

Australian Standard[®]

Amusement rides and devices

Part 2: Operation and maintenance



This Australian Standard® was prepared by Committee ME-051, Amusement Rides and Devices. It was approved on behalf of the Council of Standards Australia on 9 July 2009. This Standard was published on 31 July 2009.

The following are represented on Committee ME-051:

- Australian Amusement Association
 - Australian Amusement Leisure and Recreation Association
 - Australian Chamber of Commerce and Industry
 - Consumers' Federation of Australia
 - Department of Commerce, Worksafe Division, WA
 - Department of Justice and Attorney General, Qld
 - Department of the Premier and Cabinet, SA
 - Engineers Australia
 - Insurance Council of Australia
 - Kidsafe
 - Safety Institute of Australia
 - Showmen's Guild of Australasia
 - Workcover New South Wales
 - Worksafe Victoria
-

This Standard was issued in draft form for comment as DR 05589.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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Australian Standard[®]

Amusement rides and devices

Part 2: Operation and maintenance

Originated as part of AS 3533—1988.
Revised and redesignated in part as AS 3533.2—1997.
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PREFACE

This Standard was prepared by Joint Standards Australia/Standards New Zealand Committee ME-051, Amusement Rides and Devices, to supersede AS 3533.2—1997.

This Standard incorporates Amendment No. 1 (December 2011). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee, ME-051. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Standard is to provide proprietors and operating staff with requirements and guidance for operation and maintenance of amusement rides and devices in order to protect the health and safety of both operating staff and patrons.

Originally developed from technical literature, existing regulations and guidelines, this Standard has been developed through the combined experience of the Committee and the organizations represented on it, along with contributions from several individuals and organizations having expert knowledge in those areas covered by this Standard. The Committee acknowledges the contributions made by those individuals and organizations and wishes to record its appreciation for their permission to include this material.

Major changes to the previous edition are as follows:

- (a) Reference to AS 3533.3 for the procedures for conducting any in-service inspections required by this Standard.
- (b) Introduction of requirements for daily inspections and test runs and major inspections for amusement rides and devices.
- (c) Expansion of requirements for records pertaining to the amusement ride or device, its inspection and maintenance in place of the information previously presented in AS 3533.2 Supp 1, *Amusement rides and devices, Part 2: Operation and maintenance*, Supplement 1: *Logbook*.
- (d) Expansion of requirements and guidance concerning bolts.
- (e) Relocation of expanded specific requirements for inflatable structures, particularly for their anchoring to prevent undue movement with wind changes, to a separate part in the AS 3533 series.
- (f) Relocation of specific requirements for roller coasters to a separate part in the AS 3533.
- (g) Removal of passenger ropeways and passenger conveyors from the scope of AS 3533.2.
- (h) Replacement of requirements concerning clearances from power lines with general guidance on the types of requirements implemented by regulatory authorities.

The Committee also intends to refer to a new Standard for flying foxes that is under preparation by Committee SF-047 Artificial Climbing Structures, to replace the requirements in Clause 4.9. When the new Standard is published, this Standard will be amended accordingly.

This Standard (AS 3533.2) was created to cater specifically for the proprietors and operating staff of amusement rides and devices by providing them with a set of guidelines for the day-to-day operation of such devices.

The occupational health and safety obligations laid out in AS 3533.1 for designers and manufacturers of amusement rides and devices are continued in this Part (AS 3533.2). This Part is intended essentially as a working document and ready reference for the proprietors and operating staff associated with both mobile and permanently installed devices.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE.....	6
1.2 REFERENCED DOCUMENTS.....	6
1.3 DEFINITIONS.....	8
SECTION 2 SITE LAYOUT, ASSEMBLY AND ERECTION, AND ELECTRICAL REQUIREMENTS	
2.1 SITE LAYOUT.....	12
2.2 ASSEMBLY AND ERECTION.....	14
2.3 ELECTRICAL REQUIREMENTS	24
SECTION 3 ORGANIZATIONAL ARRANGEMENTS	
3.1 PLANNING.....	29
3.2 OPERATION.....	30
SECTION 4 SPECIFIC OPERATIONAL REQUIREMENTS	
4.1 GENERAL.....	32
4.2 AQUATIC AND WATERBORNE AMUSEMENT DEVICES	32
4.3 'Text deleted'	34
4.4 FERRARI 500-TYPE KARTS AND TRACKS	34
4.5 TOBOGGANS (LAND-BASED)	35
4.6 AMUSEMENT DEVICES INCORPORATING ELASTIC SUSPENSION SYSTEMS	36
4.7 AIR CUSHIONED VEHICLES.....	36
4.8 PARASAILING.....	37
4.9 FLYING FOXES	40
4.10 CABLE WATERSKIING	40
4.11 MINI BIKES AND MINI BIKE TRACKS	41
4.12 DRY SLIDES	42
4.13 STEAM AND HOT WATER EQUIPMENT	43
4.14 HYDRAULIC AND PNEUMATIC EQUIPMENT.....	43
SECTION 5 MAINTENANCE, REPLACEMENT, REPAIR AND INSPECTION	
5.1 GENERAL.....	45
5.2 MAINTENANCE AND REPLACEMENT.....	45
5.3 ALTERATIONS AND REPAIRS.....	46
5.4 INSPECTION	46
5.5 RECORDS.....	48
SECTION 6 FIRE SAFETY	
6.1 GENERAL.....	50
6.2 STORAGE AND HANDLING OF FLAMMABLE OR COMBUSTIBLE LIQUIDS	50
6.3 FIRE EXTINGUISHERS.....	50
6.4 FIRE DETECTORS.....	51
APPENDICES	
A STATUTORY REQUIREMENTS.....	52
B SUGGESTED TRAINING, QUALIFICATIONS AND EXPERIENCE FOR COMPETENT PERSONS	55

C	CLEARANCE DISTANCES FROM AERIAL CONDUCTORS	57
D	MARKING OF BOLTS, NUTS AND WASHERS	58
E	GROUND BEARING (SUPPORTING) CAPACITIES	64
F	HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL PROCESS	66
G	GENERAL GUIDELINES FOR OPERATOR AND ATTENDANT SELECTION AND INSTRUCTION	70
H	PATRON RESPONSIBILITY	72
I	SAFETY GUIDELINES FOR OPERATORS	73
J	WATER QUALITY	74
K	PRECAUTIONS FOR STORING AND HANDLING FLAMMABLE OR COMBUSTIBLE LIQUIDS AND LIQUEFIED PETROLEUM GAS	76
L	CONTENTS OF LOG AND AVAILABILITY FOR INSPECTION.....	78

STANDARDS AUSTRALIA

Australian Standard
Amusement rides and devices

Part 2: Operation and maintenance

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for the operation, maintenance, inspection and fire safety measures for fixed and portable amusement rides and devices, excluding—

- (a) miniature trains and railway systems owned and operated by model railway societies, clubs or associations;
- (b) rides or devices when operated under the control of public transport legislation;
- (c) plant used specifically for sporting, professional stunt, theatrical or acrobatic activities; and
- (d) passenger ropeways and passenger conveyors (see AS 4722).

