

Australian/New Zealand Standard™

Road safety barrier systems and devices

Part 1: Road safety barrier systems



AS/NZS 3845.1:2015

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee CE-033, Road Safety Barrier Systems. It was approved on behalf of the Council of Standards Australia on 1 July 2015 and on behalf of the Council of Standards New Zealand on 21 July 2015.

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Australian Industry Group
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Australian/New Zealand Standard™

Road safety barrier systems and devices

Part 1: Road safety barrier systems

Originated as part of AS/NZS 3845:1999.
Jointly revised in part and redesignated AS/NZS 3845.1:2015.

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee CE-033, Road Safety Barriers, to supersede, in part, AS/NZS 3845:1999, *Road safety barrier systems*.

This Standard is Part 1 of a series of two Standards on road safety barrier systems and devices. This Part 1 sets out the requirements for permanent and temporary safety barriers systems that include longitudinal road safety barriers, terminals, crash cushions, interfaces including transitions, and longitudinal barrier gates. Part 2 sets out the requirements for both permanent and temporary road safety devices that include bollards, pedestrian fences and channelizers, truck or trailer mounted attenuators, and sign support structures and poles.

Notes to the text contain information and guidance. They are not an integral part of the Standard.

The term 'informative' has been used in this Standard to define the application of the appendix to which it applies. An 'informative' appendix is only for information and guidance.

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FOREWORD

In 2006, the National Highway Cooperative Research Program of the US Transportation Research Board was revising the testing conditions documented in NCHRP Report 350. At this time, Standards Australia and Standards New Zealand decided to revise AS/NZS 3845:1999 in line with the American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH).

At about the same time, the Safe System approach has become the underlying philosophy for road safety. It is recognized that road crashes are the major cause of societal suffering, preventable death and injury and a major cost burden of the order of tens of billions of dollars on health systems and society in general. Some governments have recognized this societal burden and, as a result, have adopted a safe system approach in their action plans to reduce deaths and injuries on roads. The Safe System approach is based on human injury tolerance to impact forces. The Safe System approach acknowledges that humans make errors, but that the road traffic system should be designed to compensate for that error such that the road user will survive the consequences of mistakes made. Refer to OECD, [2008]. *Towards Zero: Ambitious road safety targets and the safe system approach*, International Transport Forum, ISBN 978-92-821-0195-7.

In a Safe System if a road user travels in accordance with all traffic laws and on a safe road in a safe vehicle, but finds through no fault of their own they become involved in a crash, the crash should not result in death or serious injury. Similarly, if a driver does make an error then a Safe System should react to minimize the consequences of the error. In a Safe System, the regulatory system should strongly discourage socially unacceptable road use behaviour. Thus all road user training and behaviour management, vehicle development and regulation, and road design and traffic management systems should be considered as a holistic inter-related system and governed according to this paradigm. The Safe System comprises four major interconnected elements: safe users, safe roads and roadsides, safe vehicles and safe speeds.

Road safety barriers contributing to safer roads

Road safety barriers are an integral component of the safer roads element of the Safe System approach. However, there are a limited number of ways in which road safety barrier systems can operate. Some systems and devices attempt to dissipate the kinetic energy of a vehicle crash by one or more of the following mechanisms:

- (a) Heat through friction.
- (b) Elastic movement of the device or components of the vehicle, or both.
- (c) Plastic deformation of portions of the device or the vehicle, or both.
- (d) Fracture of elements of the device or the vehicle, or both.
- (e) Physical displacement of the device or the vehicle, or both, such as lifting the vehicle.

Energy should not be dissipated in unexpected or uncontrolled ways. For instance, unintended snagging of a vehicle on an element of the system can cause violent rolling and yawing, which may result in fatal or serious injuries to vehicle occupants. The unintended snagging of the rider on an element of the system can cause fatal or serious injuries. Road safety barrier systems that fail to control the exit path may unnecessarily involve nearby vehicles in a crash.

The majority of passenger vehicles have been designed to meet New Car Assessment Programmes (NCAP) and, in Australia, the Australian Design Rules (ADRs) with a reasonable crash survivability outcome for the occupants. This means that road environments can be designed by taking into consideration safer vehicle technology.

It should not be expected that a road safety barrier system will provide complete protection for vehicle occupants over the wide range of variables that could apply in a crash, such as vehicle mass, dimensions, speed and orientation of the vehicle on impact. It should be recognized that the effect on vehicle occupants of impacting a road safety barrier should be more forgiving than the effect on vehicle occupants of impacting the hazard that it is shielding.

The AS/NZS 3845 series of Standards and the Austroads guides to road design and the operation of Austroads safety barrier assessment processes support each other. Austroads guides describe the road and roadside configurations that identify where road safety barriers may need to be installed and the appropriate longitudinal and transverse location of these barriers. This series of Standards sets out the requirements of road safety barrier systems. Road Authorities may review the information specified by the Standards and, consider the usefulness of road safety barrier systems for use on their road network.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Road safety barrier systems and devices

Part 1: Road safety barrier systems

SECTION 1 SCOPE AND GENERAL**1.1 SCOPE**

This Standard sets out the requirements for both permanent and temporary road safety barrier systems including—

- (a) longitudinal road safety barriers (rigid, semi-rigid and flexible);
- (b) terminals;
- (c) crash cushions;
- (d) interfaces, including transitions; and
- (e) longitudinal barrier gates.

NOTE: Bollards, pedestrian fences and channelizers, truck or trailer mounted attenuators, truck underrun barriers, sign support structures and poles are specified in AS/NZS 3845.2*.

The intention of this Standard is to ensure that road safety barriers and systems are crashworthy when impacted by a vehicle under specified conditions and in most cases provide redirection and containment capability when impacted by a vehicle or provide controlled absorption of the kinetic energy of a vehicle that is on a collision course with a more hazardous obstacle or with other road users.

This Standard includes the following:

- (i) Testing methods and data.
- (ii) Considerations in the evaluation process.
- (iii) Manufacturing requirements.
- (iv) Issues to be addressed in specifying road safety barrier systems including documentation required.
- (v) Erection and maintenance practices necessary to achieve expected performance.
- (vi) Minimum site conditions (cross slope, placement of kerbs or similar) that enable the system to have acceptable system performance when impacted.
- (vii) Steps to evaluate the nature of repairs necessary following a crash.

