

AS 3856.1:2021



STANDARDS
Australia



Hoists and ramps for people with disabilities — Vehicle mounted

Part 1: Product requirements



AS 3856.1:2021

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- Novita Children's Services (Australia)
- Occupational Therapy Australia
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Hoists and ramps for people with disabilities — Vehicle mounted

Part 1: Product requirements

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Preface

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee ME-067, Assistive Technology, to supersede AS/NZS 3856.1:1998, *Hoists and ramps for people with disabilities — Vehicle mounted, Part 1: Product requirements*.

The objective of this document is to provide persons concerned with the manufacture of hoists and ramps and their fitting onto vehicles, community transport organizers, regulatory authorities and operators with minimum design and performance specifications for hoists and ramps intended to be fitted on vehicles.

This document requires products to be tested in their fully assembled condition, both before and after fitment to a vehicle.

The document covers ramps as well as hoists because some hoisting appliances deploy a platform which forms a ramp or a set of ramps during the operating cycle.

The document covers only those appliances which are necessarily attached to a vehicle during their use. The types of appliances which are placed next to a vehicle for hoisting a person into the vehicle are covered in AS/NZS ISO 10535:2011.

While it is recognized that operators of vehicle fitted hoists and ramps may or may not be in the company of an attendant, the requirements in the document do not cover all requirements for the sole operation of an appliance by an operator, self-operated appliances usually being tailored to their specific needs.

The term 'normative' is used in Standards to define the application of the appendix to which it applies. A 'normative' appendix is an integral part of a Standard.

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NOTES

Australian Standard®

Hoists and ramps for people with disabilities — Vehicle mounted

Part 1: Product requirements

1 Scope and general

1.1 Scope

This document specifies requirements for the design, performance and installation of hoists and ramps for use by people with disabilities in accessing ADR compliant motor vehicles.

This document does not apply to devices for hoisting unoccupied mobility devices into or onto a vehicle.

Specific elements of the document are relevant to portable hoists or ramps not permanently fitted to the vehicle.

1.2 Normative references

For the purposes of this document, the following terms and definitions apply.

AS 3696.13, *Wheelchairs, Part 13: Determination of coefficient of friction of test surfaces*

AS 3856.2 *Hoists and ramps for people with disabilities — Vehicle mounted Part 2: Installation requirements*

AS ISO 14971, *Medical devices — Application of risk management to medical devices*

AS/NZS ISO 7176.14, *Wheelchairs, Part 14: Power and control systems for electrically powered wheelchairs and scooters — Requirements and test methods*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

UN R10. *United Nations Regulation No. 10: Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility*

1.3 Terms and definitions

For the purpose of this Standard, the definitions below apply.

1.3.1

appliance

hoist, ramp or platform

1.3.2

braking

action of force being applied to slow or stop a moving mechanism

1.3.3

deploy

move an appliance from a stored position to an operating position

1.3.4

edge barrier

barrier attached to the side edges of a platform or ramp extending above the surface of the platform or ramp

1.3.5**failure**

fault of any component, assembly or system that prevents the hoist performing additional cycles

1.3.6**hoist**

device attached to the vehicle during use, which is used for raising or lowering people into or out of the vehicle

1.3.7**inner roll stop**

barrier located at the interface between the platform and the vehicle

1.3.8**isolation switch**

device which isolates an electric circuit from the source of power

1.3.9**lifting cycle**

raising and lowering of the appliance through its complete range

1.3.10**outer roll stop**

barrier or barriers located at any of the access/egress edges of the platform

1.3.11**platform**

load-bearing surface which is constructed in the one plane

1.3.12**ramp**

sloping surface joining two different levels which is either permanently or temporarily attached to the vehicle

Note 1 to entry: A ramp may be made up of two or more sections joined together.

1.3.13**safe working load****SWL**

maximum load that an appliance is designed to lift or carry as specified by the manufacturer

1.3.14**single fault condition**

condition for which a single means for reducing a risk is defective or a single abnormal condition is present

1.3.15**store**

move an appliance from an operating position to a stored position on or in the vehicle

1.3.16**vehicle**

motor vehicle as defined in the Road Vehicle Standards Act 2018 not including a vehicle exclusively used on a railway or tramway

2 Types of appliances

The following types of appliances are referred to in this Standard:

- (a) *Type A* — A platform which is required to be raised and lowered under load. The platform is deployed, stored, raised, and lowered by power or gravity, or by a combination of these means.

- (b) *Type B* — A platform which is required to be raised and lowered under load. The platform is deployed and stored manually, and raised and lowered by power or gravity, or by a combination of these means.
- (c) *Type C* — A hoist in which the sling, seat, or harness is deployed and stored either manually or by power, and is raised and lowered by power or gravity, or by a combination of these means.
- (d) *Type D* — A ramp which is deployed and stored by power or gravity, or by a combination of these means.
- (e) *Type E* — A ramp which is deployed and stored manually.

NOTE Type A and Type B appliances include appliances which, during their operation, deploy a platform which moves from an inclined plane to a horizontal plane or to a plane which is parallel with the plane of the floor of the vehicle to which the appliance is attached.

3 General requirements

All hoists and ramps shall meet the following requirements:

- (a) A risk assessment shall be completed in accordance with AS ISO 14971.
- (b) The appliance shall be tested in a fully assembled condition including all the components used to attach the appliance to a vehicle, but the tests shall be carried out with the appliance not attached to a vehicle. The same appliance and components shall undergo all tests.
- (c) Pinch points shall be identified by the following warning label no less than 12 mm high, see [Figure 3](#).

At the completion of all tests the appliance shall operate as intended.



Figure 3 — Signage for pinch points

4 Type A, Type B, Type C and Type D ramps and hoists

4.1 Material, design and construction requirements

All hoists and ramps shall be designed and constructed such that the following requirements are met:

- (a) All controls, for lowering and raising, shall be easily accessible and operable by the operator.
- (b) Those components susceptible to wear and tear, e.g. pins, shafts and connections, shall be accessible for maintenance and replacement.
- (c) All metal parts not made of corrosion-resistant material shall be protected against corrosion.
- (d) Power operated systems necessary for exit from the vehicle shall incorporate a manual override in case of power failure.
- (e) If the hoist assembly and its controls are housed within the vehicle, all housings, switches and connector housings shall conform to IEC 60529 IP code 52. Hoist components permanently mounted outside of the vehicle shall conform to IEC 60529 IP code 54.

4.2 Enclosure integrity

Exposed enclosures for electrical circuitry shall meet the requirements of [Clause G.6.3.8](#).

4.3 Hydraulic equipment

All components that contain working fluid shall have a burst pressure which is not less than three times the normal design maximum working pressure. A pressure relief valve shall be fitted to ensure that three times the maximum working pressure is not exceeded.