NOTES:

- 1 Requirements for the design and construction of amusement rides and devices are given in AS 3533.1. Details for the conduct of the inspections required in this Standard are specified in AS 3533.3.
- 2 Specific requirements for particular types of amusement rides and devices are specified in Section 4 of this Standard, other Parts of AS 3533 and other Standards; the specific requirements take precedence over corresponding general requirements in this Standard where any difference exists. Clause 4.1 lists the other Parts of AS 3533 and the other Standards that will need to be consulted for certain types of amusement rides and devices.
- 3 Compliance with the requirements and conditions set down by associations such as The Australian Association of Live Steamers is generally required for the miniature trains and railway systems mentioned in Item (a).

1.2 REFERENCED DOCUMENTS

The following is a list of the documents referred to in this Standard, apart from referenced and related documents on bolts, nuts and washers, which are given in Appendix D.

AS

1228	Pressure equipment—Boilers
1499	Personal flotation devices—Type 2
1851	Maintenance of fire protection systems and equipment
1940	The storage and handling of flammable and combustible liquids
2076	Wire-rope grips for non-lifting applications
2260	Personal flotation devices—Type 3
2444	Portable fire extinguishers and fire blankets—Selection and location

A1	AS	
	2550	Cranes, hoists and winches—Safe use
	2550.1	Part 1: General requirements
	2593	Boilers—Safety management and supervision systems
	2790	Electricity generating sets—Transportable (Up to 25 kW)
	3533	Amusement rides and devices
	3533.1	Part 1: Design and construction
	3533.3	Part 3: In-service inspection
	3533.4.1	Part 4.1: Specific requirements—Land-borne inflatable devices
	3533.4.3	Part 4.3: Specific requirements—Roller coasters
	3533.4.4	Part 4.4: Specific requirements—Concession go-karts
	3873	Pressure equipment—Operation and maintenance
	3998	Non-destructive testing—Qualification and certification of personnel
	4024	Safety of machinery
	4024.1	Part 1: Safety of machinery series
	4024.1801	Part 1801: Safety distances to prevent danger zones being reached by the upper limbs
	4037	Pressure equipment—Examination and testing
	4291	Mechanical properties of fasteners made of carbon steel and alloy steel
	4291.1	Part 1: Bolts, screws and studs
	4722	Passenger ropeways and passenger conveyors
	HB 241	Water management for public swimming pools and spas
	AS/NZS	
	1596	The storage and handling of LP Gas
	1698	Protective helmets for vehicle users
	2293	Emergency evacuation lighting for buildings
	2293.2	Part 2: Inspection and maintenance
	2906	Fuel containers—Portable—Plastic and metal
	3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
	3002	Electrical installations—Shows and carnivals
	3190	Approval and test specification—Residual current devices (current-operated earth-leakage devices)
	3760	In-service safety inspection and testing of electrical equipment
	3788	Pressure equipment—In-service inspection
	3832	Electrical installations—Cold-cathode illumination systems
	4291	Mechanical properties of fasteners
	4291.2	Part 2: Nuts with specified proof load values—Coarse thread
	4360	Risk management
	5848	Code of practice for bungy jumping
	61558	Safety of power transformers, power supply units and similar
	61558.1	Part 1: General requirements and tests (IEC 61558-1 Ed.2, MOD)

AS/NZS

61558.2.4 Part 2.4: Particular requirements for isolating transformers for general use (IEC 61558-2-4:1997, MOD)

61558.2.6 Part 2.6: Particular requirements for safety isolating transformers for general use (IEC 61558-2-6:1997, MOD)

ISO

898 Mechanical properties of fasteners made of carbon steel and alloy steel

898-1 Part 1: Bolts, screws and studs

898-2 Part 2: Nuts with specified proof load values—Coarse thread

Australian Miniature Boiler Safety Committee Code

1.3 DEFINITIONS

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

1.3.1 Amusement device

An arrangement of equipment that produces the desired effect of amusement or entertainment when the patron moves through it or on it primarily by his or her own action, or any other system that is not covered by the term ‘amusement ride’.

NOTE: See Clause 1.3.2.

1.3.2 Amusement ride

An arrangement of structural or mechanical elements (or both) that is designed to move patrons in a controlled manner and is not necessarily reliant on patrons moving themselves to obtain the desired effect of amusement or entertainment.

NOTES:

- 1 Within this Standard the word ‘device’ may refer to an amusement ride or an amusement device.
- 2 Some regulatory authorities may refer to amusement rides and devices as ‘amusement structures’.

1.3.3 Ancillary equipment

Equipment forming part of the operational complement of the ride or device that is required, by this Standard or specific legislation, to comply with other Standards or requirements because of its specialized nature or purpose.

1.3.4 Aquatic amusement device

A device that involves patrons being intentionally, either partially or fully, immersed in water for a short period of time at some stage during the ride.

1.3.5 Arm’s reach

A distance of 2.7 m above the relevant reference plane, e.g. walking surface, and 1.5 m sideways or downwards either from the top of any edge barrier that physically prevents arm access or from the edge of that surface if there is no effective edge barrier; alternatively, lower distances determined in accordance with AS 4024.1801 considering the circumstances and any protective structures present.

1.3.6 Assembly

The process of converting a ride or device from its condition for transport to that of being suitable for operation in the case of a mobile ride or device. For a fixed ride or device, the process of building up from ‘as supplied’ component parts.

1.3.7 Attendant

A person working under the supervision of an operator.

1.3.8 Authority

The authority having statutory powers to enforce legislative requirements regarding the design, manufacture, installation, registration and operation of amusement rides and devices covered by this Standard.

NOTE: Appendix A contains information regarding legislative requirements for amusement rides and devices, and a list of some of the authorities responsible for overseeing the implementation of such requirements.

1.3.9 Cable waterskiing system

A device where patrons are towed along on a body of water by ropes attached to a powered, overhead, continuous cable system running around sheaves contained in support structures or towers.