This Standard makes significant reference to MASH and NCHRP 350. It also references some relevant European CEN Standards.

NOTE: Refer to the Commentary in Paragraph A1 of Appendix A for further details about barrier classification types.

* To be published.

1.2 EXCLUSIONS

Bollards, pedestrian fences and channelizers, truck or trailer mounted attenuators, truck underrun barriers, sign support structures and poles are covered in AS/NZS 3845.2*.

This Standard does not apply to the following:

- (a) Road safety barrier systems erected for special purposes, such as motor sport events that include vehicle, motorcycle or kart racing, concessional go-kart facilities or special permit vehicles.
- (b) Pedestrian fences which are solely to control the movement of pedestrians and not to protect pedestrians from impacts by vehicles or to guide drivers along a roadway.

The Standard does not provide guidance on—

- (i) the comparative performance of road safety barrier systems or the preferred type of road safety barrier system to be installed; and
- (ii) procedures to position a road safety barrier system, either longitudinally or transversely, or with design related issues considered in warrants and selection of road safety barrier systems for a particular site, that include among other things barrier type, barrier length, sight distance, drainage, aesthetics, costs and environmental matters.

1.3 APPLICATION

The Standard does not specify which barriers are acceptable for use on a road network. The Standard does not specify the minimum performance level of acceptable road safety systems. The specification of the minimum performance level of a road safety barrier system is at the discretion of the Road Authority.

NOTE: Road Authorities not belonging to Austroads may use the process defined in this Standard to decide whether a barrier is acceptable for their application.

This Standard should be used in conjunction with, Road Authority specifications and Austroads publications.

This Standard is not intended for application to existing installations or to road barrier systems that previously have been evaluated and adopted for use on a road network.

This part of the Standard and the Austroads *Guide to Road Design*—Part 6 support each other. *Guide to Road Design*—Part 6, describes the road and roadside configurations that require barriers to be installed and the appropriate longitudinal and transverse location of these barriers. This Standard sets out the requirements of a road safety barrier system. It details the preferred crash testing that is required to establish a system's suitability, the material specifications and the accompanying documentation. Road Authorities may review the information specified by the Standard including the results of full-scale testing and, using the assessment process described in this Standard, considers the usefulness of the barrier system, terminal, interface, crash cushion, or longitudinal barrier gate for use. Road Authorities may accept or reject a barrier system and might apply conditions on the use of a barrier system based on their assessment.

1.4 REFERENCED DOCUMENTS

AS

1111	ISO metric bolts and screws—Product Grade C
1111.1	Part 1: Bolts
1214	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)

* To be published.

AS	
1348	Roads and traffic engineering—Glossary of terms
1379	Specification and supply of concrete
1666	Wire-rope slings
1666.1	Part 1: Product specification
1742	Manual of uniform traffic control devices—Traffic control for works on roads
1742.3	Part 3: Traffic control for works on roads
2319	Rigging screws and turnbuckles
2759	Steel wire rope—Use, operation and maintenance
3569	Steel wire ropes—Product specification
3610	Formwork for concrete
3610.1	Part 1: Documentation and surface finish
3715	Metal finishing—Thermoset powder coating for architectural applications of aluminium and aluminium alloys
4506	Metal finishing—Thermoset powder coatings
5100	Bridge design
5100.1	Part 1: Scope and general principles
5100.2	Part 2: Design loads
5100.5	Part 5: Concrete
AS/NZS	
1252	High strength steel bolts with associated nuts and washers for structural engineering
1554	Structural steel welding
1554.1	Part 1: Welding of steel structures
1554.3	Part 3: Welding of reinforcing steel
1594	Hot-rolled steel flat products
1595	Cold-rolled, unalloyed, steel sheet and strip
3678	Structural steel—Hot-rolled plates, floorplates and slabs
3679	Structural steel—Hot-rolled bars and sections
3679.1	Part 1: Hot-rolled bars and sections
3845	Road safety barrier systems
3845.2	Part 2: Road safety devices
4534	Zinc and zinc/aluminium-alloy coatings on steel wire
4672	Steel prestressing materials
4672.1	Part 1: General requirements
4672.2	Part 2: Testing requirements
4671	Steel reinforcing materials
4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS ISO	
31000	Risk management—Principles and guidelines
ISO	
9227	Corrosion tests in artificial atmospheres—Salt spray tests

NZS

3109 Concrete construction

ASTM

G65 Standard test method for measuring abrasion using the dry sand/rubber wheel apparatus

G105 Standard test method for conducting wet sand/rubber wheel abrasion tests

EN

1317 Road restraint systems

1317-1 Part 1: Terminology and general criteria for test methods

1317-2 Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers

CEN/TS

1317 Road restraint systems

1317-8 Part 8: Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers

Austroroads

UNE

135900 Standard on evaluation of performance of the protection systems for motorcyclists on safety barriers and parapets

Austroroads Guide to Road Design

Part 6: Roadside Design, Safety and Barriers

American Association of State Highway and Transportation Officials (AASHTO) *Manual for Assessing Safety Hardware* (MASH), Washington DC, 2009 (Publication code MASH-1)

The National Cooperative Highway Research Program (NCHRP) Report 350, 'Recommended Procedures for the Safety Performance Evaluation of Highway Features' (NCHRP 350), Ross, Sicking, Zimmer and Michie, Washington DC, 1993.

New Zealand Transport Agency, *Traffic Control Devices*, Part 8 *Code of Practice for Temporary Traffic Management (CoPTTM)*

New Zealand Transport Agency. *Bridge Manual*. 3rd Edition SP/M/022

New Zealand Transport Agency Specification M23 Road Safety Hardware Systems

1.5 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 1348 and those below apply.

NOTE: Refer to Paragraph A1.5 in Appendix A for further definitions of terms used to describe road safety barrier systems.

1.5.1 Entities

The following are the entities that may be involved in the design, manufacture and installation of the components of a road safety barrier system, road safety devices or crash cushions. A single entity may fulfil the role of one or more of the following definitions.

