SURFACE VEHICLE RECOMMENDED PRACTICE

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Testing of Wheelchair Lifts for Entry to or Exit from a Personally Licensed Vehicle

RATIONALE

This technical report is being stabilized because the technical committee cannot find users for the technical report. It is not possible to determine with great assurance whether a technical report is being used, how often it may be used, or by whom it may be used. Stabilization is a way to alert potential users that the owning technical committee will no longer be maintaining the technical report and users should employ the technical report at their own discretion.

The compliance requirements for wheelchair lifts to assist persons with limited mobility in entering or leaving a vehicle are now mandatory in the Federal Motor Vehicle Safety Standards 49 CFR § 571.403 and 49 CFR § 571.404.

STABILIZED NOTICE

This document has been declared “Stabilized” by the SAE Adaptive Devices Standards Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. ***Scope—***This test procedure is for Qualification Testing of electrically powered hydraulic or mechanically operated devices which permit a person in a manual or powered wheelchair to enter or exit a personally licensed vehicle.

It establishes minimum test requirements for compliance. A lift completing the test without failure under this procedure shall be considered in compliance. The tests in Section 3 shall be done in the sequence listed.

1.1 SAE J2093 is the recommended practice to which this test procedure is applicable.

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J211-1—Instrumentation for Impact Test—Part 1: Electronic Instrumentation
SAE J211-2—Instrumentation for Impact Test—Part 2: Photographic Instrumentation
SAE J2093—Design Considerations for Wheelchair Lifts

2.1.2 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 1005-51—Measurement of Dry Film Thickness of Organic Coatings

2.1.3 FMVSS PUBLICATION—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9371.

FMVSS 302—Flammability of Interior Materials

3. ***Receiving Inspection Test—***A receiving inspection shall be conducted and shall include:

3.1 Weigh the lift and all installation hardware. The total weight shall not exceed 400 lb.

3.2 A visual inspection of the lift and furnished materials to assess compliance with standards for written information.

3.2.1 The manufacturer's literature shall be examined for information about the lift platform and roll stop dimensions. (SAE J2093, 6.4)

3.2.2 A visual inspection to determine the inclusion of the required owner's manual. The manual shall include instructions concerning user operation and required or recommended maintenance to be performed by the user, owner, or dealer. The maintenance instructions shall address at least the following areas: operation, lubrication, (types, frequency, and location) adjustments, calibration and alignment procedures, trouble shooting, parts lists, components requiring special attention and the name, address, and telephone number of the manufacturer or his representative.

In addition, instructions for the use of dual batteries, if applicable, and threshold warning systems shall be included.

3.2.3 A visual inspection shall be made to determine the inclusion of all electrical and hydraulic schematic diagrams necessary to properly maintain the lift.

3.2.4 Each lift shall be inspected for the inclusion of the required identification tag, evidence of manufacturer's quality control inspection, and for inclusion of the required warranty statement.

3.2.5 FLAMMABILITY—A visual inspection will be made of documentation from the manufacturer to insure a statement that FMVSS 302 for flammability has been met for all nonmetallic lift components such as protective coverings, housings, and paddings.

3.2.6 VEHICLE ALTERATIONS—The lift, the installation instructions, and the installation hardware shall be visually inspected to ensure that no vehicle alternations are required which would diminish the structural integrity of the vehicle.

3.2.7 A visual inspection shall be made of documentation from the manufacturer to insure there exists a failure mode analysis identifying all single point failures.

4. Visual Inspection of Installed Lift

4.1 Lift shall be installed in a test fixture per manufacturer's instructions using the installation hardware furnished with the lift.

4.1.1 The test fixture need not be a replica or part of a van door but should be sufficiently similar in size and configuration to allow installation per the manufacturer's installation instructions using the hardware supplied with the lift.

4.1.2 The test fixture shall have a small vertical surface nearby to allow installation of the external switches using the manufacturer's hardware.

4.1.3 The test fixture should have a horizontal panel nearby to allow installation and testing of the threshold warning system.

4.2 Each lift and its installation hardware will be visually inspected to assess its conformance with applicable standards.