1.3.10 Competent person

A person who has acquired through training, qualifications or experience, or a combination of these, the knowledge and skills enabling that person to perform a specified task.

NOTE: Appendix B provides suggestions for the training, qualifications or experience considered appropriate to possess for the various competent persons referred to in this Standard.

1.3.11 Design

The preconceived scheme and substance of the ride or device contrived to achieve the purpose of the ride or device.

1.3.12 Designer

The person responsible for the design of an amusement ride or device.

1.3.13 Failure

The cessation of the capacity of a component, element or assembly to undertake the task for which it is included in a design.

1.3.14 Fault

An observed condition—

- (a) precedent to a failure and may include—
 - (i) corrosion;
 - (ii) wear;
 - (iii) cracking;
 - (iv) instability;
 - (v) unusual noise or vibration; or
 - (vi) any other discovery that a component is no longer suitable for purpose or is likely to become unsuitable for purpose; or
- (b) creating a risk to health and safety, e.g. sharp edges, trip hazards or a breakdown in electrical insulation.

1.3.15 Flume

A shaped channel containing flowing water, along which patrons are transported in various floating vehicles.

1.3.16 Flying fox

A device consisting of an elevated rope on which a pulley or trolley system (fox) is used to transport patrons between two support structures.

1.3.17 Log

A medium for retaining records permanently, which may include electronic files, paper-based logs or logbooks.

1.3.18 Minor storage

The amount of directly available fuel kept in or around an amusement device (excluding fuel contained in dedicated in-built fuel tanks) necessary to ensure that the daily fuel requirement of the device is able to be met.

1.3.19 Operation

All aspects of the management and control of the ride or device while it is carrying people so that they experience the ride or motion that the ride or device is designed to supply.

1.3.20 Operator

The person having overall control of an amusement device.

1.3.21 Passenger conveyor

A device where skiers and others are transported, while standing, for recreational purposes on a moving element, excluding devices used as loading conveyors.

1.3.22 Passenger ropeway

A powered ropeway used for transporting, in a horizontal or inclined plane, passengers moved by carriers that are—

- (a) attached to or supported by a moving rope; or
- (b) attached to a moving rope but supported by a standing rope, or other overhead structure.

The term includes the prime mover and any transmission machinery, supporting structure and equipment. It does not include equipment such as cog railways, cablecars running on rails, equipment such as flying foxes or elevating systems for vehicles or boat-style carriers associated with amusement rides such as log or boat flume rides.

1.3.23 Patron

A person participating in an amusement ride or device.

1.3.24 Proprietor

The person having, at any given time, the legal responsibility for the management of an amusement device.

1.3.25 Roller coaster

A device that transports patrons in wheeled vehicles that are continuously in contact with and travel along a fixed rail system permitting (in part or in whole) the motion to be the result of the acceleration due to gravity. Such devices may be categorized as 'inverting' roller coasters where, by virtue of a rotation of the rail, patrons attain an attitude of head below abdomen for at least some portion of the ride.

1.3.26 Supervisor

The competent person who is appointed by the proprietor of an amusement ride or device to manage the day-to-day operation of the ride or device.

1.3.27 Toboggan ride (aquatic)

A device so designed that patrons seated on a toboggan travel down an inclined, trough-shaped track or shaped channel. The toboggan may be wheeled or on skids, and the device may or may not incorporate a braking system, a water stop, or a combination of both.

1.3.28 Toboggan ride (land-based)

A device so designed that patrons seated on a toboggan travel down an inclined slope in a shaped channel set into the ground. The toboggan may be wheeled and incorporates a patron-operated braking system.

NOTE: The term 'bobsled' is also used for this device.

1.3.29 Train

A system of linked vehicles operating on rails, pavement or hard ground and powered by internal prime mover(s) or an independent, linked prime mover vehicle.

1.3.30 Vehicle

Any carrier (e.g. car, gondola, chair, capsule, compartment or similar) on or in which patrons are supported, contained or carried when participating in an amusement ride or using an amusement device.

1.3.31 Waterborne ride

A device that involves patrons travelling, either for part of or for the whole of the ride, in vehicles floating on and propelled by water in a flume. The flume may terminate at the foot of an elevating system that returns vehicles and patrons to a higher point. Patrons are not immersed at any time, and do not become wet unless due to incidental splashing.

1.3.32 Water slide

An aquatic amusement device with an inclined sliding surface terminating in a run-out trough or pool. Patrons descend the slide (with or without any sliding device between the patron and the slide) usually under the influence of gravity, with water as the friction-reducing medium.

SECTION 2 SITE LAYOUT, ASSEMBLY AND ERECTION, AND ELECTRICAL REQUIREMENTS

2.1 SITE LAYOUT

2.1.1 Choice of site

The ground chosen for a site should have a firm surface, be well drained and shall be capable of carrying safely, without excessive settlement, any loads likely to be imposed upon it. The following additional factors should also be considered in the choice of a site:

- (a) The slope or unevenness of the ground.
- (b) Perimeter protection.
- (c) Availability of services, e.g. electricity, water, drainage and sewerage, and fire services.
- (d) Prevailing or possible wind speed.
- (e) Access and egress for patrons, emergency vehicles and equipment.
- (f) The proximity of surrounding buildings, man-made or natural objects and cultivated areas in relation to the potential for collision and the risk of the spread of fire.
- (g) The air space required for the ride to operate and not infringe on the air space of other rides or activities (see Clause 2.1.5.2).
- (h) Known history of the site (see Clause 2.1.4).
- (i) The proximity of other devices (see Clause 2.1.5).
- (j) The proximity of electrified conductors (see Clause 2.1.6).
- (k) The possibility of uplift, caused by the action of the device itself or by the wind acting upon it, and the effect of such uplift upon the ground chosen for the site.

NOTE: The foregoing considerations also apply, with appropriate modifications, where a show, carnival or similar attraction is on a pier or other elevated structure. In such cases, a detailed examination of the pier or other structure may be necessary to establish permissible loadings and to determine whether the larger point loads should be spread over the structure. The capacity of any pier or structure upon which an amusement ride or device is to be set up may need to be proved and certified by a competent person.

2.1.2 Preparation of site

The site should be prepared and maintained so that it provides an even and substantially level surface for those parts on which rides are to be assembled (to minimize the need for packing). Care should be taken to avoid creating hazards which may cause people to trip or stumble.

2.1.3 Condition of site

The condition of a site should be checked regularly to ensure that its load-bearing capabilities have not deteriorated. Settlement in the ground can cause instability, thus requiring repacking and levelling of a device.

NOTE: Evidence of deterioration of a site may be hidden from view by the devices themselves.

