee responsibilities. Private OTRB employees perform many of the information, ticket-selling, and personal assistance functions. Therefore, unlike its counterpart in the transit industry, OTRB employee training must reflect these added responsibilities.

45 Richard Summers, Division A, Southern California Rapid Transit District, personal communication, Aug. 21, 1992.

46 John Green, Plymouth & Brockton, personal communication, Aug. 20,1992.

47 Joe p_in e, customer service representative, Lift-U, personal communication, Aug. 21, 1992.

48 Ibid.

49 Econometrics, Inc., op. cit., footnote 3, P. 166.

ing programs begin with information on different disabilities and their effects on the individual's ability to use bus service. The programs aim to develop bus drivers' understanding of individual needs. These programs are often run for transportation operators by disability groups, to familiarize bus employees with people with disabilities. Some programs help drivers experience situations like those a passenger with a disability might face. For example, trainees in Denver are taken downtown, blindfolded, and given the task of locating a certain bus and getting to a destination. Other programs place trainees in a wheelchair and assign them a particular bus trip, While these experiences do not replicate those of persons with disabilities, they increase sensitivity.

For OTRB service to be accessible, tour guides, station staff, ticket clerks, commission agents, telephone information staff, and dispatchers must be trained in ADA requirements and company policy for meeting those requirements.[50] Charter and tour operators will require especially rigorous training. The bus operator, in addition to having to deal with the level-change and securement systems, might be called on to assist people moving around at the destination and at rest stops. In addition, charter and tour drivers will most likely deal with persons with disabilities for longer periods of time, and might need to assist several individuals simultaneously.[51]

One problem identified in OTRB accessibility demonstration projects is that drivers who infrequently use accessibility technologies forget their training and have difficulty recalling procedures. Periodic refresher courses could alleviate this problem. Most current transit programs require refresher training of at least 6 hours once every 3 years, to cover changes in requirements and technologies.[52] Another approach is to have drivers regularly operate the lifts. This prevents operators from forgetting how to use technology and ensures the technology is functioning properly.[53]

Another aspect of accessibility training is user training. Persons with restricted mobility might be more comfortable trying bus travel if they know what to expect. A number of user training programs have been developed and implemented by urban transit systems, several under Project ACTION.[54] These programs are often run with a local Center for Independent Living, rehabilitation center, or other local disability group.[55] For example, Plymouth & Brockton has conducted some user training in conjunction with the Massachusetts Coalition for Citizens With Disabilities. Training included informing participants as to how drivers are trained, demonstrating how the lift functions, and explaining the lift's safety features.[56] Alternative training strategies might be considered for OTRB service, including video or individual onsite training for persons who have expressed an interest in using the bus. However, user training could not under any circumstances be a prerequisite for travel on an OTRB.

5° Ibid., p. 168.

51 Ibid., p. 164.

5² Ibid., p. 167.

53 John Winski, director, Massachusetts Coalition of Citizens With Disabilities, personal communication, Aug. 6, 1992.

54 Project ACTION stands for Accessible Community Transportation In Our Nation. The project, funded by the Federal Transit Administration and managed by the National Easter Seals, was created to enhance relations between transit providers and individuals with disabilities.

55 Ecosometrics, Inc., op. cit., footnote 3.

56 Beverly Stewart, safety supervisor, Plymouth and Brockton, personal communication, Aug. 21,1992.

Appendix 4-A: Requirements for Vehicle-Based Lifts, Ramps, and Securement Systems

The U.S. Department of Transportation (DOT), in the Americans With Disabilities Act Accessibility Guidelines for Transportation Vehicles, reserves decisions on the standards for mobility aid accessibility pending the outcome of this OTA study. However, DOT regulations require that over-the-road buses purchased by public transit entities or operated under contract to public transit entities (under certain circumstances) comply with mobility aid accessibility requirements for transit buses. This appendix summarizes the regulations governing vehicle-based lifts, vehicle-based ramps, and onboard securement systems.

Vehicle-Based Lifts

- The lift shall be designed to support a load of at least 600 pounds.
- The lift platform shall be equipped with barriers to prevent a mobility aid from rolling off, and the platform shall not bend more than 3 degrees when loaded with 600 pounds.
- No part of the platform shall move at a rate exceeding 6 inches per second while lowering or lifting an occupant, and shall not exceed 12 inches per second while deploying or stowing (even if the power or equipment fails).
- Platforms on lifts shall be equipped with handrails on two sides, and the platform surface shall be slip-resistant.
- Lifts shall accommodate persons using walkers, crutches, canes, or braces, or who otherwise have difficulty using steps.
- The lift shall permit both inboard and outboard facing of the occupant.
- The controls shall be interlocked with the vehicle systems, to ensure that the vehicle cannot be moved when the lifts are not stowed and that the lift cannot be deployed unless the interlocks or systems are engaged.
- The lift shall deploy to all levels normally encountered in the operating environment.
- The lift shall incorporate an emergency method of deploying, raising, and stowing if electrical power fails,

Vehicle-Based Ramps

- Ramps 30 inches or longer shall support a minimum load of 600 pounds.
- The ramp surface shall be continuous and slip resistant and shall be at least 30 inches wide.
- Each side of the ramp shall have a barrier at least 2 inches high.
- If the height of the vehicle floor from which the ramp is deployed is greater than 9 inches above a 6-inch curb, a slope of 1 to 12 shall be achieved.
- Stowed ramps must not impinge on a passenger's mobility aid or pose any hazard to passengers in the event of a sudden stop or maneuver.

Securement Systems

- Securement systems shall restrain a force in the forward direction of up to 2,000 pounds per securement leg or clamping mechanism, and a minimum of 5,000 pounds for each mobility aid.
- The securement system shall limit the movement of an occupied wheelchair or mobility aid to no more than 2 inches in any direction under normal vehicle operating conditions.
- The securement systems shall secure common wheelchairs and mobility aids and shall either be automatic or easily attached by a person familiar with the system and mobility aid and having average dexterity.
- For each securement device provided, a passenger seat belt and shoulder harness shall also be provided for use by wheelchair or mobility aid occupants.
- The securement system shall be placed as near to the accessible entrance as practicable and shall have a floor area of 30 inches by 48 inches.
- In a vehicle in excess of 22 feet in length, at least one securement device shall secure the wheelchair or mobility aid facing toward the front of the vehicle.
- When not being used for securement, the system shall not interfere with passenger movement, shall not present any hazardous condition, shall be reasonably protected from vandalism, and shall be readily accessed when needed for use.
- For each securement device provided, a passenger seat belt and shoulder harness, complying with all applicable provisions of 49 CFR part 571, shall also be provided for use by the wheeled mobility aid occupant.

SOURCE: 56 *Federal Register* 45560-45562 (Sept. 6, 1991), Architectural and Transportation Barriers Compliance Board, Americans With Disabilities Act Accessibility Guidelines for Transportation Vehicles; Final Guidelines, 36 CFR Part 1192, Subpart B.