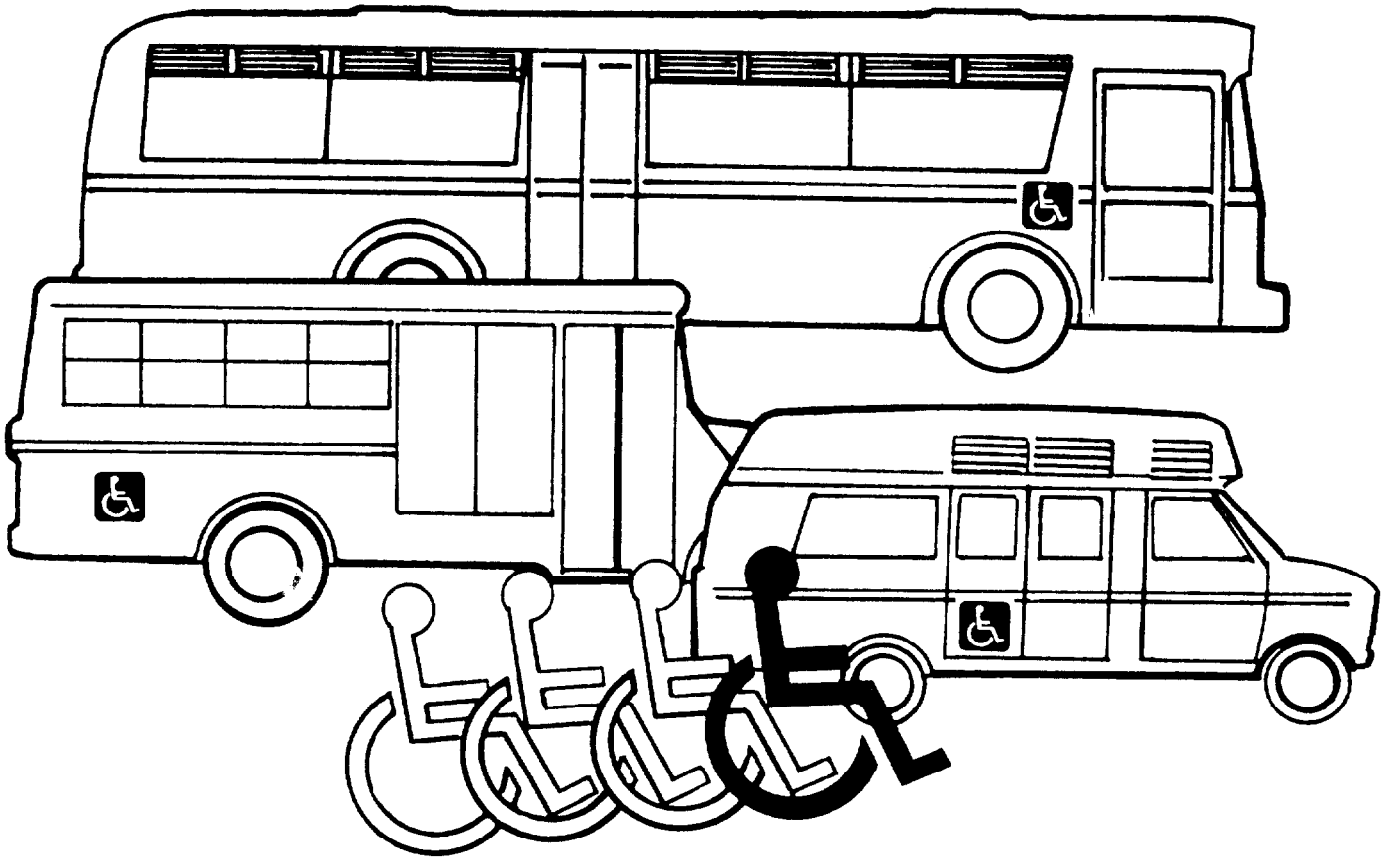
U.S. Department
of Transportation

Guideline Specifications for Passive Lifts, Active Lifts, Wheelchair Ramps and Securement Devices

September 1992



FEDERAL TRANSIT ADMINISTRATION

772

Guideline Specifications for Passive Lifts, Active Lifts, Wheelchair Ramps, and Securement Devices

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Revised Edition
September 1992

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Prepared for

Office of Technical Assistance and Safety
Federal Transit Administration
Washington, D.C. 20590

Distributed in Cooperation with

Technology Sharing Program
U.S. Department of Transportation
Washington, D.C. 20590

DOT-T-93-03

METRIC / ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)
1 foot (ft) = 30 centimeters (cm)
1 yard (yd) = 0.9 meter (m)
1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2) = 0.09 square meter (m^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)
1 acre = 0.4 hectares (he) = 4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gr)
1 pound (lb) = .45 kilogram (kg)
1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)
1 tablespoon (tbsp) = 15 milliliters (ml)
1 fluid ounce (fl oz) = 30 milliliters (ml)
1 cup (c) = 0.24 liter (l)
1 pint (pt) = 0.47 liter (l)
1 quart (qt) = 0.96 liter (l)
1 gallon (gal) = 3.8 liters (l)
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x - 32)(5/9)] °F = y °C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)
1 centimeter (cm) = 0.4 inch (in)
1 meter (m) = 3.3 feet (ft)
1 meter (m) = 1.1 yards (yd)
1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
1 hectare (he) = 10,000 square meters (m^2) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gr) = 0.036 ounce (oz)
1 kilogram (kg) = 2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

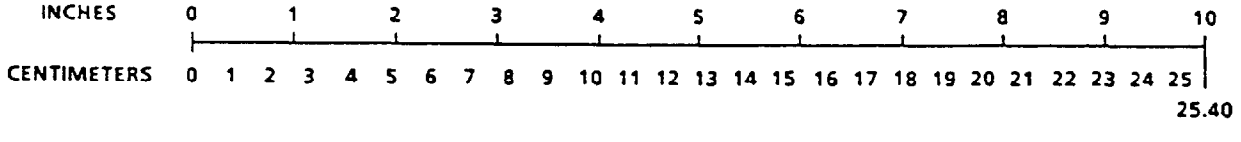
VOLUME (APPROXIMATE)

1 milliliter (ml) = 0.03 fluid ounce (fl oz)
1 liter (l) = 2.1 pints (pt)
1 liter (l) = 1.06 quarts (qt)
1 liter (l) = 0.26 gallon (gal)
1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

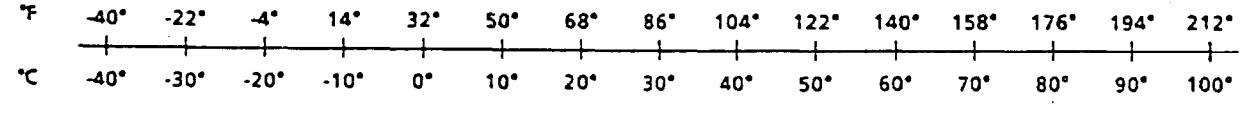
TEMPERATURE (EXACT)

[(9/5) y + 32] °C = x °F

QUICK INCH-CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT-CELCIUS TEMPERATURE CONVERSION



For more exact and/or other conversion factors, see NBS Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50. SD Catalog No. C13 10 286.

FEDERAL TRANSIT ADMINISTRATION

GUIDELINE SPECIFICATIONS FOR

PASSIVE LIFTS

SEPTEMBER 1992

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1.0 GENERAL

1.1 Background

These updated guideline specifications are for use by accessible vehicle purchasers in preparing specifications for passive lifts. A passive lift is one that when stowed allows the unimpeded use of the door in which the lift is located. Passive lifts are commonly used on large buses in fixed-route transit operations. These guidelines are an update of the Urban Mass Transportation Administration's (now Federal Transit Administration - FTA) "Guideline Specification for Passive Wheelchair Lifts" prepared in 1986. Major changes have been made in order to be in agreement with 49 CFR, Part 38. Part 38 is based on guidelines and requirements issued by the Architectural and Transportation Barrier Compliance Board, as required by Title's II and III of the Americans with Disabilities Act (ADA) of 1990. Part 38 sets forth DOT standards in compliance with the Board's guidelines and requirements for accessible transportation vehicles. These updated guideline specifications also include changes based on experience since 1986 and on comments and suggestions of people from the transit industry who have reviewed drafts of these new guideline specifications.

1.2 Scope

These updated guideline specifications relate to passive lifts, which are designed to accommodate loads that do not exceed 600 pounds. Maximum safety for all persons using such lifts and increased accessibility are of primary concern in these guideline specifications.

1.3 Use of These Guideline Specifications

These guideline specifications include some direct quotations from Part 38. All Technical Requirements based on Part 38 use the word "shall" and are specific requirements of the established regulation. The word "should" is used in other specifications and represents recommendations that are advisory. In using these guideline specifications, a vehicle purchaser may change the "shoulds" to "shalls" if the items are considered important. These advisory guideline specifications are superseded by any applicable Federal Motor Vehicle Safety Standards in the Code of Federal Regulations 49 Part 571 and by applicable rules and regulations of individual states and local regulating bodies.

1.4 Definitions

The following definitions apply to this document.

Accessible Vehicle - A vehicle that meets the requirements of Part 38.

Active Lift - An active lift is one that when stowed may interfere with the use of the vehicle entrance where the lift is located and that when being raised or lowered operates primarily outside the body of the vehicle. Active lifts are commonly used in paratransit operation.

Advisory Panel - A group of 37 specialists in areas related to the transit industry and accessibility issues. They were the major contributors to the UMTA guideline specifications for passive wheelchair lifts, active wheelchair lifts, ramps and securement devices which were developed in 1985 and 1986 and are referred to in the rationale for many of these guideline specifications.

Arc Lift - This term denotes the type of lift that has an arcing motion during operation as differentiated from elevator lift.

Barrier - A raised edge or restraint system associated with the platform of a lift intended to restrain a wheelchair on the platform during lift operation.

dBA - This term denotes decibels with reference to 0.0002 microbar as measured on the "A" scale.

Deploy - The term used to denote the operation of a lift from a stowed position to a position for use.

Design Load - The maximum weight capacity a lift is designed to support.

Dimensional Conventions - Dimensions that are not noted as maximum or minimum are absolute.

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

Drifting - The unintended movement of a lift from a stowed position.

Elevator Lift - This term denotes the type of lift that has a vertical up and down movement as differentiated from an arc lift.

Factor of Safety (Design Safety Factor) - The factor of safety is the ultimate strength of a material divided by the working stress. A structure fails or breaks when loaded to its ultimate strength. A structure deforms or takes set when loaded to its yield strength.

Fail-Safe - A characteristic of a system and its elements whereby any malfunctions affecting safety will cause the system to revert to a known safe state.

Interlock - The arrangement in which the operation or position of one mechanism automatically allows or prevents the operation of another.

Lift or Wheelchair Lift - A level change device used to assist those with disabilities in the use of transit and paratransit services. The term lift and wheelchair lift are used interchangeably in this document.

Maintenance Personnel Skill Levels - Maintenance personnel skills used in this document are defined in accordance with the White Book specifications as follows:

5M: Specialist Mechanic or Class A Mechanic Leader
4M: Journeyman or Class A Mechanic
3M: Service Mechanic or Class B Serviceman
2M: Mechanic Helper or Coach Serviceman
1M: Cleaner, Fueler, Oiler, Hostler, or Shifter.

May - This term denotes an option or alternative.

Mechanical and Hydraulic Components - Mechanical and hydraulic components include all parts of the lift drive or control system that are subject to wear and degradation due to the operation of the lift. These components are differentiated from structural components because they require lower design working stresses in anticipation of the wear and degradation.

Mobility Aid - A device that assists a person with mobility limitations to maneuver better. Examples include wheelchairs and walkers.

Paratransit Operation - Paratransit operation refers to a public transportation operation (service, vehicles, facilities, etc.) that is not a transit operation. Paratransit operations can also be categorized as operations of medium and small vehicles with active lifts.

Part 38 - The term denotes 49 CFR, Part 38, Subpart B.

Passive Lift - A passive lift is one that when stowed allows the unimpeded use of the vehicle door in which the lift is located. Passive lifts are commonly used in fixed route and fixed schedule transit operation.

Pinching Point - A location where two closely spaced parts of machinery can move together to create a human hazard.

Scooter - A three-wheel powered mobility aid steered by a single front wheel.

Shall - The term denotes that the specification is required by 49 CFR 38.

Shear Area - A hazardous condition or location where a moving part approaches or crosses a fixed part.

Should - The term denotes an advisory specification or recommendation.

Slip Resistant - A characteristic of a surface of a material that reduces unintended relative motion with respect to another surface with which it has contact.

Stow - This term denotes the movement of a passive lift from an operating position to a position where the lift is stored and does not interfere with passenger use of entrance.

Structural Components - The structural elements of the lift include those that support working loads and attach the lift to the vehicle. They do not include mechanical and hydraulic components associated with operation and control of the lift even though some mechanical and hydraulic components may support the working loads.

Transit Operation - Transit operation refers to a public transportation operation (service, vehicles, facilities, etc.) that operates with fixed routes and fixed schedules. Transit operation can also be generally characterized as using heavy duty transit buses with passive lifts.

Wheelchair - A mobility aid belonging to any class of three or four-wheeled devices, usable indoors, designed for and used by individuals with mobility impairments, whether operated manually or powered. A "common wheelchair" is such a device that does not exceed 30 inches in width and 48 inches in length measured two inches above the ground, and does not weigh more than 600 pounds when occupied.

White Book - This term is the common name for "Baseline Advanced Design Transit Coach Specifications," originally published by UMTA on April 4, 1977, and is presently maintained by APTA.

1.5 Abbreviations

The following abbreviations may be found in the guidelines.

ADA --- Americans with Disabilities Act of 1990
ANSI --- American National Standards Institute
APTA --- American Public Transit Association
ASME --- American Society of Mechanical Engineers
ASTM --- American Society for Testing and Materials
ATBCB --- Architectural and Transportation Barriers Compliance Board
CFR --- Code of Federal Regulations
CSA --- Canadian Standards Association
FMEA --- Failure Modes and Effect Analysis
FMVSS --- Federal Motor Vehicle Safety Standard
FTA --- Federal Transit Administration (formerly UMTA)
GVWR --- Gross Vehicle Weight Rating
NHTSA --- National Highway Traffic Safety Administration
SAE --- Society of Automotive Engineers
SCRTD --- Southern California Rapid Transit District
UFAS --- Uniform Federal Accessibility Standards
UMTA --- Urban Mass Transportation Administration (now FTA)
VA --- Veterans Administration

2.0 TECHNICAL REQUIREMENTS

2.1 General Requirements

2.1.1 Operating Environment

The lift should operate in temperature ranges of -10 F to 115 F, at relative humidities between 5 percent and 100 percent, and at altitudes up to 5,000 feet above sea level. Degradation of performance due to atmospheric conditions should be minimized at temperatures below -10 F, above 115 F, or at altitudes above 5,000 feet.

Special procedures, hydraulic fluids, and/or lubricants may be used to operate the lift for the low and/or high temperature operating conditions.

Rationale: The urban areas of the United States have broad ranges of climatic conditions. Weather data indicate that many cities have recorded 100 days or more per year of over 90 F temperatures. Likewise, many have recorded 20 or more days per

year below 0 F. The annual rainfall ranges as high as 60 inches per year to a low of 4 inches per year. The normal snow and sleet precipitation in some cities reach 88 inches per year. The recommended guidelines cover a broad range of conditions found in the United States and are adapted from the White Book specifications.

2.1.2 Weight

The weight of the lift should not adversely affect the legal axle loadings, the maneuverability, structural integrity, or the safe operation of the vehicle in which it is installed.

Rationale: For legal and safety reasons the weight of the lift should not adversely affect the vehicle. Since existing lifts reportedly meet these requirements, the weights of existing lifts are considered acceptable. The recommended upper limits are 1,000 pounds for lifts installed on standard heavy duty transit vehicles and 400 pounds on small vans and other vehicles.

2.1.3 Operation Constraints

2.1.3.1 The lift should operate when the bus is on level ground and up to road grades up to seven (7) percent or four (4) degrees.

2.1.3.2 The lift should operate when the bus is on level ground and when the bus is at an angle of plus or minus 8.7 percent or five (5) degrees due to road crowns, depressions, or curb geographics.

Rationale: A lift will operate in a variety of different topographical conditions and must do so safely and reliably. A balance needs to be made between the topographical conditions to be accommodated by lift design and the conditions where a lift will not be required to operate.

A seven percent grade specification has been used by Seattle Metro in its lift procurement. Since Seattle has a relatively hilly topography, using its limit for road grade seemed reasonable.

No specification reviewed during the development of these guidelines identified any requirements in terms of the roll of the bus. However, the VA sets a limit of 9 degrees in any direction for the operation of a powered wheelchair. Since a lift can tilt up to 3 degrees (Section 2.2.5), the 5 degree parameter was chosen in order to be below the 9 degree figure when the 3 degree tilt is considered.

This section is included to provide a design guide for manufacturers. Concurrently, it can be used by transit operators to help define inaccessible bus stops. These guidelines do not assume the lift will operate in all topographical conditions. Some current stops of a transit operator may be inaccessible. The transit operator would have to change the topography of the stop or change its location to provide accessibility.

2.1.4 Boarding Direction

The lift shall permit both inboard and outboard facing of wheelchair and mobility aid users.

Rationale: This requirement is directly from Part 38. To accommodate the passenger and for emergency or other special conditions, the lift needs to be able to accept and operate with a wheelchair or mobility aid user facing either inward or outward. Discussion by the Advisory Panel considered outward facing to be preferred, but both directions need to be accommodated. Local operating policies may designate outward facing.

2.1.5 Location of Lift (Use one of the following options)

(Option A) The lift should be installed in the front door of the bus.
(Option B) The lift should be installed in the rear door of the bus.
(Option C) The lift should be installed in either the front or rear door of the bus.

Rationale: The issue of lift location generated many comments from advocates of either front door or rear door lifts. The location of the lift is a local decision based on local conditions. No location is universally agreed to be better than another. A transit operation should assess several factors before specifying a lift location, since doing so might exclude certain bus manufacturers from bidding. If a clear preference is not evident, the location should be optional.

Among the factors to be considered are the following:

Accident Data - Accident data from different sources supported both front door and rear door locations. A transit operation should assess its own accident history in terms of accidents involving front or rear door operation.

Bus Stop Topography - Positioning a lift for use is affected by bus stop topography. Vehicle maneuverability requirements at a bus stop differ between front and rear door lifts.

Operating Policies - A driver must leave his seat to operate current rear door lifts. Current operating policies or labor rules may prohibit such actions and would need to be changed.

Communication with Driver - Better communication between the driver and the mobility limited passenger is possible when the wheelchair securement is located near the front of the vehicle.

Interior Maneuverability - On some vehicles wheelchair maneuverability in the front of a vehicle can be restricted by fare boxes or other items. Rear door entry is normally not as restricted.