2.1.4 Seismic activity (earthquakes)

In the case of mobile amusement devices and temporary structures not permanently founded, the proprietor should consider the known history of the site regarding seismic activity and take into account the probability of such an occurrence. Advice from the manufacturer or a competent person may be necessary to ensure the stability of a device under such circumstances.

2.1.5 Clearances

2.1.5.1 General

In all cases, the appropriate clearances as required by AS 3533.1 shall be present.

2.1.5.2 Horizontal clearances for temporary set-ups

Devices should be located so that the moving parts of one device cannot come within less than 2 m of any fixed man-made or natural object or any moving parts of another device under all conditions of operation, unless—

- (a) fixed barriers of substantial construction exist between the device and the object or the two devices; and
- (b) a hazard identification and risk assessment covering the potential for injury to patrons, bystanders, passers-by, operators or maintenance personnel indicates that the arrangement presents no risk.

2.1.5.3 Vertical clearances for temporary set-ups

Devices shall be located so that the vertical clearance between the moving parts of one ride and the moving or fixed parts of another ride is maintained at a minimum of 2.5 m in addition to any ride envelope clearances required in AS 3533.1.

For temporary set-ups, rides that overhang public access areas shall have a minimum ground to ride envelope clearance, above the public access area, of 4.5 m where vehicles can be present.

2.1.5.4 Emergency clearances

Consideration should be given to the space required for emergency evacuation of a device in the case of fire or a mechanical failure resulting in the use of emergency services to rescue patrons.

NOTE: Particular attention should be paid to devices featuring enclosed areas (e.g. ghost trains).

2.1.6 Set-up and operation near power lines

2.1.6.1 Above ground power lines

In this Clause, 'power lines' are taken to be permanent arrangements of aerial electricity conductors providing for the reticulation of electrical power to consumers.

Most States and Territories of Australia have specific rules and requirements governing activities near power lines. Rules are established and published or otherwise made readily available to any person who may have to carry out work of various types in proximity to power lines such as the use of mobile plant (cranes in particular), scaffolding and building. Persons needing to establish or operate amusement rides or devices shall comply with the specific requirements of local legislation concerning the appropriate dimensions for exclusion zones relevant to all phases of their work, e.g. set-up using cranes, set-up using only manual handling, operational clearances.

NOTES:

- 1 The diagrams in Appendix C reflect the general form of the rules set by the relevant authorities and provide a framework for the appropriate enquiry to be made.
- 2 It cannot be assumed that the dimensions for clearances, exclusion zones and zones requiring the assistance of an observer (spotter) that apply under any particular jurisdiction will equate to those under another jurisdiction. Nor is it appropriate to make any assumption as to these dimensions from the comparison of systems on poles (be they timber, metal, concrete or composite) to those on pylons or towers.

In the case of power lines carried on pylons or towers, persons should assume that the system traverses an easement extending to a considerable width along the line of the system (typically this could be 50 m each side of the extreme tower bases). Any works within such an easement may only be carried out with the express permission of the owner of the easement (typically a power supply company) and in conformity with the conditions set down by that permit.

2.1.6.2 *Underground power lines*

In this Clause, ‘underground power lines’ are taken to be permanent arrangements of electrical conductors directly buried under protective covers or slabs, within conduits or pipes or within ducts or tunnels.

Persons responsible for installing or erecting an amusement ride or device shall make all appropriate enquiries as to the existence of underground power line systems at any site and any rules applying to the permissible proximity of equipment, the permissible loading on the ground above and any necessity to avoid clearing soil or driving spikes, pegs or stakes in the vicinity or beyond any particular depth.

2.1.7 Locations within buildings—Emergency provisions

Where a device is within a building having other functions, e.g. within a shopping complex or hall, specific attention shall be paid to the following to ensure compatibility of the emergency procedures for the device with those of the building or complex:

- (a) Provision of emergency systems to effect disembarkation.
- (b) Special features required for operation under fire or emergency evacuation conditions, including provision of emergency lighting for evacuation paths and areas around the device, which operating staff may need to access to effect evacuation.
- (c) Training of operators and proof of procedures to address emergency evacuation requirements.

2.1.8 Lighting

Adequate lighting shall be provided within, and for the approaches to, any device that operates in a building or at night.

2.2 ASSEMBLY AND ERECTION

2.2.1 General

The assembly and dismantling of devices shall be carried out by or under the direct supervision of competent persons and in accordance with manufacturer’s instructions. If instructions from the manufacturer are unavailable for part or all of the assembly or dismantling processes, instructions developed and assessed by competent persons shall be used. The guidance given in Clause 2.2.5 is not intended to override such instructions.

2.2.2 Lighting

Work shall not be carried out where the lighting is insufficient to allow for the work to be safely and properly performed and checked.

2.2.3 Public safety

No work in connection with the assembly or dismantling of amusement rides and devices shall be carried out where such work can present a hazard to the public. Any zones of concern around a device during assembly or dismantling should be clearly delineated, with appropriate signage posted.

2.2.4 Suitability of equipment and parts

The parts, tools, working platforms, scaffolding and lifting equipment shall be suitable for the application. Such equipment should comply with the relevant Australian Standard.

2.2.5 Quality of assembly work

Assembly work shall comply with the following:

- (a) Parts shall not be bent, distorted, cut or otherwise damaged.
- (b) Makeshift devices shall not be used.
- (c) Parts shall be aligned in order to fit them.
- (d) Parts requiring lubrication shall be lubricated prior to or in the course of assembly.
- (e) Cotter pins, split pins, tab washers and similar shall be suitable for the particular application and properly spread where necessary.
- (f) Reusable retaining pins such as R-pins and lynch pins shall be replaced when outside their allowable tolerance.
- (g) Any fitting used in conjunction with a wire rope (e.g. a loadcell, turnbuckle or shackle) to secure an amusement device whilst in service shall be of adequate strength, stamped with its working load limit (WLL) and not be exposed to forces beyond its WLL.

2.2.6 Wire rope grips (bulldog grips)

Wire rope grips shall not be used for making terminations on live running ropes (i.e. a rope that applies force to a moving object) nor where the rope is required to support persons or suspended loads.

Unless special types of wire rope grips are specified by the manufacturer, wire rope grips shall comply with AS 2076 and have correct markings for the rope size being used. Wire rope grips shall not be used to directly connect two straight lengths of rope. Wire rope grips should not be used where there is a likelihood of the rope having to be lengthened at the grip end. Unless a manufacturer calls for the use of a special type of wire rope grip, the correct fitting method shall be used (see Figure 2.1).

