

TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION R132

SAFETY BARRIER SYSTEMS

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REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 1		First Issued	GM, CMS	Jan 91
Ed 1/Rev 2		Clause numbers and lists have been restructured to suit the new format.	GM, PSP; J Woodward	24.03.95
Ed 2/Rev 0	All	Specification Number changed from RTA R69. Converted to MS Word 6.0c. References to RTA Specifications changed. Completely rewritten.	GM, PSP	16.07.96
Ed 2/Rev 1	Various 2.1 2.5	Editorial changes. Deleted requirement for steel posts to be marked for identification. Deleted reference to American Douglas Fir.	GM, PSP (J Woodward)	18.11.96
Ed 2/Rev 2	Revisions to Edition 2	New clause	GM, RNIC (J Woodward)	18.02.97
Ed 2/Rev 3	1.2, 2.2, 2.3.1, 4.1.1 Annex R132/6	AS 1650 replaced by AS/NZS 4680 New annexure listing Identified Records	GM, RNIC	16.07.99
Ed 3/Rev 0	Notice Global Foreword	RTA PO Box and Fax numbers updated Text revised to direct imperative style. "Superintendent" replaced by "Principal". "shall" replaced by "must". Reformatting and minor editing to clarify intent. Some clauses moved to Annexures. Foreword, incorporating copyright clause, added.	GM, IC	16.06.09

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 0 (cont'd)	Guide Notes	Notes on the use of Ed 3/Rev 0 added.		
	Global	“terminal” changed to “end treatment”.		
	1.1	Scope clarified to exclude pedestrian safety barriers.		
	1.2.4	Definitions of “you” and “your” added.		
		Definitions for “List of accepted road safety barrier products”, “Crash cushion”, “RTA requirements” and “Joint” added.		
		Definitions for “Delineation unit”, “Device” and “Leading end treatment” revised.		
	1.4	Requirements for shielding unprotected barrier ends modified. HOLD POINT added.		
		Requirements for temporary road safety barrier systems and stacking of new or surplus materials or components added.		
	2.1	New clause on road safety barrier systems standards.		
	2.4.1	New clause on steel properties of various components.		
	2.4.2	New clause on bolts, nuts and washers requirements.		
	2.4.5	New clause on wire rope requirements.		
	2.5	Title: “..... and Mortar” added.		
		Requirements for concrete and mortar amended.		
		Requirement for submission of details of proposed steam curing added.		
	2.6	Retroreflective materials requirements relocated to clause 2.8. Requirements for plastic added.		
	2.7	New clause on aluminium requirements.		
	2.8	New clause on retroreflective materials requirements.		
2.9	New clause on powder coating requirements.			
2.10	Clause on timber re-numbered and revised.			
3.1	“existing installed” added before “safety barrier system”.			
3.3	Requirements for removal of redundant components added.			
3.4	Clause reference for temporary stacking of materials on site added.			

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 0 (cont'd)	4.1 4.1.2 Hold Point 4.1.3 4.2.1 4.2.2(e) 4.2.3 4.4 4.5.1 4.5.2 4.5.3 4.6 4.7	Requirement for prevention of damage to utilities added. Field welding and flame cutting prohibited. Requirement to record non standard materials or installations added. Requirement for survey to comply with RTA G71 added. Method of measurement of offsets for flares clarified. "Submission Details" re-worded to improve its clarity. Requirement for provision of temporary end treatments added. Entire clause re-arranged and re-worded to improve its clarity. 4 th paragraph – "Cement may be added..." changed to "Do not add cement...". "and soil plates of gating leading end treatments and" added after "steel tubes". Prohibition of alternative post support for end treatments added. Requirement for submission of proposals for extending safety barrier added. New clause on wire rope safety barrier systems construction requirements Method of measuring heights defined. Requirements for shelf angles included. Requirements for contraction joints and movement joints added. Requirements for delineators for concrete barriers and slash markers at end treatments included. Waste to be handled to G34/G35/G36 requirements added.		
Ed 3/Rev 1	4.6 Guide Notes, 2.1	Drawing numbers for RTA Model Drawings for delineators corrected. Reference to list in Annex M of RTA Model Drawings for public domain safety barrier systems inserted.	GM, IC	06.11.09

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 1 (cont'd)	Annex M	AS 3610 added to list of Australian Standards. List of RTA Model Drawings for public domain safety barrier systems added.		
Ed 3/Rev 2	Pay Items P5 & P8	Clarification of extent of payment.	GM, IC	15.11.10
Ed 3/Rev 3	Guide Notes Annex I	Notes on Annex I deleted. Link to "Accepted Safety Barrier Products List" on internet inserted.	GM, IC (M.Andrew)	27.02.12
Ed 3/Rev 4	4.6, Annex M	Model Drawing reference numbers updated.	MCQ	23.01.17
Ed 3/Rev 5	Global	References to "Roads and Maritime Services" or "RMS" changed to "Transport for NSW" or "TfNSW" respectively.	DCS	22.06.20

GUIDE NOTES

(Not Part of Contract Document)

EDITION 2 REVISION 1

Edition 2 Revision 1 of Specification TfNSW R132 Safety Barrier Systems was an amplification of the earlier Specification RTA R69. The scope of RTA R69 was limited only to guardfence (i.e. post and rail safety barrier).

EDITION 3 REVISION 0

Overview

The changes in this revision includes updating the format to that currently in use for TfNSW roadworks specifications, updating the references, re-writing certain clauses to improve its clarity, and other changes to reflect current practice.

A major change is the requirement that all safety barrier systems must have been accepted by the TfNSW for use on classified roads. These fall into two categories: **public domain systems** and **proprietary systems**. For public domain systems, the manufacture, supply and construction must comply with the details shown on the TfNSW Model Drawings listed in Annexure R132/M. For proprietary systems, the manufacture, supply and construction must comply with the manufacturer's recommendations, and with any TfNSW requirements for the product.

Any such TfNSW conditions attached to the acceptance of a product are made available to all persons using the product in NSW. Project Managers should not add any other requirements which do not comply with the intent of the acceptance process.