Dwell Time - The dwell time at a bus stop can be affected by the location of a lift. As noted above, a driver must leave his seat to operate current rear door lifts. However, the location and type of securement device and the interior maneuverability can also affect dwell time. Properly positioned securement devices may require less time when associated with a rear door lift. Thus, in terms of dwell time the lift location must be considered with regard to other factors.

Lift Dimensions - Some buses can accommodate larger lifts in the rear door. Specifying wider lifts may force some manufacturers to offer a rear door lift.

Fare Collection - The fare box on a transit vehicle is almost always in the front. Rear door boarding requires different fare collection procedures.

Current Lift Location - If a transit property currently has front or rear door lifts, it may find it advantageous to procure more of the same. For example, if a transit operator has invested in pads or made other bus stop improvements based on current lift location, procuring vehicles with a different lift location might require more bus stop improvements. Mixed lift locations also put extra demands on passengers and drivers.

2.1.6 Warning Signals

2.1.6.1 When the lift is in motion, the lift should have an audible warning signal of 85 dBA (as measured five feet outside the door of the vehicle).

2.1.6.2 When the lift is being deployed, operated, or stored, the four-way flasher, hazard lights on the vehicle and a warning light inside the vehicle should be operating automatically.

Rationale: Transit operators report that lift accidents involve both persons using and not using the lift. The audible warning will signal passengers at a bus stop that the lift is being deployed. In the original guideline specification there was an audible warning only when the lift is being deployed. Recent inputs from industry have made it clear that there should be a warning anytime the lift is in motion for the safety of ambulatory passengers using the doorway and the safe operation of the lift by the bus driver. The 85 dBA level is a frequently used level for annunciators. A person can be exposed to this sound level for long periods of time without hearing damage; and the level is loud enough that it can be heard above normal background noise.

The four-way flasher, hazard lights will serve as a visual signal that the lift is being deployed. Since lift operation adds to the dwell time at a bus stop, the visual signal will alert motorists that the bus will be stopped for a longer than usual period. Although this requirement adds costs that could be avoided with an operational policy that drivers activate the hazard signals, to avoid human error the guidelines specifications require automatic warning lights.

The need for a warning light in the vehicle was emphasized by a an accident where a wheelchair passenger on board a bus rolled off the bus floor into the exit when the lift platform was deployed to ground level. The light alone will not prevent this type of accident, but when combined with appropriate operating procedures the risk of an accident can be reduced.

2.1.7 Maximum Noise Level

The operating noise level of the lift should not exceed 75 dBA inside the vehicle or on the lift platform, except for the audible warning signal as specified in Section 2.1.6.1.

Rationale: The lift operation should not audibly disrupt the transit operations nor should it obscure the warning signal. The 75 dBA level has been used by the San Diego Transit Corporation in its lift specifications and has been adopted for use in these guidelines.

2.1.8 Protective Covering

2.1.8.1 Pinching movements, shear areas or places where clothing or other objects could be caught or damaged should be covered or in other ways protected to prevent passenger injury.

2.1.8.2 All exposed edges or other hazardous protrusions on the wheelchair lift should be protected to minimize injury during lift operation and in case of accident.

Rationale: To ensure safer operations, potentially hazardous areas should be protected. This is especially true of lift operations where individuals with certain handicaps have limited control of or no feelings in parts of their body and may not sense a hazardous condition. When a hazardous area cannot be adequately covered or padded, the lift manufacturer must use other means to ensure safety. One alternative is a pressure sensing device that would automatically stop lift movement if an object is detected.

2.1.9 Operation Counter (Optional)

The lift may have an operations or use counter that records each complete cycle of the lift.

Rationale: A counter can provide data on lift use. The data would be especially useful in recording lift cycling, scheduling maintenance, and evaluating the performance of the lifts. The Advisory Panel considered this feature useful but not required. Local operating practices would determine whether it should be an option. The additional cost of this item may be offset by lower operating costs resulting from more timely maintenance.

2.1.10 Power Source Interface

The lift should operate and meet all requirements of these specifications while using the electrical and/or hydraulic power sources normally used on public transportation vehicles. The lift should meet these requirements whenever those power sources are performing within their specified ranges. The lift should continue to meet the requirements of Sections 2.2.6, 2.4.3, 2.5.5, and 2.5.8 during and following power source transients, including failure, that may be experienced on transit vehicles.

Rationale: The electrical and hydraulic interface between the vehicle and the lift is an important consideration in lift performance. This guideline is intended to ensure both proper interface consideration for normal operations and safe lift conditions in abnormal situations.

The guideline specifications have been primarily developed for passive lifts in large buses. Although much of the guideline specifications could be used for other modes of transit, not all sections would apply. This is especially true for this section relative to trolley buses and small buses. The power source of a trolley bus places special

requirements on the power source interface between the lift and the vehicle. A transit property planning to purchase lifts for use in trolley buses may have to add other power source interface requirements.

2.2 Platform

2.2.1 Platform Surface and Size

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

Rationale: This requirement is directly from Part 38. Any wheelchair or mobility aid that fits into these minimum clearances will also meet the space requirements of active lifts, ramps, and securement devices that are established by Part 38. The platform surface should be slip resistant under the conditions defined in Section 2.1.1.

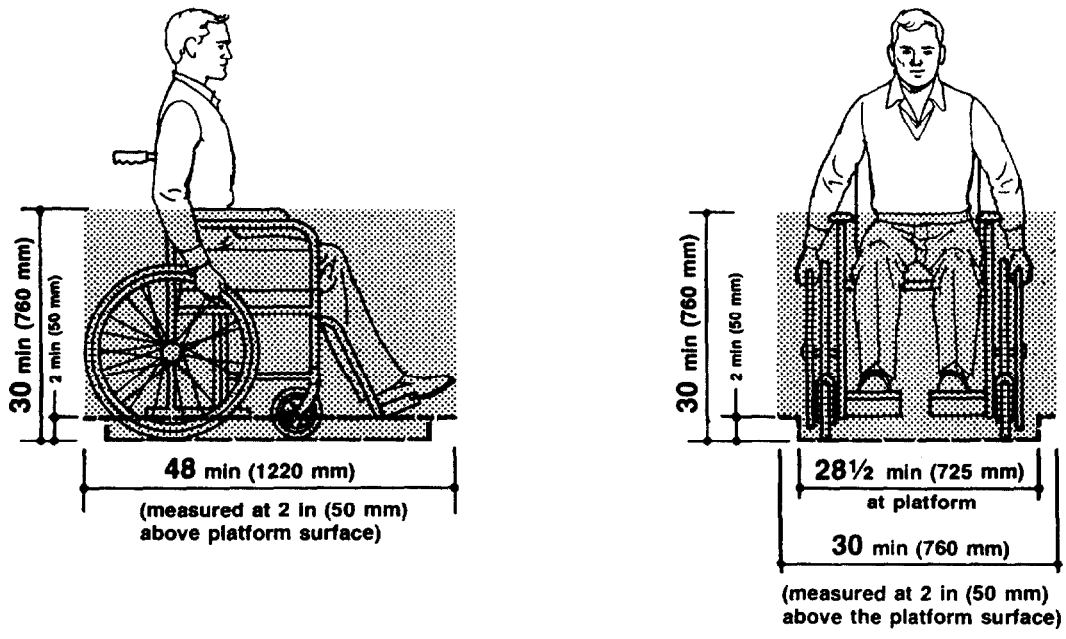

FIGURE 1. MINIMUM CLEARANCES ON PASSIVE LIFT

2.2.2 Edge Guards, Outer Barrier, and Inner Roll Stop

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

2.2.2.1 Each side of the lift platform that extends beyond the vehicle in its raised position shall have a barrier a minimum 1-1/2 inches high. Such barriers shall not interfere with maneuvering into or out of the aisle.

2.2.2.2 The loading-edge barrier (roll-off barrier) that functions as a loading ramp when the lift is at ground level, shall be sufficient when raised or closed, or a supplementary system shall be provided, to prevent a power wheelchair or mobility aid from riding over or defeating it.

2.2.2.3 A movable barrier or inherent design feature shall prevent a wheelchair or mobility aid from rolling off the edge closest to the vehicle until the platform is in its fully raised position.

2.2.2.4 The outer barrier of the lift shall automatically raise or close, or a supplementary system shall automatically engage, and remain raised, closed, or engaged at all times that the platform is more than 3 inches above the roadway or sidewalk and the platform is occupied. Alternatively, a barrier or system may be raised, lowered, opened, closed, engaged, or disengaged by the lift operator provided an interlock or inherent design feature prevents the lift from raising unless the barrier is raised or closed or the supplementary system is engaged.

Rationale: Section 2.2.2 is directly from Part 38. Tests for the barriers and their functions are described in Section 3.1.6. The test described in Section 3.1.6.1 is highly recommended.

The contractor should identify and clearly emphasize in the operations and maintenance manuals any barrier or roll stop adjustment or maintenance action that if done improperly could result in an unsafe condition.

Edge guards can prevent a wheelchair from accidentally sliding over the sides of the lift. Since edge guards are not in the direct path of a wheelchair using a lift, they are not designed to retain a wheelchair in direct forward or reverse motion, but are designed to deflect tire direction.

In 1985, Garrett Engineers, Inc. conducted tests for Southern California Rapid Transit District (SCRTD). These tests showed that outer barriers on all existing passive wheelchair lifts could be overcome by commonly available powered wheelchairs. The powered wheelchairs could ride over the outer barriers or push them down. SCRTD initiated these tests following an accident investigation that indicated a powered wheelchair had defeated an outer barrier.

The Advisory Panel considered having the same requirements for an inner barrier. However, transit operators reported no problems with the existing inner roll stop. Also, the accident scenarios involving running over the inner roll stop or off the inside of a lift appeared to involve less risk of serious injury. Given these conditions, the Advisory Panel considered the requirements of an inner "barrier" to be different from an outer barrier. The inner roll stop is designed to stop inadvertent rolling of a wheelchair and provide an acceptable margin of safety.

It is recognized that certain lift designs may obviate the need for a separate inner roll stop by using a solid part of the vehicle structure as the inner roll stop. In such a case, the vehicle structure will function as the inner roll stop.

2.2.3 Platform Gaps

Any openings between the platform surface and the raised barriers shall not exceed 5/8 inch in width. When the platform is at vehicle floor height with the inner barrier (if applicable) down or retracted, gaps between the forward lift platform edge and the vehicle floor shall not exceed 1/2 inch horizontally and 5/8 inch vertically.

Rationale: This requirement is directly from Part 38. Note that some lift designs may meet the intent of this guideline through equivalent facilitation.

2.2.4 Platform Entrance Ramp

The entrance ramp, or loading-edge barrier used as a ramp, shall not exceed a slope of 1:8, measured on level ground, for a maximum rise of 3 inches, and the transition from roadway or sidewalk to ramp may be vertical without edge treatment up to 1/4 inch; thresholds between 1/4 inch and 1/2 inch shall be beveled with a slope no greater than 1:2.

Rationale: This requirement is directly from Part 38.

2.2.5 Platform Deflection

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

Rationale: This requirement is directly from Part 38. To reduce the ability of a wheelchair to gain additional speed and overcome the barrier or roll stop and to reduce the chance of a wheelchair tilting off the lift, a maximum deflection standard is established. The three (3) degree deflection is currently found in the California Administrative Code.

2.2.6 Platform Movement

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

Rationale: This requirement is directly from Part 38.

2.2.7 Handrails

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

Rationale: This requirement is directly from Part 38.

2.2.8 Accommodation of Standees

2.2.8.1 Use by standees. Lifts shall accommodate persons using walkers, crutches, canes or braces or who otherwise cannot use steps. The platform may be marked to indicate a preferred standing position.

2.2.8.2 Door height. For vehicles in excess of 22 feet in length, the overhead clearance between the top of the door opening and the raised lift platform, or highest point of a ramp, shall be a minimum of 68 inches. For vehicles of 22 feet in length or less, the overhead clearance between the top of the door opening and the raised lift platform, or highest point of a ramp, shall be a minimum of 56 inches.

Rationale: These requirements are directly from Part 38.

2.2.9 Platform Lighting

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

2.2.9.2 Other stepwells and doorways, including doorways in which lifts or ramps are installed, shall have, at all times, at least 2 foot-candles of illumination measured on the step tread, or lift or ramp, when deployed at the vehicle floor level.

2.2.9.3 The vehicle doorways, including doorways in which lifts or ramps are installed, shall have outside light(s) which, when the door is open, provide at least 1 foot-candle of illumination on the street surface for a distance of 3 feet perpendicular to all points on the bottom step tread outer edge. Such light(s) shall be located below window level and shielded to protect the eyes of entering and exiting passengers.

Rationale: These requirements are directly from Part 38.

2.2.10 Platform Markings

2.2.10.1 The side edges, the outer edge, and the inner edge of the platform or the inner edge of the floor of the bus adjacent to the lift should be clearly marked in a color different from the lift platform.

2.2.10.2 The lift may have a designated standing area for lift passengers who are not in a wheelchair.

Rationale: The marking of the platform edges will provide greater visibility and reduce the potential for accidents. A designated standing area may be desirable. This standing area would be designated in a location to provide the passenger enhanced safety when using the lift.

On buses where the steps form part of the wheelchair lift platform, the platform marking required by 2.2.10.1 could detract from the step edge marking. Marking the inner edge of the floor of the bus adjacent to the platform instead of the inner edge of the platform should be considered as one way of addressing this problem.

2.3 Structural

The structural elements of the wheelchair lift include those that support working loads and attach the lift to the bus. They do not include mechanical and hydraulic components associated with operation and control of the lift.

2.3.1 Lift Capacity

The design load of the lift shall be at least 600 pounds.

Rationale: This requirement is directly from Part 38.

2.3.2 Structural Safety Factor

Nonworking parts such as platform, frame, and attachment hardware which would not be expected to wear, shall have a safety factor of at least three based on the ultimate strength of the material.

Rationale: This requirement is directly from Part 38.

2.3.3 Useful Life

When used and maintained in accordance with manufacturer recommended procedures, the lift structure should be designed to have a useful life equal to the useful life of the vehicle on which it is used.

Rationale: Once installed the lift becomes part of the vehicle. As with other components of the vehicle, the lift with normal maintenance, including repair and replacement of parts, should be operable as long as the vehicle.

2.3.4 Materials

Structural components should be made of steel or other durable construction material.

2.3.4.1 Ferrous surfaces should be either plated with a protective coating or be cleaned, primed, and have a corrosion and abrasion resistant flat finish.

2.3.4.2 Nonferrous and nonmetallic surfaces should be coated using a durable flat or matte finish.

2.3.4.3 Stainless steel does not require coating or surface treatment.

Rationale: The structural components of the lift should have a useful life equal to that of the vehicle upon which it is mounted. The materials and coatings identified in these guidelines are intended to ensure the useful life. Discussions of the Advisory Panel included using a salt spray test or paint thickness measure to ensure compliance. No specific tests have been designated in order to allow manufacturers flexibility, recognizing that the overall goal is to have materials lasting the useful life of the vehicle.

2.3.5 Interface with the Vehicle

2.3.5.1 The interface with the vehicle should have the structural strength required for in situ static loading of the lift platform to 1,800 pounds (three times the lift capacity).

2.3.5.2 Installation of the lift should not reduce or in any way compromise the structural integrity of the vehicle.

2.3.5.3 Attachment of the wheelchair lift, including any modification of the vehicle, should not cause an imbalance of the vehicle that will adversely affect vehicle handling characteristics.

2.3.5.4 No part of the installed and stowed lift should cause a hazard to a passenger entering or exiting the bus.

2.3.5.5 The stowed lift should not inhibit the operation of the vehicle door; and there should be no contact or rubbing between the opened door and/or the door frame that would damage the door or the lift during deployment and normal operation of the lift.

Rationale: The structural safety factor of the lift is three (3) and the designated lift capacity is 600 pounds. This section requires that the lift interface with the bus have the same design safety factor as the lift structure.

The design of a wheelchair lift dictates the required space for installation. The bus manufacturer has the responsibility to determine compatibility of the bus structural design and the selected lift.

The original guidelines recommended that no part of the lift extend into the stepwell or beyond the center or the bus. The purpose of these recommendations was to ensure passenger safety. Lift designs may have extensions inside the stepwell or outside the vehicle that pose no safety hazards to passengers, which is allowed by the revised guideline. It should be noted that a lift should not protrude from underneath the bus and adversely affect the approach or breakover angles.

Interlocks that prevent lift operation unless a vehicle door is open are included in these guideline specifications (Section 2.5.8.2). Observations at public transportation operations indicated that door adjustments or improper lift installation can result in interference between the lift and the door. This guideline specification does not allow such an operating condition. Concurrently, it encourages increased door clearances and/or more precision in the lift operation. The specification does not prohibit the use of brushes or other devices that are designed to allow contact between the door and lift.

2.4 Mechanical and Hydraulic

Mechanical and hydraulic components include all parts of the lift drive or control systems that support the platform load during normal operation of the wheelchair lift.

2.4.1 Mechanical Safety Factor

Working parts such as cables, pulleys, and shafts, which can be expected to wear, and upon which the lift depends for support of the load, shall have a safety factor of at least six based on the ultimate strength of the material.

Rationale: This requirement is directly from Part 38.

2.4.2 Hydraulic Safety Factor

Hydraulic components should comply with all applicable Society of Automotive Engineers Standards. These Standards include, but are not limited to the following.

SAE J 190 - Power Steering Pressure Hose - Wire Braided
SAE J 191 - Power Steering Pressure Hose - Low Volumetric
SAE J 514APR80 - Hydraulic Tubing Fittings
SAE J 516JUN84 - Hydraulic Hose Fittings
SAE J 517JUN85 - Hydraulic Hose

All other components that contain working fluid should have a minimum burst pressure of at least four (4) times normal design working pressure.

Rationale: The mechanical safety factor is in agreement with the California Administrative Code. Also, "Safety Standard for Manlifts," ANSI A90.1-1976 states that all parts of the machine shall have a safety factor of six (6) based on a full load. Although the wheelchair lift operates at a lower velocity and is subjected to less severe shock loads than a manlift, a safety factor of six (6) is considered appropriate. The hydraulic system design guideline is structured to make use of applicable Society of Automotive Engineers Standards. Hydraulic components that are not the subject of SAE Standards should be burst pressure tested at least four (4) times normal design working pressure to ensure the integrity of the complete hydraulic system. A safety factor of four (4) is the industry standard for hydraulic cylinders and components.

2.4.3 Platform Free-Fall Limits

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

Rationale: This requirement is directly from Part 38.

2.4.4 Hydraulic Power Source (Use one of the following options)

(Option A) The hydraulic power source for the lift should be the vehicle power steering pump or another existing hydraulic power source on the vehicle.

(Option B) The lift hydraulic system shall be independent and shall operate the lift ---(*)--- percent of design speeds at a minimum temperature of ---(*)--- F.

*** To be completed by Procuring Agency.**

Rationale: Cold weather affects the operation of the hydraulic systems on current lifts. Where cold weather is not a problem, Option A can be used in lift specifications. When cold weather conditions are expected to affect the operation of the lift, Option B can be used to specify an independent hydraulic system that will function in cold weather. This separate system could be driven by the power steering pump.