- (a) *System Designer* The entity that has designed the system or device and had it tested to suit a particular application.
- (b) *System Owner* The entity that has the property rights to the system or device through their ownership of the patent.
- (c) *System Manufacturer* The entity that manufactures the system or device components.
- (d) *System Supplier* The entity that supplies the system or device.

- (e) *Installation Designer* The entity that designs the length, location and types of components of a system to be installed on a section of the road network. The Installation Designer designs the system to suit the particular conditions of the section of road network.
- (f) *Road Authority* The entity that is responsible for the section of the road network where a system or device is installed.
- (g) *System Installer* The entity that installs the system.

1.5.2 Vehicle interactions with a longitudinal barrier system

The following definitions describe the interaction of a vehicle with a longitudinal road safety barrier. A barrier might exhibit more than one interaction type depending on the barrier type, impacting vehicle and the impact conditions.

- (a) *Capture* An impacting vehicle is contained by a barrier system, but is not redirected.
- (b) *Snagging* A vehicle component, such as a wheel or frame element contacts a barrier component causing large vehicular longitudinal decelerations and yawing. The most common type of snagging is when a wheel engages the side of a post.
- (c) *Penetration* An impacting vehicle is not contained, but breaches a barrier system. Uncontrolled penetration by the barrier system failing in tension, the vehicle over-riding or being forced under the barrier system is unacceptable. Components of a barrier system may be designed to perform safely with controlled penetration.
- (d) *Pocketing* An impacting vehicle causes the barrier system to have relatively large lateral deflections within a relatively short longitudinal distance. The impacting vehicle may have large longitudinal decelerations or yawing. Pocketing may occur during capture.
- (e) *Redirection* An impacting vehicle is caused to be directed away from the barrier system. It is preferable that the vehicle trajectory is through the 'exit box', as defined in MASH.

1.5.3 Anchor

The component used to restrain the end of the barrier system and to transmit impact forces to the ground. Its form is dependent on the barrier system.

1.5.4 Attachments

Accessories that are not an integral part of the road safety barrier system such as signs and sight screens.

1.5.5 Backup structure

A backup structure resists the longitudinal loads in a crash cushion which has sections that compress or break in an end-on impact.

1.5.6 Blockout

Used in some road safety barrier systems to offset a longitudinal, horizontal rail from a post.

1.5.7 Crash cushions

An energy absorption device installed in front of an object to reduce the severity of impact.

NOTE: Crash cushions are often used to shield the leading end of a road safety barrier system.

1.5.8 Crash test

A test carried out in controlled conditions in which a production model test vehicle or a surrogate test vehicle impacts a road safety barrier system or device.

1.5.9 Dynamic deflection

The largest transverse deflection of any part of a road safety barrier system recorded during a full-scale crash test.

1.5.10 Feature

Refers to a specific element of a highway or road. It may be a hardware item and its associated foundation, such as a sign, post, pole or barrier installation, or it may be a geometric element, such as a side slope or a ditch cross-section.

1.5.11 Fittings

Accessories that are a part of the road safety barrier system.

1.5.12 Flare

A change in the offset of a road safety barrier to move it further from the travelled way or closer to the travelled way.

1.5.13 Flexible barrier

A barrier system where the barrier elements under an impact respond and absorb kinetic energy, by substantial movement, deformation and deflection.

1.5.14 Gating terminal

A road safety barrier terminal designed to allow an impacting vehicle to pass through the terminal. Terminals that are designed to break away, pivot or hinge, and allow a vehicle to pass through when impacted at an angle to the end, or at a point upstream of the beginning of the length of the associated road safety barrier system.

NOTE: Some length of the gating terminal may be re-directive, the length of which is dependent on the specific terminal.

1.5.15 Hazard

A hazard is an object or feature that could cause serious injury (including fatal injury) to vehicle occupants when impacted by an errant vehicle.

1.5.16 Interface

A transition or an overlap of two different road safety barrier systems.

1.5.17 Length of need

The distance over which a longitudinal road safety barrier is required to be redirective. It is based on the geometry of the road, the dimensions of the hazard, the profile of the roadside and the offset of a barrier. It is a dimension that is independent of the barrier system type.

1.5.18 May

Indicates the existence of an option.

1.5.19 Median barrier system

A longitudinal road safety barrier system designed to be impacted from either side.

1.5.20 Motorcyclist protection systems

Devices, fittings or attachments to road safety barrier systems to provide additional protection for motorcyclists to reduce their risk of injury.

1.5.21 Non-gating terminal

A road safety barrier terminal that is designed to re direct or contain an impacting vehicle and absorb part of the energy of the impacting vehicle at any point along the terminal without allowing it to pass through the terminal.

1.5.22 Overlap

Interfaces between road safety barriers of different stiffness may be provided by overlapping of the barrier systems separated by the dynamic deflection of the terminating system. If an overlap is used to change the barrier types then the end of the commencing barrier shall be protected by the overlapping barrier.

1.5.23 Pinned

A system that is fixed to the ground at regular intervals along its length to reduce barrier system deflection.

1.5.24 Point of redirection

The location along the length of a longitudinal road safety barrier or terminal where the impacting vehicle interaction changes from gating or capture to redirection.

NOTE: In measuring the point of redirection, its reference point is the first point on the test vehicle that makes contact with the longitudinal road safety barrier, terminal or crash cushion on impact.

1.5.25 Proprietary system

A road safety barrier system that is the subject of patent or other intellectual property rights within Australia and New Zealand.

1.5.26 Public domain system

A road safety barrier system that is not the subject of patent or other intellectual property rights within Australia and New Zealand.

NOTE: These systems are also referred to as non-proprietary road safety barrier systems.

1.5.27 Redirective devices

A redirective device that causes an errant vehicle to change direction away from the shielded object.

1.5.28 Rigid barrier

A road safety barrier where there is limited dynamic deflection during a vehicle impact. The deformation is contained within the impacting vehicle.

1.5.29 Road safety barrier system

A road safety barrier system, consisting of a longitudinal road safety barrier, terminals and appropriate interfaces.