4.4 Manually operated folding mechanisms

Manually operated folding mechanisms shall conform to the following:

- (a) Manually deployed appliances shall have a handhold to deploy and store the appliance.
- (b) The force required for any manual folding and unfolding operations shall be not more than 60 N applied at the handhold.

4.5 Control systems

Control systems shall conform with the following:

- (a) Hoist assembly including the control system shall be tested in accordance with [Appendix F](#).
- (b) Audible noise requirements shall be assessed in accordance with AS/NZS ISO 7176.14.
- (c) Power circuits shall be —
 - (i) protected with a rated current overload device (e.g. fuse) in accordance with AS 3856.2; and
 - (ii) fitted with an operator accessible isolation switch, in accordance with [Table 4.1](#).
- (d) EMC testing for radiation immunity and general EMC shall be in accordance with UN R10.
- (e) Power-operated systems shall actuate a braking function when a control device is released.

- (f) The ramp or hoist may be lowered under power or under gravity. If the ramp or hoist is lowered under power, a safety device shall be provided to prevent jacking of the vehicle. All hoists shall have a back-up control system.
- (g) There shall be a mechanical safety device to prevent the platform from falling in an uncontrolled manner in the event of a hydraulic or power actuator failure. The safety device shall hold the platform in its stowed position unless released by means of normal operation of the appliance. The application of this device shall also be applicable to ramps that have dual purposes.
- NOTE An example of dual purpose is where the floor of the vehicle also acts as the access ramp.
- (h) The safety device shall still be effective in its operation if springs or other means are used as part of the safety device to hold it in place experience a failure.
- (i) A platform or ramp shall be capable of being manually deployed and lowered.
- (j) No control function may be overridden by another control function while the first control function is active.
- (k) The control unit shall be located so that —
- (i) the risk of damage to the control unit during operation is minimized;
 - (ii) the risk of damage to the control cable of any pendent control is minimized; and
 - (iii) it is no greater than 1 m from the isolation switch.
- (l) Switches for the control of moving parts of the appliance shall be of the momentary type so that operation requires constant pressure on the switch.
- (m) A risk assessment shall be completed in accordance with AS ISO 14971 for any alternative means for control of moving parts.
- (n) The function selection switch or integrated operating and function switches shall be labelled according to the symbols in [Table 4.1](#).

The control unit should not be operable except when located so that the operator has an unobstructed view of moving parts during operations.

Further requirements on electrical safety are specified in [Appendix G](#).

Markings identifying the control function of each switch shall be clear, durable and indicate the resulting function.

Table 4.1 — Labelling of switches

Designation	Function	Examples of Graphic Symbols
'up' or 'raise'	Raises a platform, ramp, sling, seat, or harness	
'down' or 'lower'	Lowers a platform, ramp, sling, seat, or harness	
'store' or 'fold'	Moves a platform, ramp, sling, seat or harness from an operating position to a stored position	 Store
'deploy' or 'unfold'	Moves a platform, ramp, sling, seat, or harness from a stored position to an operating position	 Deploy

Table 4.1 (continued)

Designation	Function	Examples of Graphic Symbols
Battery isolation	Isolates the battery power supply.	
Stand by switch		
ON/OFF switch	Push ON / Push OFF	
ON/OFF switch	Push and hold (Momentary switch)	

5 Type A and B appliances

5.1 Design and construction requirements

Platforms shall conform to the following:

- (a) The platform surface and outer roll stop surface when lowered shall have a slip-resistant finish. The surface shall be an acceptable surface when tested in accordance with AS 3696.13.
- (b) The platform shall have edge barriers with a height of not less than 75 mm, see [Figure 5](#) which shall be effective when in use to prevent the wheelchair wheels rolling over the barrier.
- (c) The platform shall have an outer roll stop with a height of not less than 75 mm. A locking device shall be included to prevent the roll stop inadvertently lowering while the platform is in a raised position.

NOTE 1 An inner roll stop with a height of not less than 75 mm is recommended (see [Figure 5](#)).

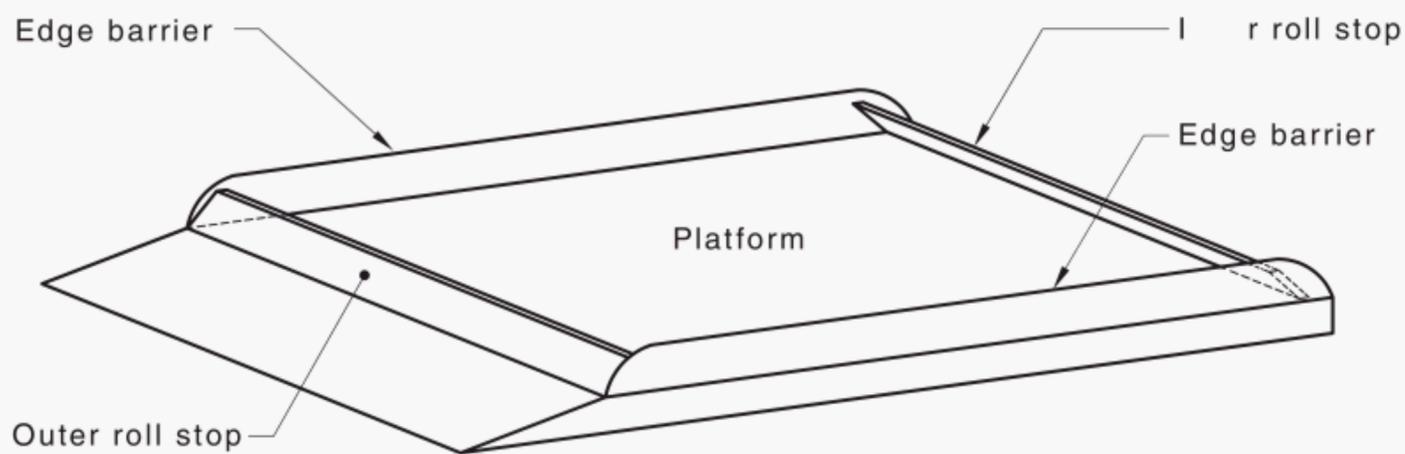


Figure 5 — Typical platform showing edge barriers and inner and outer roll stops

- (d) The platform shall have no protrusions extending from the surface greater than 6 mm, except for the edge barriers, inner roll stops, or outer roll stops.
- (e) The platform shall not have any openings greater than 40mm in width, except for a hand hold for the purpose of manual deployment and storage of the platform. Hand holds shall have an effective clear opening not exceeding 40 mm by 120 mm and be located midway between the edge barriers of the surface of the platform.
- (f) Entryways, including retracted rollstops, shall not have a vertical rise of more than 12 mm (refer to requirements for interface of a platform with the vehicle in AS 3856.2).