2.5 Control Systems

2.5.1 Control Console

2.5.1.1 The lift controls should be located on a console and shall consist of a power switch, a function selection switch, and an operating switch.

2.5.1.2 The control console should be located in a position where the lift operator (driver) has a direct unobstructed view of the platform during lift operation and should be secure from operation or tampering by unauthorized individuals.

2.5.1.3 The control console should have simple instructions on or near it that directs the operator in the lift operating procedures.

2.5.1.4 The switches on the control console should by their location or by other means prohibit simultaneous, one-handed operation of more than one switch.

Rationale: Discussions with public transportation operators indicated that lift operator error contributes to a significant proportion of lift accidents and cause maintenance and reliability problems. Several factors contribute to lift operator error--infrequent use of the lift, different controls for different lifts, and lack of follow-up training. One means

to reduce operator error is to make lift control systems functionally standard and simple. These guideline specifications seek to do this.

The first step is to have the lift operation controlled by three switches, which operate as described in Sections 2.5.2 to 2.5.4. For safety reasons the operator must have a clear view of the movement of the lift when it is in operation. This requirement means that the console for a rear door lift must be located near the rear door and be secure from unauthorized access. To assist in reducing operator error, simple instructions for the lift operator should be available.

Simultaneous, one-handed operation has been identified as a source of operator error. Proper positioning of the switches or other means can eliminate this source of driver error.

2.5.2 Power Switch

The lift controls should have a power switch with two positions--on and off. The "on" position enables lift operation and should be designated by a lighted indicator. The "off" position prevents lift movement.

Rationale: The power switch must be "on" to operate the lift. This switch enables the function selection and the operating switches. This switch is considered important for the safe design of the control logic, especially since it can also act as a back-up, emergency "off" switch. The requirement for a lighted indicator is to allow the driver to discern the status of the power switch.

2.5.3 Control Function Selection Switch

2.5.3.1 The lift controls should have a function selection switch to designate the desired lift function. The switch should have at least five designated functions (as defined) in the following order:

(1) Off - no function can be activated
(2) Deploy - lift is operated from a stowed position to a platform position.
(3) Down - lowers lift platform
(4) Up - raises lift platform
(5) Stow - lift is operated from a platform position to a stowed position.

2.5.3.2 The lift may have four optional functions--outer barrier down, outer barrier up, roll stop down, and roll stop up. If any one or more of these functions are included, their order on the function switch shall be as follows:

(1) Off
(2) Deploy
(3) Down
(4) Outer Barrier Down - lowers outer barrier
(5) Outer Barrier Up - raises outer barrier
(6) Up
(7) Roll Stop Down - lower inner roll stop
(8) Roll Stop Up - raises inner roll stop
(9) Stow

2.5.3.3 The function selection switch should not allow the selection of more than one function at one time.

2.5.3.4 The controls shall allow reversal of the lift operation sequence, such as raising or lowering a platform that is part way down, without allowing an occupied platform to fold or retract into the stowed position.

Rationale: Section 2.5.3.4 is directly from Part 38. The control selection switch specification identifies functions for a lift and defines these functions. Existing lifts designate functions with various terms. This specification identifies the terms that should appear on lifts produced by any manufacturer.

A distinction is made between recommended functions and optional functions. The recommended functions are considered the minimum acceptable for operation. Existing lifts have barriers or roll stops controlled either automatically or by driver action. The specification allows both options. The minimum designated functions assume automatic roll stop and barrier functions.

The sequence for listing the mandatory and optional functions has been chosen to provide more standardization. The switch itself may be different (e.g., rotary, lever, or pushbutton); but the order of the functions remains the same. A lift operator can expect identical functional relationships, although the control switches may be different. Section 2.5.3.3 provides for increased safety and reliability in the lift operation by having only one function selected at a time.

The Advisory Panel also discussed having an interlock that would prevent the function selection switch from being changed when the operating switch is activated. Some members considered this option expensive and redundant with other safety features in the specifications. For these reasons such an interlock was not included.

2.5.4 Control Operating Switch

2.5.4.1 The lift controls should have an operating switch labeled "operate" or "start" that will activate the designated function for the lift.

2.5.4.2 Where provided, each control for deploying, lowering, raising, and stowing the lift and lowering the roll-off barrier shall be of a momentary contact type requiring continuous manual pressure by the operator and shall not allow improper lift sequencing when the lift platform is occupied.

2.5.4.3 Release of the operating switch should stop the lift motion.

2.5.4.4 The lift shall deploy to all levels (i.e., ground, curb, and intermediate positions) normally encountered in the operating environment.

Rationale: Sections 2.5.4.2 and 2.5.4.4 are directly from Part 38. The third type of switch on the control console is an operating switch. This switch will allow the lift to perform the designated function. For safety reasons, it is a momentary-type switch that requires continuous force for operation. If a driver is disabled or wants to stop the lift immediately, the only required action is the release of the switch. The lift operator should be able to stop and change to any control function in order to adjust to operating conditions, safety hazards, or passenger requests. The momentary nature of the operating switch in combination with the function switch provides this control capability.

2.5.5 Design Safety

The control system should be designed to be fail-safe for single failure modes that would negate the proper operations of the interlocks specified in Section 2.5.8. A complete failure modes and effects analysis (FMEA) or a suitable test that demonstrates these design requirements have been met should be provided.

Rationale: Safe operation is a primary concern of the guideline specifications. The safety protection for some operator errors and equipment failures resides in the integrity of the Interlocks and Safety Features of Section 2.5.8. The safety of the lift/vehicle system is enhanced by requiring that the interlocks remain in a known safe state under conditions of any single failure of the control system or loss of power to the control system.

Most system safety evaluations include both analysis (e.g., FMEA) and testing. The lift is a mechanical system that includes mechanical hardware, but could also

include computer hardware and software. The degree to which analysis and/or equipment testing are used in the safety evaluation should be based on the lift design and what combination of analysis and testing will assure safe operation.

An FMEA is a frequently used method in safety analysis to demonstrate what a design will do under selected failure modes. There are many reports and papers explaining FMEA. Three such reports are:

(1) Dussault, N. B. "The Evolution and Practical Applications of Failure Modes and Effects Analyses," RADC-TR-83-72. March 1983.

(2) MIL-STD-7858, Sept. 15, 1980, "Reliability Program for Systems and Equipment Development and Production," Task 204, Failure Modes, Effects, and Criticality Analysis (FMECA).

(3) ARP 926 A, "Fault/Failure Analysis Procedure," SAE Aerospace Recommended Practice, Rev. 11-15-79.

The first reference is a report that discusses several methods. The second reference is a Military standard that is used in many defense system developments. The third reference is a SAE Recommended Practice used in the aerospace industry.

2.5.6 Jacking Prevention

The control system or inherent lift design should prevent the operation of the lift from jacking the bus and causing damage to the bus or the lift.

Rationale: Jacking is the support or lifting of the bus by the wheelchair lift when the platform is power driven into the ground. The release of load from the bus when the occupied platform contacts the ground is sometimes mistakenly considered jacking. Early models of some passive lifts did result in jacking and damaging to the lift or bus. To prevent such damage the control system or inherent lift design should not allow jacking.

2.5.7 Emergency Operation

The lift shall incorporate an emergency method of deploying, lowering to ground level with a lift occupant, and raising and stowing the empty lift if the power to the lift fails. No emergency method, manual or otherwise, shall be capable of being operated in a manner that could be hazardous to the lift occupant or to the operator when operated according to manufacturer's instructions, and

shall permit the platform to be stowed or folded when occupied unless the lift is a rotary lift and is intended to be stowed while occupied.

Rationale: This requirement is directly from Part 38. The wording of this requirement as published in the September 6, 1991 Federal Register is: "No emergency method, manual or otherwise, shall be capable of being operated in a manner that could be hazardous to the lift occupant or to the operator when operated according to manufacturer's instructions, and shall not permit the platform to be stowed or folded when occupied, unless the lift is a rotary and is intended to be stowed while occupied." This grammatical error in Part 38 is corrected in these specifications.

In the event of a power failure, the lift must have a manual backup system. To accommodate passengers the manual system will be able to be used to take passengers off the vehicle. Also, the manual operation will allow the lift to be stowed in order for the vehicle to move. For safety reasons, the barriers and inner roll stop would be operable.

2.5.8 Interlocks and Safety Features

The controls shall be interlocked with the vehicle brakes, transmission, or door or shall provide other appropriate fail-safe mechanisms or systems, to ensure that the vehicle cannot be moved when the lift is not stowed and so the lift cannot be deployed unless the interlocks or systems are engaged.

Rationale: Section 2.5.8 is directly from Part 38.

2.5.9 Maintenance Controls (Optional)

The lift should have a separate maintenance control that allows complete lift operation, is inaccessible during normal vehicle operation, and is located in a functional position for maintenance of the lift. The design of the maintenance controls should ensure all safety features of the lift operator when the maintenance controls are in use.

Rationale: The control requirements for normal operation and maintenance are different depending on console location and maintenance access. To assist in the maintenance of the lift, it is suggested that separate maintenance controls be provided. However, this requirement is optional. An operator will have to decide whether the initial cost for such controls will be offset by reduced maintenance costs.

2.5.10 Wiring

Wiring should be in accordance with SAE Recommended Practice SAE J1292 OCT 81 and referenced Standards, except when good engineering practice dictates special conductor insulations.

Rationale: The SAE Recommended Practice, "Automobile, Truck, Truck-Tractor, Trailer, and Motor Coach Wiring," is accepted by the automotive industry and provides a baseline for design. The practice recognizes that unique design will require engineering practices that cannot be envisioned and incorporated into a recommended practice.

3.0 TESTING, CERTIFICATION, AND INSPECTION

3.1 Design Tests

The tests defined in Section 3.1 should be performed on a representative production unit of the wheelchair lift model purchased by this procurement. Unless otherwise specified, the lift should meet the requirements given in Section 2.0 when attached to a fixture that simulates a vehicle installation and when supplied by electric, hydraulic, air, or other power source of output equal to that normally available on the vehicle. Only one representative production unit is required to be tested for certification for design tests 3.1.1 through 3.1.7. Design tests 3.1.1 through 3.1.5 should be conducted on the same unit, without failure, in the order given, and without any repairs or maintenance other than that permitted by Section 3.1.11. The contractor may elect to conduct the tests specified in Section 3.1.6 with the lift installed in a vehicle. Design tests 3.1.8 and 3.1.9 require a lift model and vehicle model combination. For certification these tests need only be conducted once for each lift and vehicle model combination.

3.1.1 Durability Tests

3.1.1.1 Vertical Cycling Test. The lift platform should be operated up and then down through its maximum vertical operating range for 15,600 cycles with a load of 600 pounds for the first 600 cycles and 400 pounds for the remaining cycles. The ambient temperature for the first half of the cycles in each of these tests should be at least 110 F. The tests may be continuous or separated into groups of not less than 10 cycles with nonoperating periods of not more than one minute between each cycle in the group. The platform shall raise and lower

smoothly throughout the test with vertical and horizontal accelerations not exceeding 0.3g.

3.1.1.2 Deployment Cycling Test. The lift platform should be deployed and stowed for 10,000 cycles. The ambient temperature for the first half of the cycles should be at least 115 F. The tests may be continuous or separated into groups and may have nonoperating periods between cycles as specified in Section 3.1.1.1.

3.1.1.3 Combination Vertical and Deployment Cycling Test. The tests in Sections 3.1.1.1 and 3.1.1.2 may be combined into a single test that meets the requirements of both tests.

Rationale: The tests in Section 3.1.1.1 and 3.1.1.2 are adapted from those required by the California Administrative Code. Section 3.1.1.3 has been added to accommodate manufacturers equipped to conduct the tests simultaneously.

Note that the language in Section 3.1 does not mean that a manufacturer must perform these tests for each procurement. Once a production unit of a specific lift model and vehicle combination has been tested, the design tests apply to all procurements of that combination. Section 3.1.1.1 includes testing for limits on platform acceleration established in Part 38.

3.1.2 Low Temperature Operation Test

After 16 hours of exposure to a temperature not higher than 20 F, the wheelchair lift should be operated unloaded through 10 cycles of deploying, lowering, raising, and stowing and through 10 cycles of raising and lowering with a 600-pound load. Each cycle should be separated by at least a 30-minute cooling period at a temperature not higher than 20 F. The lift should meet all performance requirements while operating at exposure temperatures.

Rationale: The above test is a modification of the low temperature test of the California Administrative Code. The major changes extend the soak time to correspond to an overnight storage at a low temperature, increase the test weight to the 600 pound limit contained in these specifications, explicitly require the lift to meet all performance requirements at the test temperature, and change the cycling to avoid loading and unloading the lift during the test.

3.1.3 Platform Deflection Test

A static load of 600 pounds should be applied through the centroid of a test pallet 26 inches by 26 inches placed at the centroid of the platform. The platform should be raised and lowered with this weight. During the lift operation the platform should not deflect more than three degrees in any direction between the loaded position and its unloaded position.

Rationale: The California Administrative Code has a platform deflection requirement. For the guideline specifications, platform deflection has been defined in terms of test requirements. The test requirement have been developed based on the design load and the platform deflection requirement in the California Administrative Code.

3.1.4 Self-Damage Tests

The controls should be held in operating position for five (5) seconds after the unloaded lift meets resistance to its travel under each control position with any limit switch disabled. The test should be performed twice at each lift position of deploy, stow, full up at floor level, and full down at ground level.

Rationale: Section 3.1.4 is adapted from the California Administrative Code.

3.1.5 Power and Equipment Failure Test

A failure of power, chain, cable, hydraulic hose, or air hose that allows the lift to deploy or the platform to lower should be simulated. The wheelchair lift should comply with Section 2.4.3 during this test. An FMEA may be provided in lieu of conducting actual tests.

Rationale: Section 3.1.5 is adapted from the California Administrative Code and allows an FMEA to be used in place of actual testing. Such an analysis examines the consequences of failures such as those specified for simulation.

3.1.6 Barrier and Roll Stop Tests

3.1.6.1 The contractor should test the ability of the outer barrier to retain a powered wheelchair. Two of four wheelchairs and a three-wheel powered mobility aid are to be tested. The Everest and Jennings Magnum or the Invacare Power Rolls Arrow Model 4M929 and the Invacare Power Rolls Arrow XT or the Fortress Scientific 760N should

be used. The two wheelchairs and the three-wheel scooter with secured load should not leave the platform and the outer barrier should not be defeated (driven through or climbed over) by the wheelchairs or scooter when tested under all of the following conditions:

(a) fully charged battery system
(b) equivalent occupant loads of both 110 and 250 pounds
(c) operated both forwards and backwards
(d) accelerated at full power from a starting position off of the lift platform and a minimum of 48 inches between the front edge of the foot rests or rim of the rear tires and the outer barrier
(e) a platform positioned with an 8 degree outward slope
(f) the lift platform in a raised position.

The Everest and Jennings Magnum or the Invacare Power Rolls Arrow Model 4M929 should be equipped with a standard adult size seat, standard foot rests, and a standard upright back. The Invacare Power Rolls Arrow XT or the Fortress Scientific 760N should also be equipped with all the above features. The three-wheel powered scooter tested should be of a size and weight typical of those in present use.

3.1.6.2 The contractor should test the ability of the inner roll stop to prevent a wheelchair from inadvertently rolling off the platform. In its raised position the roll stop should withstand a total force of at least 300 pounds parallel to the platform surface in the unloading direction. The force should be applied at a minimum height of 2-1/2 inches above the top surface of the platform with 150 pounds at each of two points 11.8 inches in each side of the center of the roll stop.

Rationale: As discussed in the rationale for Section 2.2.2, barriers existing in 1985 failed in tests using powered wheelchairs. This test of the outer barrier is designed to ensure that the barrier meets the requirements of Part 38.

The four models represent two types of current wheelchairs that are powered and could override barriers. They have been selected because they have been identified as representing those wheelchair models that are currently available and produce high and possibly the highest amounts of force that could overcome a barrier. A three-wheel mobility aid should be included in this test.

Specific models of wheelchairs have been chosen to standardize this test and to make transit operators aware of the limits of the test. A transit operator faced with

transporting wheelchairs or mobility aids more powerful than those mentioned (e.g. specially designed wheelchairs) will be faced with different safety and risk levels.

The wheelchairs and the three-wheel scooter are to be tested with two different weights. The 110 pound represents a 5th percentile woman. With this lighter load, a wheelchair would be more susceptible to climbing or bouncing over a barrier. The 250 pound load represents a 99th percentile male, the standard used in defining the design load. The heavier weight will test the ability of a wheelchair to be powered through a barrier.

It is recognized that this guideline will become dated as makes and models of wheelchairs change. This is attested to by the fact that the wheelchair models suggested here are different from those selected in 1986. The term "or equivalent" was considered for inclusion in 1986; however, determining equivalency could be complicated. The intent of the test is to have "common", known wheelchairs used for testing.

3.1.7 Static Load Test

A static load of 1,800 pounds should be applied through the centroid of a test pallet placed at the centroid of the platform when the platform is positioned at its raised position. The length and width dimensions of the test pallet should be 26 inches by 26 inches to correspond to the approximate outer dimensions of a wheelchair "footprint." The load should remain on the platform not less than two (2) minutes. After the load is removed, an inspection should be made to determine if fractures have occurred.

Rationale: The test given in Section 3.1.7 is adapted from the California Administrative Code. Section 3.1.7 was modified to specify a time period for the test. The two-minute period is the same as that specified by the VA.

3.1.8 Vehicle Interface Test

This test should be conducted on a lift installed in an actual vehicle of the same model as being purchased through this procurement. A static load of 900 pounds should be applied through the centroid of a test pallet placed at the centroid of the platform when the platform is positioned at its raised position. The length and width dimensions of the test pallet should be 26 inches by 26 inches. The load should remain on the platform not less than two (2) minutes.

Rationale: Section 3.1.8 has been developed for these guideline specifications and tests the structural interface between the vehicle and the lift. This test needs to be done once for each lift-vehicle model combination.

3.1.9 Interlock Safety Tests

The Contractor should submit a test plan for approval by the Procurement Agency or certification of tests that demonstrate that the lift model, when installed in the vehicle model, meets the safety related interlocks as given in Section 2.5.8.

Rationale: This test will demonstrate the level of safety provided by the lift interlocks.

3.1.10 Visual Inspection

At the conclusion of any test described in Section 3.1--except Sections 3.1.6 and 3.1.7--with all loads removed, the parts of the wheelchair lift should show no condition of fracture, permanent deformation, wear that would exceed manufacturer's tolerances, perceptible impairment, or other deterioration that would be dangerous.

Rationale: Section 3.1.10 is adapted from the California Administrative Code. Visual inspection is a means to determine if the tests have been passed.

3.1.11 Maintenance During Tests

During the Durability Tests of Section 3.1.1, the inspection, lubrication, maintenance, and replacement of parts (other than bulbs and fuses) may be performed only as specified in the contractor's maintenance manual for the lift and at intervals no more frequent than specified in the manual. Maintenance specified for certain time intervals should be performed during the vertical cycling and deployment cycling tests at a number of cycles that is in the same proportion to the total cycles as the maintenance period is to 36 months.