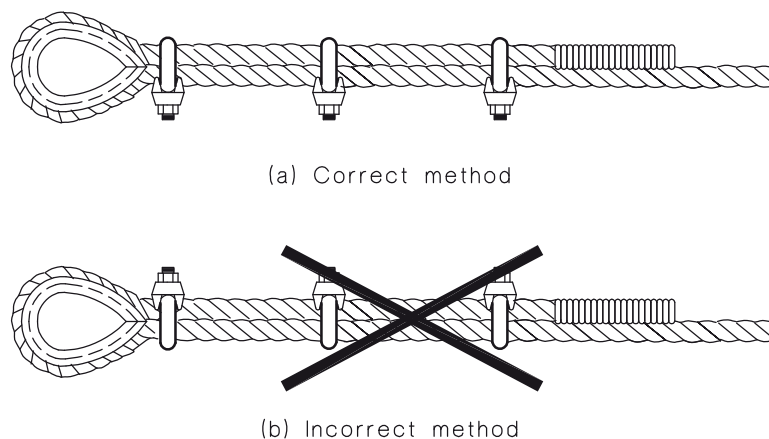


FIGURE 2.1 FITTING WIRE ROPE GRIPS

Wire rope grip terminations shall have the minimum number of grips as shown in Table 2.1. Where there is the potential for injury if a grip termination failure occurs, one additional grip shall be used.

TABLE 2.1
INSTALLATION OF WIRE ROPE GRIPS
FOR EYE ATTACHMENT

Rope diameter mm	No. of grips	Min. spacing of grips mm
8	3	50
9	3	60
11	3	65
12	3	75
16	3	100
18	4	115
22	4	135
24	4	150
28	5	175
32	5	200

2.2.7 Bolted joints

Bolted joints shall be assembled, disassembled (if required), and regularly checked in accordance with the following requirements:

- (a) All bolts shall be the correct size and grade or property class, as specified for the ride or device by the designer, manufacturer or a competent person. They shall fit the fastening holes in the designed manner and be equipped with appropriate nuts and washers. When high tensile bolts are used, a nut of corresponding grade or property class and a high tensile washer under the rotating component shall be used. High tensile bolts shall not be used with lower strength nuts and washers.

NOTES:

- 1 Bolt heads and nuts should be checked for marks indicating their tensile strength and items not showing such marks should not be used. If existing bolts that are being removed from a ride or device do not show identification marks, they should be replaced after checking the details of the bolt that should be used in documentation supplied by the designer or manufacturer, or consulting a competent person if this is not available.
 - 2 Appendix D provides information on commonly used markings and their meanings.
 - 3 A certificate of compliance should be requested when purchasing fastener assemblies.
- (b) Bolts shall not be forced into a misaligned hole in such a way that the bolt can be bent or damaged in installation. Bolts shall not be bent and any bent bolt shall be discarded. The alignment of the bolt head and nut shall be checked prior to tightening to ensure they are parallel.

NOTE: When tightening a joint, it is recommended that bolts be inserted and nuts loosely done up in all positions that relate to the particular joint, then an alignment check of the joint surfaces be carried out and alignment corrected as necessary, prior to any bolt being tightened to its final required tension.

- (c) Bolts shall be tightened in accordance with an appropriate tightening procedure set down by the designer or manufacturer or decided after consultation with a competent person. The tightening specification shall clearly identify the bolt size, grade or property class, designed pre-tension and tolerance limits. If torque is specified as the tightening method, it shall be accompanied with the specified coating or finish of the bolt, condition of the bolt (new or used) and lubricity level or use of particular thread anti-seize, corresponding to the specified torque. Regular checking of the remaining bolt pre-tension on safety-critical joints shall be carried out at intervals determined by

the designer or manufacturer of the ride or device or decided after consultation with a competent person. During this inspection, other parameters that could impact the performance of the joint such as existence of micro-cracks, corrosion, stress corrosion and physical damage shall also be evaluated. Bolts tightened to yield shall not be used again.

NOTES:

- 1 The safety-critical joints that are subject to cyclic loading can develop cracks and the bolts can disintegrate if the joints are under or over tightened. Bolt pre-tension is very important and the bolt should be tensioned to the design pre-tension within a certain tolerance limit identified in the design. Documentation for the ride or device should include the appropriate pre-tension value and its tolerance limits. Direct tension indication devices may need to be used to ensure correct pre-tension. If torque is used as a tightening method for safety-critical joints subject to cyclic loading, laboratory tests or in-situ tests need to be conducted to check that the prescribed torque will always achieve a tension within the design tolerance limits. If the design pre-tension and the tolerance limits are not available in the documentation supplied by the designer or manufacturer, this should be established through consulting the designer or manufacturer or a competent person.
 - 2 If the surfaces to be joined together do not close with reasonable force used on the bolt, the joint should be investigated and corrective action to be taken prior to tightening the bolts.
 - 3 The cleanliness and condition of bolts prior to tightening should be assessed and the use of a new bolt should be considered if the bolt is not adequately clean or the integrity of the bolt is suspect. This is more so when torque is used as the tightening specification.
- (d) The use of proprietary thread repair systems shall be supervised by a competent person.
- (e) Stainless steel bolts shall not be used unless the ride or device is specifically designed for their use or they are being used following consultation with a competent person.
- (f) Bolts shall not be reused if there is any thread damage visible. Bolts showing distortion or wear shall be discarded.
- NOTE: The thread may be checked using a thread gauge or a new bolt as a thread gauge.
- (g) Bolts and nuts, particularly high tensile bolts, shall not be welded unless this is part of the original design, or it is deemed appropriate by a competent person.
- (h) Prevailing torque nuts (e.g. Nyloc nuts) shall not be used for joints subject to frequent disassembly or to replace any nuts without approval from the designer or manufacturer or a competent person.
- NOTE: The suitability of some prevailing torque nuts for reuse depends on the application and reference should be made to the manufacturer's instructions.
- (i) Safety-critical joints shall not rely solely on prevailing torque nuts.

In addition to the requirements in Items (a) to (j), a regular replacement program should be instituted for assembly bolts that are subject to stress corrosion cracking (SCC). High tensile bolts (Class 10.9 or higher) and stainless steel bolts are prone to SCC. The interval of replacement should be as set down by the designer or manufacturer or decided after consultation with a competent person.

2.2.8 Packing and blocking

2.2.8.1 General

Amusement rides and devices shall be set up to maintain stability under all conditions of operation. Where packings and blockings are used to achieve this, the following should be considered in their selection and deployment:

- (a) The manufacturer's instructions.