Clause 1.4

Clause 1.4 prohibits any safety barrier system without fully operational end treatments to be unshielded on a road open to traffic. There will be cases, for example on the near side of a dual carriageway, where this prohibition could be relaxed for trailing end treatments. A HOLD POINT is provided to allow the Contractor to submit proposals to vary the requirement, provided that the proposal is accompanied by a satisfactory risk assessment.

Note that delineation is required on bridge traffic barriers and concrete safety barriers. However, the method of attachment of delineators to bridge traffic barriers requires approval from TfNSW Engineering Services Bridge and Structural Engineering Section.

Clause 4.2.1

Clause 4.2.1 has been modified to prohibit the addition of cement to the backfilling around the steel tubes at Posts Nos 1 and 2 in a Modified Eccentric Loader Terminal (MELT). Experience has shown that the bound soil can become airborne as a hard lump during an accident. For the same reason, it is very important to ensure that all concrete surrounding the buried part of a post or tube is monolithic and extends to the base of hole.

The TfNSW does not accept all the current provisions of AS/NZS 3845 "Road safety barrier systems" and this Standard is not referenced in this Specification. The Standard is currently under review and it is intended that updating TfNSW R132 will be considered when the new version of the Standard is issued.



SAFETY BARRIER SYSTEMS

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VERSION FOR:
DATE:

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FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW R132 Edition 3 Revision 4.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

- (a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.
- (b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION R132

SAFETY BARRIER SYSTEMS

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for the construction of new safety barrier systems, including safety barriers, end treatments, transitions and delineation, and the removal of existing safety barrier systems. It does not include the construction of clear areas behind safety barrier systems.

Pedestrian fences have a road safety function but are not road safety barriers. Their construction is not included in the scope of this Specification.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 Project Specific Requirements

Annexure R132/A outlines the types, locations and delineation details of safety barrier systems and devices to be removed, and supplied and constructed, in accordance with this Specification.

1.2.2 Measurement and Payment

The method of measurement and payment must comply with Annexure R132/B.

1.2.3 Schedules of HOLD POINTS and Identified Records

The schedules in Annexure R132/C list the **HOLD POINTS** that must be observed. Refer to Specification TfNSW Q for the definition of **HOLD POINTS**.

The records listed in Annexure R132/C are **Identified Records** for the purposes of TfNSW Q Annexure Q/E.

1.2.4 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure R132/D and must be implemented.

In all cases where this Specification refers to the manufacturer's recommendations, these must be included in the PROJECT QUALITY PLAN along with any applicable TfNSW requirements.

1.2.5 Referenced Documents

Unless specified otherwise, the applicable issue of a referenced document, other than a TfNSW Specification, must be the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 2350). For convenience, the full titles are given in Annexure R132/M.

1.3 DEFINITIONS

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

“TfNSW” refers to the Transport for NSW.

The following definitions apply to this Specification.

- (a) **Crash cushion:** See “end treatment”.
- (b) **Delineation unit:** Delineation refers to treatments which enhance the visual definition of the roadway operating area. In the context of this Specification, a delineation unit is either:
- a retroreflector fixed to a mounting plate attached to a road safety barrier, or
 - a retroreflector attached to, or placed immediately in front of, an end treatment.
- (c) **Departure end treatment:** An end treatment for a safety barrier system of a type which is used only at the departure end with respect to the direction of flow of traffic.
- (d) **Device:** A generic term used to refer to a safety barrier, an end treatment or a transition. In this context, a device is usually part of a safety barrier system.
- The term is also used to describe a type of retroreflector. Refer to AS/NZS 1906.2 for further information.
- (e) **End treatment:** A device to protect vehicle occupants from injury in an impact with the end of a safety barrier. End treatments can be either leading end treatments or departure end treatments.
- (f) **Joint:** Three types of joints are used in concrete road safety barriers:
- Construction joints** are provided for the convenience of construction and their presence must not impair the load-carrying capacity and serviceability of the structures.
 - Contraction joints** are joints provided to control shrinkage cracking without impairing the strength of the structure.
 - Movement joints** (also called expansion or isolation joints) are provided between portions of a structure or between adjacent structures to permit relative movements between the portions or structures on either sides of the joints.
- Reinforcing steel usually continues through construction and contraction joints but not through movement joints. Movement joints may include dowels or other items designed to limit relative movements in some directions.
- (g) **Leading end treatment:** An end treatment at the end of a safety barrier which faces oncoming traffic.
- (h) **List of accepted safety barrier products:** The list of road safety barrier products that have been accepted by the TfNSW for use on classified roads. For a copy of this list, refer to Clause 2.1. The date of issue of this list is as shown.
- (i) **Manufacturer’s recommendations:** The specification, installation manual and drawings for a specific proprietary safety barrier system or device, prepared by or for the manufacturer,

detailing the components, the system or device, and the methods and/or procedures for installation.

- (j) **Nested rails:** Two or more steel rails erected together (one inside the other) to increase stiffness. Nested rails share bolts.
- (k) **Safety barrier system:** A longitudinal structure whose prime purpose is to restrain and/or redirect in a controlled manner vehicles which are out of control. A safety barrier system includes one or more safety barriers with associated end treatments and transitions.
- (l) **TfNSW requirements:** When used in relation to proprietary products, this phrase refers to any specific requirements for the products included in the TfNSW's acceptance advice to the supplier. It is a requirement of each acceptance that these requirements be made known to any purchaser of the product for use on the NSW classified road system.
- (m) **Safety barrier:** That part of a safety barrier system other than end treatments and transitions.
- (n) **Terminal:** See "end treatment".
- (o) **Transition:** A connecting device to provide effective continuity of the protection offered by a safety barrier between safety barriers of different properties or dimensions. The part of a safety barrier system with varying properties such as stiffness and dimensions, between and linking safety barriers with different properties or dimensions. A transition may also link or connect a safety barrier to a fixture.

1.4 TRAFFIC MANAGEMENT

On a road open to traffic, you must implement a suitable traffic management plan, conforming to Specification TfNSW G10, to shield any partly dismantled or partly constructed safety barrier system or any safety barrier system without fully operational end treatments.