- (g) Handrails shall be provided and shall be capable of withstanding a force of 450 N applied at any position and in any direction without showing any permanent deformation.
- (h) Removable handrails shall be securely fixed to the platform when the hoist is fully deployed. Guardrails shall not become detached when subjected to a force of 450 N applied at any position and in any direction.
- (i) Where handrails are detachable, a suitable means of storing them shall be provided.

NOTE 2 The size of the platform will depend on the application. The hoist may be for a private operator or it may be for a specific group or for use by the public in public transport. There will also be limitations imposed by the motor vehicle to which the hoist is fitted.

NOTE 3 The platform length will be limited by the vehicle design. The clear length is measured between the outer roll stop and the inner roll stop when the platform is deployed. The minimum length should be 1 000 mm but this would need to be longer if the platform was designed to allow for an attendant. The minimum length of a hoist platform required for public transport is 1 300 mm.

NOTE 4 The clear width is measured between the inside of the edge carriers when the platform is deployed. The minimum width should be 760 mm, however the recommended minimum clear width is 780 mm. The minimum width of a hoist platform required for public transport is 800 mm.

NOTE 5 Consideration should be given to the maximum head room allowance where access will be required by ambulant persons.

5.2 Performance requirements

5.2.1 Uncontrolled descent under gravity

When tested in accordance with [Appendix A](#), the platform shall not descend at a rate of more than 0.3 m/s.

5.2.2 Deflection

When tested in accordance with [Appendix B](#), any deflection of the platform under test load shall not change the inclination of any part of the platform by more than 3 degrees.

5.2.3 Static strength

When the appliance is tested in accordance with [Appendix C](#), there shall be no permanent deformation of any part of the appliance, no fracture shall have occurred in any part of the appliance, and the appliance shall operate without failure.

5.2.4 Speed

When the appliance is tested in accordance with [Appendix D](#), the speed of the platform shall be not more than 0.15 m/s.

5.2.5 Acceleration

When the appliance is tested in accordance with [Appendix D](#), any horizontal and vertical accelerations of the platform shall be not more than 0.3 m/s².

5.2.6 Durability

When tested in accordance with [Appendix D](#) the appliance shall not fail.

6 Type C appliances

6.1 Design and construction requirements

Type C appliances shall conform to the following:

- (a) The choice of materials used in the construction of the hoist shall be suited to the intended area of use.

NOTE It is recommended that polymeric materials are not used due to degradation associated with ultraviolet light.
- (b) All load-bearing fasteners shall be either self-locking or fitted with a locking device to prevent inadvertent detachment.
- (c) It shall not be possible to assemble the hoist in a manner which affects the overall safety of the unit. If the lifting device incorporates a mast, it shall be so located in relation to its base that it can only be assembled or adjusted in the correct safe working position.
- (d) A connection point shall be so designed that the body-support unit shall not become inadvertently detached.
- (e) Where necessary, all precautions shall be taken [e.g. by the fitting of a safety devices(s)] to protect the lifted person from inadvertently falling off/from the body-support unit.

6.2 Performance requirements

6.2.1 Static Strength

The requirements of [Clause 5.2.3](#) shall apply.

Care should be taken to ensure the installation of a type C appliance does not compromise the vehicle's compliance with ADR 42. Portable variants in the worst-case load scenario shall have a load at least 1.5 times the manufacturer's rated capacity.

6.2.2 Durability

The requirements of [Clause 5.2.6](#) shall apply.

7 Type D and E appliances

7.1 General

Ramps shall conform to the following:

- (a) The surface of the ramp shall have a slip-resistant finish when tested in accordance with AS 3696.13.
- (b) A ramp shall have edge barriers.

NOTE The recommended minimum height for edge barriers is 75 mm.
- (c) When deployed, the gradient of a ramp shall be no steeper than 1 in 6.
- (d) A ramp shall have no protrusions extending for more than 7 mm above the surface.
- (e) When the ramp is deployed, there shall be no opening or gap in the ramp that a 40 mm diameter ball can fit through.

- (f) A ramp shall have a means of being attached to a vehicle which will secure the ramp against displacement and disengagement from the vehicle while the ramp is in use. Refer to AS 3856.2 for requirements.

7.2 Performance requirements

7.2.1 Type D appliances

7.2.1.1 Durability

The requirements of [Clause 5.2.6](#) shall apply.

7.2.1.2 Ramp strength

When tested in accordance with [Appendix E](#), there shall be no permanent deformation of the ramp and no fracture shall have occurred in the ramp or at its point of attachment or in its means of attachment. Any deflection of the ramp under test load shall not change the inclination of any part of the ramp by more than 3 degrees.

7.2.1.3 Uncontrolled descent under gravity

When tested in accordance with [Appendix A](#), the ramp shall not descend at a rate of more than 0.3 m/s.

7.2.1.4 Acceleration

When the appliance is tested in accordance with [Appendix D](#), any horizontal and vertical accelerations of the platform shall be not more than 0.3 m/s².

7.2.1.5 Speed

When the appliance is tested in accordance with [Appendix D](#), the speed of the platform shall be not more than 0.15 m/s.

7.2.2 Type E appliances

The requirements of [Clause 7.2.1.2](#) for ramp strength shall apply.

8 Information disclosure requirements

8.1 General

Documentation and labelling shall be available in English, for each vehicle modification supplied in Australia. The full test report (which may be in electronic format), resulting from testing to this Standard, shall be provided on request. Details for how to obtain the documentation required under this [Clause \(8\)](#), including alternative formats, shall be provided with the modification and include the following:

- (a) A contact name, telephone number and email address of the sponsor in the country of supply (i.e. Australia or New Zealand).
- (b) Operator information as specified in [Clause 8.4](#).

Where printed information is supplied to meet the requirements of [Clauses 8.3 to 8.4](#), it shall be made available in three separate sections (pre-sale, operator and servicing information) if requested, and through accessible electronic format (e.g. accessible PDF, etc.).

8.2 Labelling

Each appliance shall be clearly and permanently marked in a position where it can easily be read by the operator, with the following information:

- (a) Name or trade mark of the manufacturer.

NOTE For imported products, the name or trade mark of the distributor should also be on the appliance.
- (b) Model designation.
- (c) Serial number.
- (d) The safe working load (kg).
- (e) Instructions for the operation of the appliance shall be written in English and permanently fixed near the control unit.
- (f) Except for Type E appliances, information that brakes need to be applied and electrically powered wheelchairs switched off during hoisting operations.
- (g) Indication that appliance conforms to AS 3856.