- (b) The bearing capacity of the ground or mounting surface on which the ride or device is to be erected.
- (c) The period of time for which the ride or device will be situated at the particular location.
- (d) The drainage of the site both with and without the device in position.
- (e) The topography of the site in so far as it affects the provision of level surfaces under load points, and the stability of soil at those points (slippage problems).

NOTE: Amusement rides and devices are generally designed in mobile or permanent (park) models. Mobile equipment is, by nature, configured to have reasonably adjustable, specific mounting points usually arranged for level ground, while permanent or park equipment frequently requires purpose-built foundations, which are independent of the device itself. It is not unusual for mobile equipment to become permanent or semi-permanent installations, in which case the design of packing and blocking systems should be overseen by the manufacturer or a competent person.

2.2.8.2 Short term set-ups

Brittle fibre composites shall not be used in any packing.

The following principles should be adhered to for the packing of amusement rides and devices, where the set-up is for a period not exceeding 3 months and, where specific instructions, equipment or systems are not provided by the manufacturer of the device:

- (a) The bearing capacity of the site should be estimated on the basis of prior experience or the advice of a competent person. In the absence of such an estimate, no site should be assessed to have a capacity in excess of 100 kPa (10 t/m²). The base area of packings (i.e. at the ground surface) should be estimated from the above and the known or estimated total of static and dynamic load to be applied at each point of support.

NOTE: Guidelines for establishing the suitability of a particular site for load-bearing capabilities are given in Appendix E.

- (b) The site should be checked for drainage and the absence of soft spots, sink holes or other factors which would affect the capacity or stability of the packing at any of the load points.

NOTE: Special care is required where tarmac is the bearing surface.

- (c) The ground should be cleared of debris and surface irregularities in the location of the load points, and levelled at those points either by cutting or building up with a suitable fill such as brick sand.

NOTE: Where fill is required it may be necessary to reduce the estimate of bearing capacity.

- (d) Packings should be assembled from blocks and shims.

Blocks should be of timber (such as Australian hardwood, oregon or moisture-resistant plywood) or reinforced concrete, and should be free of defects. They should be in square or rectangular sections and cut cleanly with parallel sides. Masonry blocks, bricks, or similar should not be used for short-term set-ups, and should only be used in permanent or semi-permanent installations (see Note to Clause 2.2.8.1) where deemed acceptable by a competent person.

Shims (packings of less than 32 mm timber or 25 mm plywood) should be from steel, moisture resistant plywood, high quality, dressed hardwood with thickness greater than 8 mm or should be proprietary plastic shims.

- (e) No packing, block or stack should have a ground bearing area dimension less than that of the load point (float, jack, or similar) to which it applies. Blocks in ground contact in any circumstance should provide an area not less than 200 mm × 200 mm.

- (f) Packing stacks should be assembled from the minimum number of individual blocks, constructed in alternate layers of increasing dimension (from the top down) so as to maintain stability. Bridged packing layers should be avoided. Shims installed to level and stabilize layers should be fixed by nailing as the layers are constructed.
- (g) Before a device is put into operation, packings should be checked to ensure that they are securely fixed in position and do not permit differential settlement, which can be detrimental to the safe running and stability of the device.

2.2.9 Control stations

Control stations shall be arranged to prevent any interference by the public when unattended.

Wherever possible, control stations should be located to provide the operator of the device with an unrestricted view of the device and all embarkation and disembarkation stations.

Where a device has remote areas or areas obscured from the view of the operator, means of observing and communicating with patrons should be provided at the control station.

2.2.10 Access

Access doors and hatches and any gaps on or beneath devices, which are large enough to permit unauthorized whole or part of body access, should be sealed or effectively guarded.

2.2.11 Crowd control

2.2.11.1 General

An amusement ride or device shall be provided with crowd control fences, barriers, or other physical measures as may be necessary to—

- (a) facilitate the orderly queuing of patrons;
- (b) ensure the safety of spectators, passers-by and persons queuing to use the device;
- (c) define the safe loading and unloading area;
- (d) provide adequate passage for operating staff and patrons; and
- (e) exclude unauthorized persons from operating staff and patron areas.

NOTE: Fences and guards required to exclude operating staff, patrons and other persons from unsafe areas should have been determined in accordance with AS 3533.1 by a competent person and their continued adequacy may be assessed by application of the process described in Appendix F (see also Clause 2.2.12).

2.2.11.2 Crowd control barriers

Crowd control barriers shall be not less than 900 mm in height, and shall remain stable when loaded by a horizontal force of 70 N (approximately equivalent to the weight of a 7 kg mass), applied in any direction, to the uppermost edge. Crowd control barriers shall not be used as the fence around a ride.

2.2.12 Additional fencing

Any additional site-specific fencing required to prevent any person from reaching a danger point shall—

- (a) delineate the zone of concern;
- (b) be not less than 1 m in height above adjacent surfaces;
- (c) be constructed to effectively prevent any person from moving through it or under it; and
- (d) have no less strength and stability than the existing fence.

NOTE: [AS 4024.1801](#) illustrates distances for prevention of access to danger points.

2.2.13 Signage

Where required, signs for the control of patrons, the safe use of a device or the operating restrictions for a device shall be prominently positioned, clearly legible and of a consistent presentation. The information on such signs should include the following:

- (a) The minimum or maximum allowable dimensions of patrons.
NOTE: Indicators may be installed to assist operating staff in preventing patrons of unsuitable size from boarding a device.
- (b) Advice that physical capabilities may be required where forces created by the device may demand limb use or body control.
- (c) Advice for patrons who are pregnant, have medical conditions or are under medication.
- (d) Advice for patrons under the influence of alcohol or drugs.
- (e) Advice on the potential for motion sickness.
- (f) Any other specific advice about the safe operation of the device, e.g. loose articles.

Emergency exit signs shall comply with the requirements of Clause 2.3.6.

2.2.14 Discharge of exhaust fumes

Engine exhaust fumes or noxious fumes from any source shall be discharged clear of any persons or equipment.