Should you wish to vary this requirement, you must provide to the Principal full details of your proposals to protect the passing traffic. Your submission must include a risk assessment.

HOLD POINT

Process Held:	On a road open to traffic, allowing any safety barrier system which does not have fully operational end treatments to be unshielded.
Submission Details:	Submit, at least 3 working days before the proposed exposure of the safety barrier system without fully operational end treatments, full details of your proposals together with a risk assessment of your proposals.
Release of Hold Point:	The Principal will examine the proposals and the associated risk assessment prior to authorising the release of the Hold Point.

On a road open to traffic, you must consider the locations of any temporary stacks of new or surplus materials or components when preparing your traffic control plan in accordance with TfNSW G10.

If stacks are located behind a serviceable road safety barrier system, the clear space between the road safety barrier system and the stack must allow for the dynamic deflection of the system and be at sufficient distance from the ends of the system to allow the proper functioning of the end treatments.

2 COMPONENTS FOR SAFETY BARRIER SYSTEMS

2.1 STANDARDS

Road safety barrier systems must comply with this Specification, the manufacturer's recommendations along with any applicable TfNSW requirements, or the Drawings, as applicable.

All road safety barrier systems must have been accepted by the TfNSW for use on classified roads. The list of TfNSW accepted safety barrier products can be accessed from:

<http://www.rms.nsw.gov.au/business-industry/partners-suppliers/approved-products-materials/safety-barriers/index.html>

Their manufacture, supply and construction must comply with this Specification and:

- (a) for public domain systems, the TfNSW Model Drawings listed in Annexure R132/M; or
- (b) for proprietary systems, the manufacturer's recommendations and any TfNSW requirements for the product,

as applicable.

If a particular safety barrier system is specified in the documents, an alternative to the specified system may be submitted for consideration by the Principal only if the alternative is accepted for use by the TfNSW for the same duty.

2.2 IDENTIFICATION

Mark on any steel rails, precast concrete segments and all plastic components of safety barrier systems and devices unobtrusively and permanently in text not more than 20 mm high, the following information:

- (a) name of the manufacturer;
- (b) batch number, or date of manufacture;
- (c) strength grade and base metal thickness of the steel rails.

2.3 CERTIFICATES OF COMPLIANCE

At least seven (7) days prior to the proposed use of any materials and components supplied by you, submit to the Principal a signed statement certifying that the materials and components supplied comply with the requirements of this Specification. Support this statement with any relevant test reports and a copy of your verification checklist.

For galvanised steel components, include a manufacturer's certificate of compliance certifying that the zinc coating mass is in accordance with the requirements of AS/NZS 4680, or, for components of proprietary safety barrier systems or devices, the manufacturer's recommendations and any specified TfNSW requirements.

2.4 STEEL

2.4.1 Properties

Steel for the safety barriers must comply with the following:

Item	Standard	Requirement
Posts and blockouts	AS/NZS 1594	Grade HA 300
Rails and rail stiffening pieces	AS/NZS 1594	Grade HA 350, 2.7 mm base metal thickness unless shown otherwise on the Drawings
Strut and yoke	AS 1163 and AS/NZS 3678	Tubes to be Grade C350. Yoke to be fabricated from Grade 250
Tubes for breakaway posts and soil plates	AS/NZS 1594	Grade HA 250
Base plates	AS/NZS 3678	Grade 250

For proprietary products, steel must comply with the manufacturer's recommendations and any TfNSW requirements.

2.4.2 Bolts, Nuts and Washers

Bolts, nuts and washers must comply with the details shown on the Drawings or the manufacturer's recommendations and any TfNSW requirements.

2.4.3 Protective Treatment

Unless stated otherwise in the manufacturer's recommendations and any TfNSW requirements for a specified proprietary safety barrier system or device, the surfaces of all ferrous metal components including posts, blockout pieces, rail elements, anchor plates, connectors and end treatment pieces must, after fabrication, be treated in accordance with AS 1627.4 or AS 1627.5, and finished by hot-dipped galvanising in accordance with AS/NZS 4680.

Galvanise all ferrous bolts, nuts and washers in accordance with AS 1214.

2.4.4 Curving Steel Rail

Where a radius of less than 45 m is specified, curve the steel rail at the factory. Carry out the curving operation in a manner that will not result in damage to the galvanising.

Clearly mark the curve radius in a permanent manner on the rear face of factory curved steel rail.

2.4.5 Wire Rope

Wire rope for post and rail end treatments must comply with AS 3569 and the details shown on the Drawings.

Wire rope used in proprietary systems must comply with the manufacturer's recommendations and any applicable TfNSW requirements.

2.5 CONCRETE AND MORTAR

Unless stated otherwise in the manufacturer's recommendations and any applicable TfNSW requirements for a specified proprietary safety barrier system or device, or in Clause 4.3 for a concrete safety barrier system or device, the supply, placing and curing of concrete and mortar must comply with Specification TfNSW R53.

If steam curing is proposed, submit such details as part of your PROJECT QUALITY PLAN (refer Annexure R132/D).

2.6 PLASTIC

Plastic components must comply with the manufacturer's recommendations and any applicable TfNSW requirements or the Drawings, as applicable.

2.7 ALUMINIUM

Sheet aluminium for delineator mounting plates for concrete road safety barriers must comply with AS/NZS 1734. Sheet must be alloy designation 1150 and anodised black in accordance with AS 1231. Anodising thickness grade must be AA15.

2.8 RETROREFLECTIVE MATERIALS

Retroreflective materials and combination of fluorescent/retroreflective materials must comply with AS 1906.1 or AS 1906.2 as appropriate. Colour testing for fluorescent material in daylight must be carried out by the double monochromator method.

2.9 POWDER COATING

Powder coating must comply with AS 4506.

2.10 TIMBER

Timber posts and blockout pieces where specified for terminals must be strength grade F8 Australian Slash Pine, preservative treated to hazard level H4 in accordance with AS 1604.1. Preservative treatment must be carried out using a vacuum/pressure autoclave process in a State Forests of NSW approved facility. The preservative used must not contain any chromium or arsenic. After treatment the timber must not be resawn, dressed, planed or otherwise have its original dimensions altered.