Rationale: Section 3.1.11 is taken from the California Administrative Code. Scheduled maintenance is permitted during the tests, and parts scheduled for replacement can be replaced. However, if replacement or other parts fail during the tests, the test would have to be repeated.

3.1.12 Certification

The contractor should provide written certification of compliance to the tests specified in Section 3.1, Design Tests.

Rationale: This is a standard practice in design testing.

3.2 Acceptance Tests (Optional)

The contractor should submit for approval to the Procuring Agency an independent test report or a test plan to demonstrate that the lifts purchased by this procurement meet the requirements given in Section 2.0, unless otherwise tested in Section 3.1. The Procuring Agency may witness any or all of these acceptance tests. A mutually agreed upon notification time prior to the conduct of a test should be made between the two parties. The test results should be recorded, witnessed, and submitted to the Procuring Agency as proof of meeting the acceptance criteria of the approved test plan.

Rationale: This section is optional since most lifts would be purchased as a part of a vehicle procurement and any lift acceptance testing would be included in the vehicle acceptance testing. Acceptance testing needs to be considered as a separate price item in the lift procurement. The more comprehensive the acceptance tests, the more expensive this option can be to the Procuring Agency. The successful completion of acceptance tests is the time at which the warranty period normally begins.

FEDERAL TRANSIT ADMINISTRATION

GUIDELINE SPECIFICATIONS FOR

ACTIVE LIFTS

SEPTEMBER 1992

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ACTIVE LIFTS

1.0 GENERAL

1.1 Background

These updated guideline specifications are for use by accessible vehicle purchasers in preparing specifications for active wheelchair lifts. Active lifts are ones that when stowed may interfere with use of the vehicle entrance where the lift is located. Active lifts are the type that are usually installed on paratransit vehicles and small buses not used in general fixed route scheduled transit service. These guidelines are an update of the Urban Mass Transportation Administration's (now Federal Transit Administration - FTA) "Guideline Specification for Active Wheelchair Lifts" prepared in 1986. Major changes have been made in order to be in agreement with 49 CFR, Part 38. Part 38 is based on guidelines and requirements issued by the Architectural and Transportation Barriers Compliance Board, as required by Title's II and III of the Americans with Disabilities Act (ADA) of 1990. Part 38 sets forth DOT standards in compliance with the Board's guidelines and requirements for accessible transportation vehicles. These updated guideline specifications also include changes based on experience since 1986 and on comments and suggestions of people from the transit industry who have reviewed drafts of these new guideline specifications.

1.2 Scope

These updated guideline specifications relate to active lifts for wheelchairs and mobility aids, both manual and powered. The lifts are designed to accommodate loads that do not exceed 600 pounds. Maximum safety for all lift users and attendants and increased accessibility are of primary concern in these guideline specifications.

1.3 Use of These Guideline Specifications

These guideline specifications include some direct quotations from Part 38. All Technical Requirements based on Part 38 use the word "shall" and are specific requirements of the established regulation. The word "should" is used in other specifications and represents recommendations that are advisory. In using these guideline specifications, a vehicle purchaser may change the "shoulds" to "shalls" if the items are considered important. These advisory guideline specifications are superseded by any applicable Federal Motor Vehicle Safety Standards in the Code of Federal Regulations 49 Part 571 and by applicable rules and regulations of individual states and local regulatory bodies.

1.4 Definitions

The following definitions apply to this document.

Accessible Vehicle - A vehicle that meets the requirements of Part 38.

Active Lift - An active lift is one that when stowed may interfere with the use of the vehicle entrance where the lift is located and that when being raised or lowered operates primarily outside the body of the vehicle. Active lifts are commonly used in paratransit operations.

Advisory Panel - A group of 37 specialists in areas related to the transit industry and accessibility issues. They were the major contributors to the FTA guideline specifications for passive wheelchair lifts, active wheelchair lifts, ramps and securement devices which were developed in 1985 and 1986 and are referred to in the rationale for many of these guideline specifications.

Arc Lift - This term denotes the type of lift that has an arcing motion during operation as differentiated from elevator lift.

Automatic Lift - This term refers to an active lift that has powered up, down, fold, and unfold functions.

Barrier - A raised edge or restraint system associated with the platform of a lift intended to restrain a wheelchair on the platform during operation.

dBA - This term denotes decibels with reference to 0.0002 microbar as measured on the "A" scale.

Deploy - The term used to denote the operation of a lift from a folded position to a position for use.

Design Load - The maximum weight capacity a lift is designed to support.

Dimensional Conventions - Dimensions that are not noted as maximum or minimum are absolute.

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

Drifting - The unintended movement of a lift from a folded position.

Elevator Lift - This term denotes the type of lift that has a vertical up and down movement as differentiated from an arc lift.

Factor of Safety (Design Safety Factor) - The factor of safety is the ultimate strength of a material divided by the working stress. A structure fails or breaks when loaded to its ultimate strength. A structure deforms or takes set when loaded to its yield strength.

Fail-Safe - A characteristic of a system and its elements whereby any malfunctions affecting safety will cause the system to revert to a known safe state.

Fold - The term designating the operation of an active lift from an operating position to a stowed position on the vehicle.

Interlock - The arrangement in which the operation or position of one mechanism automatically allows or prevents the operation of another.

Lift or Wheelchair Lift - A level change device used to assist those with disabilities in the use of transit and paratransit services. The term lift and wheelchair lift are used interchangeably in this document.

Maintenance Personnel Skill Levels - Maintenance personnel skills used in this document are defined in accordance with the White Book specifications as follows:

5M: Specialist Mechanic or Class A Mechanic Leader
4M: Journeyman or Class A Mechanic
3M: Service Mechanic or Class B Serviceman
2M: Mechanic Helper or Coach Serviceman
1M: Cleaner, Fueler, Oiler, Hostler, or Shifter.

May - This term denotes an option or alternative.

Mechanical and Hydraulic Components - Mechanical and hydraulic components include all parts of the lift drive or control system that are subject to wear and degradation due to the operation of the lift. These components are differentiated from structured components because they require lower design working stresses in anticipation of the wear and degradation.

Mobility Aid - A device that assists a person with mobility limitations to maneuver better. Examples include wheelchairs and walkers.

Paratransit Operation - Paratransit operation refers to a public transportation operation (service, vehicles, facilities, etc.) that is not a transit operation. Paratransit operation can also be generally categorized as operation of medium and small vehicles with active lifts.

Part 38 - The term denotes 49 CFR, Part 38, Subpart B.

Passive Lift - A passive lift is one that when stowed allows the unimpeded use of the vehicle door in which the lift is located. Passive lifts are commonly used in fixed route and fixed schedule transit operation.

Pinching Point - A location where two closely spaced parts of machinery can move together to create a human hazard.

Scooter - A three-wheel powered mobility aid steered by a single front wheel.

Semi-Automatic Lift - This term refers to an active lift that has powered up and down functions and requires manual operation for folding and unfolding the lift.

Shall - The term denotes that the specification is required by 49 CFR 38.

Shear Area - A hazardous condition or location where a moving part approaches or crosses a fixed part.

Should - The term denotes an advisory specification or recommendation.

Slip Resistant - A characteristic of a surface of a material that reduces unintended relative motion with respect to another surface with which it has contact.

Structural Components - The structural elements of the lift include those that support working loads and attach the lift to the vehicle. They do not include mechanical and hydraulic components associated with operation and control of the lift even through some mechanical and hydraulic components may support the working load.

Transit Operation - Transit operation refers to a public transportation operation (service, vehicles, facilities, etc.) that operates with fixed routes and fixed schedules. Transit operations can also be generally characterized as using heavy duty transit buses with passive lifts.

Unfold - The term designating the operation of a lift from a stowed position on the vehicle to an operating position.

Wheelchair - A mobility aid belonging to any class of three or four-wheeled devices, usable indoors, designed for and used by individuals with mobility impairments, whether operated manually or powered. A "common wheelchair" is such a device that does not exceed 30 inches in width and 48 inches in length measured two inches above the ground, and does not weigh more than 600 pounds when occupied.

White Book - This term is the common name for "Baseline Advanced Design Transit Coach Specifications," originally published by FTA on April 4, 1977, and is presently maintained by APTA.

1.5 Abbreviations

The following abbreviations may be found in the guidelines.

ADA --- Americans with Disabilities Act of 1990
ANSI --- American National Standards Institute
APTA --- American Public Transit Association
ASME --- American Society of Mechanical Engineers
ASTM --- American Society for Testing and Materials
ATBCB --- Architectural and Transportation Barriers Compliance Board
CFR --- Code of Federal Regulations
CSA --- Canadian Standards Association
FMEA --- Failure Modes and Effect Analysis
FMVSS --- Federal Motor Vehicle Safety Standard
FTA --- Federal Transit Administration (formerly UMTA)
GVWR --- Gross Vehicle Weight Rating
NHTSA --- National Highway Traffic Safety Administration
SAE --- Society of Automotive Engineers
UFAS --- Uniform Federal Accessibility Standards
UMTA --- Urban Mass Transportation Administration (now FTA)
VA --- Veterans Administration

2.0 TECHNICAL REQUIREMENTS

2.1 General Requirements

2.1.1 Operating Environment

The lift should operate in the temperature range of -10 F to 115 F, at relative humidities between 5 percent and 100 percent, and at altitudes up to 5,000 feet above sea level. Degradation of performance due to atmospheric conditions should be minimized at temperatures below -10 F, above 115 F, or at altitudes above 5,000 feet.

Special procedures, hydraulic fluids, and/or lubricants may be used to operate the lift for the low and/or high temperature operating conditions.

Rationale: The urban areas of the United States have broad ranges of climatic conditions. Weather data indicate that many cities have recorded 100 days or more per year of over 90 F temperatures. Likewise, many have recorded 20 or more days per year below 0 F. The annual rainfall ranges as high as 60 inches per year to a low of 4 inches per year. The normal snow and sleet precipitation in some cities reach 88 inches per year. The recommended guidelines cover a broad range of conditions found in the United States and are adapted from the White Book specifications.

2.1.2 Weight

The weight of the lift should not adversely affect the legal axle loadings, the maneuverability, structural integrity, or the safety operation of the vehicle in which it is installed.

Rationale: For legal and safety reasons the weight of the lift should not adversely affect the vehicle. Since existing lifts reportedly meet these requirements, the weights of existing lifts are considered acceptable. The recommended upper limits are 1,000 pounds for lifts installed on standard heavy duty transit vehicles and 400 pounds on small vans and other vehicles.

2.1.3 Operation Constraints

2.1.3.1 The lift should operate when the bus is on level ground and up to road grades up to seven (7) percent or four (4) degrees.

2.1.3.2 The lift should operate when the bus is on level ground and when the bus is at an angle of plus or minus 8.7 percent or five (5) degrees due to road crowns, depressions, or curb geographics.

Rationale: A lift will operate in a variety of different topographical conditions and must do so safely and reliably. A balance needs to be made between the topographical conditions to be accommodated by lift design and the conditions where a lift will not be required to operate.

A seven percent grade specification has been used by Seattle Metro in its lift procurement. Since Seattle has a relatively hilly topography, using its limit for road grade seemed reasonable.

No specification reviewed during the development of these guidelines identified any requirements in terms of the roll of the bus. However, the VA sets a limit of 9 degrees in any direction for the operation of a powered wheelchair. Since a lift can tilt up to 3

degrees (Section 2.2.5), the 5 degree parameter was chosen in order to be below the 9 degree figure when the 3 degree tilt is considered.

2.1.4 Boarding Direction

The lift shall permit both inboard and outboard facing of wheelchair and mobility aid users.

Rationale: This requirement is directly from Part 38. To accommodate the passenger and for emergency or other special conditions, the lift needs to be able to accept and operate with a wheelchair occupant facing either inward or outward. Discussion by the Advisory Panel considered outward facing to be preferred, but both directions need to be accommodated. Local operating policies may designate outward facing.

2.1.5 Location of Lift

The lift should be installed on the side of the vehicle opposite the driver's seat (recommended) or at the rear of the vehicle.

Rationale: An active lift usually requires a separate entry. For safety reasons, the preferred location is the curb side of a vehicle. However, in some cases a rear entrance may be preferred (e.g., in order to better utilize interior space). A rear entrance was not recommended, by the Advisory Panel although they recognized that special situations exist. If a rear door lift is used, vehicle loadings and unloadings should occur at off-street locations. Also, where a lift is located in the rear, the wheelchair securement position is also usually in the rear. The wheelchair occupant thus experiences the "roughest" ride in the vehicle when the occupant may be the passenger least able to withstand the shock and vibration. A rear mounted lift is also subjected to increased shock and vibration and could increase maintenance costs.

2.1.6 Padding and Protective Covering

2.1.6.1 Pinching movements, shear areas, or places where clothing or other objects could be caught or damaged should be covered or in other ways protected to prevent passenger injury when lift is in operation.

2.1.6.2 All exposed edges or other hazardous protrusions on the lift or on the bus in an area associated with the lift or securement device (except the platform) should be padded with energy absorbing material to minimize injury in normal use and in case of accident.

Rationale: To ensure safer operations, all potentially hazardous areas should be protected. This is especially true of lift operations where individuals with certain disabilities have limited control and/or feelings in parts of their body and may not sense a hazardous condition. When a hazardous area cannot be adequately protected, the lift manufacturer must use other means to ensure safety. One recommended alternative is a pressure sensing device that would automatically stop lift movement if an object were detected.

Tests have shown that edges and protrusions can be especially hazardous in accident situations. To reduce the potential danger, energy absorbing material should be used to protect these areas. The stowed platform should be protected on its edges. The Advisory Panel discussed having protection for the platform surface. When stowed the platform surface becomes a secondary "wall" inside the vehicle. A removable pad would provide additional protection, but was considered optional. California requires the pad, but some states prohibit the pad because it reduces the field of vision.

2.1.7 Operation Counter (Optional)

The lift should have an operations or use counter that records each complete up and down cycle of the lift.

Rationale: A counter would provide data on lift use. The data would be especially useful in recording lift cycling, scheduling maintenance, and evaluating the performance of the lifts. The Advisory Panel considered this feature useful, but not required. Although a counter adds cost to the purchase price, the expense is considered to be offset by better maintenance and lower operating costs resulting from the use of the counter.

2.1.8 Power Source Interface

2.1.8.1 The lift should operate and meet all requirements of these guideline specifications while using the power sources on the transit vehicle.

2.1.8.2 For small transit and paratransit vehicles, lifts may be powered by a heavy-duty alternator system or a dual battery system with batteries similar to that supplied by the manufacturer of the vehicle.

2.1.8.3 The lift should meet the requirements of these guideline specifications whenever the power sources are performing within their specified ranges. The lift should remain in a safe state during the following

power source transients, including failure, that may be experienced on transit vehicles.

Rationale: The electrical interface between the vehicle and the lift is an important consideration in performance. This guideline is intended to ensure both proper interface consideration for normal operations and safe conditions in abnormal situations, including power source excursions and power failure. A heavy duty alternator or separate battery is recommended for small vehicles to provide for more reliable operations. While the requirement for safe lift operations during and following power source transients may be somewhat redundant with other sections of the guidelines, it serves to emphasize the importance of continued safe lift operations even during and following such power excursions.

2.2 Platform

2.2.1 Platform Surface and Size

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

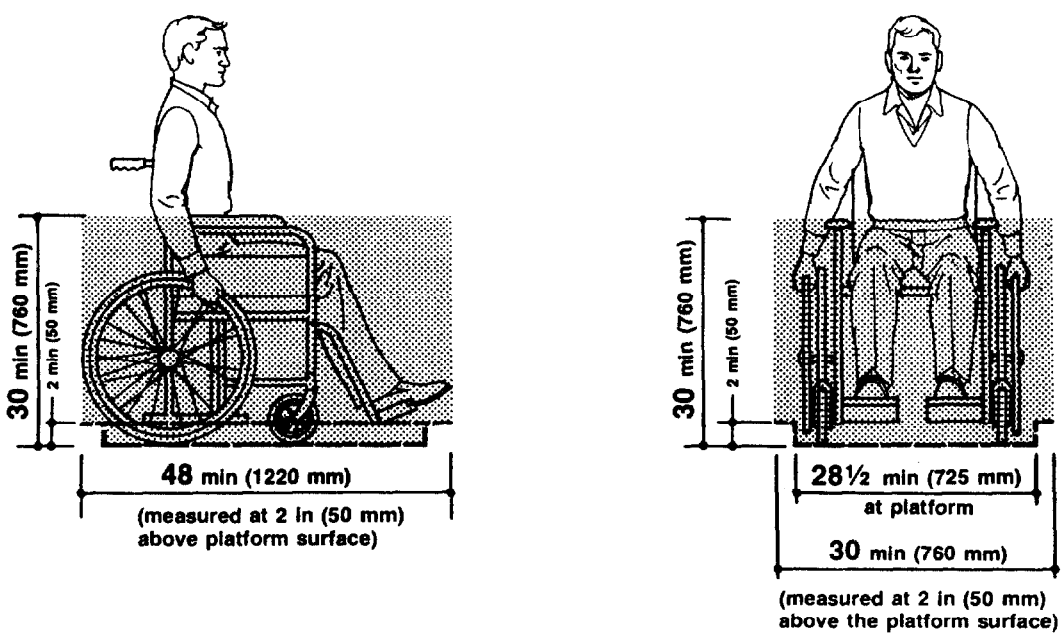

FIGURE 1. MINIMUM CLEARANCES ON ACTIVE LIFT

Rationale: This requirement is directly from Part 38. Any wheelchair or mobility aid that fits into these minimum clearances will also meet the space requirements of passive lifts, ramps, and securement devices that are established by Part 38. Part 38 requires that mobility aids to be accommodated include the most common types of manual and power wheelchairs and three-wheel mobility aids. The platform surface should be slip resistant under the conditions defined in Section 2.1.1.

2.2.2 Platform Barriers

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

Rationale: This requirement is directly from Part 38. Barrier tests are described under Section 3.1.6

2.2.3 Platform Gaps

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

Rationale: This requirement is directly from Part 38.

2.2.4 Platform Entrance Ramp

The entrance ramp, or loading-edge barrier used as a ramp, shall not exceed a slope of 1:8, measured at ground level, for a maximum rise of 3 inches, and the transition from the roadway or sidewalk to ramp may be vertical without edge treatment up to 1/4 inch. Thresholds between 1/4 inch and 1/2 inch shall be beveled with a slope no greater than 1:2.

Rationale: This requirement is directly from Part 38.

2.2.5 Platform Deflection

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

Rationale: This requirement is directly from Part 38. To reduce the ability of a wheelchair to gain additional speed and overcome the barrier or roll stop and to reduce the chance of a wheelchair tilting off the lift, a maximum deflection standard is established.

2.2.6 Platform Movement

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

Rationale: This requirement is directly from Part 38.