1.5.30 Run out area

An area, behind or in front of a road safety barrier system, which should be kept free of hazards for the proper operation of the road safety barrier system or combination of systems.

NOTE: The run out area is often associated with gating terminals and allows for vehicles to travel behind the terminal for a nominated distance unimpeded by hazards.

1.5.31 Semi-rigid barrier

A barrier where the barrier elements under an impact, manage and absorb kinetic energy by limited movement, yielding deformation and deflection.

1.5.32 Shall

Indicates that a statement is mandatory.

1.5.33 Should

Indicates a recommendation.

1.5.34 Temporary road safety barrier system

A road safety barrier system used at roadworks, emergencies or similar situations for limited durations.

NOTE: Its purpose is to redirect an impacting vehicle so as to minimize damage to the vehicle and injury to the occupants, while providing protection for workers or other road users.

1.5.35 Terminal

A road safety barrier system element designed to treat the end of a road safety barrier. The terminal may function by decelerating a vehicle safely within a relatively short distance, or permit controlled penetration of the vehicle behind it, or contain and redirect the vehicle, or a combination of these performance characteristics. It may be required to provide longitudinal anchorage.

NOTE: Terminals are subdivided into the classifications of gating and non-gating terminals.

1.5.36 Test level (TL)

Categorizes the impact severity of a crash test matrix and is defined in terms of vehicle type and mass, speed and impact angle.

1.5.37 Test vehicle

A vehicle used in a crash test to evaluate the impact performance of a test article.

1.5.38 Thrie-Beam

A public domain triple corrugated rail used in semi-rigid road safety barrier systems both public domain and proprietary systems.

1.5.39 Transition

A type of interface used when a less stiff longitudinal road safety barrier system is connected to a stiffer one. Also see the definitions for 'interfaces' and 'overlaps'.

1.5.40 Vulnerable road users

Non-motorized road users, such as pedestrians and cyclists, as well as motorcyclists and persons with disabilities or reduced mobility and orientation.

1.5.41 W-beam

A public domain double corrugated rail used in semi rigid road safety barrier systems both public domain and proprietary systems.

1.5.42 Working width

The distance between the traffic face of the road safety barrier system before the impact and the maximum lateral position of any major part of the system or vehicle during and after the impact.

NOTE: In design, the working width is the required clearance between the face of a road safety barrier and a hazard.

1.6 NOTATIONS

Where non-dimensional ratios are involved, the numerator and denominator are expressed in identical units.

The dimensional units for length, stress and energy in all expressions and equations are to be taken as millimetres (mm), megapascals (MPa) and kilojoules (kJ) respectively, unless specifically noted otherwise.

1.7 GENERAL REQUIREMENTS FOR ROAD SAFETY BARRIER SYSTEMS

Road safety barrier systems shall be—

- (a) supported by technical literature and assembly instructions that clearly illustrate the essential mode of operation;
- (b) maintained and repaired in a manner that reflects the specified requirements;
- (c) returned into service following a crash only after an evaluation and effective execution of repairs; and
- (d) comprise components (longitudinal road safety barrier, terminal or crash cushion and interfaces) that are each accepted for use and that are appropriate to the system being used.

1.8 USE OF SUBSTITUTED MATERIALS AND OTHER COMPONENTS

Substitution of materials or products not specifically referred to in this Standard shall only occur with the agreement of both the respective Road Authority and the System Owner in accordance with the System Owner's specifications and Clause 4.4.

1.9 VULNERABLE ROAD USERS

When specifying a road safety barrier system, vulnerable road users shall be considered.

In the case of a road safety barrier installed to shield pedestrians and cyclists, from errant vehicles, consideration shall be given to the likelihood of pedestrians and cyclists being injured if they impact the rear of the system.

Road safety barriers used near footpaths or cycle paths adjacent to a roadway should be designed to minimize qualities that are a potential trip or snag hazard.

The design of road safety barrier systems should minimize edges or protrusions that could injure vulnerable road users.

NOTES:

- 1 A road safety barrier system designed to contain and redirect a test vehicle will not be optimal when impacted by a cyclist or motorcyclist. A road safety barrier system that is designed to reduce the likelihood of injury to the occupant of a vehicle could increase the risk of injury to a cyclist or motorcyclist.
- 2 Refer to Paragraph A1.9 of Appendix A for commentary on this Clause.

1.10 MAINTENANCE AND INSTALLATION

1.10.1 Maintenance

For maintenance of road safety barriers, the following shall be applied:

- (a) Replace like with like, provided the damaged safety barrier system conforms to the current edition of this Standard.
- (b) If a significant proportion of a system that does not conform to the current edition of this Standard is damaged, consider replacing with a system compliant with the current edition.
- (c) Public domain systems shall be maintained in accordance with the Road Authority's requirements.
- (d) Proprietary systems shall be maintained in accordance with the System Owner's published requirements and in accordance with Road Authority's specifications.
- (e) Metallic components subjected to the effects of fire may be retained in service provided the galvanized coating is undamaged.

1.10.2 Installation

Installation requirements for road safety barriers are as follows:

- (a) Public domain systems shall be installed in accordance with the Road Authority's requirements.
- (b) Proprietary systems shall be installed in accordance with the System Owner's published requirements and any conditions imposed by a Road Authority with the latter taking precedence.
- (c) Installation shall proceed in a manner to reduce the risks to travelling public and workers.
- (d) Where site conditions (e.g. weak soil conditions) dictate non-standard installations prior to installation, direction shall be provided by the System Owner.
- (e) Gating terminals shall have a run-out area behind the terminal that is free of hazards.

NOTE: Refer to Paragraph A1.10 of Appendix A for commentary on this Clause.

SECTION 2 SYSTEM DOCUMENTATION

2.1 SCOPE OF SECTION

This Section specifies the documentation that is required to accompany road safety barrier systems so that the necessary information is produced and made available to those owning, specifying, supplying, constructing, manufacturing, installing, maintaining and refurbishing such systems.