4.2.1 ELECTRICAL COMPONENTS (SAE J2093, 5.1)

4.2.2 CHAIN DRIVE COMPONENTS (SAE J2093, 5.2)

4.2.3 HYDRAULIC COMPONENTS (SAE J2093, 5.3)

4.2.4 POWER SCREW COMPONENTS (SAE J2093, 5.5)

4.2.5 FASTENERS (SAE J2093, 5.6)

4.2.6 CONTROLS (SAE J2093, 6.1)

4.3 Weldment Inspection—A visual inspection shall be made of all welds to detect structural flaws such as undercutting, cracking, poor penetration, and surface defects. Dimensional flaws such as warpage, incorrect weld size or profile, and incorrect joint separation shall be observed. Nondestructive testing using radiographic, ultrasonic, dye penetrant, or other methods may be conducted to verify visual findings. Significant defects shall disqualify the lift from compliance.

4.4 Occupant Hazards Test—The fully assembled and installed wheelchair lift shall be carefully inspected with regard to safeguards, sharp edges, projections, unprotected shear and pinch points, and dirty or greasy surfaces with which the occupant might come in contact during normal operation of the lift.

4.5 Slip Resistance Test—The wheelchair platform shall be inspected for utilization of slip-resistant surfaces on which the wheelchair rolls.

4.6 Lift Dimensional Measurements

4.6.1 Measure the lift platform, the vertical height of the roll stop and the minimum height and width of the access path to see that they correspond to that provided in the literature and placards.

4.6.2 Lift and installation hardware shall be measured and compared to the relevant dimensions of the vehicles for which it is intended to assure 1/4 in clearance from the edge of the door opening.

4.7 Single Point Failure—The lift shall be inspected to detect any single point failure which would constitute a hazard to the user (SAE J2093, 4.2).

4.8 Electrical Hazards—The lift, as installed, shall be inspected to detect any aspects of the design which fail to protect the driver or passenger(s) against injuries resulting from short circuits, electrical fires, or other such incidents.

4.9 Circuit Breaker—The lift shall be inspected to ensure that a suitable circuit breaker or other device has been designed into the power circuit close to the battery connection. A solenoid or other device may be incorporated, per the manufacturer's instructions, into the power circuit to insure that no voltage is applied to the main power unit until a lift-operating control is activated.

4.10 Hydraulic Hoses—The lift shall be inspected to detect any hoses which are not protected from bearing or rubbing on structural components.

4.11 Load Distribution—The lift shall be inspected to ensure that the lift does not apply any load to the wheelchair which is contrary to the normal load characteristics of the structural design of the wheelchair.

4.12 Vandal Protection—The lift's external controls shall be inspected to determine that they are protected from misuse or vandalism by the use of key locks, key switches, or other security systems.

4.13 Maintainability—The maintenance procedures prescribed by the manufacturer in SAE J2093, 8.1 shall be performed (using documents provided (SAE J2093, 8.3)) to ascertain compliance with SAE J2093, 8.4 and SAE J2093, 8.5. These procedures may be performed as a part of the maintenance needed in the Accelerated Lift Cycle portion of this Test Procedure (see 6.1).

4.14 Wire Rope System Test—An inspection of the wire rope system shall be made to ensure compliance with standards specified in SAE J2093, 5.4. This inspection shall include measurement of the nominal diameters of rope, sheaves, and drum. The fleet angle between the lead sheave and drum and between sheaves at all platform positions shall be measured. Attachments and fittings shall be inspected for compliance. The travel of the rope during all lift movements shall be followed to observe possible rope contact with structural members.

4.15 Compliance—Refer to Section 7.

5. Specification Tests

5.1 Control Switch Tests—Control switches and circuits shall be tested for conformity with the operational requirements of SAE J2093, 6.1. Any nonconformance to be noted.

5.2 Water Spray Test—The exposed portions of electrical components intended for installation external to the vehicle will be subjected to a 5 min, fine droplet water spray test in which the droplets contact the components both vertically and horizontally. The wetted components will be allowed to air dry for approximately 3 min and then the circuits will be electrically checked for successful operation.

5.3 Electrical Current Test—Electrical current flow will be measured for each lift movement. The ammeter used will be of laboratory quality with appropriate shunts. Only steady-state current, ignoring momentary surges, will be recorded using a SAE J211 class 60 filter.