2.2.15 Access and egress for patrons of rides and devices

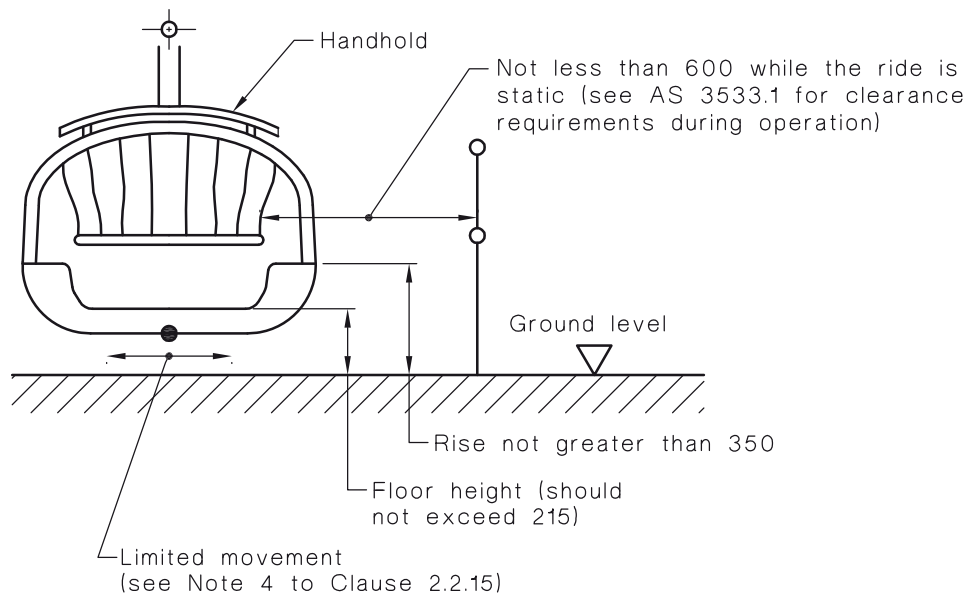
Access ways for patrons boarding or disembarking from a ride or device shall be clearly defined, illuminated where necessary and supervised by the operator.

Where clearances and step-up heights to cars and gondolas are set by the operator on erection of the ride or device, the operator shall ensure the clearances and heights comply with those specified by the manufacturer in documentation with the device or by a competent person.

Where a single step up, or over a combing of more than 300 mm is necessary to board (or exit) a car or gondola, the operator shall provide appropriate instructions to ensure patrons are aware of the most appropriate method for boarding and exiting the car. Operators shall ensure that sufficient trained attendants are available to assist patrons in boarding and exiting the cars or gondolas of devices where the motion of cars due to boarding activities or the step-up height could create a hazard to patrons.

NOTES:

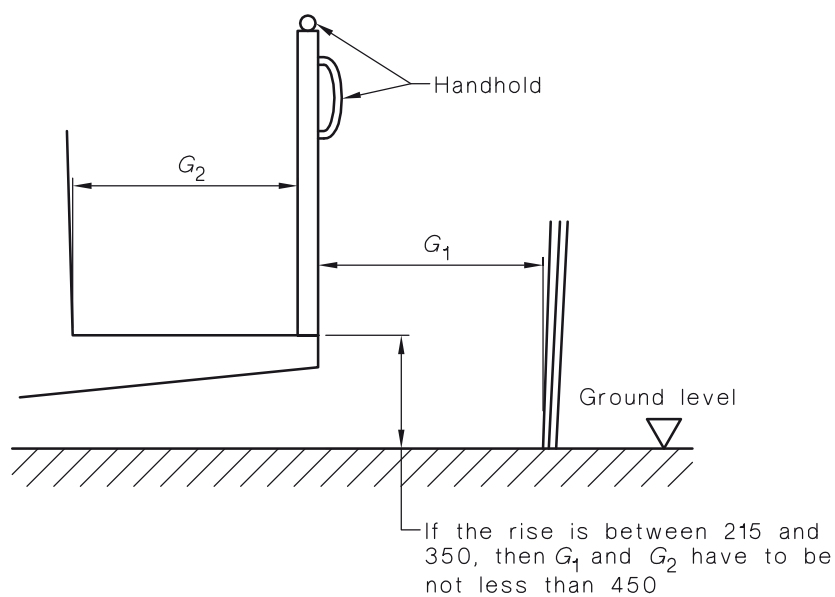
- 1 Where any step exceeds 215 mm, handholds should be provided wherever practical.
- 2 Edges of steps and combings should be highlighted, and illuminated when visibility is poor.
- 3 Step surfaces should, as far as practical, be slip resistant and kept free of any substance which may reduce the anti-slip characteristics (e.g. mud or water).
- 4 Refer to requirements for restricting the motion of freewheeling vehicles in [AS 3533.1](#).
- 5 Examples of appropriate arrangements for a selection of circumstances are illustrated in Figure 2.2. While not shown here, many other types of rides and devices have similar sets of arrangements which address the issues of access and egress appropriately.