2.2 DOCUMENTATION ACCOMPANYING ROAD SAFETY BARRIER SYSTEMS

The System Owner or System Supplier of a road safety barrier system shall provide the following documentation:

- (a) Details of testing demonstrating the crash performance of the system (see Clause 2.3).
- (b) Details of the performance characteristics and limitations on use of the system (see Clause 2.4).
- (c) Requirements for, and guidance on, the fabrication, installation and maintenance of the system (see Clauses 2.5 and 2.6).
- (d) Details of tolerance (see Clause 2.5.2).
- (e) Details of properties of plastic materials (see Paragraph C3.2.3 of Appendix C).

NOTE: Road Authorities and other entities may have additional requirements.

2.3 CRASH PERFORMANCE STATEMENT

All road safety barrier systems shall be crash tested in accordance with the procedures specified in this Standard. The following aspects shall be included in the documentation of a road safety barrier system:

- (a) Details of the article tested including the installation configuration (refer to Note 1) together with details of the site conditions (refer to Note 2) at the time it was tested.
- (b) The test criteria and outcome based on the evaluation described in Section 4.
- (c) The working width and the dynamic deflection width for all tests.
- (d) Where the road safety barrier system comprises inter-connected elements, then any relationship between the number of units, the working width and the dynamic deflection width shall be documented.
- (e) The points of redirection at both the leading and trailing end where the road safety barrier system becomes redirective and any minimum length requirements.
- (f) Details shall be provided of any special requirements where lengths longer or shorter than the test installation of the road safety barrier system are installed.

NOTES:

- 1 Configuration of the test installation including alignment, flaring, proximity to roadside features (such as drains, embankments and kerbs), post and anchorage spacing, post embedment, length of installation, number of interconnected units, dimensions and location of key elements and materials, and tension of cables and ropes.
- 2 Site conditions include soil details (soil type, grading and moisture content), air temperature, and surface type.
- 3 For commentary on this Clause, see Paragraph B2.3 of Appendix B.

2.4 CHARACTERISTICS AND LIMITATIONS

Characteristics and limitations include but are not limited to the following.

2.4.1 Plan and elevation details

The normal range of horizontal road curve radii, and the range of crest and sag vertical curves, together with details of the dynamic deflection and working width for the system shall be documented.

Any combinations of vertical and horizontal geometry that render the system less effective, or reduce the efficiency of the road safety barrier system, shall be documented. If there are any details available where the range of applications can be extended by modifications, these details shall be documented.

NOTE: For commentary on this Clause, see Paragraph B2.4.1 of Appendix B.

2.4.2 Transverse details

For transverse details, the following shall be documented:

- (a) Range of cross-falls that the system can be installed on.
- (b) Any limitations on the proximity of drains, kerbs and gutters on the effectiveness of the system.
- (c) Proximity to hinge point, slopes behind the system.

NOTE: For commentary on this Clause, see Paragraph B2.4.2 of Appendix B.

2.4.3 Terminals and crash cushions

The terminals and crash cushions that can be used on the system shall be documented.

In addition to the requirements that apply to all components of the barrier system, the following information on terminals shall be provided:

- (a) Type of terminal, i.e. gating or non-gating.
- (b) For gating terminals, a run-out area is required. This area is to be traversable and free from hazards. In the absence of provided information, Clause 9.3.4 shall apply.
- (c) The type of barrier system(s), the particular crash cushion or terminal is compatible with and the type of transition or connection.

In addition to the requirements that apply to all components of the barrier system, the following information on crash cushions shall be provided:

- (i) Type of crash cushion, i.e. redirective or non-redirective.
- (ii) Width of hazard that can be protected using the crash cushion.
- (iii) Transition and connection details available to other components of the system.

2.4.4 Transitions

The transitions that can be used on the system shall be documented.

The following information on the transitions shall be provided:

- (a) Classification of the transition (refer to Section 11).
- (b) Testing the transition has been subjected to (refer to Clause 4.3.7).

2.4.5 Attributes to reduce injury risks to vulnerable road users

A road safety barrier system shall be designed to limit injury to vulnerable road users.

Qualities which may reduce injuries include some or all of the following:

- (a) Smooth unbroken surfaces without openings or sharp edges.

- (b) Lack of points that will snag.
- (c) Protection against impact with posts.
- (d) Locating attachments, such as reflectors, where they are less likely to be impacted.

These qualities shall be part of the basic design or obtained by fitting additional components.

Any crash testing undertaken with attachments or additional components shall be documented. For commentary on this Clause, see Paragraph B2.4.5 of Appendix B.

2.4.6 Operational temperature range

The temperature range over which the system is expected to perform without any reduction in effectiveness shall be documented.

NOTE: For commentary on this Clause, see Paragraph B2.4.6 of Appendix B.

2.4.7 Environment

The materials and components used in the system and the expected design life of the components shall be documented.

Impacts of the environment, such as fire, wind, flooding, snow drifts, coastal areas which may—

- (a) reduce the performance of the system;
- (b) reduce the life of the system;
- (c) place limitations where it can be used; or
- (d) require specific maintenance requirements, shall be documented.

Any susceptibility of the system to specific chemical spills shall be documented.

NOTE: For commentary on this Clause, see Paragraph B2.4.7 of Appendix B.

2.4.8 Emergency access

Any accommodation of access through the barrier system by emergency vehicles, emergency and maintenance personnel shall be documented. This shall include the following—

- (a) tools required; and
- (b) estimates of time and resources necessary.

For information required for longitudinal barrier gate systems, refer to Section 12.

NOTE: For commentary on this Clause, see Paragraph B2.4.8 of Appendix B.

2.5 FABRICATION AND INSTALLATION

2.5.1 Road safety barriers on structures

Bridge barriers designed in accordance with AS 5100.1 and AS 5100.2 or the NZ Transport Agency Bridge Manual as appropriate and which are integral parts of the bridge structure provide protection for road users. Otherwise road safety barrier systems are installed on structures. If so, the road safety barrier system shall allow for expansion and contraction of supporting or adjacent structures. The documentation shall include information on the following:

- (a) Possible modifications to the system to accommodate structure movement.
- (b) Structural attachment details which will ensure speedy replacement or repair of the barrier system as well as long- term serviceability of the connection.