8.3 Pre-sale information

A statement of warranty shall be provided with each appliance assuring the quality of materials and workmanship of the product.

8.4 Operator information

Printed instructions shall be supplied with each appliance for its safe use, operation, and maintenance as follows:

- (a) The name and address of the manufacturer or distributor.
- (b) Instructions for operation of the appliance.
- (c) Instructions for routine inspection and maintenance.
- (d) Fitting guide, including information for installation requirements.
- (e) Service and spare parts guide.
- (f) Any other information needed for safe usage.

Instructions shall also be available in an accessible electronic format e.g. accessible PDF.

Appendix A (normative)

Test for performance of a platform under simulated failure of operating power or equipment

A.1 Scope

This Appendix sets out a method for testing the descent rate of a powered appliance in the event of failure of operating power or equipment.

A.2 Principle

The platform is loaded and a failure of the operating power or the equipment which allows the appliance to lower is simulated. The rate of descent of the platform under these conditions is noted.

A.3 Apparatus

The following apparatus is required:

- (a) A rigid surface to which the appliance to be tested can be secured.
- (b) A means by which a test load of $1.5 \times \text{SWL}$ can be applied through the centroid of the platform.
NOTE [Figure A.1](#) shows of the design requirements for a standard loading pad.
- (c) A means of measuring the rate of descent of the platform to an accuracy of $\pm 10\%$. Measurement device shall have a minimum sample rate of 50 Hz.

A.4 Procedure

The procedure shall be as follows:

- (a) Secure the appliance. If adjustments are provided, test at adjustment limits so that the ramp remains parallel to the ground.
- (b) With the platform in the fully lowered position, apply a test load of $1.5 \times \text{SWL}$ to the surface of the platform at the centroid of the platform, equally through four loading pads as shown in [Figure A.2](#).
- (c) Fully raise the platform.
- (d) Simulate the most likely mode, or modes, of failure of the primary hoisting or lowering system which could result in a free fall.
- (e) Measure and note the maximum rate of the platform's descent.

A.5 Report

The following shall be reported:

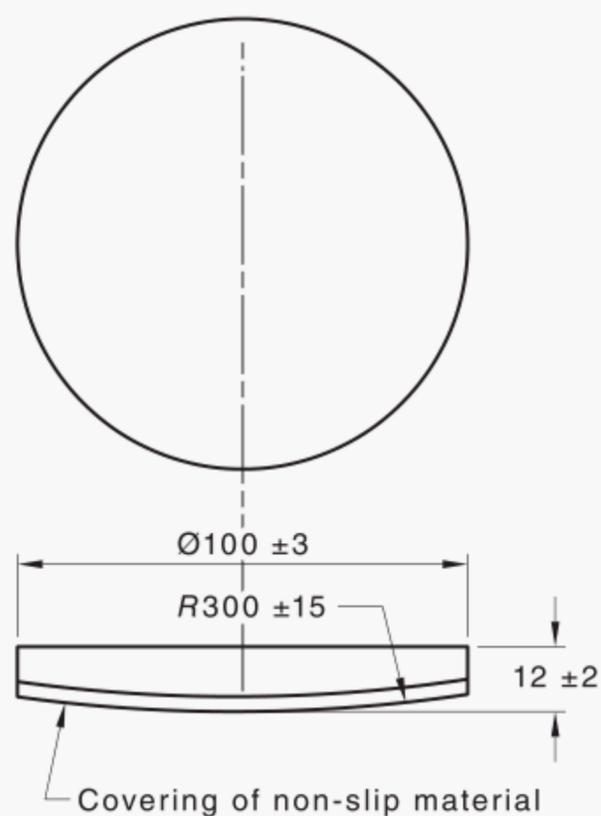
- (a) The brand and model number of the appliance.

- (b) The maximum rate of descent of the platform.
- (c) A reference to this test method, i.e. AS 3856.1 Appendix A.

A.6 Record

A copy of the report shall be retained.

Dimensions in millimetres



Key

The standard loading pad is a rigid, circular object $100 \text{ mm} \pm 3 \text{ mm}$ in diameter whose face has a convex spherical curvature of $300 \text{ mm} \pm 15 \text{ mm}$ radius with a total thickness of $12 \text{ mm} \pm 2 \text{ mm}$. The loading surface may be covered with non-slip material up to 3 mm thick, e.g. plastic foam.