Address the hazards associated with timber preservatives and treated timber to comply with Specification TfNSW G22 and comply with WorkCover NSW Code of Practice for the Safe Handling of Timber Preservatives and Treated Timber.

3 REMOVAL OF SAFETY BARRIER SYSTEMS

3.1 REMOVAL - SCOPE

Removal of an existing installed safety barrier system includes:

- (a) dismantling or demolition of safety barriers, transitions and end treatments;
- (b) extracting all posts, anchors and other in-ground components and materials;
- (c) removing all components and waste materials from the site;
- (d) cleaning, backfilling and mechanically compacting all excavations and holes formed by the extraction of posts, anchors and other in-ground components and materials; and
- (e) stacking or disposing of components and waste materials.

3.2 COORDINATION AND SEQUENCE OF WORK

Where the safety barrier system being removed is on a road open to traffic, coordinate the removal with other work at the Site to eliminate or minimise the exposure of an incomplete safety barrier system to traffic.

If practicable, commence removal of a safety barrier system from the departure end (remote from the approach of traffic), to improve traffic safety.

3.3 POST HOLES

Remove all redundant posts, anchors and other in-ground components by extraction or excavation. Following removal of the posts, clean out and backfill the holes. Backfilling and compaction of holes must proceed in 150 mm layers using similar materials to existing surrounding layers. Compact backfill to not less than the density of the surrounding layers.

3.4 STACKING OR DISPOSING OF COMPONENTS

Temporary stacking of materials on site must comply with Clause 1.4.

Do not damage any components to be retained by the Principal. Components to be retained by the Principal are listed in Annexure R132/F.

Deliver to and stack in an orderly manner at the locations stated in Annexure R132/F all components to be retained by the Principal.

All other surplus materials resulting from removal of safety barrier systems become your property, and must be removed from the site.

4 CONSTRUCTION OF SAFETY BARRIER SYSTEMS

4.1 CONSTRUCTION - GENERAL

Construction of safety barrier systems includes supply, delivery, handling and assembly of components and devices, setting out, and supply and installation of delineation.

Plan and execute your work in a manner that prevents damage to underground and above ground facilities such as utilities, services, structures, pavements, vegetation, etc.

The Principal will supply the components listed in Annexure R132/G and make them available to you at the locations and dates shown in Annexure R132/G.

Supply all other components and materials necessary to complete the work.

Unless stated otherwise in the manufacturer's recommendations or shown otherwise on the Drawings, construct safety barrier systems with post supports with the posts vertical. Construct other safety barrier systems with the upright axis normal to the surface at the front of the barrier.

Construct the safety barrier system to form a smooth line vertically and horizontally, when viewed along the line of the system, free from humps, sags, or other irregularities, within tolerances.

Any component of a safety barrier system must not be welded or flame cut in the field under any circumstances. Welding and flame cutting in a workshop may be undertaken only where shown on the Drawings or in accordance with the manufacturer's recommendations.

Record details of any non-standard materials or installation in your Quality Records.

4.1.1 Damage

Transport, handle and install components of safety barrier systems to avoid damage.

Where damage occurs, address the nonconformity in accordance with TfNSW Q.

After installation, components must not be left with splits, burrs, or sharp edges.

Repair any minor damage to galvanising in accordance with Appendix E of AS/NZS 4680 immediately, if practicable, and in any case within 24 hours, using at least two coats of a zinc-rich paint in accordance with AS/NZS 3750.9. Match the colour of the original surface either directly or by applying a further compatible treatment. Restrict this method of repair to individual areas not exceeding 40 cm² for any point repaired and a total 0.1% of the surface area of any face for multiple repairs.

4.1.2 Setting Out

Survey work must comply with Specification TfNSW G71.

Install pegs in the ground (or mark with paint on hard ground) to mark the start and finish points and line of safety barriers, transitions and end treatments including the line of flare if applicable, before commencing construction. Measure offsets for flares from a line parallel to the adjacent lane line.

HOLD POINT

Process Held: Installation of safety barrier system.

Submission Details: Notification that the set out is in accordance with this Specification, the Drawings and the manufacturer's recommendations, at least 2 working days before the proposed commencement of installation of posts or assembly of components or devices whichever is earlier.

Release of Hold Point: The Principal will inspect the set out of the safety barriers prior to authorising the release of the Hold Point.

4.1.3 Sequence of Work

Where a safety barrier system is being constructed on a road open to traffic, commence the work at the end closest to approaching traffic, except where the barrier connects at its departure end to a fixed object such as an existing barrier or the end of a bridge or tunnel.

Commission end treatments and transitions at the earliest practicable time. Provide temporary end treatments until the permanent treatment is complete.

4.2 POST AND RAIL SAFETY BARRIER SYSTEMS

4.2.1 Installation of Posts - Method Constraints

In ground conditions where you consider that installation of the posts by driving is unsuitable and that 400 mm diameter holes are necessary, you must promptly advise the Principal. Do not commence excavation of the 400 mm diameter holes until the Principal has approved the use of 400 mm diameter holes for installation of the posts.

Where the post is to be installed through a bound pavement layer, or when installing the posts for a Modified Eccentric Loader Terminal (MELT), or where directed by the Principal, carry out excavation or preboring to achieve a minimum hole diameter of 400 mm. Extend this hole diameter at least to within 300 mm of the level of the bottom of the installed post.

Locate each hole so that the post will be positioned centrally or towards the nearest traffic lane in the prebored hole.

Backfill around the steel tubes at Posts Nos 1 and 2 in a MELT must be clean, well graded, granular material. Do not add cement to this backfill.

Backfill around other posts must be clean, well graded, non-cementitious granular material or material obtained from excavating the post holes, provided that any different material types from within a hole are placed to match surrounding layers.