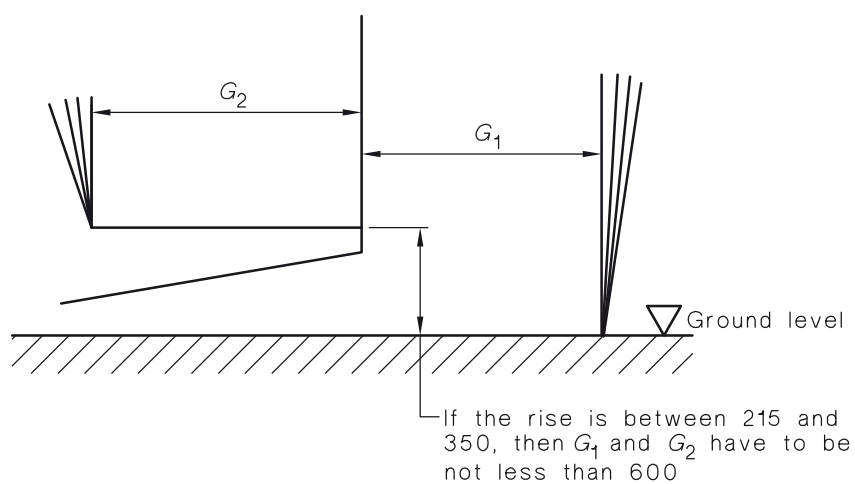
(a) Matterhorn-type ride

DIMENSIONS IN MILLIMETRES

FIGURE 2.2 (in part) EXAMPLES OF APPROPRIATE ACCESS AND EGRESS ARRANGEMENTS



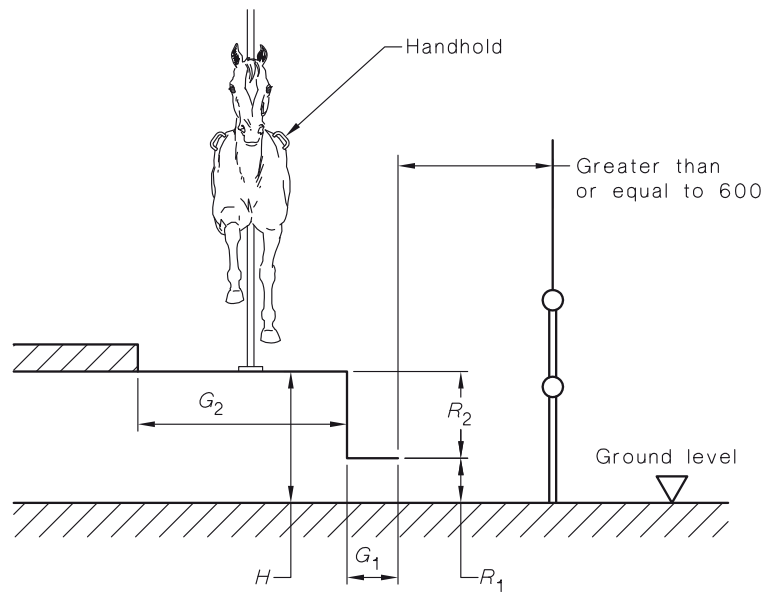
(b) Flat type ride with handholds



(c) Flat type ride without handholds

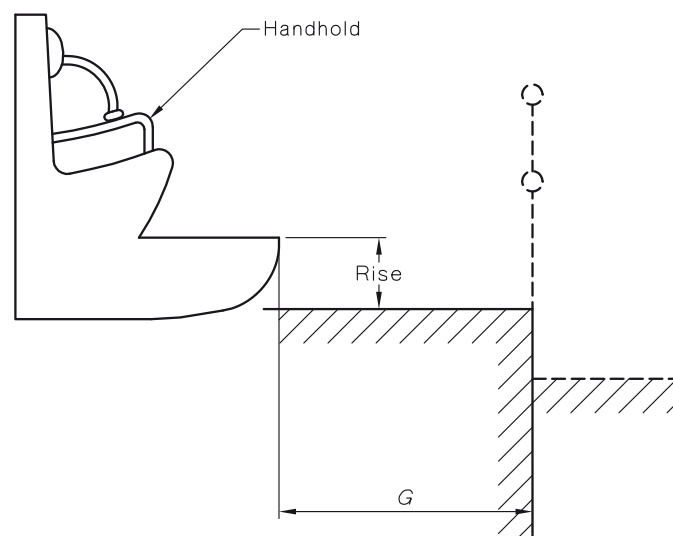
DIMENSIONS IN MILLIMETRES

FIGURE 2.2 (in part) EXAMPLES OF APPROPRIATE ACCESS AND EGRESS ARRANGEMENTS



If H is greater than 350, then R_1 is to be less than 215, R_2 may be more than 215 but is to be less than, 350.
 G_1 is to be not less than 150. G_2 is to be not less than 600.

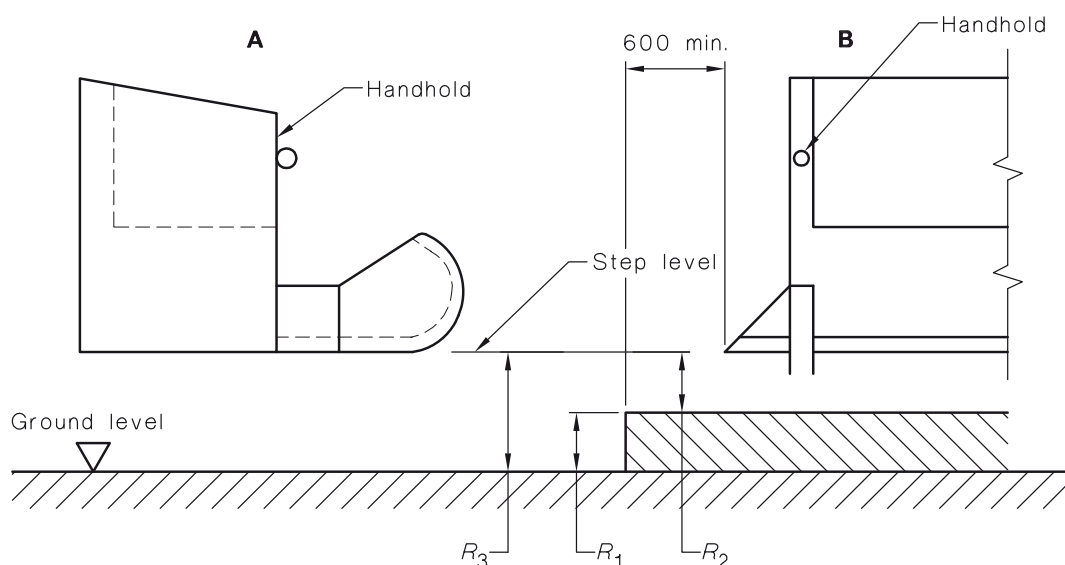
(d) Typical carousel-type ride



If rise is between 215 and 350, G is to be not less than 600.
 If rise is less than 215, G is to be not less than 250

(e) Space loop-type ride
 DIMENSIONS IN MILLIMETRES

FIGURE 2.2 (in part) EXAMPLES OF APPROPRIATE ACCESS AND EGRESS ARRANGEMENTS



Where B is an alternative to A while loading R_1 , R_2 are to be not greater than 350 and R_3 not greater than 600, otherwise R_3 is to be less than or equal to 350

(f) Cha Cha, whizzer type of ride

DIMENSIONS IN MILLIMETRES

FIGURE 2.2 (in part) EXAMPLES OF APPROPRIATE ACCESS AND EGRESS ARRANGEMENTS

2.3 ELECTRICAL REQUIREMENTS

2.3.1 General

All electrical equipment used in the assembly, erection and operation of an amusement device shall comply with this Clause and AS 3533.1.

NOTE: Some provisions of AS/NZS 3002 may apply to mobile amusement rides and devices.

2.3.2 High voltage

High voltage shall not be used on any amusement device unless used for—

- (a) cold-cathode illumination systems (e.g. neon lights), which shall comply with AS/NZS 3832;
- (b) special effects, e.g. flame effects, which shall comply with relevant Standards; or
- (c) ignition systems for internal combustion engines.

NOTE: In accordance with AS/NZS 3000 the following defines the values for extra-low, low and high voltages:

Voltage	a.c.	d.c.
Extra-low	Less than or equal to 50 V	Less than or equal to 120 V ripple free
Low	Greater than 50 V, less than or equal to 1 000 V	Greater than 120 V, less than or equal to 1 500 V
High	Exceeding low voltage	