Where road safety barrier systems are to be erected on or in vicinity of structures, the following shall be ensured:

- (i) No damage occurs to the supporting or adjacent structure due to the loading imposed during a crash.
- (ii) The barrier system allows for structure movement and for underground site constraints.
- (iii) Rapid restoration of the road safety barrier system is possible following a crash.

NOTE: For commentary on this Clause, see Paragraph B2.5.1 of Appendix B.

2.5.2 Tolerances

Tolerances shall be provided in the documentation and shall include the following:

- (a) *Fabrication tolerances* Components that are galvanized or metal coated shall be measured as base metal thickness.
- (b) *Installation tolerances* Includes tolerances for key elements of the system (height, post spacing and the like).

2.5.3 Assembly details and component identification

The System Supplier shall furnish the assembly instructions, a bill of materials complete with an identification code and description and specification for all items.

The bill of materials item reference shall be reconcilable with assembly instructions.

Assembly instructions for public domain items shall be in accordance with the requirements of the responsible Road Authority.

Any concerns about the integrity or identification of a particular item shall be clarified before attempting assembly.

The items supplied for a road safety barrier system and the assembly thereof shall be consistent with those used in crash tested configuration.

2.5.4 Foundation

Documentation of the foundation support necessary for the road safety barrier system to operate effectively shall be provided and shall include the following:

- (a) The ground conditions that are not appropriate and soil types that do not suit the road safety barrier system including foundations for posts, footings and anchors, e.g. soil materials that are likely to reduce the design life of posts and expansive clays that may render barrier foundations unstable or have reduced effectiveness.
- (b) The horizontal extent of foundation support necessary, such as the minimum distance required to hinge-points on embankments.
- (c) The procedures, where excavation to the specified depth is not practicable, where driving posts to the required depth cannot be achieved, or where special care is necessary, shall be documented. Examples include sites where rock is encountered, public utilities are present or where there are site restrictions, such as underground drainage infrastructure and street lighting conduits.

NOTE: Alternative details for systems such as short or offset posts, which may be used for installation around underground structural elements or services where available, should be provided. Refer to Clause 4.4.3.

- (d) For systems that contain posts, the documentation shall include the load to which the post can be tested that ensures that it provides the necessary support to the system.
- (e) For tests on wire rope barriers, the documentation shall include a test load to be exerted on the anchors to confirm their adequacy.

Where road safety barrier systems are to be erected on structures, the following shall be ensured:

- (i) No damage occurs to the supporting structure due to the loading imposed during a crash.
- (ii) Rapid restoration of the road safety barrier system is available following a crash.

NOTE: For commentary on this Clause, see Paragraph B2.5.4 of Appendix B.

2.5.5 Attachments

There shall be no attachment to a road safety barrier system unless it can be shown by crash testing or by assessment as a modification (refer to Clause 4.4) that it is suitable.

Any permissible attachments such as delineators, headlight screens, signs, lighting posts and fences for pedestrians shall be documented.

Attachments to road safety barrier systems shall not be located where they increase the risk of snagging vehicles, nor shall they have qualities that create an undue hazard to the community of road users, particularly pedestrians, pedal cyclists and motorcyclists.

Work-zone warning lights may be used providing they are—

- (a) light weight (less than 1.5 kg including batteries); and
- (b) securely fastened to the system such that during an impact they do not separate.

Devices that can be fitted to protect motorcyclists from impacting posts shall be assessed in accordance with Clause 4.3.6.

NOTE: For commentary on this Clause, see Paragraph B2.5.5 of Appendix B.

2.5.6 Minimum and maximum height of installations

The documentation shall include details of the range of installation heights that provide effective performance.

2.6 MAINTENANCE

2.6.1 Components that are vulnerable to vandalism

If the system contains components that are vulnerable to vandalism (i.e. easily damaged or removed) and are likely to affect system performance, then these shall be highlighted in the documentation.

NOTE: For commentary on this Clause, see Paragraph B2.6.1 of Appendix B.

2.6.2 Maintenance requirements

Documentation shall be provided that covers the following:

- (a) Periodic maintenance requirements, e.g. requirement for checking of tension in cables or checking of bolt tension and removal of foreign objects.
- (b) Post-crash repair—this shall include information on how to assess if system components can be re-used and if repair is an option how this is to be done.
- (c) If a particular cleaning agent/method is required then it shall be documented.

SECTION 3 SUPPLY, ERECTION AND MAINTENANCE

3.1 SCOPE OF SECTION

This Section sets out the requirements for supply, erection, maintenance, repair and dismantling of road safety barrier systems. The requirements apply where relevant to proprietary systems and to public domain systems.

3.2 SUPPLY AND ERECTION

3.2.1 Materials

The material requirements specified in Clauses 3.2.2, 3.2.3, 3.2.4 and 3.2.5 shall apply to all road safety barrier systems unless specified elsewhere within the relevant Section of this Standard (e.g. specific requirements for rigid barriers in Section 5 may override the requirements specified below).

For proprietary systems, the system documentation shall specify the material properties required. Some of the materials may be imported or may be substituted with local equivalents, subject to the requirements of Clause 4.4.

3.2.2 Steel

All cold-rolled products shall comply with AS/NZS 1595, and hot rolled products with either AS/NZS 1594, AS/NZS 3678 or AS/NZS 3679.1, as applicable.

Welds shall be category GP or SP in accordance with AS/NZS 1554.1.

Other metal materials, not specified herein, shall comply with the appropriate Joint Standard. If such a Standard is not available, they shall comply with specifications or Standards issued by bodies accredited by an authority, such as the American Society for Testing and Materials (ASTM).

All steel used for the posts shall comply with AS/NZS 1594 and be galvanized in accordance with AS/NZS 4680.

NOTE: For commentary on this Clause, see Paragraph C3.2.2 of Appendix C.

3.2.3 Plastic

All plastic used shall be UV stabilized.

Any special precautions necessary to reduce risks associated with fire shall be provided.

NOTE: For commentary on this Clause, see Paragraph C3.2.3 of Appendix C.

3.2.4 Concrete

All concrete shall comply with AS 1379 for Australia or NZS 3109 for New Zealand.

Additional requirements for concrete are contained in other Sections of this Standard.