4.2.2 Installation of Posts - Acceptance Criteria

Installation of the posts must comply with the following requirements:

- (a) The posts must be installed to the depth, line and spacing shown on the Drawings, and to the tolerances in Clause 4.5;
- (b) The installation process must not cause any structural damage to the post, including any soil plates attached to the post;
- (c) The installation must not cause any damage to the pavement beyond 100 mm from any part of any post, including any soil plate attached to the post;
- (d) When a lateral force of 1 kN is applied in any direction within the top 200 mm of an installed post but before the rail is secured, the movement of the post at ground level must be not more than 3 mm;
- (e) Backfill material around the steel tubes and soil plates of gating leading end treatments, and at Posts Nos 1 and 2 in a Modified Eccentric Loader Terminal (MELT), must be compacted to a minimum 95% relative compaction, measured in accordance with Test Method TfNSW T166;
- (f) The disturbed pavement or ground around a post must be trimmed and compacted to a dense, tight, smooth and sealed condition so that resistance to water penetration is similar to that of the adjacent surface.

4.2.3 Installation of Posts - Difficult Sites

If, in your opinion and for reasons outside your control, it is not feasible to install posts at the specified depth or location, submit to the Principal a proposal for a different method of supporting the safety barrier.

Alternative methods of support are not permitted for end treatments. You may, however, submit proposals for extending the safety barrier to a location where installation of the end treatment is feasible, or proposals for a different end treatment, for consideration by the Principal.

4.2.4 Orientation of Posts and Blockout Pieces

Install steel posts in a median facing the direction shown in Annexure R132/H.

Erect all C-section blockout pieces and steel posts with the open or concave face away from the ultimate direction of approach of traffic in the closest adjacent carriageway, unless shown otherwise on the Drawings.

4.2.5 Cables in End Treatments

Tension cables in end treatments by tightening the nuts at both ends of each cable to 50 Nm as part of the construction of end treatments.

Maintain tension in cables in end treatments until the Date of Completion, and keep the nuts at both ends tightened to 50 Nm.

4.3 CONCRETE SAFETY BARRIER SYSTEMS

4.3.1 General

Construct concrete safety barrier systems using either precast segments, by placing concrete using fixed forms or by slipforming, or a combination of these methods.

4.3.2 Preparatory Work on a Rigid Pavement (Concrete Surface)

Prior to constructing any part of a concrete safety barrier system on a concrete surface, you must:

- (a) where you intend to use fixed forms or slipforming,
 - (i) fill each joint in the concrete surface on the line of the barrier with a bead of silicone sealant, extending the full width and a minimum of 100 mm outside both edges of the base of the safety barrier system, and forming a convex surface wholly proud of the plane of the pavement;
 - (ii) after filling each joint as in (i) above, debond the concrete surface on the line of the barrier by applying a uniform cover of curing compound at the rate of 0.3 litre/m², extending the full width and a minimum of 100 mm outside both edges of the base of the safety barrier system; and
- (b) where you intend to use precast safety barrier system segments, after debonding the concrete surface, construct a (nominal) 15 mm cement mortar pad beneath and for the full width and length of the barrier system.

4.3.3 Joints in Concrete Placed Insitu

For concrete placed insitu (either using fixed forms or by slipforming), control the shrinkage cracking by sawing or forming contraction joints. Contraction joints must be straight, square to the line of the barrier, 50 mm deep, and spaced at intervals of not more than 4.5 m along the barrier.

Where you elect to use sawing to control cracks, carry out sawing before uncontrolled cracking begins, and in any case, within 12 hours after placing the concrete.

Construct movement joints where shown on the Drawings. Movement joints must be straight, square to the line of the barrier, and 6 mm wide. Fill movement joints with a preformed joint filler complying with Specification TfNSW 3204.

Where a concrete safety barrier system is cast or slipformed adjacent to or on top of a concrete pavement base layer, the same type of movement or contraction joint in the concrete base must be made in the safety barrier system and located to form a continuous joint through both structures.

4.4 WIRE ROPE SAFETY BARRIER SYSTEMS

Construct wire rope safety barrier systems in accordance with the manufacturer's recommendations and any applicable TfNSW requirements. Unless otherwise shown in Annexure R132/A or on the Drawings, all posts must be coloured white.

Where the horizontal radius of the barrier is less than 200 m or the vertical curvature at a sag is such that K (which is the length of the vertical curve measured in metres divided by the change in grade expressed as a %) is less than 30 m, do not install a wire rope safety barrier system. Advise the Principal and request instructions on the type of safety barrier system to be constructed.

HOLD POINT

Process Held:	Construction of a wire rope safety barrier system.
Submission Details:	Proposed barrier system and a statement that horizontal and vertical curvatures are suitable, or, A statement that the horizontal curvature and/or vertical curvature at the Site is/are unsuitable for a wire rope barrier system.
Release of Hold Point:	The Principal will inspect the site and, if necessary, advise on the type of safety barrier system to be constructed prior to authorising the release of the Hold Point.

4.5 CONSTRUCTION TOLERANCES

4.5.1 General

Unless stated otherwise in the manufacturer's recommendations and any applicable TfNSW requirements for a particular proprietary safety barrier system or device, tolerances for construction of all safety barrier systems and devices must be as follows:

- (a) For height of barrier: ± 20 mm;
- (b) For line of safety barrier system: ± 20 mm in plan view; and
- (c) For departures from the upright axis (vertical or normal to the surface as applicable - see Clause 4.1): ± 15 mm at the top of the barrier.

The height must be measured vertically for systems constructed with vertical posts and normal to the road surface for other systems. Measure the height as follows:

- (i) where the barrier is within the pavement, from the pavement surface;
- (ii) where the barrier is adjacent to the pavement, from the line of pavement crossfall extended to the barrier line; and

(iii) for all other circumstances, as shown on the Drawings or as directed by the Principal.

Do not take into account local surface level deviations with maximum horizontal dimensions of 2 m when measuring heights.

Do not exceed the height tolerance on the basis of producing a straight line along the top of a barrier.

In addition to the above, the tolerances stated in Clauses 4.5.2, 4.5.3 and 4.5.4 will also apply as appropriate.

4.5.2 Post and Rail Safety Barrier Systems

Refer to Figure R132.1.