2.2.7 Handrails

Platforms on lifts shall be equipped with handrails on two sides, which move in tandem with the lift, and which shall be graspable and provide support to standees throughout the entire lift operation. Handrails shall have a usable component at least 8 inches long with the lowest portion a minimum 30 inches above the platform and the highest portion a maximum 38 inches above the platform. The handrails shall be capable of withstanding a force of 100 pounds concentrated at any point on the handrail without permanent deformation of the

rail or its supporting structure. The handrail shall have a cross-sectional diameter between 1-1/4 inches and 1-1/2 inches or shall provide an equivalent grasping surface, and have eased edges with corner radii of not less than 1/8 inch. Handrails shall be placed to provide a minimum 1-1/2 inches knuckle clearance from the nearest adjacent surface. Handrails shall not interfere with wheelchair or mobility aid maneuverability when entering or leaving the vehicle.

Rationale: This requirement is directly from Part 38.

2.2.8 Accommodation of Standees

2.2.8.1 Lifts shall accommodate persons using walkers, crutches, canes or braces or who otherwise cannot use steps. The platform may be marked to indicate a preferred standing position.

2.2.8.2 Door Height. For vehicles in excess of 22 feet in length, the overhead clearance between the top of the door opening and the raised lift platform, or highest point of a ramp, shall be a minimum of 68 inches. For vehicles of 22 feet in length or less, the overhead clearance between the top of the door opening and the raised lift platform, or highest point of a ramp, shall be a minimum of 56 inches.

Rationale: These requirements are directly from Part 38.

2.2.9 Platform Lighting

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

2.2.9.2 Other stepwells and doorways, including doorways in which lifts are ramps are installed, shall have, at all times, at least 2 foot-candles of illumination measured on the step tread, or lift or ramp, when deployed at the vehicle floor level.

2.2.9.3 The vehicle doorways, including doorways in which lifts or ramps are installed, shall have outside light(s) which, when the door is open, provide at least 1 foot-candle of illumination on the street surface for a distance of 3 feet perpendicular to all points on the bottom step

tread outer edge. Such light(s) shall be located below window level and shielded to protect the eyes of entering and exiting passengers.

Rationale: These requirements are directly from Part 38.

2.2.10 Line of Sight

When the platform is in a stowed position, it should not interfere with direct line of sight, especially between a passenger desiring to use the lift and the lift operator.

Rationale: The operational requirements of a lift may result in a lift operator and passenger being separated by the lift platform. The line of sight requirement means that in such a situation the platform should not impair sight contact. The operator should be able to see through or around the lift platform.

2.3 Structural

The structural elements of the wheelchair lift include those that support working loads and attach the lift to the bus. They do not include mechanical and hydraulic components associated with operation and control of the lift.

2.3.1 Lift Capacity

The design load of the lift shall be at least 600 pounds.

Rationale: This requirement is directly from Part 38.

2.3.2 Structural Safety Factor

Nonworking parts such as platform, frame, and attachment hardware which would not be expected to wear, shall have a safety factor of at least three based on the ultimate strength of the material.

Rationale: This requirement is directly from Part 38.

2.3.3 Useful Life

When used and maintained in accordance with manufacturer recommended procedures, the lift structure should be designed to have a useful life equal to the useful life of the vehicle on which it is used.

Rationale: Once installed the lift becomes part of the vehicle. As with other components of the vehicle, the lift with normal maintenance, including repair and replacement of parts, should be operable as long as the vehicle.

2.3.4 Materials

Structural components should be made of steel or other durable construction material.

2.3.4.1 Ferrous surfaces should be either plated with a protective coating or be cleaned and have a corrosion and abrasion-resistant flat protective finish.

2.3.4.2 Nonferrous and nonmetallic surfaces should be coated using a durable finish.

2.3.4.3 Stainless steel does not require coating or surface treatment.

Rationale: The structural components of the lift are to have a useful life equal to that of the vehicle upon which they are mounted. Materials and coatings identified in these guidelines are intended to ensure this useful life. The discussions of the Advisory Panel include using a salt spray test or paint thickness measurement to insure compliance. The VA standard includes both ferrous material coating and test methods. However, no specific tests or coating methods have been designated so that manufacturers can continue to use their preferred methods. Panel members considered placing any coatings or surface treatments on stainless steel unnecessary.

2.3.5 Interface with the Vehicle

2.3.5.1 Installation of the lift should not reduce or in any way compromise the structural integrity of the vehicle and shall have a structural safety factor as specified in Section 2.3.2.

2.3.5.2 Attachment of the lift, including any modification of the vehicle, should not cause an imbalance of the vehicle that will adversely affect vehicle handling characteristics.

2.3.5.3 No part of the installed and stowed lift should extend laterally beyond the normal width of the vehicle.

2.3.5.4 The lift should not contact the opened door and/or door frame during deployment and normal operation.

Rationale: The design of a lift dictates the required space for installation. It should be the responsibility of the vehicle manufacturer to determine compatibility of his vehicle's structural design with the selected lift. These guideline specifications require that the interface with the vehicle should have the same design safety factor as the lift structure.

Interlocks that prevent lift operation unless a vehicle door is open are recommended. However, observation at public transportation operations indicated that door adjustments or improper lift installation can result in interference between the lift and the door. These specifications do not allow such operating conditions. Concurrently, these specifications encourage increased door clearances and/or more precision in lift operation. This specification does not prohibit the use of brushes or other devices that are designed to allow contact between the door and lift.

2.4 Mechanical and Hydraulic

Mechanical and hydraulic components include all parts of the lift drive or control systems that support the platform load during normal operation of the wheelchair lift.

2.4.1 Mechanical Safety Factor

Working parts such as cables, pulleys, and shafts, which can be expected to wear, and upon which the lift depends for support of the load, shall have a safety factor of at least six based on the ultimate strength of the material.

Rationale: This requirement is directly from Part 38.

2.4.2 Hydraulic Safety Factor

Hydraulic components should comply with all applicable Society of Automotive Engineers Standards. These Standards include, but are not limited to the following.

SAE J 190 - Power Steering Pressure Hose - Wire Braided
SAE J 191 - Power Steering Pressure Hose - Low Volumetric
SAE J 514APR80 - Hydraulic Tubing Fittings
SAE J 516JUN84 - Hydraulic Hose Fittings
SAE J 517JUN85 - Hydraulic Hose

All other components that contain working fluid should have a minimum burst pressure of at least four (4) times normal design working pressure.

Rationale: The mechanical safety factor is in agreement with the California Administrative Code. Also, "Safety Standard for Manlifts," ANSI A90.1-1976 states that all parts of the machine shall have a safety factor of six (6) based on a full load. Although the wheelchair lift operates at a lower velocity and is subjected to less severe shock loads than a manlift, a safety factor of six (6) is considered appropriate. The hydraulic system design guideline is structured to make use of applicable Society of Automotive Engineers Standards. Hydraulic components that are not the subject of SAE Standards should be burst pressure tested at least four (4) times normal design working pressure to ensure the integrity of the complete hydraulic system.

2.4.3 Power or Equipment Failure

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

Rationale: This requirement is directly from Part 38.

2.5 Control Systems

2.5.1 Control Unit

2.5.1.1 The control unit should be a console or box with a function switch, or a combination thereof. The control unit may also have a power switch.

2.5.1.2 The control unit location should allow the lift operator to have an unobstructed view of the platform during lift operation and should allow the lift operator to be on or off the vehicle during lift operation.

2.5.1.3 The control unit should be located in a position that minimizes its damage during use of the lift.

2.5.1.4 The control console should have simple instructions on or near it that directs the operator in the lift operating procedures.

Rationale: The control system should be simple. Operator error, a factor in lift accidents, can be reduced with simple control systems and instructions. Existing, popular active lift models do have easily understood controls that meet this requirement. Another safety factor is for the control unit to be located in a position that allows the lift operator constantly to monitor lift operations. Tethered or pendant-mounted control units are common in the industry but must be carefully positioned for both safe operation and long life.

2.5.2 Control Power Switch

The lift controls should have a power switch with two positions--on and off. The "on" position enables lift operation. The "off" position prevents lift operation.

Rationale: The power switch must be on to operate the lift. This switch enables the function selection and the operating switches. This switch is considered important for the safe design of the control logic. The switch may be on the control unit. The switch may also be located elsewhere on the vehicle. For example, the switch may be activated by opening or closing the door that is used for the lift.

2.5.3 Control Functions

(USE ONE OF THE FOLLOWING OPTIONAL SECTIONS)

Option A - Automatic Control

The complete lift should be attendant operated, fully automatic, including folding and unfolding of the platform.

2.5.3.1 The lift control system should have at least four designated operation functions as defined:

(1) Up - raises a lift platform, while maintaining an operating position
(2) Down - lowers lift platform, while maintaining an operation position

(3) Fold - moves lift platform from an operating position to a stowed position
(4) Unfold - moves lift platform from a stowed position to an operating position.

2.5.3.2 The lift may have four additional optional functions as defined:

(1) Outer Barrier Up - raises outer barrier
(2) Outer Barrier Down - lowers outer barrier
(3) Inner Roll Stop Up - raises inner roll stop
(4) Inner Roll Stop Down - lowers inner roll stop.

Option B - Semi-Automatic Control

The control lift unit should be semi-automatic including a manual fold and unfold of the lift platform. The folding and unfolding of the lift from and to the stored position should be accomplished with not more than a 20-pound force.

2.5.3.1 The lift control system should have at least two designated operating functions as defined:

(1) Up - raises a lift platform, while maintaining an operating position
(2) Down - lowers lift platform, while maintaining an operation position.

2.5.3.2 The lift may have four additional optional functions as defined:

(1) Outer Barrier Up - raises outer barrier
(2) Outer Barrier Down - lowers outer barrier
(3) Inner Roll Stop Up - raises inner roll stop
(4) Inner Roll Stop Down - lowers inner roll stop.

Rationale: To help reduce driver error in fleets with different lifts, the operating terminology is standardized for both automatic and semi-automatic lifts. A distinction is made between recommended functions and optional functions. The recommended functions are considered the minimum acceptable for safe operation. Existing active lifts usually have an automatic barrier, and/or roll stop. The guideline allows an option for controlled barrier or roll stop operation.

It is important that durable markings identify the control functions. The durable markings help experienced operators and are vitally important when new or inexperienced operators are responsible for lift operation.

No nationally established standards for manual lifting exist. Ergonomists make judgements and recommendations for each type of manual lift that is encountered. The 20-pound force for folding and unfolding the semi-automatic lift platform is based on recognition that at and below this number the force is considered moderate. Ergonomists suggest engineering control, such as power assists, when a 20-pound lift force is exceeded.

2.5.4 Control Operating and Function Switches

2.5.4.1 The control system should consist of:

(a) separate operating and function selection switches or
(b) integrated operating and function switches.

2.5.4.2 The function selection switch or integrated switches should be labeled with the functions defined in Section 2.5.3.

2.5.4.3 Where provided, each control for deploying, lowering, raising, and stowing the lift and lowering the roll-off barrier shall be of a momentary contact type requiring continuous manual pressure by the operator and shall not allow improper lift sequencing when the lift platform is occupied.

2.5.4.4 The controls shall allow reversal of the lift operation sequence, such as raising or lowering a platform that is part way down, without allowing an occupied platform to fold or retract into the stowed position.

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

2.5.4.5 The lift shall deploy to all levels (i.e., ground, curb, and intermediate positions) normally encountered in the operating environment.

Rationale: Section 2.5.4.3, Section 2.5.4.4 and the EXCEPTION, and Section 2.5.4.5 are directly from Part 38.

The control system allows two approaches. The first is a function selection switch, which is used to designate a function, and an operating switch that activates the

function. The second approach is separate integrated switches. Under this approach, separate or combined switches (e.g. a single button "up" switch or a combined "up" and "down" toggle switch with a neutral position) control lift operation. Both approaches would be possible only by momentary switches that would stop lift movement when released. Also, for safety purposes the lift will only perform one function at a time.

2.5.5 Design Safety

The control system should be designed to be fail-safe for single failure modes that would negate the proper operations of the interlocks specified in Section 2.5.8. A complete failure modes and effects analysis (FMEA) or a suitable test that demonstrates that this design requirement has been met should be provided.

Rationale: Safe operation is a primary concern of the guideline specifications. The safety protection for some operator errors and equipment failures resides in the integrity of the interlocks and safety features of Section 2.5.8. The safety of the lift/vehicle system is enhanced by requiring that the interlocks remain in a known safe state under conditions of any single failure of the control system or loss of power to the control system.

Most system safety evaluations include both analysis (e.g., FMEA) and testing. The lift is a mechanical system that includes mechanical hardware, but could also include computer hardware and software. The degree to which analysis and/or equipment testing are used in the safety evaluation should be based on the lift design and what combination of analysis and testing will assure safe operation.

An FMEA is a frequently used method in safety analysis to demonstrate what a design will do under selected failure modes. There are many reports and papers explaining FMEA. Three reports are:

(1) Dussault, N. B., "The Evolution and Practical Applications of Failure Modes and Effects Analysis," RADC-TRC-83-72, March 1983.

(2) MIL-STD-7858, Sept. 15, 1980, "Reliability Program for Systems and Equipment Development and Production," Task 204, Failure Modes, Effects, and Criticality Analysis (FMECA).

(3) ARP 926 A, "Fault/Failure Analysis Procedure," SAE Aerospace Recommended Practice, Rev. 11-15-79.

The first reference is a report that discusses several methods. The second reference is a Military Standard that is used in many defense system developments. The third reference is an SAE Recommended Practice used in the aerospace industry.

2.5.6 Jacking Prevention

The control system or inherent lift design should prevent the operation of the lift from jacking the vehicle and causing damage to the vehicle or the lift.

Rationale: To prevent damage to the lift or vehicle, the control system or inherent lift design shall not allow jacking. In some cases, the release of load on the vehicle suspension when the lift platform reaches the ground is mistakenly considered jacking.

2.5.7 Emergency Operation

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

Rationale: Sections 2.5.7 is directly from Part 38.

2.5.8 Interlocks and Safety Features

The controls shall be interlocked with the vehicle brakes or transmission, or shall provide other appropriate fail-safe mechanisms or systems, to ensure that the vehicle cannot be moved when the lift is not stowed and so the lift cannot be deployed unless the interlocks or systems are engaged.

Rationale: Section 2.5.8 is directly from Part 38. The interlock and safety features are designed to prevent unsafe conditions.

2.5.9 Wiring

Wiring should be in accordance with SAE Recommended Practice SAE J1292 OCT 81 and referenced Standards, except when good engineering practice dictates special conductor insulations.

Rationale: This SAE Recommended Practice, "Automobile, Truck, Truck-Tractor, Trailer, and Motor Coach Wiring," is accepted by the automotive industry and provides a baseline for design. The practice recognizes that unique design will require engineering practices that cannot be envisioned and incorporated into a recommended practice.

2.5.10 Lift Operational Requirements

2.5.10.1 The maximum speed of platform motion when lowering and lifting an occupant shall be 6 inches per second. The operating time required to deploy the lift, lower or raise the platform, and stow the platform should not exceed 60 seconds.

2.5.10.2 The maximum platform horizontal and vertical acceleration when occupied shall be 0.3g.

2.5.10.3 The maximum allowable jerk should be 0.3g/sec.

Rationale: The maximum speed of platform motion in 2.5.10.1 and the maximum platform acceleration in 2.5.10.2 are from Part 38 as quoted in 2.2.6 (Platform Movement).

"Safety Guidelines for Wheelchair Lifts on Public Transit Vehicles," FTA-CA-06-0098-80-1 states that jerk, the rate of change of acceleration, shall not exceed 0.3g/seconds throughout horizontal motion of the occupied lift platform.

3.0 TESTING, CERTIFICATION, INSPECTION, AND WARRANTIES

3.1 Design Tests

The tests defined in Section 3.1 should be performed on one representative production unit of the lift model purchased by this procurement. Unless otherwise specified, the lift should meet the requirements given in Section 2.0 when attached to a fixture that simulates a bus installation and when supplied by electric, hydraulic, air, or other power source of output equal to that normally available on the bus. Only one representative production unit is required to be tested for certification, with all tests of Section 3.1 conducted on the same unit without any repairs or maintenance during the test other than permitted by Section 3.1.11.

3.1.1 Durability Tests

The following tests should be performed without failure in the order given.

3.1.1.1 Vertical Cycling Tests. The lift platform should be operated up and then down through its maximum vertical operating range for 15,600 cycles with a load of 600 pounds for the first 600 cycles and 400 pounds for the remaining cycles. The ambient temperature for the first half of the cycles in each of these tests should be at least 115 F. The tests may be continuous or separated into groups of not less than 10 cycles with nonoperating periods of not more than one minute between each cycle in the group. The platform should raise and lower smoothly throughout the test with vertical and horizontal accelerations not exceeding 0.3g.

3.1.1.2 Deployment Cycling Test. The lift platform of an automatic lift should be folded and unfolded for 10,000 cycles. The ambient temperature for the first half of the cycles should be at least 115 F. The tests may be continuous or separated into groups and may have nonoperating periods between cycles as specified in Section 3.1.1.1.

3.1.1.3 Combination Vertical and Deployment Cycling Test. The tests in Sections 3.1.1.1 and 3.1.1.2 may be combined into a single test that meets the minimum requirements of both tests.

Rationale: The first two of the above tests are adapted from the California Administrative Code. Section 3.1.1.2 is only for automatic lifts. Since semi-automatic lifts do not have a power fold or unfold function, a durability test of fold and unfold is not necessary. Section 3.1.1.3 has been added to accommodate manufacturers equipped to conduct the tests simultaneously.

Note that the language in Section 3.1 does not mean that a manufacturer must perform these tests for each procurement. Once a production unit of a specific lift model and vehicle combination has been tested, the design tests apply to all procurements of that combination. Section 3.1.1.1 includes testing for Part 38's limit on platform acceleration.

3.1.2 Low Temperature Operation Test

After 16 hours of exposure to a temperature not higher than 20 F, the wheelchair lift should be operated unloaded through 10 or more cycles of unfolding, lowering, raising, and folding (or lowering and raising for semi-automatic lifts) and through 10 or more cycles of raising and lowering with a 600-

pound load. Each cycle should be separated by at least a 30-minute cooling period at a temperature not higher than 20 F. The lift should meet all performance requirements while operating at the exposure temperature.

Rationale: The above test is a modification of the low temperature test of the California Administrative Code. The major changes were to extend the soak time to correspond to an overnight storage at a low temperature, to add testing at the design load, and explicitly to require the lift to meet all performance requirements at the test temperature.

3.1.3 Platform Deflection Test

A static load of 600 pounds should be applied through the centroid of a test pallet 26 inches by 26 inches placed at the centroid of the platform. The platform should be raised and lowered with this weight. During the lift operation, the platform should not deflect more than three degrees in any direction from the loaded position and its unloaded position.

Rationale: This test would assure compliance with Section 2.2.5 (Platform Deflection).

3.1.4 Self-Damage Tests

The controls should be held in operating position for 5 seconds after the unloaded lift meets resistance to its travel under each control position with any limit switch disabled. The test should be performed twice at each lift position of unfold, fold, full up at floor level, and full down at ground level.