5.4 Platform Angle Test—With the lift installed according to the procedure in 4.1. The lift when unloaded should be adjusted to manufacturer's specifications at the level of the vehicle floor. The platform shall then have a load of 600 lb placed upon it in the same manner as noted in 6.1. Measure the platform to determine that the slope does not change more than 3.6 degrees in any plane (or 0.75 rise to 12 in of run). When this test has been completed, the lift should be reset to the platform angle, if any, recommended by the manufacturer for the remainder of the tests.

5.5 Finish Coating Test—An inspection of the coating will be made to include, but not be limited to, overall appearance and existence of a dull, matte surface finish. Measurements of film thickness shall be made in at least three locations using a dial comparator or dial indicator as described in ASTM D 1005-51. A subjective evaluation of coating adherence will be obtained in at least three locations as follows: use a machinist's scribe to scribe a single line approximately 1 in long with sufficient force to penetrate to the base metal. Lay on a strip of transparent mending tape and burnish the scribed area for approximately 15 s with a smooth-ended metal tool. Pull the tape off with a quick, perpendicular motion. A very thin line of coating particles is indication of good adhesion. Upon completion of the Accelerated Life Cycle Test and the Operational Safety Test, another inspection will be made to determine long-term wear and use characteristics of the coating.

5.6 Acceleration Test—Accelerations in all planes (vertical, lateral, and horizontal) will be measured in accordance with SAE J211 using frequency class 1000 accelerometers during the entire life cycle. Accelerometers shall be mounted at the center of the lift platform at surface level. A weight of 1780 kg (600 lb) shall be placed on the lift at the center of the platform during acceleration measurements. Acceleration signals shall be filtered using a frequency class 8 filter with either manual or automatic operation. The filtered acceleration in any direction shall not exceed 0.3 g during any operation motion of the lift platform.

5.7 Slope Dimension Test—The empty platform will be lowered to the ground position with the roll stop at its entry/exit position. Linear measurements of rise and run will be made. Likewise, any step over which the wheelchair must roll will be measured to determine that the dimensions specified in SAE J2093, 6.3 are not exceeded.

5.8 Test for Openings in Platform—The platform will be positioned at ground level and at van floor level, and all openings therein will be tested with a metal ball of 19.1 mm (3/4 in) diameter for oversize dimensions of the openings.

5.9 Operational Safety Test—The fully assembled and installed wheelchair lift shall be operated by both able-bodied and disabled persons in the manner specified in the Operating Instructions, and observations made as to whether the lift can be operated with minimum potential for injury.

5.9.1 Observation shall be made of the floor level stop position as to safe entry/exit of the wheelchair into/out of the van and to assure that the 5/8 in maximum step height is achieved (SAE J2093, 6.5).

5.9.2 OCCUPATIONAL HAZARDS INSPECTION—The fully assembled and installed wheelchair lift shall be carefully inspected with regard to safeguards, sharp edges, projections, unprotected shear and pinch points, and dirty or greasy surfaces with which the occupant might come in contact during normal operation.

5.10 Wheelchair Retaining Test—Block the roll stop open and measure the operation of the roll stop interlock to assure that it does not allow the outboard end of the lift to travel more than 6 in above the ground plane. If the lift is a semi-automatic lift with a manually operated roll stop, operate the roll stop to assess application and release mechanisms for essential clarity of operation.

Test equipment will be constructed to fit each wheelchair retaining device. The equipment will apply a static load of 1600 lb at a height of 2.5 in above and parallel to the wheelchair ground plane, evenly distributed over the full width of the roll stop device. In cases where the roll stop device falls at or above 2.5, in the load shall be applied as close as possible to 0.5 in above the bottom edge of the roll stop as indicated previously.

The load will be applied to the stop device for at least 5 s with the lift platform at the van floor level and also will be applied as the lift platform ground plane moves down. A load of 600 lb will be on the lift during the test if the wheelchair retaining operation is dependent on such a load for its proper operation.