Figure A.1 — Standard loading pad

Dimensions in millimetres

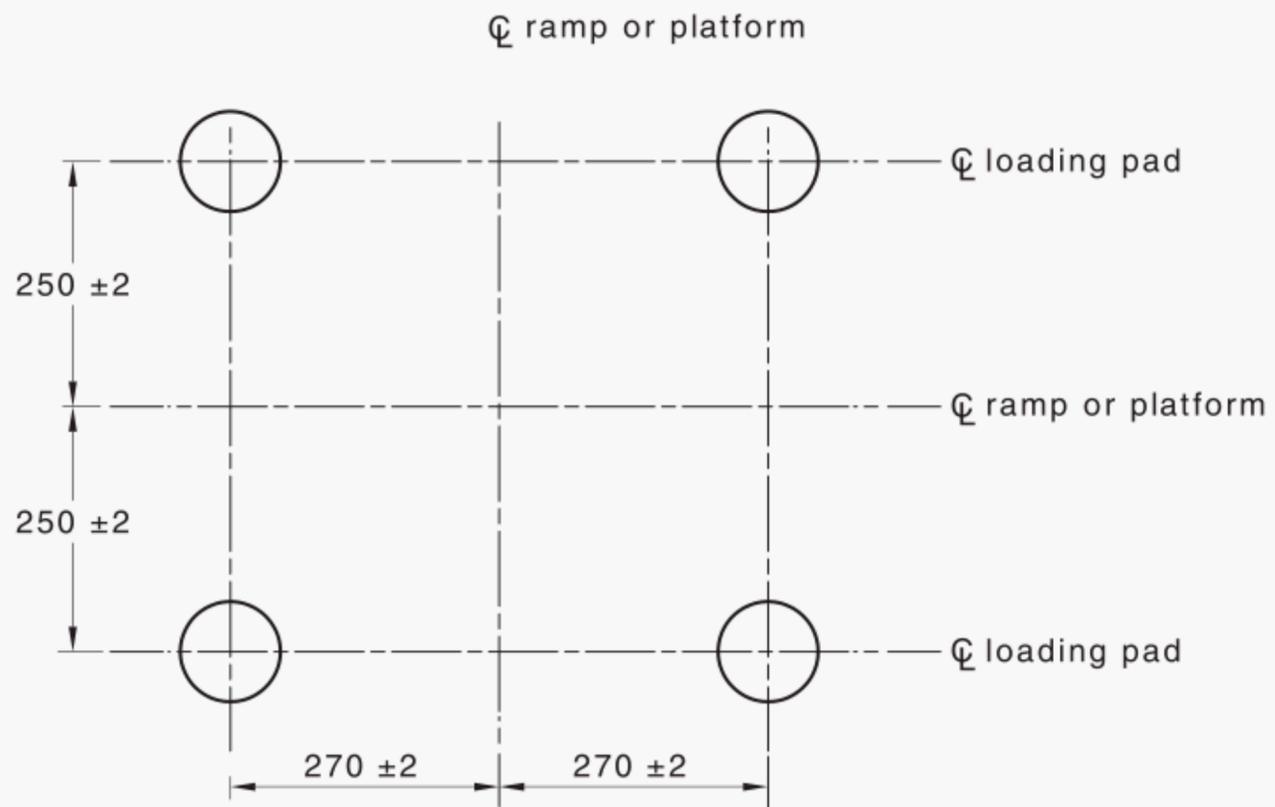


Figure A.2 — Top view showing position of loading pads on the test surface

Appendix B (normative)

Test for platform deflection

B.1 Scope

This Appendix sets out a method of testing an appliance for deflection under load.

B.2 Principle

The hoist platform loaded with a static load is raised and lowered and any deflection of the platform is noted.

B.3 Apparatus

The following apparatus is required:

- (a) A rigid surface to which the appliance to be tested can be secured.
- (b) A means by which a test load of $1.5 \times \text{SWL}$ can be applied through the centroid of the platform as described in [Appendix A](#).

NOTE [Appendix A, Figure A.1](#) shows an example of a standard loading pad.

- (c) A means of measuring deflection to an accuracy of 0.5 degrees.

B.4 Procedure

The procedure shall be as follows:

- (a) Secure the appliance.
- (b) Place the platform in the deployed position and measure the position of the platform.
- (c) Lower the platform to within 100 mm of the floor level.
- (d) Apply a test load of $1.5 \times \text{SWL}$ to the surface of the platform at the centroid of the platform, equally through four loading pads as shown in [Appendix A, Figure A.2](#).
- (e) Raise and lower the platform for one cycle.
- (f) Following completion of the cycle, measure and note any deflection of the platform which occurs in any direction between the loaded position and its equivalent unloaded position as measured in (b).

B.5 Report

The following shall be reported:

- (a) The brand and model number of the appliance.
- (b) The amount of any deflection of the platform while under test load, in degrees.

- (c) A reference to this test method, i.e. AS 3856.1 Appendix B.

B.6 Record

A copy of the report shall be retained.

Appendix C (normative)

Platform strength test

C.1 Scope

This Appendix sets out a method of testing a platform for strength under a static load.

C.2 Principle

A static load is placed on the platform when the platform is in its fully raised position, and the load is left in position for a specified time. The load is removed and the appliance is inspected and any deformation which has occurred is noted. This procedure is repeated with the application of an increased load and the appliance is inspected and any fracture which has occurred is noted. The appliance is then operated and any failure which has occurred is noted.

C.3 Apparatus

The following apparatus is required:

- (a) A rigid surface to which the appliance to be tested can be secured.
- (b) A means by which the test loads specified in [Clause C.4\(c\)](#) and [Clause C.4\(g\)](#) can be applied through the centroid of the platform or support surface.

NOTE [Appendix A, Figure A.1](#) shows an example of a standard loading pad.

C.4 Procedure

The procedure shall be as follows:

- (a) Secure the appliance.
- (b) Place the platform or support surface in its fully raised position.
- (c) Apply a test load of 1.5 x SWL to the surface of the platform or support surface through the centroid of the platform equally through four loading pads as shown in [Appendix A, Figure A.2](#).
- (d) Leave the load in place for a period of 2 min.
- (e) Remove the load.
- (f) Inspect the appliance and note any permanent deformation or fracture which has occurred to any part of the appliance.
- (g) Store and deploy the appliance and operate through the lifting cycle, noting any failure in operation.

C.5 Report

The following shall be reported:

- (a) The brand and model number of the appliance.
- (b) Whether permanent deformation of any part of the appliance has occurred, whether any fracture to any part of the appliance has occurred, and whether the appliance operated without failure.
- (c) A reference to this test method, i.e. AS 3856.1 Appendix C.

C.6 Record

A copy of the report shall be retained.

Appendix D (normative)

Tests for dynamic durability, and measurement of speed and acceleration

D.1 Scope

This Appendix sets out a method for testing an appliance for durability in dynamic conditions.

D.2 Principle

The power-operated functions of an appliance are operated for a specified number of cycles and the speed and any vertical or horizontal accelerations of a platform or support surface are noted.

D.3 Apparatus

The following apparatus is required:

- (a) For all appliances: a rigid platform or surface to which the appliance to be tested can be secured.
- (b) For Type A, Type B and Type C appliances as follows:
 - (i) A means of loading the platform or support sling with $1.25 \times \text{SWL}$.
NOTE [Appendix A, Figure A.2](#) shows an example of loading a platform.
 - (ii) A means of recording the number of test cycles.
 - (iii) A means of measuring the speed of the platform and any horizontal or vertical accelerations of the platform to an accuracy of $\pm 0.3 \text{ m/s}^2$. Measurement device shall have a minimum sample rate of 50 Hz.

D.4 Temperature conditions for test

No external or artificial heating or cooling shall be applied to the specimen during the test.

D.5 Procedure

During the test, inspection, lubrication, maintenance and replacement of parts (other than bulbs or fuses) shall be performed only as specified in the maintenance manual for the appliance and at intervals not exceeding the frequency specified in the manual.

The following cycles may be performed separately or they may be combined into a single cycle:

- (a) *Deployment cycle* — The procedure shall be as follows:
 - (i) Secure the appliance.
 - (ii) Deploy and store the platform, hoist or ramp for 1 000 cycles.

- (iii) If an appliance is designed for deployment under load, place the test rig at an angle of 5° laterally from the horizontal to simulate operation on a crowned road. Operate the appliance and while it is operating in a deployment cycle, measure and note the maximum values of any vertical or horizontal accelerations.
- (b) *Lifting cycle (Type A, Type B and Type C appliances only)* — The procedure shall be as follows:
- (i) Apply a test load of $1.25 \times \text{SWL}$ to the surface of the platform or support sling.
 - (ii) Operate the platform or support sling up and then down through its maximum vertical operating range for 4 400 cycles with inspections to be made every 500 cycles for failures and/or movements changes in any of the components; then these changes are recorded.
- During each cycle the platform or support sling shall reach the end of its normal travel limits and if designed to do so, bottom out on the test surface to remove the load from the operating mechanism.
- The cycles may be continuous or may be separated into groups with a non-operating period of not more than 1 min between each cycle.
- NOTE This may be done so that the ratings of any motor or associated equipment will not be exceeded.
- (iii) While the platform or support sling is operating during any one cycle, measure and note the maximum speed of the motion.
 - (iv) While the platform or support sling is operating during any one cycle, measure and note in metres per second the maximum values of any vertical or horizontal accelerations.