The tolerance on post spacing must be plus or minus 25 mm. The deviation of the top of any post from a straight line joining the tops of the posts on either side must not exceed 10 mm, after allowing for horizontal and vertical curves

When the barrier is erected, the maximum combined tolerance for rotation in plan of the post and blackout piece must be 30 mm, except that this may be increased to 60 mm for an isolated post where separated by at least 8 m from another post with a rotation in plan beyond 30 mm.

Where the rail is supported on a shelf angle, there must be no horizontal or vertical gap between the rail and the inner faces of the shelf angle.

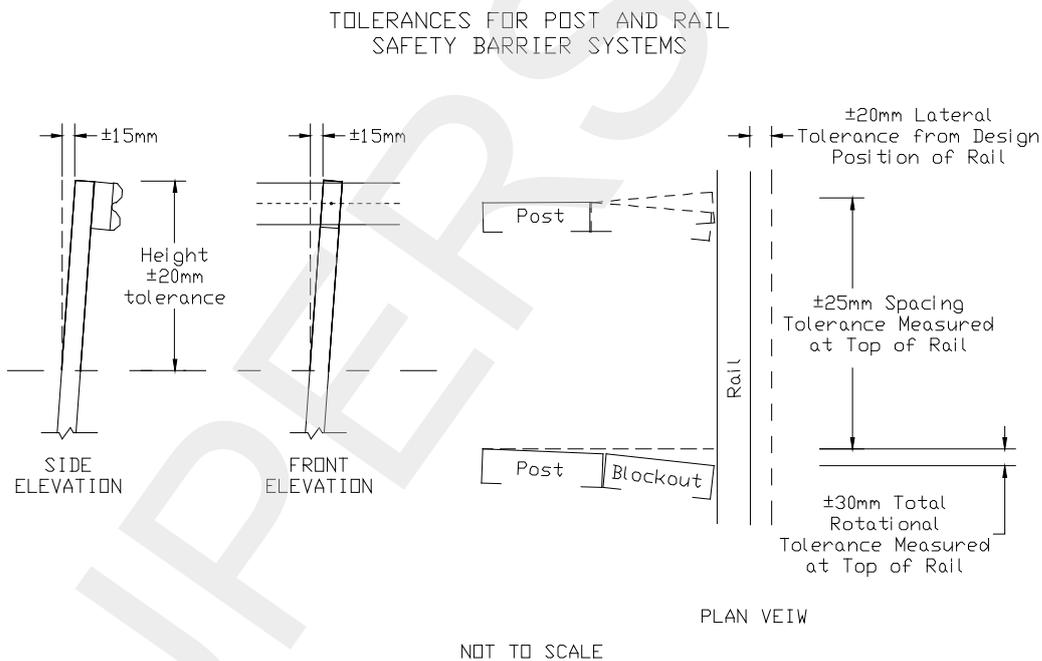


Figure R132.1

4.5.3 Concrete Safety Barrier Systems

Face steps, including at construction joints, must not exceed the limits in Table 3.4.2 in AS 3610 for Class 3 surface finish, viz 5 mm for 100% of readings and 3 mm for 80% of readings.

The deviation from any specified plan or cross-sectional dimension must not exceed 1/200 times the specified dimension, or 5 mm, whichever is the greater.

The deviation of any point from a straight line joining any two points on top of the barrier must not exceed 1/250 times the length of the line or 10 mm, whichever is the greater, after allowing for horizontal and vertical curves.

Surface undulations on the faces of a barrier must not exceed the limits in Table 3.4.2 in AS 3610 for Class 3 surface finish, viz:

Length of Straight Edge	Percent of Readings	
	80%	100%
300 mm	3 mm	4 mm
1,500 mm	5 mm	7 mm

Any offset between the line of an existing joint in a concrete pavement base layer and the line of the corresponding joint in the concrete safety barrier system placed insitu adjacent to or on top of the concrete pavement base layer must not exceed 15 mm at the bottom of the barrier.

The line of a transverse joint must not deviate by more than 10 mm from a line comprising a series of contiguous straight lines on the surfaces of the barrier. Contraction joints must not deviate more than 5° from the square to the line of the barrier and be 50 (± 5) mm deep. Movement joints must not deviate from the square to the line of the barrier by more than 5° and the width must be within – 0, + 2 mm of the specified width.

4.5.4. Wire Rope Safety Barrier Systems

Comply with the tolerances specified in Clause 4.5.1, the manufacturer's recommendations and any applicable TfNSW requirements.

4.6 DELINEATION

Supply delineation units and mount them on safety barrier systems at locations and spacings as shown on the Drawings or as detailed in Annexure R132/A.

Except on a concrete safety barrier, arrange delineation units so that drivers approaching from either direction will see only:

- (a) red retro-reflectors on their left;
- (b) white retro-reflectors on their right on two-way carriageways; and
- (c) yellow retro-reflectors on their right on one-way carriageways and medians separating traffic in opposing directions.

The retro-reflectors must be either discrete device type retro-reflectors or sheeting type retroreflectors complying with AS 1906.2.

For post and rail safety barriers, delineation units are as shown on TfNSW Model Drawing R0710 - 18.

Fix slash markers G9-257(L) or G9-257(R) as appropriate to end treatments for post and rail safety barriers. Remove any manufacturer's labels or markings.

Details of the slash markers may be found at

www.rms.nsw.gov.au/cgi-bin/index.cgi?action=searchtrafficsigns.form.

Sheeting must be Class 1 in areas without roadway lighting and Class 1W in areas which are lit.

Retro-reflectors on concrete safety barriers must be as shown on TfNSW Model Drawing R0720 - 06.

The combination fluorescent/retro-reflective sheeting must comply with AS 1906.1 for Class 1 in areas without roadway lighting and for Class 1W in areas which are lit.

Fasten the base plate to the top of the barrier using an epoxy adhesive formulated for the purpose. Use the adhesive in accordance with the manufacturer's recommendations and any applicable TfNSW requirements.

Safety barrier delineators are to be spaced to comply with AS 1742.2 or at 20 m centres, whichever gives the closer spacing.