Rationale: Section 3.1.4 is adapted from the California Administrative Code.

3.1.5 Power and Equipment Failure Test

A failure of power, chain cable, hydraulic hose, or air hose that allows the lift to deploy or the platform to lower should be simulated. The lift should comply with Section 2.4.3 during this test. An FMEA may be provided in lieu of conducting actual tests.

Rationale: Section 3.1.5 has also been adapted from the California Administrative Code. It has been modified by allowing an FMEA to be used in place of actual testing. Such an analysis examines the consequences of failures such as those specified for simulation.

3.1.6 Outer and Inner Barrier Test

3.1.6.1 Outer Barrier Test. The contractor should test the ability of the outer barrier to retain a powered wheelchair or mobility aid. Two of four wheelchairs and a three-wheel powered mobility aid are to be tested. The Everest and Jennings Magnum or the Invacare Power Rolls Arrow Model 4M929 and the Invacare Power Rolls Arrow XT or the Fortress Scientific 760N should be used. The two wheelchairs and secured load should not leave the platform and the outer barrier should not be defeated (driven through or climbed over) by the wheelchairs or scooter when tested under all of the following conditions:

(a) fully charged battery system
(b) equivalent occupant loads of both 110 and 250 pounds
(c) operated both forwards and backwards
(d) accelerated at full power from a starting position off of the lift platform and a minimum of 48 inches between the front edge of the foot rests or rim of the rear tires and the outer barrier
(e) a platform positioned with a 8 degree outward slope
(f) the lift platform in a raised position.

The Everest and Jennings Magnum or Invacare Power Rolls Arrow Model 4M929 should be equipped with a standard adult size seat, standard foot rests, and a standard upright back. The Invacare Power Rolls Arrow XT or the Fortress Scientific 760N should also be equipped with all the above features. The three-wheel powered scooter tested should be of a size and weight typical of those in present use.

3.1.6.2 Inner Barrier Test

The contractor should test the ability of the inner barrier to prevent a wheelchair or mobility aid from inadvertently rolling off the platform. In its raised position the roll stop should withstand a total force of at least 300 pounds parallel to the platform surface in the unloading direction. The force should be applied at a minimum height of 2-1/2 inches above the top surface of the platform with 150 pounds at each of two points 11.8 inches on each side of the center of the roll stop. Inherent design features may preclude the need for an inner barrier.

Rationale: The barrier tests described in this section should be performed to demonstrate compliance with the platform barrier requirements included in Part 38. Part 38 is quoted in Section 2.2.2 of these guideline specifications.

The four wheelchair models represent current wheelchairs that are powered and could override barriers. They have been selected because they have been identified as representing those models that are currently available and produce high and possibly the highest amounts of force that could overcome a barrier. A three-wheel mobility aids should also be used in this test.

Specific models of wheelchairs have been chosen to standardize this test and to make transit operators aware of the limits of the test. A transit operator faced with transporting wheelchairs more powerful than those mentioned (e.g., specially-adapted wheelchairs) will be faced with different safety and risk levels.

The wheelchairs and the three-wheel scooter are to be tested with two different weights. The 110-pound represents a 5th percentile woman. With this lighter load, a wheelchair would be more susceptible to climbing or bouncing over a barrier. The 250-pound load represents a 99th percentile male, the standard used in defining the design load. The heavier weight will test the ability of a wheelchair to be powered through a barrier.

It is recognized that this guideline will become dated as makes and models of wheelchairs change. This is attested to by the fact that the wheelchair models suggested here are different from those selected in 1986. The term "or equivalent" was considered for inclusion in 1986; however, determining equivalency could be complicated. The intent of the test is to have "common", known wheelchairs used for testing.

3.1.7 Static Load and Interface Test

A static load of 1,800 pounds should be applied through the centroid of a test pallet placed at the centroid of the platform when the platform is positioned at its raised position. The length and width dimensions of the test pallet should be 26 inches by 26 inches to correspond to the approximate outer dimensions of a wheelchair "footprint." The load should remain on the platform not less than two (2) minutes. After the load is removed, an inspection should be made to determine if fracture has occurred.

Rationale: Section 3.1.7 is adopted from the California Administrative Code. It was modified to specify a time period for the test. The two-minute period is the same as that specified by the VA.

3.1.8 Vehicle Interface Test

This test should be or should have been conducted on a lift installed in an actual vehicle model being purchased through this procurement. A static load of 900 pounds should be applied through the centroid of a test pallet placed at the centroid of the platform when the platform is positioned at its raised position. The length and width dimensions of the test pallet should be 26 inches by 26 inches. The load should remain on the platform not less than two (2) minutes.

Rationale: Section 3.1.8 has been developed for these guideline specifications and tests the structural interface between the vehicle and the lift. This test need be done once for each lift-vehicle model combination.

3.1.9 Interlock Safety Tests

The contractor shall submit a test plan for approval by the Procuring Agency or a statement of certification that demonstrates that the lift meets the safety related interlocks as given in Section 2.5.8. The test results or certification should be based on a lift installed in a vehicle of the same make and model of that being procured through this bid package.

Rationale: The test plan or certification of a design test will demonstrate the level of safety provided by the lift interlocks. The results of a previous test, which are certified, can be used if that test had been conducted on the vehicle make and model being procured.

3.1.10 Visual Inspection

At the conclusion of any test described in Section 3.1--except Sections 3.1.6 and 3.1.7--with all loads removed, the parts of the lift should show no condition of fracture, permanent deformation, wear that would exceed manufacturer's tolerances, perceptible impairment, or other deterioration that would be dangerous.

Rationale: Section 3.1.10 is adapted from the California Administrative Code. Extreme wear implies that point where a component or part shows wear that would indicate failure before its design life.

3.1.11 Maintenance During Tests

During the Durability Tests of Section 3.1.1, the inspection, lubrication, maintenance, and replacement of parts (other than bulbs and fuses) may be

performed only as specified in the contractor's maintenance manual for the lift and at intervals no more frequent than specified in the manual. Maintenance specified for certain time intervals should be performed during the vertical cycling and deployment cycling tests at a number of cycles that is in the same proportion to the total cycles as the maintenance period is to 36 months.

Rationale: Section 3.1.11 is adapted from the California Administrative Code. Scheduled maintenance is permitted during the tests, and parts scheduled for replacement can be replaced. However, if replacement or other parts fail, the test would have to be repeated.

3.1.12 Testing Certification

The contractor should provide written certification of compliance to the tests specified in Section 3.1, Design Tests.

Rationale: This is a standard practice in design testing.

3.2 Acceptance Test or Inspection (Optional)

The contractor should submit for approval to the Procuring Agency an independent test report or a plan to demonstrate that the lifts purchased by this procurement meet the requirements given in Section 2.0, unless otherwise tested in Section 3.1. A mutually agreed upon notification time prior to the conduct of any test should be made between the two parties. The test or inspection results should be recorded and witnessed and submitted to the Procuring Agency as proof of meeting the acceptance criteria of the approved test plan.

Rationale: This section is optional since most lifts would be purchased as a part of a vehicle procurement and any lift acceptance inspection or testing would be included in the vehicle acceptance testing.

3.3 Installation Certification

The contractor should submit written certification that the lift has been installed according to lift or vehicle manufacturer specification.

Rationale: Section 3.1.8 describes a design test for installation. The requirement in Section 3.3 is to ensure that the fleet installation has been satisfactorily accomplished for the actual vehicles procured. Even though vehicle manufacturers do not normally specify how a lift

should be installed, it is important that the lift installed not violate vehicle manufacturer specifications for vehicle performance, safety, and life.

3.4 Warranty

A statement of warranty should be provided with each lift assuring the quality of materials and workmanship of the product for at least one (1) year from the date of acceptance by the final consumer.

Rationale: The above is based on warranty provision found in the VA specifications.

SECTION 4.0, MAINTENANCE, TRAINING, AND SERVICE, IS ADAPTED FROM THE WHITE BOOK SPECIFICATIONS. IT IS NOT NECESSARY IF THESE CONDITIONS ARE COVERED BY GENERAL CONDITIONS OF THE PROCUREMENT PACKAGE.

4.0 MAINTENANCE, TRAINING, AND SERVICE

4.1 Documents

The contractor should provide ---(*)--- current maintenance manual(s), ---(*)--- current parts manual(s), and ---(*)--- operator's manual(s), or ---(*)--- combination manual(s) thereof as part of this contract. The contractor should keep maintenance manuals available for a period of three (3) years after the date of acceptance of the lift procured under this contract.

(*) Procuring Agency to fill in number of manuals to be provided.

4.2 Maintenance and Inspection

Scheduled maintenance or inspection tasks as specified by the contractor should require a skill level of 3M (Service Mechanic or Class B Serviceman) or less. Scheduled maintenance tasks should be related and should be grouped in maximum bus mileage intervals. Routine scheduled maintenance actions, such as lubrication and adjustments, should not be required at intervals of less than 6,000 bus miles or 1,000 up and down lift cycles, whichever comes first, except for routine daily service performed during the fueling operations. Higher levels of scheduled maintenance tasks should occur at even multiples of the vehicle mileage for lower level tasks.

4.3 Maintenance Accessibility

All systems or components serviced as part of the periodic maintenance of the lift, whose failure may cause a safety hazard or a roadcall, shall be readily accessible for service and inspection. To the extent practicable, removal of physical movement of components unrelated to the specific maintenance and/or repair tasks involved should be unnecessary. Relative accessibility of components, measured in time required to gain access, should be inversely proportional to frequency of maintenance and repair of the components.

4.4 Training (Optional)

The contractor should have at least one qualified instructor who should be available at the Procuring Agency's property for ---(*)--- calendar days between the hours of ---(*)--- and ---(*)--- after acceptance of the first lift. Instructor(s) should conduct classes and advise the personnel of the Procuring Agency on the proper operation and maintenance of the lift. The contractor should also provide visual and other teaching aids for use by the Procuring Agency's own training staff.

(*) Procuring Agency to fill in pertinent information

Rationale: For small procurements this type of training would be expensive and excessive. This section is, therefore, optional. For small procurements the contractor should be requested to provide brief instructions on lift use at the time of vehicle delivery.

4.5 Service

4.5.1 Engineering

The contractor should, at its own expense, have a competent engineering representative(s) available on request to assist the Procuring Agency's staff in the solution of engineering or design problems within the scope of these specifications that may arise during the warranty period. This does not relieve the lift contractor of responsibilities under Section 3.4, Warranty.

4.5.2 Spare Parts

The contractor shall guarantee the availability of replacement parts for lifts procured under this contract for at least a period equal to the useful life of the lift. Spare parts shall be interchangeable with the original equipment and shall be manufactured in accordance with the quality assurance provisions of this contract.

FEDERAL TRANSIT ADMINISTRATION

GUIDELINE SPECIFICATIONS FOR

TRANSIT VEHICLE RAMPS

SEPTEMBER 1992

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FEDERAL TRANSIT ADMINISTRATION
GUIDELINE SPECIFICATIONS FOR
TRANSIT VEHICLE RAMPS

1.0 GENERAL

1.1 Background

These updated guideline specifications are for use by accessible vehicle purchasers in preparing specifications for ramps. These guidelines are an update of the Urban Mass Transportation Administration's (now Federal Transit Administration - FTA) "Guideline Specifications for Wheelchair Ramps" prepared in 1986. Major changes have been made in order to be in agreement with 49 CFR, Part 38. Part 38 is based on guidelines and requirements issued by the Architectural and Transportation Barriers Compliance Board, as required by Title's II and III of the Americans with Disabilities Act (ADA) of 1990. Part 38 sets forth DOT standards in compliance with the Board's guidelines and requirements for accessible transportation vehicles. These updated guideline specifications also include changes based on experience since 1986 and on comments and suggestions of people from the transit industry who have reviewed drafts of these new guideline specifications.

1.2 Scope

These updated guideline specifications relate to ramps that are used on public transportation vehicles, both large and small. The ramps are designed to accommodate loads that do not exceed 600 pounds. Maximum safety for all ramp users and increased accessibility are of primary concern in these guideline specifications.

1.3 Use of These Guideline Specifications

These guideline specifications include some direct quotations from Part 38. All Technical Requirements based on Part 38 use the word "shall" and are specific requirements of the established regulation. The word "should" is used in other specifications and represents recommendations that are advisory. In using these guideline specifications, the vehicle purchaser may change the "shoulds" to "shalls" if the items are considered important. These advisory guideline specifications are superseded by any applicable Federal Motor Vehicle Safety Standards in the Code of Federal Regulations 49 Part 571 and by applicable rules and regulations of individual states and local regulating bodies.

1.4 Definitions

The following definitions apply to this document.

Accessible Vehicle - A vehicle that meets the requirements of Part 38.

Advisory Panel - A group of 37 specialists in areas related to the transit industry and accessibility issues. They were the major contributors to the UMTA guideline specification for passive wheelchair lifts, active wheelchair lifts, ramps, and securement devices which were developed in 1985 and 1986 and are referred to in the rationale for many of these guideline specifications.

dBA - This term denotes decibels with reference to 0.0002 microbar as measured on the "A" scale.

Deploy - The term used to denote the operation of a ramp from a stowed position to a position for use.

Design Load - The maximum weight capacity a ramp is designed to support.

Dimensional Conventions - Dimensions that are not noted as maximum or minimum are absolute.

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

Factor of Safety (Design Safety Factor) - The factor of safety is the ultimate strength of a material divided by the working stress. A structure fails or breaks when loaded to its ultimate strength. A structure deforms or takes set when loaded to its yield strength.

Fail-Safe - A characteristic of a system and its elements whereby any malfunctions affecting safety will cause the system to revert to a known safe state.

Interlock - The arrangement in which the operation or position of one mechanism automatically allows or prevents the operation of another.

Maintenance Personnel Skill Levels - Maintenance personnel skills used in this document are defined in accordance with the White Book specifications as follows:

5M: Specialist Mechanic or Class A Mechanic Leader
4M: Journeyman or Class A Mechanic
3M: Service Mechanic or Class B Serviceman

2M: Mechanic Helper or Coach Serviceman
1M: Cleaner, Fueler, Oiler, Hostler, or Shifter.

May - This term denotes an option or alternative.

Mobility Aid - A device that assists a person with mobility limitations to maneuver better. Examples include wheelchairs and walkers.

Paratransit Operation - Paratransit operation refers to a public transportation operation (service, vehicles, facilities, etc.) that is not a transit operation. Paratransit operation can also be generally categorized as operation of medium and small vehicle.

Part 38 - The term denotes 49 CFR, Part 38, Subpart B. Part 38 is being implemented in response to the Americans with Disabilities Act of 1990.

Scooter - A three-wheel powered mobility aid steered by a single front wheel.

Shall - The term denotes that the specification is required by 49 CFR, Part 38.

Should - The term denotes an advisory specification or recommendation.

Slip Resistant - A characteristic of a surface of a material that reduces unintended relative motion with respect to another surface with which it has contact.

Stow - This term denotes the movement of a ramp from a position of use to a position where the ramp is stored and does not interfere with passenger movement.

Structural Components - The structural elements of the ramp include those that support working loads and attach the lift to the vehicle. They do not include mechanical and hydraulic components associated with operation and control of the ramp.

Transit Operation - Transit operations refers to a public transportation operation (service, vehicles, facilities, etc.) that operates with fixed routes and schedules. Transit operation can also be generally characterized as using heavy duty transit buses.

Wheelchair - A mobility aid belonging to any class of three or four-wheeled devices, usable indoors, designed for and used by individuals with mobility impairments, whether operated manually or powered. A "common wheelchair" is such a device that does not exceed 30 inches in width and 48 inches in length measured two inches above the ground, and does not weigh more than 600 pounds when occupied.

White Book - This term is the common name for "Baseline Advanced Design Transit Coach Specifications," originally published by UMTA on April 4, 1977, and presently maintained by APTA.

1.5 Abbreviations

The following abbreviations may be found in the guidelines.

APTA --- American Public Transit Association
ATBCB --- Architectural and Transportation Barriers Compliance Board
CFR --- Code of Federal Regulations
CSA --- Canadian Standards Association
FMVSS --- Federal Motor Vehicle Safety Standard
FTA --- Federal Transit Administration (formerly UMTA)
GVWR --- Gross Vehicle Weight Rating
SAE --- Society of Automotive Engineers
UMTA --- Urban Mass Transportation Administration (now FTA)
VA --- Veterans Administration

2.0 TECHNICAL REQUIREMENTS

2.1 General Requirements

2.1.1 Operating Environment

The ramp should operate in a temperature range of -10 F to 115 F, at relative humidities between 5 percent and 100 percent, and at altitudes up to 5,000 feet above sea level. Degradation of performance due to atmospheric conditions should be minimized at temperatures below -10 F, above 115 F, or at altitudes above 5,000 feet.

Rationale: The urban areas of the United States have broad ranges of climatic conditions. Weather data indicate that many cities have recorded 100 days or more per year of over 90 F temperatures. Likewise, many have recorded 20 or more days per year below 0 F. The annual rainfall ranges as high as 60 inches per year to a low of 4 inches per year. The normal snow and sleet precipitation in some cities reach 88 inches per year. The above guidelines cover a broad range of conditions found in the United States and are taken from the White Book specifications.

2.1.2 Operation Constraints

The ramp should operate when the vehicle is on level ground and up to road grades of seven (7) percent or four (4) degrees.

Rationale: A ramp will be required to operate under a variety of different topographic conditions. A balance needs to be made between the topographical conditions to be accommodated by a ramp and the conditions where a ramp will not be required to operate. A seven percent grade specification is currently used by Seattle Metro in its lift procurements. Since Seattle has a relatively hilly topography, using its limits for road grade seemed reasonable.

By its very nature a ramp will be able to accommodate different roll attitudes of a vehicle. The result will be an increased or decreased ramp slope. Section 2.1.7 identifies the maximum ramp slope.

2.1.3 Boarding Direction

A ramp should be capable of handling a wheelchair with the occupant facing inboard or outboard.

Rationale: The ability to maneuver inside the vehicle or at a vehicle stop may require a person in a wheelchair to use a ramp in either direction. However, the Advisory Panel recommends that under normal operating conditions the wheelchair passenger face the vehicle, and where applicable, with the attendant or driver in the back of the wheelchair.

2.1.4 Location of Ramp

The ramp should be installed on the side of the vehicle opposite the driver's seat (recommended); at the rear of the vehicle; or on both sides of the vehicle.

Rationale: A ramp could be used in a regular vehicle door or in a separate entrance. For safety reasons, the preferred location is the curbside or the vehicle. However, in some cases, a rear entrance may be preferred. If a rear entrance is used, vehicle loading and unloading should occur at off-street locations. In urban environments with one-way streets, having openings on both side of a vehicle may be convenient.

2.1.5 Useful Life

When used and maintained in accordance with manufacturer's recommended procedures, the ramp structure should be designed to have a useful service life at least equal to that of the vehicle in which it is installed.

Rationale: Once installed the ramp becomes a part of the vehicle. As with other subsystems of the vehicle, the ramp with recommended maintenance (including repair

and replacement of mechanical parts) should be operable throughout the vehicle's service life.