D.6 Report

The following shall be reported:

- (a) For all appliances the following:
 - (i) The brand and model number of the appliance.
 - (ii) Whether the appliance failed.
 - (iii) A reference to this test method, i.e. AS 3856.1 Appendix D.
- (b) For Type A, Type B and Type C appliances, the following:
 - (i) The maximum speed of the platform or support sling.
 - (ii) The maximum values of any vertical or horizontal accelerations.

D.7 Record

A copy of the report shall be retained.

Appendix E (normative)

Ramp strength test

E.1 Scope

This Appendix sets out a method of testing a ramp (type D or E) for strength under a static load.

E.2 Principle

A static load is placed on the ramp when the ramp is in the deployed position, and the load is left in position for a specified time. The load is removed and the ramp is inspected and any permanent deformation which has occurred is noted. The procedure is repeated with the application of an increased load and the ramp and its means of attachment are inspected and any fracture which has occurred is noted.

E.3 Apparatus

The following apparatus is required:

- (a) A rigid platform or surface to which the ramp(s) to be tested can be secured.
- (b) A means by which by which the test forces specified in [Paragraph E.4\(b\)](#) and [Paragraph E.4\(g\)](#) can be applied through the centroid of the ramp.

NOTE [Appendix A, Figure A.1](#) shows the design requirements of a standard loading pad.

- (c) A means of measuring deflection to an accuracy of ± 0.5 degrees.

E.4 Procedure

The procedure shall be as follows:

- (a) Place the ramp horizontally or at the manufacturer's specified angle.
- (b) Apply a force of 1.5 x SWL vertically at the surface of the ramp at the centroid of the ramp equally through four loading pads as shown in [Appendix A, Figure A.2](#). The ramp shall only be supported at either end unless specified by the manufacturer. For multiple ramps, distribute the load proportionately through the centroid of each ramp. For a ramp with manufacturer specified supplementary supports the load shall be applied to the centroid of the longest unsupported span.

- (c) Leave the force in place for a period of 2 min.

- (d) Measure worst case deflection of the ramp.

NOTE Worst case deflection may either be angular or vertical displacement.

- (e) Remove the test force.

- (f) Inspect the ramp and note whether any permanent deformation or any fracture has occurred.

- (g) Inspect the point of attachment and means of attachment and note whether any deformation or fracture has occurred.

E.5 Report

The following shall be reported:

- (a) The brand and model number of the appliance.
- (b) The amount of any deflection of the ramp while under load, in degrees.
- (c) Whether any permanent deformation of the ramp has occurred or whether any fracture to the ramp has occurred.
- (d) Whether any fracture has occurred at the point of attachment or in the means of attachment.
- (e) A reference to this test method, i.e. AS 3856.1 Appendix E.

E.6 Record

A copy of the report shall be retained.

Appendix F (normative)

Temperature cycling test

F.1 Scope

This Appendix sets out a method for testing an appliance for reliable operation in extremes of temperature that may be encountered during its service life.

F.2 Principle

Appliance types A, B, C and D that use electrical power with a control system may be subject to extremes of temperature.

F.3 Apparatus

The following apparatus is required:

- (a) Load of 1.5 x S.W.L applied through the centroid of the horizontal load carrying area.
- (b) Thermometer to measure ambient air temperature to an accuracy of $\pm 1.0^\circ\text{C}$.
- (c) Hygrometer to measure relative humidity to an accuracy of $\pm 2\%$.
- (d) Cold test environment to subject a hoist to ambient conditions of $-25_{-5}^{+2}^\circ\text{C}$.
- (e) Hot test environment to subject a hoist to ambient conditions of $(50_{-2}^{+5})^\circ\text{C}$ and $(65 \pm 5)^\circ\text{C}$.
- (f) Ambient test environment to subject a hoist to ambient standard conditions of $20^\circ\text{C} \pm 5^\circ\text{C}$ and relative humidity of $60\% \pm 20\%$.

F.4 Preparation of the test hoist

The hoist shall be deployed and the load shall be applied to the support surface. The load shall be raised midway through its normal travel. The moving components of any actuator shall be marked to determine if it moves during the test.

NOTE The hoist may be tested installed in the vehicle or attached to a stand simulating the vehicle.

F.5 Requirements

The hoist shall continue to function according to the manufacturer's specifications after being subjected to each of the tests specified in [Clause F.6](#).

When the hoist is tested as specified in [Clause F.6](#) it shall meet the requirements of the functional check specified in [Clause F.7](#). No driven part shall exhibit unintended movement during exposure to the specified test conditions.

F.6 Test procedure

Temperature cycling tests shall be carried out in the following sequence:

- (a) Cold operating conditions and resistance to condensation.
- (b) Hot operating conditions.
- (c) Cold storage conditions.
- (d) Hot storage conditions.

CAUTION — DURING THESE TESTS THE HOIST WILL BECOME VERY COLD/HOT. IT IS ESSENTIAL THAT APPROPRIATE SAFETY PRECAUTIONS ARE TAKEN TO PROTECT TEST PERSONNEL.

F.6.1 Cold operating conditions and resistance to condensation

The following steps shall be taken for the cold operating conditions and resistance to condensation test:

- (a) Store the hoist for not less than 24 h in standard ambient conditions with the power isolated.
- (b) Carry out the functional check specified in [Clause F.7](#).
- (c) Restore power to the hoist and subject it to a temperature of $(-25 \begin{smallmatrix} +2 \\ -5 \end{smallmatrix})^{\circ}\text{C}$ for not less than 4 h.
- (d) Inspect the hoist for evidence that any driven part has not moved.
- (e) Conduct the functional check specified in [Clause F.7](#) commencing within 5 min from the completion of (c) and continue testing until all visible parts of the control system have warmed such that no frost remains.
- (f) Leave the hoist switched on for $1 \text{ h} \pm 5 \text{ min}$ in standard ambient conditions.
- (g) Inspect the hoist for evidence that any driven part has moved.
- (h) Conduct the functional check specified in [Clause F.7](#) commencing within 5 min from the completion of (f).
- (i) Repeat (c) to (h) for a total of two times, commencing as soon as practicable, and within 5 min after completing the functional test in (h).