4.7 WASTE

Recycle, reuse or dispose of all surplus material, rubbish and other debris in accordance with the requirements of Specification TfNSW G36.

ANNEXURE R132/A – PROJECT SPECIFIC REQUIREMENTS

The types, locations of safety barrier systems and devices to be removed and constructed, and the locations of delineation units are described in the table below or on the Drawings.

Safety Barrier System Details						Delineation Units		
Type			Locations			Locations		
Type (Safety Barriers, End Treatments, and Transitions)	* P / NP	* R / I	* Side L / R / M	From (km)	To (km)	Carriage- way	Left (km)	Right (km)

Note*:

- P: Patented NP: Non patented
- R: Remove I: Install
- L: Left R: Right M: Middle

ANNEXURE R132/B – MEASUREMENT AND PAYMENT

Payment will be made for all costs associated with completing the work detailed in this Specification in accordance with the following Pay Items.

Where no specific pay items are provided for a particular item of work, the costs associated with that item of work are deemed to be included in the rates and prices generally for the Work Under the Contract.

Unless specified otherwise, a lump sum price for any of these items will not be accepted.

The rate for each Pay Item for construction of safety barriers, end treatments and transitions includes the supply and installation of delineation.

No additional payment will be made for royalties or the like payable in connection with any product supplied by you in the performance of the Contract.

No additional payment will be made for disposal or recycling of surplus material.

No additional payment will be made for laps in barrier rails or nested rails when measuring length for payment.

Pay Item R132P1 Removal of Safety Barriers

The unit of measurement for Pay Item R132P1 is the linear metre calculated from the actual length of safety barrier removed not including end treatments or transitions.

Pay Item R132P2 Removal of End Treatments and Transitions

The unit of measurement for Pay Item R132P2 is “each” end treatment or transition removed.

Pay Item R132P3 Construction of Post and Rail Safety Barriers

The unit of measurement for Pay Item R132P3 is the linear metre calculated from the actual length of barrier constructed not including end treatments or transitions.

R132P3.1 Near side (single sided) post and rail barriers

R132P3.2 Median (double sided) post and rail barriers

Pay Item R132P4 Post Holes at 400 mm Diameter

The unit of measurement for Pay Item R132P4 is “each” 400 mm diameter post hole required and excavated or bored. The schedule quantity for Item R132P4 is a provisional quantity.

Pay Item R132P5 Construction of Wire Rope Safety Barrier Systems

The unit of measurement for Pay Item R132P5 is the linear metre calculated from the actual length of barrier system constructed including wire rope anchor blocks.

Pay Item R132P6 Construction of Plastic Safety Barriers

The unit of measurement for Pay Item R132P6 is the linear metre calculated from the actual length of plastic barrier constructed not including end treatments or transitions.

Pay Item R132P7 Construction of Concrete Safety Barrier Systems

The unit of measurement for Pay Item R132P7 is the linear metre calculated from the actual length of concrete safety barrier system including end treatments constructed from concrete and transitions supplied and constructed.

The schedule rate includes preparation of the existing surface and incorporation of any voids or inserts.

Pay Item R132P8 Construction of End Treatments

The unit of measurement for Pay Item R132P8 is “each” end treatment supplied and constructed, but not including concrete end treatments which are included in Pay Item R132P7 or wire rope anchor blocks which are included in Pay Item R132P5.

Pay Item R132P9 Construction of Transitions

The unit of measurement for Pay Item R132P9 is “each” transition supplied and constructed, but not including concrete transitions which are included in Pay Item R132P7.

ANNEXURE R132/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS

Clause	Description
1.4	Exposure of traffic to a barrier without operational end treatments.
4.1.2	Setting out.
4.4	Construction of a wire rope safety barrier system.

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
2.3	Statement that the materials and components comply with the requirements of this Specification, supported by test reports and a copy of your verification checklist.
4.1	Details of non-standard materials or installation.
4.2.1	The locations at which you consider that ground conditions are such that 400 mm diameter holes are necessary

ANNEXURE R132/D – PLANNING DOCUMENTS

Refer to Clause 1.2.4.

The following documents are a summary of documents that must be included in the PROJECT QUALITY PLAN. The requirements of this Specification and others included in the Contract must be reviewed to determine additional documentation requirements.

Information to be supplied by you as part of the PROJECT QUALITY PLAN must include, but not be limited to, the following:

Clause	Description
1.2.4	Copies of the manufacturer's recommendations and any TfNSW requirements for the product for each proprietary system to be used.
2.4	Details of proposed steam curing of concrete.
4.1	Precautions to prevent damage to underground and above ground facilities (utilities, services, structures, etc).
4.1.4	Procedure to provide temporary shielding to end treatments on roads open to traffic.
4.2.2	Details of driving equipment and helmet proposed for driving steel posts, plus procedure to prevent damage to posts if installing by driving.

ANNEXURE R132/E – (NOT USED)

ANNEXURE R132/F – COMPONENTS TO BE STACKED BY THE CONTRACTOR

Refer to Clause 3.4.

Stack the following components from removed safety barrier systems at the locations shown, for retention by the Principal.

Components to be stacked	Location of stack

ANNEXURE R132/G – MATERIALS AND COMPONENTS TO BE SUPPLIED BY THE PRINCIPAL

Refer to Clause 4.1.

The following materials and components will be supplied by the Principal.

Materials and Components	Where available to you	When available to you

**ANNEXURE R132/H – DOUBLE-SIDED SAFETY BARRIER SYSTEMS
SUPPORTED ON STEEL POSTS IN MEDIANS**

Refer to Clause 4.2.4.

The orientations of steel posts and blockout pieces must be as described in the table below or as detailed on the Drawings.

Location			Orientation of C-Section Steel Posts and Blockout Pieces: Open (i.e. concave) face towards ...
Side of Median	From	To	

ANNEXURES R132/I TO R132/L – (NOT USED)

ANNEXURE R132/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.5.