3.2.5 Reinforcement

The amount of reinforcement required within the system shall be not less than the reinforcement used on the crash tested article unless approved as a modification in accordance with Clause 4.4.

Reinforcing bar and fabric shall comply with AS/NZS 4671.

Prestressing strand and all steel stressing wire, tendons and stress bars shall comply with AS/NZS 4672.1 and AS/NZS 4672.2, as appropriate.

3.2.6 Other materials

Other materials not specifically mentioned shall be in accordance with the relevant Australian, New Zealand or International Standard.

3.2.7 Storage and damage

All components of road safety barrier systems shall be stored, transported, stacked, handled and installed in such a way to prevent permanent damage, particularly to threaded components and components, such as wire ropes, that are prone to damage from twisting and kinking. Critical elements that are vulnerable to damage shall be packaged in a manner that provides protection.

NOTE: For commentary on this Clause, see Paragraph C3.2.7 of Appendix C.

3.2.8 Traceability of components

Unless exempted by the Road Authority the following shall apply:

- (a) All steel rails, posts and other critical components shall be permanently marked in lettering at least 10 mm high with the name of System Manufacturer, the date and month of manufacture the grade of steel and base metal thickness (BMT) to allow the product to be traced.
- (b) Where plastic components make up a key element of the system, they shall be permanently marked clearly indicating the month and year of manufacture in a location that can be easily inspected.
- (c) Bolts shall be marked in accordance with AS 1111.1 or AS/NZS 1252.

3.2.9 Setting out

Before commencing any construction, the start and finish points, and the transverse location of any road safety barrier system, shall be marked on the ground. The location of any transitions and terminals shall also be marked.

The location of any services that may conflict with the road safety barrier system installation shall be determined prior to commencing installation. Where it is not possible to install an element of the barrier system, (e.g. a post or anchor) due to the service conflicts, refer to the system documentation for alternatives, otherwise refer to Clause 4.4.3.

NOTE: For commentary on this Clause, see Paragraph C3.2.9 of Appendix C.

3.2.10 Sequence of work

Where a road safety barrier system is being constructed on a road that is open to traffic, arrangements shall be made to the sequence of construction to minimize the hazard to road users and workers. Leading terminals and any transitions between road safety barrier systems shall be commissioned at the earliest practicable time. Unprotected ends shall not be left exposed to traffic.

NOTE: For commentary on this Clause, see Paragraph C3.2.10 of Appendix C.

3.2.11 Installation alignment

A road safety barrier system that conforms to the specified tolerances shall be provided. The appearance of the road safety barrier system shall be smooth and even, i.e. free from kinks, in both the vertical and horizontal planes.

In general, road safety barrier systems shall be vertical. However, if they are installed on the high side of a pavement with a cross-fall of more than 5%, they may be tilted to be perpendicular to the pavement unless otherwise specified by the system documentation or Road Authority.

Where posts form part of the road safety barrier system, they shall be installed to the depth, line and spacing shown on the drawings. The orientation of posts shall be in accordance with the drawings. This shall apply to any block-out pieces that are part of the system. After the posts are installed, all elements in the road safety barrier system shall fit together without the need to enlarge any holes or modify any component.

Unless specified by the System Owner or elsewhere in this Standard the following tolerances shall be applied:

- (a) Alignment of the face of the barrier shall be ± 30 mm from its indicated location.
- (b) Post spacing shall be ± 25 mm.
- (c) System height shall be ± 20 mm.
- (d) Verticality of posts shall be ± 15 mm, measured at the top of the post.

NOTE: For commentary on this Clause, see Paragraph C3.2.11 of Appendix C.

3.2.12 Component damage at installation

When installing road safety barrier systems, care shall be taken to avoid any damage to existing structures or utilities, or both, and to ensure that the barrier system will work as intended.

The installation process shall not cause damage to the components, such that it reduces the effective operation of the road safety barrier system or its design life, or introduces sharp tearing edges, nor shall it cause damage to any pavement layer located in the immediate vicinity of the post. If the pavement or components are damaged, they shall be replaced or repaired to meet the pavement's or component's specification.

Post materials that may be affected by rot or attack by termites shall be treated in accordance with the Road Authority requirements.

3.2.13 Construction of foundations, footings and anchorages

Road safety barrier systems shall be placed on formed foundations complying with the documentation accompanying the system.

Where the sides of any excavation act as the formwork for any concrete work, then the sides of the excavation shall match the dimensions of the footing or anchorage. Any cutting of existing seal or asphalt to accommodate the footings or anchorage shall be done such that it does not damage the surfacing.

Unless specified otherwise by the system documentation, the following tolerances shall apply:

- (a) Footings (length, width and depth)..... $-20, +50$ mm.
- (b) Anchor blocks (length, width and depth)..... $-20, +100$ mm.
- (c) Height of footing and anchor relative to adjacent ground level..... ± 20 mm.

Where posts form part of the road safety barrier system, the existing ground conditions shall be assessed against the documentation supplied, prior to installation to ensure that the system will perform as designed.

Footings and anchors shall be able to resist the loads specified in Clause 2.5.4.

NOTE: For commentary on this Clause, see Paragraph C3.2.13 of Appendix C.

3.3 MAINTENANCE

3.3.1 General

In order for road safety barrier systems to perform, they need to be maintained and regularly inspected. The frequency of maintenance inspections of road safety barrier systems shall consider the following:

- (a) The system documentation.
- (b) The operating environment.
- (c) The traffic volumes and composition.
- (d) The risk at the sites.
- (e) In the case of temporary barrier systems, the duration of deployment and the attributes of the system.

During the maintenance inspection, an assessment shall be made of any changes that may have occurred that will alter the frequency of inspections required, or the elements to be inspected. Particular attention shall be given to any changes in the volume of traffic or its speed, and whether the vehicle adopted for the original design remains appropriate. Where reverse direction crashes are possible at an installation, an assessment shall be made to ensure that the original design criteria remain valid.

Road safety barrier systems shall be inspected on a routine basis to identify incidental damage that has occurred in unreported crashes.

The installation shall be examined to see whether there are site issues that have increased the risk of a collision with the device, or the severity of such a collision. Particular attention shall be given to debris that may reduce the friction supply for other vehicles in the vicinity, or increase the hazard for pedestrians.