NOTE The test is repeated to provide a build-up of condensation.

F.6.2 Hot operating conditions

The following steps shall be taken for the hot operating conditions test:

- (a) Store the hoist for not less than 24 h and not more than 72 h in standard ambient conditions with the power isolated.
- (b) Carry out the functional check specified in [Clause F.7](#).
- (c) Restore power to the hoist and subject it to a temperature of $(50 \begin{smallmatrix} +5 \\ -2 \end{smallmatrix})^{\circ}\text{C}$ for not less than 4 h.
- (d) Inspect the hoist for evidence that any driven part has not moved.
- (e) Conduct the functional check specified in [Clause F.7](#) commencing within 5 min from the completion of (c).
- (f) Leave the hoist switched on for $1 \text{ h} \pm 5 \text{ min}$ in standard ambient conditions.
- (g) Inspect the hoist for evidence that any driven part has moved.

- (h) Conduct the functional check specified in [Clause F.7](#) commencing within 5 min from the completion of (f).

F.6.3 Cold storage conditions

The following steps shall be taken for the cold storage conditions test:

- (a) Store the hoist for not less than 24 h and not more than 72 h in standard ambient conditions with the power isolated.
- (b) Carry out the functional check specified in [Clause F.7](#).
- (c) If the hoist has its own battery power supply, remove the batteries.
- (d) Subject the hoist to a temperature of -20 ± 5 °C for not less than 6 h
- (e) Store the hoist for $1 \text{ h} \pm 5 \text{ min}$ in standard ambient conditions.
- (f) If required, replace the batteries removed in (c).
- (g) Conduct the functional check specified in [Clause F.7](#) commencing within 5 min from the completion of (f).

F.6.4 Hot storage conditions

The following steps shall be taken for the hot storage conditions test:

- (a) Store the hoist for not less than 24 h and not more than 72 h in standard ambient conditions with the power isolated.
- (b) Carry out the functional check specified in [Clause F.7](#).
- (c) Isolate the power to the hoist.
- (d) Subject the hoist to a temperature of 65 ± 5 °C for not less than 5 h.
- (e) Inspect the hoist for evidence that any driven part has moved.
- (f) Conduct the functional check specified in [Clause F.7](#) commencing within 5 min from the completion of (c).
- (g) Store the hoist switched on for $1 \text{ h} \pm 5 \text{ min}$ in standard ambient conditions.
- (h) Inspect the hoist for evidence that any driven part has moved.
- (i) Conduct the functional check specified in [Clause F.7](#) commencing within 5 min from the completion of (g).

F.7 Functional check

The following test is used to determine whether the hoist performs acceptably before and after being subjected to the thermal cycling specified in [Clause F.6](#).

When the loaded hoist is cycled through two complete cycles of raise, stow deploy and lower starting from the mid raise position, neither the hoist nor any part of the hoist shall function abnormally. This procedure shall be completed within 10 min.

F.8 Report

The following shall be reported:

- (a) The brand and model number of the appliance.
- (b) A statement as to whether the hoist met the requirements of the functional check after exposure to the thermal cycling in each of the tests.
- (c) Any reasons for failure to meet the requirements.
- (d) A reference to this test method, i.e. AS 3856.1 Appendix F.

Appendix G **(normative)**

Electrical safety tests

G.1 Scope

This section applies only to A, B, C and D type hydraulic or electrically powered vehicle mounted appliances where the primary source of power is from the vehicle battery.

G.2 General

Appliance controls and actuation systems shall be designed and manufactured in such a way that, in the event of a single fault condition (in the systems) they will not compromise the safety of the operator or any other person.

G.3 Requirements

Appropriate means shall be adopted to eliminate or reduce as far as possible the probability of a hazardous situation developing in the event of a single fault condition. The means by which the intended user is made safe against single fault conditions shall be declared. A risk assessment shall be conducted in accordance with AS ISO 14971.

G.4 Single fault failure

Single fault conditions that have been observed in appliances include —

- (a) short and open circuits of conductors and wiring;
- (b) exposure of electronic components to humidity and liquids, such as rainwater and urine;
- (c) component failure, such as leakage, internal short circuit, latched logic state; and
- (d) mechanical linkage failures.

G.5 Single fault safety

The manufacturer shall employ AS ISO 14971 to manage risk and shall consider the following in the risk management process for a single fault condition:

- (a) Fire and or explosion.
- (b) Software.
- (c) Exposure to working fluids used in the hoist mechanism.
- (d) Technical knowledge, experience, education or training of the intended operator.

G.6 Circuit protection

G.6.1 General

Vehicle batteries store considerable energy and are capable of supplying that energy quickly with power levels sufficient to burn unprotected or inadequate wiring in fault situations.

It is important that all wiring has adequate protection for its conductor size. It is also important that the protective devices are placed as close as practicable to the energy source to minimize the amount of unprotected wiring.

Wiring that carries hydraulic pump motor or electrical actuator power is subjected to short-term/intermittent peak current but under normal conditions is not subjected to high current for long periods.

NOTE ADR 42 Part 9 specifies requirements for wiring installation.

CAUTION — IF FUSES ARE USED IN PLACE OF THERMAL OVERLOADS, IT MAY BE NECESSARY TO USE A CURRENT RATING THAT IS SUBSTANTIALLY HIGHER THAN IS TYPICAL FOR THE THERMAL OVERLOAD THAT THEY ARE REPLACING IN ORDER TO STOP UNWANTED BLOWING OF FUSES. IN SUCH CASES, BATTERY WIRE SIZES MAY NEED TO BE INCREASED PROPORTIONALLY.

G.6.2 Requirements

All wiring and connections in a hoist system shall be protected against excessive current flow from energy sources within the vehicle or external energy sources connected to it.

When the appliance is tested in accordance with [G.6.3](#), there shall be no visible damage to any current-carrying conductor, insulation, electronic component or connector, and wire insulators and connectors shall not exceed their dry air rated temperature.

NOTE 1 Examples of visible damage include melting, colour change, smoke, copper migration and oxidation.

NOTE 2 Further information on connectors can be found in AS 3200.

Circuit protection devices shall not be of the type that can self-reset while a fault is still present.

NOTE 3 The necessary over-current protection may be provided by a battery integrated battery management system such as in a lithium ion battery.

When changing fuses that do not need a tool for access, it shall not be possible for leads or terminals exposed during the procedure to touch any other part of any electrical circuit.

In order to prevent inadvertent misconnection, connectors shall not be interchangeable.

G.6.3 Test methods

G.6.3.1 General

CAUTION — THESE TESTS CAN BE HAZARDOUS. IT IS ESSENTIAL THAT APPROPRIATE SAFETY PRECAUTIONS BE TAKEN TO PROTECT TEST PERSONNEL.