TfNSW Specifications

TfNSW G10	Traffic Management
TfNSW G22	Work Health and Safety (Construction Work)
TfNSW G36	Environmental Protection
TfNSW G71	Construction Surveys
TfNSW Q	Quality Management System
TfNSW R53	Concrete for General Works
TfNSW 3204	Preformed Joint Fillers for Concrete Road Pavements and Structures

TfNSW Test Methods

TfNSW T166	Determination of relative compaction
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TfNSW Model Drawings for Each Public Domain System or Device

R0710-01	W Beam and Thrie Beam Safety Barriers – Post and Block Out Components
R0710-02	W Beam and Thrie Beam Safety Barriers – Notched Blockout
R0710 - 03	W Beam and Thrie Beam Safety Barriers - Post on Base Plate
R0710 - 04	W Beam and Thrie Beam Safety Barriers - Post on Slip Base Plate
R0710 - 05	W Beam Safety Barriers - Abraham Blockout for Raising Pail Height on Existing Post
R0710 - 06	W Beam Rail and Stiffening Piece Connection
R0710 - 07	Thrie Beam Rail (2.7BMT & 3.5BMT) and Stiffening Piece Connection
R0710 - 08	W Beam and Thrie Beam Safety Barriers - Terminal Connectors
R0710 - 09	W Beam and Thrie Beam Safety Barrier - W Beam to Thrie Beam Transition
R0710 - 10	W Beam Nesting Rail and Half Length Rail
R0710 - 11	Thrie Beam Half Length Rail
R0710 - 12	Thrie Beam 3.5 BMT Rail for Transition to Rigid Barrier
R0710 - 13	W Beam Rail - Terminal Component - Anchor Plate
R0710 - 14	W Beam Rail - Maintenance Rail (for Variable Gap Connection)
R0710 - 15	W Beam and Thrie Beam Rail - Fastener Components - M16 Mushroom Head Bolts & Nuts
R0710 - 16	W Beam and Thrie Beam Rail - Fastener Components - Hexagon Head Bolts & Nuts
R0710 - 17	W Beam and Thrie Beam Rail - Posts - Base Plates and Slip Base Plates - Hexagon Head Bolts and Nuts
R0710 - 18	W Beam and Thrie Beam Safety Barrier Delineation Unit

R0710 - 19	AASHTO G4 W Beam Assembly
R0710 - 20	Thrie Beam Assembly Using Standard Blockouts
R0710 - 21	Modified Thrie Beam Assembly Using Notched Blockouts
R0710 - 22	AASHTO G4 W Beam Nested Rail Assembly
R0710 - 23	Thrie Beam Nested Rail Assembly
R0710 - 24	W Beam and Thrie Beam Post Installation - Hard Ground and Terminals
R0710 - 25	Wire Rope Barrier Transition to W Beam Barrier - One Way Roads
R0720 - 01	Type F Concrete Barrier - Galvanised Cover Assembly - 1100mm Openings
R0720 - 02	Type F Concrete Safety Barrier - Cast-in-Situ Applications - Sections and Profiles
R0720 - 03	Type VCB Vertical Concrete Safety Barrier - Cast-in-Situ Applications - Section
R0720 - 04	Type F Concrete Barrier - Detail of Power Supply Opening - 1100mm wide
R0720 - 05	Type F Concrete Safety Barrier - Cast-in-Situ Applications - Single Sided Sections and Profiles
R0720 - 06	Concrete Barrier Delineation Unit
R0720 - 07	Thrie Beam Connection to Type F Barrier or Parapet on Concrete Bridges
R0720 - 08	Type F Concrete Safety Barrier - Transition to Type SF Kerb and Type SA Kerb and Gutter
R0720 - 09	Type F Concrete Safety Barrier - Median Transition to Elsholz Redirective Kerb
R0720 - 10	Type F Concrete Safety Barrier Transition to Type SA Kerb and Gutter
R0730 - 01	Modified Eccentric Loader Terminal (MELT) - Post, Tube and Yoke Details
R0730 - 02	MELT and TT Terminals - W Beam Rail - Terminal Rail Detail
R0730 - 03	Modified Eccentric Loader Terminal (MELT) - Diaphragm Plate Details
R0730 - 04	MELT and TT Terminals - Buffered End Section Details
R0730 - 05	MELT and TT Terminals - Cable Assembly and Fasteners
R0730 - 06	Modified Eccentric Loader Terminal (MELT) - General Arrangement
R0730 - 07	Modified Eccentric Loader Terminal (MELT) - Buffered End & Anchorage Detail
R0730 - 08	Trailing Terminal (TT) General Arrangements - Post and Anchorage Details
R0730 - 09	Type F Concrete Safety Barrier - Cast-in-Situ Sloped End Terminal - Permanent Installations
R0730 - 10	Type VCB Concrete Safety Barrier - Cast-in-Situ Sloped End Terminal - Permanent Installations
R0740 - 01	Elsholz Concrete Safety Barrier - Median and Nearside Installation - Sections/Profiles

Australian Standards

AS 1163	Structural steel hollow sections
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AS 1214	Hot-dip galvanised coatings on threaded fasteners (ISO metric course thread series)
AS 1231	Aluminium and aluminium alloys – Anodic oxidation coatings
AS/NZS 1594	Hot-rolled steel flat products
AS 1604.1	Specification for preservation treatment – Sawn and round timber
AS 1627	Metal finishing – Preparation and pre-treatment of surfaces
AS 1627.4	Abrasive blast cleaning of steel
AS 1627.5	Pickling
AS/NZS 1734	Aluminium and aluminium alloys – Flat sheet, coiled sheet and plate
AS 1742.2	Manual of uniform traffic control devices – Traffic control devices for general use
AS/NZS 1906	Retroreflective materials and devices for road traffic control purposes
AS/NZS 1906.1	Retroreflective sheeting
AS/NZS 1906.2	Retroreflective devices (non-pavement application)
AS 3569	Steel wire ropes
AS 3610	Formwork for concrete
AS/NZS 3678	Structural steel – Hot-rolled plates, floorplates and slabs
AS/NZS 3750.9	Paints for steel structures – Organic zinc-rich primer
AS 4506	Metal finishing – Thermoset powder coatings
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

Other Documents

Manufacturer's recommendations and any applicable TfNSW requirements for each proprietary safety barrier system or device.