Following any road works that change the geometry of the road, other works in the road corridor which alter the nature of hazards being protected, or other activities that modify the operating environment of the barrier system, a review shall be carried out to ensure that the need for the system remains and that the barrier system complies with the operational specifications contained in the system documentation.

The required maintenance is a function of the system type and Road authorities shall develop a maintenance inspection schedule for each system type based on supplied information. Specific maintenance requirements shall be as specified in Clauses 3.3.2 and 3.3.3.

NOTE: For commentary on this Clause, see Paragraph C3.3.1 of Appendix C.

3.3.2 Removal of road grime and graffiti

Routine maintenance for removal of road grime and graffiti shall be required at certain system locations, particularly those at worksites or permanent installations where there is high pedestrian usage.

NOTE: Whilst mainly an aesthetic issue, the build-up of grime or the application of graffiti may reduce the system effectiveness.

3.3.3 Removal of debris

The system shall be kept clear of all rubbish and debris that are likely to affect the performance of the road safety device.

NOTE: This includes any foreign objects, such as excess sealing chip or tree branches that could affect the performance of the road safety device because of the possibility that they may disable, or substantially reduce the effectiveness of elements of the device, or cause corrosion that will lock up the system.

3.3.4 Systems utilizing ballast, road attachment or interconnected units

Where a road safety system relies on ballast, as is the case for water filled barriers or sand barrels, inspections shall be carried out to ensure that the correct ballast is present.

Where a road safety system relies on attachment to the road surface to function to the required test level as in the case of temporary steel road safety barriers, an inspection of all attachment points shall be part of the maintenance inspection.

Systems that comprise interconnected units shall be inspected to ensure that they are interconnected in accordance with the system documentation.

Installations shall be checked for any unsuitable decrease in road safety, e.g. ballast spill onto the carriageway or missing components required for surface attachment.

NOTE: For commentary on this Clause, see Paragraph C3.3.3 of Appendix C.

3.4 DISMANTLING AND DISPOSAL OR RECYCLING

Dismantling of the road safety barrier system shall be in accordance with the system documentation.

Some barrier components may be able to be recycled or re-used. If components are to be re-used then care shall be taken during the dismantling and storage to ensure no damage occurs. Galvanizing and fittings are prone to damage. Damaged components shall be made good before being re-used.

If in doubt about the suitability of re-using the components then the System Owner shall be consulted.

3.5 POST-CRASH ASSESSMENT AND REPAIR

NOTE: For commentary on this Clause, see Paragraph C3.5 of Appendix C.

3.5.1 General

Before a road safety barrier system is installed, action plans shall be prepared for assessing and repairing the system in case of damage. The need for the development of an action plan depends on the following:

- (a) Complexity of the system.
- (b) Damage likely to occur to the system and any reduction in its performance due to this damage.
- (c) Familiarity of maintenance persons with the system.

Specific maintenance requirements for each system type can be found under the relevant section of this Standard.

Assessment of the damage to a road safety barrier system shall be undertaken as soon as is practicable after a crash. Crash sites shall not be left in a condition that increases the risk to other traffic to unsuitable levels.

When assessing the damage, consideration shall be given to the following:

- (i) The continuing need for the system, factors may have changed such that the system is now redundant.
- (ii) Refurbishment of the barrier system to bring it in line with current requirements (refer to Clause 3.5.3).
- (iii) Replacement of the system with another type of system.

3.5.2 Damage

Following an assessment by a competent person if there is any doubt about the reuseability of a component, then it shall be replaced. Decisions to leave damaged components in service shall be documented.

3.5.3 Refurbishment

Either as part of repair to a damaged system or as part of some maintenance activity, barriers shall be refurbished so as to maintain performance.

NOTES:

- 1 Refer to Clause 5.4 for rigid barriers and to AS/NZS 3845.4 for appropriate heights for semi-rigid public domain barriers.
- 2 For commentary on this Clause, see Paragraph C3.5.3 of Appendix C.

SECTION 4 SUITABILITY

4.1 SCOPE OF SECTION

This Section describes the processes and requirements to evaluate the suitability of a road safety barrier system for Australian and New Zealand roads. The suitability of a barrier system is primarily based on the full-scale crash testing but is also based on the consideration of a number of other attributes.

4.2 GENERAL

This Section provides details of full-scale testing requirements, and evaluation requirements for new road safety barrier systems or modifications and substitution of components to establish whether a road safety barrier system is suitable for use on Australian and New Zealand roads.

The Standard does not specify the minimum performance level of acceptable road safety barrier systems. The decision to accept and use a road safety barrier system is at the discretion of the Road Authority.

This Standard is not intended for application to existing installations or to road barrier systems that previously have been evaluated and adopted for use on a road network.

Road safety barrier systems developed prior to this Standard and accepted for use by Road Authorities are not required to be re-evaluated in accordance with Clause 4.3 unless required by the Road Authority.

NOTE: For commentary on this Clause, see Paragraph D4.2 of Appendix D.

4.3 TESTING

4.3.1 Scope of Clause

This Clause covers the requirements for the following type of crash testing:

- (a) Testing of new road safety barrier systems.
- (b) Performance validation of existing road safety barrier systems following changes in components.
- (c) Verification of performance of road safety barrier systems due to site specific issues, including kerbs or drains in front or within the working area of the road safety barrier system, the proximity of a road safety barrier system to embankments, and so on.

NOTE: Many of the existing public domain road safety barrier systems have not been crash tested to current requirements but may continue to be used providing there is satisfactory in-service performance of the system.

4.3.2 Manual for Assessing Safety Hardware (MASH)

MASH shall be the basis of testing procedures for road safety barrier systems. Road safety barrier systems may be evaluated in accordance with Clauses 4.3.4 and 4.3.5 if tested to other test procedures other than MASH.

NOTES:

- 1 The testing specified is a basic set of requirements that a system has to meet to demonstrate satisfactory impact performance. The testing is, by no means, all-inclusive and does not test all possible crash configurations. Tests other than those specified in MASH may be required to cover specific road features (e.g. kerbs, drains, etc.) or road safety barrier system attributes.