Short-circuit test for wiring that predominantly carries power from the batteries to the hydraulic pump drive or actuators shall be conducted.

The theoretical state of charge of the battery set of the vehicle or battery power supply shall be not less than 75 % of its rated capacity C5. Thermocouples shall be used for monitoring the highest temperatures of wire insulation and connectors.

NOTE 1 Often the inner wires of a bundle will reach a higher temperature than the outer ones.

NOTE 2 Infrared thermography may be used to determine the location of high temperatures in the wiring loom to identify where the thermocouple is to be inserted.

G.6.3.2 Test method for short-circuit for wiring that predominantly carries power from the batteries to the hydraulic pump drive, actuators or control system

The following steps shall be taken for the test method for short-circuit for wiring that predominantly carries power from the batteries to the hydraulic pump drive or actuators:

- (a) The point closest to the battery terminals where the positive conductor from the battery, or their insulation, can be pulled into contact with any component that is at an earth potential with a force that is less than 10 N shall be determined. The hoist fails the test if there is no circuit protection device within the circuit containing this contact point and the battery.
- (b) If there is a circuit protection device present in the circuit loop containing the contact point described in (a) and the battery, the insulation from the wires at the contact point shall be stripped and the positive and negative wires shall be connected to the circuit breaker so that the wires will be connected when the circuit breaker is closed. The circuit breaker shall be positioned so that the tester can operate it without personal hazard.
- (c) The contacts of the circuit breaker shall be closed.
- (d) Any failure of the circuit protection device to operate shall be recorded. This includes where the following occurs:
 - (i) The wire insulation shows visible damage due to heating.
 - (ii) Any smoke.
 - (iii) Any burning smell.
 - (iv) Any wire insulation or connector exceeds its rated temperature.
 - (v) An electronic component fails.
 - (vi) Battery failure.
- (e) The contacts shall be left closed for at least 2 min and the ability of the circuit protection device to reset automatically shall be assessed and recorded.

NOTE A measuring instrument may be used to assess the ability of the circuit protection device to reset automatically.

- (f) The contacts of the circuit breaker shall be opened.

G.6.3.3 Current leakage

All electrical systems installed and/or modified shall not exceed 50 mA total current draw when the vehicle is dormant, i.e. parked, locked and at rest allowing the necessary time to elapse for all systems to power down. The following steps shall be taken:

- (a) Immediately adjacent to the battery side of any circuit protection device, connect a low current ammeter between the battery supply cable and the point at which it is connected to the hoist assembly.
- (b) Ensure all functions of the hoist are in the OFF position.
- (c) The leakage current should not exceed 50 mA during a period of 1 h .

G.6.3.4 Operation with low battery voltage

The hoist should allow the wheelchair and occupant to be lowered to the ground when the battery set nears depletion. The hoist, loaded as specified in [Clause A.4\(b\)](#), shall allow the load to be lowered from its maximum raised height at a constant speed to the ground when the battery voltage is at 90 % of its nominal voltage.

G.6.3.5 Test method for operation with low battery voltage

The following steps shall be taken for the test method for [Clause G.6.3.6](#):

- (a) Load the hoist as specified in [Clause A.4\(b\)](#).
- (b) Raise the platform to its maximum height.
- (c) Drain the battery set to 90 % of its nominal voltage.
- (d) Use the hoist controls to lower the platform to the ground.
- (e) Observe the lowering of the platform.

G.6.3.6 Switch durability

Switches that are intended for use by the operator or wheelchair occupant shall be rated for not less than 50 000 switch electrical cycles.

NOTE Switch cycles may be determined from switch manufacturer's published specifications.

The emergency stop switch shall be in an accessible position no further than 1 m away from the operator's normal position.

Identify all operator accessible switches and associated circuits which could be a safety hazard if they or their connecting circuitry was to suffer a single failure. For the switches identified, use the methods of AS ISO 14971 and planned testing to ensure that the methods used to mitigate failure are effective.

G.6.3.7 Connector compatibility

Instructions for inspection of connectors shall be included in the owner and/or service manual. Checking should be performed at least annually.

Connectors provided for use by the operator shall be impossible to connect in a manner that will cause operation to be different to that specified by the manufacturer. Colour coding shall not be the only means used to prevent incorrect assembly.

Connectors intended for 240 V applications shall not be used.

Suitable methods include but are not limited to —

- (a) plug and socket shapes that only permit correct assembly; and
- (b) length of wire to plugs and sockets that only permits correct assembly.

It shall not be possible to connect any connector intended for operation at or below the battery set nominal voltage to any socket intended for domestic or industrial supply mains.

G.6.3.8 Enclosure integrity

G.6.3.8.1 General

Exposed enclosures for electrical circuitry shall be able to withstand impacts with objects in the wheelchair's intended operating environment without mechanical failure that could lead to a safety hazard.

G.6.3.8.2 Requirements

When tested in accordance with [G.6.3.8.3](#), enclosures for electrical circuitry that are at risk of impact with static external structures during normal operation shall not —

- (a) be fractured or have visible cracks;
- (b) have nut, bolt, screw, locking pin, adjustable component or similar item that has become detached;
- (c) have electrical connector that has become displaced or disconnected;
- (d) have failure of any parts intended to be removable or folding or adjustable, in accordance with the manufacturer's instructions;
- (e) have hand-grips that have become displaced; or
- (f) have component or assembly of parts that exhibits deformation, free play or loss of adjustment that adversely affects the function of the hoist.

NOTE Cracks in surface finishes, such as paint, that do not extend into the structural material of an enclosure do not constitute a failure.

Following the test, when the loaded hoist is cycled through two complete cycles of raise, stow deploy and lower starting from the mid raise position, the hoist and all its parts shall function normally.

G.6.3.8.3 Test method

Test each enclosure using the test method specified in IEC 62262 for IK10, with the following provisions:

- (a) Test a single sample.
- (b) Use a pendulum hammer.
- (c) Test each enclosure fitted to the hoist.
- (d) Conduct the test with the hoist ramp deployed and the hoist assembly active.

G.7 Test Report

The test report shall contain the following information:

- (a) The brand and model number of the appliance, and the make and model of the vehicle.
- (b) A list of identified hazards and their means of mitigation as a result of the AS ISO 14971 assessment.
- (c) A statement to say that the appliance met the requirements of this test method, i.e. AS 3856.1 Appendix G.

Bibliography

AS 3200, *Medical electrical equipment (series)*

AS/NZS ISO 10535:2011, *Hoists for the transfer of disabled persons — Requirements and test methods*

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NOTES

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