5.11 Threshold Warning Test—A four-wheeled wheelchair with a 50 lb load shall be rolled across the access area to the lift up to what would be the edge of the van floor with the lift platform at van floor level. This condition should not cause the audible warning to be activated. The wheelchair should then be removed from the access area, the lift lowered to 1-1/2 in below the van floor level and the wheelchair again moved through the access area to the lift. This condition should cause the audible warning system to be activated with a minimum 80 decibels (dBA) between 500 and 3000 Hz. In the event the client is hearing impaired, a rotating red beacon can be used in addition. It must be located within full view of the wheelchair occupant.

5.12 Manual Backup System

5.12.1 LIFT OPERATIONS—The lift shall be positioned in the unfolded position at the vehicle floor level, loaded with the 600 lb test load, lowered to the ground plane, raised back to the vehicle floor level, unloaded, and folded in under 30 min with no more than 25 lb of force required of the operator.

5.12.2 EMERGENCY EGRESS—The lift shall be deployed and lowered in under 5 min loaded with the 600 lb test load and operated by the test lab staff. Tools provided by the manufacturer shall be used.

5.13 Lifts employing a power down feature shall provide a shut-off device at ground contact. The jacking force shall be limited to not more than an amount equal to the weight of the platform assembly.

6. ***Stress Tests—***The stress testing shall be done in the following sequence after the Specification Tests.

6.1 **Accelerated Life Cycle Test—**An accelerated life cycle test will be performed by repeating the wheelchair lift use cycle 4400 times. The cycles will be conducted in blocks of 10 cycles with the time between each cycle in any block to be not longer than 1 min. The minimum wait time between blocks shall be specified by the manufacturer. In most cases, the minimum wait time can be determined by monitoring critical housing temperatures. The ambient temperatures for this test shall be between 10 °C and 32 °C (50 °F and 90 °F). The alteration of the load shall be by following four (4) sequences:

a. 1100 cycles unloaded (including fold)
b. 1100 cycles loaded with 600 lb
c. 1100 cycles unloaded (including fold)
d. 1100 cycles loaded with 600 lb

6.1.1 Periodic visual inspection of components identified in 6.1.5 will be made at intervals less than but not to exceed 1100 cycles. Changes in alignment, component wear, loosening of fasteners, and the like will be recorded. A decision whether or not to continue the tests will be made by the tester based on these inspections. Preventive maintenance will be performed in accordance with the manufacturer's instructions.

6.1.2 Repeat Operational Safety Test (SAE J2092, 5.9) every 1100 cycles.

6.1.3 Repeat Wheelchair Retaining Test Part I (SAE J2092, 5.10) every 1100 cycles.

6.1.4 Repeat Threshold Warning Test (SAE J2092, 5.11) every 1100 cycles.

6.1.5 Conditions of meeting the Accelerated Life Cycle Test requirements.

6.1.5.1 In addition to the basic structural and mechanical components of the lift, all electrical, chain drive, hydraulic, power screw, wire rope, and fastener components shall be considered integral parts of the lift system and shall be inspected for failures during the Accelerated Life Cycle Testing. Any failure of any of these components during testing shall constitute noncompliance. The previous components shall be functional during the entire Accelerated Life Cycle Test.

6.1.5.2 *Hydraulic Components Test*—Hydraulic components shall be considered integral parts of the wheelchair lift and shall be tested for failures during the performance of the Accelerated Life Cycle Test. Any failures, including significant leaks, shall constitute noncompliance. A significant leak is defined as seepage or leakage which produces one or more droplets (e.g., a teardrop approximately 0.1 cc) in 10 complete cycles of the wheelchair lift.

6.1.5.3 Inspection of Finish Coating for signs of excessive wear.

6.2 **Static Proof Load Test—**A static proof load test shall be performed with the lift platform 6 in above the ground plane. A static load of 1.5 times the rated load shall be applied to the centroid of the lift platform. The load shall remain for not less than 2 min. After removal of the load, a visual inspection of the lift shall be made to determine any failures. The lift shall then be cycled 10 times with rated load (600 lb) applied to the platform. An equivalent test shall be performed on lifts which do not have a platform but meet 4.11 (Load Distribution). The Static Proof Load Test shall be performed after the Accelerated Life Cycle Test (6.15). Paragraph 6.1.5 shall remain as conditions of compliance after the 10 cycles.