2.1.6 Weight

2.1.6.1 The weight of the ramp should not adversely affect the legal axle loadings, the maneuverability, or the safe operation of the vehicle.

2.1.6.2 The ramp should be able to be deployed and stowed by one person.

Rationale: For legal and safety reasons, the weight of the ramp should not adversely affect the vehicle on which it is used. Most transit operations have one operator per vehicle. Whether the ramp is powered or manual, it should be safely handled by one person. The use of counter balances to assist in manual operation may be necessary.

2.1.7 Ramp Slope and Door Height

2.1.7.1 Ramp Slope. Ramps shall have the least slope practicable and shall not exceed 1:4 when deployed to ground level. If the height of the vehicle floor from which the ramp is deployed is 3 inches or less above a 6-inch curb, a maximum slope of 1:4 is permitted; if the height of the vehicle floor from which the ramp is deployed is 6 inches or less, but greater than 3 inches, above a 6-inch curb, a maximum slope of 1:6 is permitted; if the height of the vehicle floor from which the ramp is deployed is 9 inches or less, but greater than 6 inches, above a 6-inch curb, a maximum slope of 1:8 is permitted; if the height of the vehicle floor from which the ramp is deployed is greater than 9 inches above a 6-inch curb, a slope of 1:12 shall be achieved. Folding or telescoping ramps are permitted provided they meet all structural requirements of this section.

Rationale: This requirement is directly from Part 38. This requirement does not permit the much greater ramp slopes that have been used when the mobility aid user is being assisted.

2.1.7.2 Door Height. For vehicles in excess of 22 feet in length, the overhead clearance between the top of the door opening and the raised lift platform, or highest point of a ramp, shall be a minimum of 68 inches. For vehicles of 22 feet in length or less, the overhead

clearance between the top of the door opening and the raised lift platform, or highest point of a ramp, shall be a minimum of 56 inches.

Rationale: This requirement is directly from Part 38.

2.1.8 Ramp Surface and Width

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

Rationale: This requirement is directly from Part 38. The ramp must provide a non-slip surface under wet and winter conditions so that the wheelchair wheels will not slip during entry or exit. Also, the surface must be slip-resistant for persons walking on the ramp. If cleats for attendant assistance are specified, it should be recognized that cleats should not interfere with a three-wheeled mobility aid.

2.1.9 Attachment and Ramp Openings

2.1.9.1 When in use for boarding or alighting, the ramp shall be firmly attached to the vehicle so that it is not subject to displacement when loading or unloading a heavy power mobility aid and that any gaps between vehicle and ramp shall not exceed 5/8-inch.

Rationale: This requirement is directly from Part 38.

2.1.9.2 When the ramp is positioned for use any opening in the ramp surface should reject a 5/8-inch diameter metal ball.

Rationale: It is desirable to minimize both gaps and openings in a ramp. The 5/8-inch diameter ball test for openings in a ramp was selected to be in agreement with Part 38 gap width requirement.

2.1.10 Ramp Threshold

The transition from roadway or sidewalk and the transition from vehicle floor to the ramp may be vertical without edge treatment up to 1/4 inch. Changes in

level between 1/4 inch and 1/2 inch shall be beveled with a slope no greater than 1:2.

Rationale: This requirement is directly from Part 38.

2.1.11 Ramp Barriers

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

Rationale: This requirement is directly from Part 38.

2.1.12 Handrails

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

Rationale: This optional requirement is directly from Part 38. Handrails, if installed, must meet this requirement. It should be noted that the requirement that the handrails shall be used "while starting to board" means that the handrails would probably be needed on the ramp, not the vehicle, on almost all standard heavy-duty buses and low-floor buses.

2.1.13 Ramp Lighting

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

2.1.13.2 Other stepwells and doorways, including doorways in which lifts or ramps are installed, shall have, at all times, at least 2 foot-candles of illumination measured on the step tread, or lift or ramp, when deployed at the vehicle floor level.

2.1.13.3 The vehicle doorways, including doorways in which lifts or ramps are installed, shall have outside light(s) which, when the door is open, provide at least 1 foot-candle of illumination on the street surface for a distance of 3 feet perpendicular to all points on the bottom step tread outer edge. Such light(s) shall be located below window level and shielded to protect the eyes of entering and existing passengers.

Rationale: These requirements are directly from Part 38.

2.1.14 Ramp Stowage

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

Rationale: This requirement is taken directly from Part 38.

Tests have shown that edges and protrusions can be especially hazardous in accident situations. To reduce the potential danger, energy absorbing material may be used to protect these areas. Some operators consider the obstruction of vision a greater hazard than exposed edges.

Ramps are frequently used on small vehicles, such as vans. Crash tests have shown that peak decelerations of 21 to 25 g's can be experienced in small vehicles.

2.2 Structural Requirement

2.2.1 Capacity and Structural Safety Factor

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

Rationale: This requirement is directly from Part 38. Static test procedures are described in Section 3.1.1.

2.2.2 Materials

Ramp structural components should be made of steel or other durable construction material.

2.2.2.1 Ferrous surfaces should be either plated with a protective coating or be cleaned and have a corrosion and abrasion resistant flat protective finish.

2.2.2.2 Nonferrous and nonmetallic surfaces should be coated using a durable flat or matte finish.

2.2.2.3 Stainless steel does not require coating or surface treatment.

Rationale: The ramp is to have a useful life equal to that of the vehicle upon which it is mounted. Materials and coatings identified in these guidelines are intended to ensure this useful life. The discussions of the Advisory Panel with regard to materials included using a salt spray test or paint thickness measurement to ensure compliance. No specific tests or coating methods have been designated so that manufacturers can continue to use their preferred methods. Panel members considered placing any coatings or surface treatments on stainless steel unnecessary.

2.3 Interface With Vehicle

Installation of the ramp should not reduce or in any way compromise the structural integrity of the vehicle nor cause an imbalance of the vehicle that would adversely affect vehicle handling characteristics.

Rationale: The installation of a ramp in a vehicle may require some modification. It is the responsibility of the vehicle manufacturer to determine compatibility of his vehicle's structural design with the selected ramp.

2.4 Power Ramp Requirements (The following guidelines are for power ramps.)

2.4.1 Warning Signals

2.4.1.1 Sound

When the ramp is being deployed or stored, an audible warning signal of 85 dBA, as measured 5 feet outside the door of the vehicle, should be sounded.

2.4.1.2 Lights

When the ramp is being deployed or used, the four-way flasher, hazard lights on the vehicle should be automatically operating.

Rationale: The audible warning will signal passengers at a bus stop that a powered ramp is being deployed. The 85 dBA level is a frequently used level of annunciators. A person can be exposed to this sound level for long periods of time without hearing damage; and the level is loud enough that it can be heard above normal background noise.

2.4.2 Controls

2.4.2.1 Ramp Control Terminology

The following ramp control terminology should be used:

Ramp Authorized or Ramp Power -- enables the ramp to deploy or stow
Ramp Out -- ramp is commanded to a deploy position
Ramp In -- ramp is commanded to a stowed position

2.4.2.2 Ramp Authorized or Ramp Power Switch

The ramp authorized or power switch should have two positions, on and off. When the "on" position, the ramp is enabled to deploy or stow. When in the "off" position, ramp operation is prevented.

2.4.2.3 Function Switch

The function switch or switches for ramp movement should be of the momentary type for the ramp out and ramp in commands so that ramp movement requires constant pressure on the switch. The ramp should stop moving when the "ramp out" or "ramp in"

switch is released. It should not be possible to command both the "ramp out" and "ramp in" simultaneously.

2.4.2.4 Control Location

The control should be on a pendant or mounted on the vehicle. The control location shall be such that the operator can observe the ramp while using the control. Provision shall be made for storage of a pendant control unit when not being used by the operator.

Rationale: The intent is to have a simple control so as to reduce the potential of operator error and reduce cost. The general control terminology and approach is patterned after existing ramps currently supplied by a small bus manufacturer.

The ramp power switch may be a key type to prevent use of the ramp by unauthorized persons. The function switch could be a 3-position toggle switch, spring loaded to return to the center position when released or it could be done with two push button switches or other suitable implementation.

2.4.2.5 Interlocks

2.4.2.5.1 Interlocks may prevent vehicle movement or provide a driver warning light unless the ramp is stowed and the power is off.

2.4.2.5.2 Interlocks should prevent operation of the ramp unless the vehicle is stopped and inhibited from moving and the appropriate door is open.

2.4.2.5.3 Interlocks or inherent design features should prevent stowing when ramp is occupied.

Rationale: Interlocks are designed to prevent unsafe conditions and damage to the ramp or vehicle. The first interlock (2.4.2.5.1) has two options. Although preventing vehicle movement is recommended, providing an interlock to prevent movement for small vehicles is technically difficult and, therefore, raises the cost. This interlock is easier for vehicles with air brakes.

The second interlock (2.4.2.5.2) is recommended. Some Advisory Panel members felt that this interlock could cause problems in an accident situation. If this option is used, it must be designed with allowance for possible lift operation in emergency situations by people not familiar with lift details.

The third interlock (2.4.2.5.3) is also recommended. A ramp that cannot be stowed when occupied provides for increased safety in ramp operations.

2.4.2.6 Manual Operation

The power ramp should be equipped with a manual override to enable the operator to deploy and stow the ramp in case of power failure.

Rationale: In the event of power failure a ramp must be available to unload passengers. Also, the manual operation should allow a ramp to be stowed in order to continue vehicle operations.

2.4.2.7 Wiring

Wiring should be in accordance with SAE Recommended Practice SAE J1292 OCT 81 and Referenced Standards, except when good engineering practice dictates special conductor insulations.

Rationale: This SAE Recommended Practice, "Automobile, Truck, Truck Tractor Trailer, and Motor Coach Wiring," is accepted by the automotive industry and provides a baseline for design. The practice recognizes that unique design will require engineering practices that cannot be envisioned and incorporated into a recommended practice.

3.0 TESTING, CERTIFICATION, INSPECTION, AND WARRANTIES

3.1 Design Tests

The tests defined in Section 3.1 should be performed on a representative production model of the ramp procured under this specification. The ramp should meet the requirements given in Section 2.0 when attached to a fixture that simulates the vehicle installation and when supplied by a power source typically available on the vehicle. Only one representative production unit is required to be tested for certification, with all tests of Section 3.1 conducted on the same unit without repairs or maintenance during the tests, other than that permitted by Section 3.1.2.4.

3.1.1 Static Load Test (All Ramps)

A static load of 1800 pounds shall be applied through the centroid of a test pallet placed half way up the ramp when the ramp is positioned horizontally at its

deployed position. The length and width of the test pallet should be 26 inches by 26 inches. The load should remain on the ramp not less than two (2) minutes. After the load is removed, an inspection should be made to determine if fractures have occurred. A ramp shorter than 30 inches should be tested with a load of 900 pounds.

Rationale: Since the design capacity of a ramp 30 inches or longer is 600 pounds, the proof test load was selected to demonstrate that the ramp meets the safety factor of three that is required. This test could produce permanent deformation or set of the ramp. The test in Section 3.1.1 is an adaptation of the VA Wheelchair Lift Static Load Test.

3.1.2 Power Operated Ramp Tests

The tests of Section 3.1.2 should be performed on power operated ramps.

3.1.2.1 Durability Tests

For a power operated ramp, the ramp should be deployed and stowed for 15,600 cycles. The ambient temperature for the first half of the cycles should be at least 115 F. The tests may be continuous or separated into groups of not less than 10 cycles and may have nonoperating periods of not more than one minute between each cycle in the group.

Rationale: The above test is an adaptation of the tests required for wheelchair lifts in the California Administrative Code. The test is intended to give an indication of the expected service life of a ramp.

3.1.2.2 Self Damage Tests

The controls should be held in the operating position for five (5) seconds after the ramp meets resistance to its travel under each control position with any limit switch disabled. The tests should be performed twice at each ramp position of deploy and stow.

Rationale: The test is designed to show that the ramp will not damage itself or the vehicle when operated with any of the limited switches failed. The test is an adaptation of the tests for wheelchair lifts found in the California Administrative Code.

3.1.2.3 Visual Inspection

At the conclusion of the tests of powered ramps described in Sections 3.1.2.1 and 3.1.2.2, with all loads removed, the parts of the ramp should show no condition of fracture, permanent deformation, wear that would exceed manufacturer's tolerances, perceptible impairment, or other deterioration that would be hazardous.

3.1.2.4 Maintenance During Tests

During the Durability Test of Section 3.1.2.1, the inspection, lubrication, maintenance, and replacement of parts (other than bulbs and fuses) may be performed only as specified in the contractor's maintenance manual for the ramp.

Rationale: The guidelines given in Sections 3.1.2.3 and 3.1.2.4 are an adaptation of those found in the California Administrative Code.

3.1.3 Certification

The contractor should provide certification that the ramp procured under this specification has been tested as required by Section 3.1 and has met all requirements.

Rationale: This is a standard practice in design testing.

3.2 Acceptance Tests (Optional)

The contractor should submit for approval to the Procuring Agency an acceptance test plan to demonstrate that the ramps procured by this specification meet the requirements given in Section 2.0. This acceptance test plan, at a minimum, should contain tests that demonstrate that the ramp meets the safety interlock requirements as given in Section 2.3.2.5. The Procuring Agency may witness any or all of these tests. A mutually agreed upon notification time prior to the start of a test should be made between the two parties. The test results should be recorded, witnessed, and submitted to the Procuring Agency as proof of meeting the acceptance criteria contained in the approved test plan.

Rationale: This section is optional since ramps would normally be purchased as part of a vehicle procurement and ramp acceptance testing would be included in the vehicle acceptance testing.

THE WARRANTY PROVISIONS AND MAINTENANCE AND SERVICE GUIDELINES THAT FOLLOW ARE ADAPTED FROM THE WHITE BOOK SPECIFICATIONS. IF THE RAMP IS PROCURED AS A PART OF A VEHICLE SPECIFICATION, THESE SECTIONS MAY NOT BE REQUIRED.

3.3 Ramp Warranty

The ramp should be warranted and guaranteed to be free from defects for one (1) year beginning on the date of acceptance of each ramp. The warranty should not apply to any part or component of the ramp that has been subjected to misuse, negligence, accident, or that has been repaired or altered in any way so as to affect adversely its performance or reliability, except insofar as such repairs were in accordance with recognized standards of the industry. The warranty should not apply to scheduled maintenance items, and items damaged as a result of normal wear and tear in service such as floor coverings and paint.

4.0 MAINTENANCE AND SERVICE

4.1 Documents

The contractor should provide ---(*)--- current maintenance manual(s), ---(*)--- current parts manual(s), and ---(*)--- current operator's manuals, or ---(*)--- combination manuals thereof as part of this contract. The contractor should keep maintenance manuals available for a period of 3 years after the date of acceptance of the ramp procured under this contract.

(*) Procuring Agency to fill in pertinent information.

4.2 Maintenance and Inspection

Scheduled maintenance or inspection tasks, as specified by the contractor, shall require a skill level of 3M (Service Mechanic or Class B Serviceman) or less. Scheduled maintenance tasks should be related and should be grouped in maximum vehicle mileage intervals. Routine scheduled maintenance actions should not be required at intervals of less than 6,000 vehicle miles.

4.3 Service

4.3.1 Engineering

The contractor should, at its own expense, have a competent engineering representative(s) available on request to assist the Procuring Agency's staff in the solution of engineering or design problems within the scope of these specifications that may arise during the warranty period. This does not relieve the contractor of responsibilities under Section 3.6 Warranty Provisions.

4.3.2 Replacement Parts

The contractor should guarantee the availability of replacement parts for ramps procured under this contract for at least a ---(*)--- year(s) period after the date of acceptance. Spare parts should be interchangeable with the original equipment and should be manufactured in accordance with the same quality assurance as the original part.

(*) Pertinent information to be filled in by Procuring Agency.

FEDERAL TRANSIT ADMINISTRATION

GUIDELINE SPECIFICATIONS FOR WHEELCHAIR SECUREMENT DEVICES

SEPTEMBER 1992

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1.0 GENERAL

1.1 Background

These updated guideline specifications are for use by accessible vehicle purchasers in preparing specifications for securement systems. These guidelines are an update of the Urban Mass Transportation Administration's (now Federal Transit Administration - FTA) "Guideline Specifications for Wheelchair Securement Devices" prepared in 1986. Major changes have been made in order to be in agreement with 49 CFR, Part 38. Part 38 is based on guidelines and requirements issued by the Architectural and Transportation Barriers Compliance Board, as required by Title's II and III of the Americans with Disabilities Act (ADA) of 1990. Part 38 sets forth DOT standards in compliance with the Board's guidelines and requirements for accessible transportation vehicles. These updated guideline specifications also include changes based on experience since 1986 and on comments and suggestions of people from the transit industry who have reviewed drafts of these new guideline specifications.

1.2 Scope

These updated guideline specifications relate to wheelchair and mobility aid securement devices that are used on public transportation vehicles, both large and small. The securement devices are designed to accommodate wheelchairs and mobility aids that together with their occupant do not exceed 600 pounds in weight. Maximum safety for all passengers and reliable securement device operation are of primary concern in these guideline specifications.

1.3 Use of These Guideline Specifications

These guideline specifications include some direct quotations from Part 38. All Technical Requirements based on Part 38 use the word "shall" and are specific requirements of the established regulation. The word "should" is used in other specifications and represents recommendations that are advisory. In using these guideline specifications, the vehicle purchaser may change the "shoulds" to "shalls" if the items are considered important. These advisory guideline specifications are superseded by any applicable Federal Motor Vehicle Safety Standards in the Code of Federal Regulations 49 Part 571 and by applicable rules and regulations of individual states and local regulatory bodies.

1.4 Definitions

The following definitions apply to this document.

Accessible Vehicle - A vehicle that meets the requirements of Part 38.

Advisory Panel - A group of 37 specialists in areas related to the transit industry and accessibility issues. They were the major contributors to the UMTA guideline specification for passive wheelchair lifts, active wheelchair lifts, ramps, and securement devices which were developed in 1985 and 1986 and are referred to in the rationale for many of these guideline specifications.

Dimensional Conventions - Dimensions that are not noted as maximum or minimum are absolute.

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

Maintenance Personnel Skill Levels - Maintenance personnel skills used in this document are defined in accordance with the White Book specifications as follows:

5M: Specialist Mechanic or Class A Mechanic Leader
4M: Journeyman or Class A Mechanic
3M: Service Mechanic or Class B Serviceman
2M: Mechanic Helper or Coach Serviceman
1M: Cleaner, Fueler, Oiler, Hostler, or Shifter.

May - This term denotes an option or alternative.

Mobility Aid - A device that assists a person with mobility limitations to maneuver better. Examples include wheelchairs and walkers.

Part 38 - The term denotes 49 CFR, Part 38, Subpart B. Part 38 is being implemented in response to the Americans with Disabilities Act of 1990.

Scooter - A three-wheel powered mobility aid steered by a single front wheel.

Securement Device - A device anchored to a vehicle and used to limit movement of a wheelchair or mobility device when the vehicle is in motion.

Shall - The term denotes that the specification is required by 49 CFR, Part 38.

Should - The term denotes an advisory specification or recommendation.

Wheelchair - A mobility aid belonging to any class of three or four-wheeled devices, usable indoors, designed for and used by individuals with mobility impairments, whether operated manually or powered. A "common wheelchair" is such a device that does not exceed 30 inches in width and 48 inches in length measured two inches above the ground, and does not weigh more than 600 pounds when occupied.

White Book - This term is the common name for "Baseline Advanced Design Transit Coach Specifications," originally published by UMTA on April 4, 1977, and is presently maintained by APTA.

1.5 Abbreviations

The following abbreviations may be found in the guidelines.

APTA --- American Public Transit Association
ATBCB --- Architectural and Transportation Barriers Compliance Board
CFR --- Code of Federal Regulations
FMVSS --- Federal Motor Vehicle Safety Standard
FTA --- Federal Transit Administration (formerly UMTA)
GVWR --- Gross Vehicle Weight Rating
UMTA --- Urban Mass Transportation Administration (now FTA)

2.0 TECHNICAL REQUIREMENTS

2.1 General Requirements

2.1.1 Useful Life

When properly used and maintained (normal maintenance should include replacement of parts subject to wear and damage - e.g., belts) in accordance with manufacturer recommended procedures, a wheelchair or mobility aid securement device should be designed to have a useful life equal to the useful life of the vehicle.

Rationale: The securement system may be belts, clamps, lock-pin devices, an interface with a device attached on a wheelchair or a combination thereof. Once installed the system becomes a part of the vehicle. As with other components of the vehicle, with normal maintenance, including repair and replacement of parts, and proper use, the securement device should last as long as the vehicle.

2.1.2 Mobility Aid to be Accommodated

The securement system shall secure common wheelchairs and mobility aids and shall either be automatic or easily attached by a person familiar with the system and mobility aid and having average dexterity. A "common wheelchair" is such a device which does not exceed 30 inches in width and 48 inches in length measured two inches above the ground, and does not weigh more than 600 pounds when occupied.

Rationale: This requirement is directly from Part 38. Note that 49 CFR Part 37 also requires that operating personnel assist passengers with disabilities to be secured, if requested, or when necessary. While securement is not mandatory (i.e. a person cannot be denied service if the wheelchair cannot be secured), assistance in securement is mandated.

2.1.3 Wheelchair/Mobility Aid Orientation

In vehicles in excess of 22 feet in length, at least one securement device or system shall secure the wheelchair or mobility aid facing toward the front of the vehicle. Additional securement devices or systems shall secure the wheelchair or mobility aid facing forward, or rearward with a padded barrier, extending from a height of 38 inches from the vehicle floor to a height of 56 inches from the vehicle floor with a width of 18 inches, laterally centered immediately in back of the seated individual. In vehicles 22 feet in length or less, the required securement device may secure the wheelchair or mobility aid either facing toward the front of the vehicle or facing rearward, with a padded barrier as described. Additional securement locations shall be either forward or rearward facing with a padded barrier. Such barriers need not be solid provided equivalent protection is afforded.

Rationale: This requirement is directly from Part 38. The barrier requirement is meant for the rearward facing mobility aid only.

2.1.4 Location and Number

2.1.4.1 Location and Size. The securement system shall be placed as near to the accessible entrance as practicable and shall have clear floor area of 30 inches by 48 inches. Such space shall adjoin, and may overlap, an access path. Not more than 6 inches of the required clear floor space may be accommodated for footrests under another seat provided there is a minimum of 9 inches from the floor to the lowest

part of the seat overhanging the space. Securement areas may have fold-down seats to accommodate other passengers when a wheelchair or mobility aid is not occupying the area, provided the seats, when folded up, do not obstruct the clear floor space required. (See Figure 1.)

2.1.4.2 Number of Securements. At least two securement locations and devices, complying with 2.3.1, shall be provided on vehicles in excess of 22 feet in length; at least one securement location and device, complying with 2.3.1, shall be provided on vehicles 22 feet in length or less.

Rationale: The requirement in 2.1.4.1 and 2.1.4.2 are directly from Part 38. Several comments were received that the securement area should be greater than 48 inches to allow maneuvering. The 48-inch requirement is a minimum.

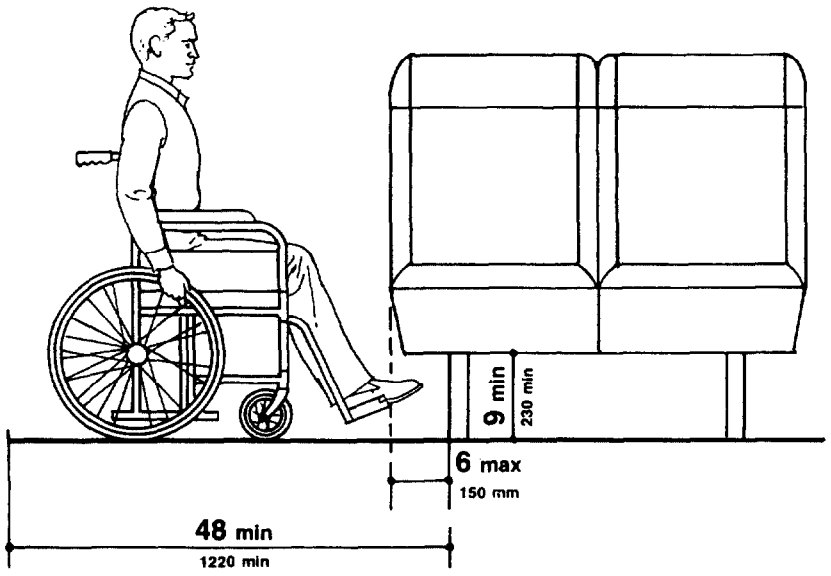

FIGURE 1. REQUIRED SECUREMENT SPACE

2.1.5 Storage

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

Rationale: This requirement is from Part 38.

Transit systems report that vandalism is a problem that impairs the operation of a securement system. Although vandalism cannot be totally prevented, the securement system should be designed and located in a manner that will minimize vandalism. This guideline also applies when occupant restraint belts are specified.

2.2 Securement Process

2.2.1 Engaging and Releasing Wheelchair

The securement system shall either be automatic or easily attached by a person familiar with the system and mobility aid and having average dexterity.

Rationale: 2.2.1 is a requirement for Part 38. As indicated earlier, 49 CFR Part 37 also requires that operating personnel assist when necessary or when requested in the securement process.

2.2.2 Time for Securement

The securement should be able to be engaged or released by a person familiar with the use of the securement device in no more than ---(*)--- minutes.

(*) To be completed by Procuring Agency.

*2.2.2 is not from Part 38. The time allowed for securement of a wheelchair should be set by the bus or vehicle purchaser and be based on the purchaser's experience and requirements. In 1985, the Advisory Panel recognized that for fixed route service the securement engaging and releasing processes should require a minimum amount of time. Less than 1 or 2 minutes were both discussed. They concluded that in no case should the time exceed 5 minutes. There was no consensus on a desirable time for securement for paratransit service. During the preparation of these updated guideline specifications, both bus manufacturers and wheelchair securement system suppliers commented on the ability of securement devices to meet

the requirements of 1 and 2 minutes to secure a wheelchair. Some felt that the 5-minute maximum time for securement is an appropriate limit. Others believe that a lower limit can be used. The bus purchaser should carefully consider the consequences of setting a time limit so low that it will eliminate bidders that would otherwise be excellent sources of vehicles. Also, research is underway in the securement area and new devices that incorporate attachments on wheelchairs are being developed. Such devices, if successful and brought to the marketplace, could provide quick securement.

When using this specification, the bus purchaser may wish to designate the wheelchair types to be secured within the specified time.

2.3 Wheelchair or Mobility Aid Restraint Requirements

2.3.1 Force to be Restrained

2.3.1.1 Design Load. Securement systems on vehicles with GVWRs of 30,000 pounds or above, and their attachments to such vehicles, shall restrain a force in the forward longitudinal direction of up to 2,000 pounds per securement leg or clamping mechanism and a minimum of 4,000 pounds for each mobility aid.

2.3.1.2 Securement systems on vehicles with GVWRs of up to 30,000 pounds, and their attachments to such vehicles, shall restrain a force in the forward longitudinal direction of up to 2,500 pounds per securement leg or clamping mechanism and a minimum of 5,000 pounds for each mobility aid.

Rationale: 2.3.1.1 and 2.3.1.2 are directly from Part 38. Crash tests have shown the following:

(a) Small school buses crashed at 30 mph experienced peak decelerations of 21-25g's

(b) Large school buses crashed at 21 mph experienced peak decelerations of 12-15g's

(c) Transit buses crashed at 21 mph experienced peak decelerations of 8-10g's.

The wheelchair securement systems and the seat belts and shoulder harnesses are two independent systems. The forces to be restrained by the wheelchair securement system should meet the forces measured in the crash tests if (1) the occupant is not belted to the wheelchair and (2) the wheelchair used in buses with GVWRs of 30,000 pounds or above weighs less than 400 pounds and the wheelchair used in vehicles with GVWRs up to 30,000 pounds weighs less than 200 pounds.

2.3.2 Movement

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

Rationale: This requirement is directly from Part 38. The testing in Section 3.1.2 is not required by Part 38. Limiting wheelchair movement during normal operation provides a more comfortable ride for the wheelchair passenger and reduces the risk of a moving wheelchair injuring another passenger. Note that nominal movement will most likely require self-locking securement for belts or it may be possible to use limited-movement inertial securement belts.

2.4 Seat Belt and Shoulder Harness

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

Rationale: This requirement is directly from Part 38.

3.0 TESTING, CERTIFICATION, AND WARRANTIES

3.1 Design Tests

The tests defined in Section 3.1 should be performed on a representative production unit of the wheelchair and mobility aid securement device model procured under this specification. The securement device should meet the requirements given in Section 2.0 when attached to a fixture that simulates a bus or paratransit vehicle

installation. Only one representative production unit is required to be tested for certification.

3.1.1 Wheelchair Securement Device and Attachment Test (Use one of the following options)

(Option A) Wheelchair Securement Device and Attachment Test for Vehicles with GVWRs of 30,000 Pounds or Above.

(1) For clamps and similar systems:

A force of 2,000 pounds on each of two or more clamps or similar systems should be applied in a forward longitudinal direction at the height at which the securement device is mounted to, attached to, or interfaces with a wheelchair.

(2) For belt systems:

A force of 3,000 pounds on each of two or more securement legs should be applied at an angle of 45 degrees from the floor plane of the bus. The 45 degree angle should project forward from the attachment that restrains forward motion of the wheelchair and rearward for an anchor that restrains rearward motion of the wheelchair (see Figure 2).

Permanent deformation of the restraint or anchor is not considered a failure if the required force is sustained for 10 seconds.

(Option B) Wheelchair Securement Device and Attachment Test for Vehicles with GVWRs Up to 30,000 Pounds.

(1) For clamps and similar systems:

A force of 2,500 pounds on each of two or more clamps or similar systems should be applied in a forward longitudinal direction at the height at which the securement device is mounted to, attached to, or interfaces with a wheelchair.

(2) For belt systems:

A force of 4,000 pounds on each of two or more securement legs should be applied at an angle of 45 degrees from the floor plane of the

bus. The 45 degrees should project forward from the attachment that restrains forward motion of the wheelchair and rearward from the anchor that restrains rearward motion of the wheelchair (see Figure 2).

Permanent deformation of the restraint or anchor is not considered a failure if the required force is sustained for 10 seconds.

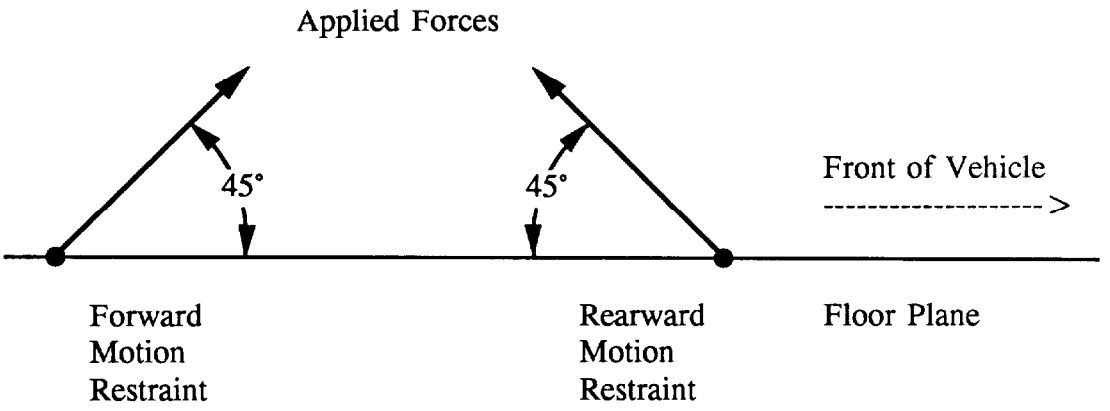

FIGURE 2. WHEELCHAIR SECUREMENT AND ATTACHMENT TEST LOADING DIRECTION

Rationale: These tests are based on the requirements of Part 38 and Section 2.3.1 of these guideline specifications. These securement tests are based on the assumption that there will be two or more attachments or anchors to the vehicles that restrain motion of the secured wheelchair toward the front of the vehicle. The definition of what is not considered a failure is similar to that used in FMVSS210; Seat Belt Assembly Anchorages.

There are many organizations that are now preparing standards and/or requirements for securement systems. Some of these organizations are expected to suggest or require dynamic tests. The tests suggested here are relatively simple static tests that are closely related to securement anchorage tests that are now used in the transit industry.

3.1.2 Nominal Movement Test

The contractor should test the ability of the securement device to maintain nominal movement. One or more of the following wheelchairs should be used in this test:

- **a standard manual wheelchair (e.g., an Everest and Jennings Traveller model or equivalent)**
- **a standard powered wheelchair (e.g., an Invacare Power Rolls Arrow Model 4M929E or equivalent)**
- **a modular powered wheelchair (e.g., a Fortress Scientific 655 or equivalent)**
- **a three-wheel powered mobility device of size and weight typical of those in present use.**

When the wheelchair is loaded with a restrained weight of 110 and 250 pounds, it should not move more than 2 inches in any direction at any point of contact with the floor when the vehicle is being operated under the following conditions:

(a) **Full throttle acceleration on dry pavement from a standstill to 25 mph with the vehicle at its curb weight plus one occupied wheelchair.**

(b) **Maximum braking from 22 mph to a standstill on dry pavement with the vehicle at its curb weight plus one occupied wheelchair.**

(c) **Driving both clockwise and counterclockwise with the outer front wheel around one of the following:**

(i) **50 ft diameter circle at a minimum steady speed of 12 mph**
(ii) **75 ft diameter circle at a minimum steady speed of 14 mph**
(iii) **100 ft diameter circle at a minimum steady speed of 16 mph**

Use of the securement device during normal bus operation should not cause damage to the wheelchair being transported.

Rationale: This section is adapted from the Canadian Standards Association. The 2-inch maximum displacement is required by CFR 38. The vehicle circular operating tests all generate 0.35 to 0.39 gs of lateral force. The circle to be operated will depend on the size and maneuverability of the vehicle.

The selection of which wheelchair or wheelchairs should be used in this movement test should be based on the experience of the transit agency procuring vehicles. The use of a heavier wheelchair increases the forces on the securement system in these tests.

3.1.3 Visual Inspection

At the conclusion of the tests described in Section 3.1.2, the securement device and components for attachment to the vehicle should show no condition of fracture, wear that would exceed manufacturer's tolerances, perceptible impairment, or other deterioration.

Rationale: The tests in Section 3.1.2 involve loads well below those applied in Section 3.1.1 and these tests should not reduce the capacity of the system to restrain loads.

3.1.4 Certification

The contractor should provide written certification of compliance of test tests in Section 3.1.

Rationale: Section 3.1.4 is standard practice in design testing.

3.2 Acceptance Tests (Optional)

The contractor should submit for approval to the Procuring Agency an independent test report or a test plan to demonstrate that the securement devices purchased by this procurement meet the requirements in Section 2.0. The Procuring Agency may witness any or all of these acceptance tests. A mutually agreed upon notification time prior to the conduct of a test should be made between the two parties. The test results should be recorded, witnessed (i.e., signed), and submitted to the Procuring Agency as proof of meeting the acceptance criteria of the approved test plan.

Rationale: Acceptance tests are standard industry practice in vehicle procurement. It is anticipated that acceptance testing will primarily concern the requirements of Section 2.2 and 2.3. For small procurements the Procuring Agency could choose to accept test data from other procurements of the same vehicle and securement device. For this reason the acceptance test requirement is optional based on the size of the procurement.

3.3 Warranty

A statement of warranty should be provided with each securement device assuring the quality of materials and workmanship of the product for at least one (1) year from the date of delivery to the final consumer.

Rationale: When securing accessible equipment, the above is standard practice in the industry.

THE MAINTENANCE, TRAINING, AND SERVICE GUIDELINES THAT FOLLOW ARE ADAPTED FROM WHITE BOOK SPECIFICATIONS. IF WHEELCHAIR SECUREMENT DEVICES ARE PROCURED AS A PART OF A VEHICLE SPECIFICATION, THESE SECTIONS MAY NOT BE REQUIRED.

4.0 MAINTENANCE, TRAINING, AND SERVICE

4.1 Documents

The contractor should provide ---(*)--- current maintenance manual(s), ---(*)--- current parts manual(s), and ---(*)--- operator's manual(s) or ---(*)--- combination manuals thereof as part of the contract. The contractor should keep maintenance manuals available for a period of 3 years after the date of acceptance of the securement device procured under this contract.

(*) Procuring Agency to fill in pertinent information.

4.2 Maintenance and Inspection

Scheduled maintenance or inspection tasks as specified by the contractor should require a skill level of 3M (Service Mechanic or Class B Serviceman) or less. Scheduled maintenance tasks should be related and should be grouped in maximum bus mileage or time intervals.

4.3 Replacement Parts

The contractor should guarantee the availability of replacement parts for securement devices procured under this contract for at least the useful life of the securement device. Spare parts should be interchangeable with the original equipment and should be manufactured in accordance with the quality assurance provisions of this contract.

4.4 Training (Optional)

The contractor should have at least one qualified instructor who should be available at the Procuring Agency's property for ---(*)--- calendar days between the hours of ---(*)--- and ---(*)--- after acceptance of the first securement device. Instructor(s) should conduct classes and advise the personnel of the Procuring Agency on the proper operation and maintenance of the securement device. The contractor should also provide visual and other teaching aids for use by the Procuring Agency's own training staff.

(*) Procuring Agency to fill in pertinent information.

Rationale: For small procurements this type of training would be expensive and excessive. This section is, therefore, optional. For small procurements the contractor should be requested to provide brief instructions on securement device used at the time of vehicle delivery, and to be available for consultation on an as-needed basis.

★U.S. GOVERNMENT PRINTING OFFICE:1992-343-120/75805

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DOT-T-93-03

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