

# Engineering Construction Specification C21 Non-rigid road safety barrier systems

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Non-rigid road safety barrier systems October 2018 version

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# 1 General

## 1.1 Responsibilities

### 1.1.1 General

Requirement: Provide non-rigid road safety barriers and terminals, as documented.

Authority requirements: where the site is located on a classified Regional or State road, all additional requirements of the Roads & Maritime Services shall be met.

## 1.2 Cross references

### 1.2.1 General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- C01 General requirements (Construction)
- C02 Quality management (Construction)
- C03 Control of traffic

## 1.3 Standards

### 1.3.1 General

Road safety barrier systems: To AS/NZS 3845.1.

## 1.4 Interpretation

### 1.4.1 Abbreviations

General: For the purposes of this worksection the following abbreviation applies:

- MELT: Modified eccentric loader terminal.

### 1.4.2 Definitions

General: For the purposes of this worksection the following definitions apply:

- Anchor: Restraint used to transmit impact forces into the ground.
- Clear zone: The area adjacent to the traffic lane to be kept clear of obstructions that could be hazardous to errant vehicles. It consists of the verge area and is measured from the nearside edge of the left-hand traffic lane. For divided roads, it is also measured from the offside edge of the right-hand traffic lane to the edge of the pavement for opposing traffic.
- End terminals: Devices that protect vehicle occupants from injury in an impact with the end of the safety barrier. Can be either leading or departure end treatment.
- Non-gating terminal: A road safety barrier terminal designed to allow an impacting vehicle to pass through the terminal and so compromise the safety barrier.
- Non-rigid road safety barrier system: A flexible barrier system where the barrier elements under an impact provide substantial movement, deformation and deflection.
- Rock catch fence: Fence to prevent rocks landing on roads.
- Safety barrier system: A longitudinal structure which restrains and/or redirects, 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.
- Safety bollard: A heavy duty post designed to prevent vehicular access into a pedestrian area.
- Security fence: A fence designed to prevent pedestrian entrance to unsafe areas

- Semi rigid barrier: A barrier with limited movement.
- Thrie beam: Triple corrugated beam component of a public domain non-rigid road safety barrier system.
- Transition: A type of interface used when less stiff longitudinal road safety barrier system is connected to a stiffer interface.
- W-beam: Double corrugated beam component of a public domain non-rigid road safety barrier system.
- Wildlife fence: Fence that prevents wildlife approaching a roadway and creating a hazard.
- Wire rope safety barrier: A road safety system consisting of wire rope cables under high tension that are supported on posts and anchored at the ends.

## **1.5 Tolerances**

### **1.5.1 Concrete footings**

Post foundations: To AS/NZS 3845.1 clause 3.2.13.

### **1.5.2 Post position**

Line of the tops of posts:  $\pm 20$  mm of the documented height.

### **1.5.3 Steel posts**

Ground movement: 3 mm maximum in any direction when force tested to AS/NZS 3845.1.

### **1.5.4 Steel components**

Steel railing erection: To AS/NZS 3845.1 clause 3.2.11.

## **1.6 Submissions**

Design: Details showing compliance with AUSTRROADS standards

Proprietary items: Details showing type and locations where proprietary systems are used

Technical data: Provide supplier/manufacturers technical specifications

### **1.6.1 Execution details**

Method statement: Before installation of road safety barrier system, submit description of the installation process.

- Submission time: 5 working days before erection.

Alternative methods of setting posts: If the documented depth cannot be achieved because of an underground obstruction, submit details of proposed alternative post setting method before carrying out the works.

Steel post driving details: Submit details of driving equipment, helmets and procedures for preventing damage to posts.

### **1.6.2 Operation and maintenance manuals**

Installation and maintenance manuals: On completion, submit manuals for all proprietary barrier and end treatment systems used in the works.

### **1.6.3 Products and materials**

Evidence of conformance: Submit evidence that materials, components and systems including steel and timber components conform to the requirements of this worksection.

Galvanized steel components: Provide evidence from the manufacturer that zinc coating mass conforms to AS/NZS 4680.

## 1.6.4 Records

Work-as-executed drawings: Submit drawings with the following:

- Proprietary safety barrier systems or end treatments: Details of the system, name and post spacing.
- Non-proprietary end treatments: Details of the end treatment name and post types. If timber posts are used, details of the timber species and stress grade.

Supply warranty documents with Work as Executed details

## 1.6.5 Tests

Tests: Submit results, as follows:

- Wire rope tension: Submit wire rope tension test certificate as evidence of conformity. Include the date, time, ambient air temperature, tension force and signature and name of the individual managing the work at the time.

Submission time: 5 working days after erection.

## 1.6.6 Warranties

Manufacturer's warranty: Submit the manufacturer's published product warranties.

## 1.7 Inspections

### 1.7.1 Notice

General: Give notice so that inspection may be made of the following:

- Location of barriers: Completed section set-out of safety barriers and terminal sections.
- Erection of barrier systems:
  - Posts set in natural ground: After completion of backfilling for posts.
  - Posts set in concrete pavement: After completion of post fixings.
  - Rectification of any damage to steel posts.
  - Completed barrier system erection, including posts, rails, end treatments and wire ropes.
- Removal of existing safety barrier systems: Completed removal and disposal of barriers, and reinstatement of surrounding material including backfilling.
- Rectification of ground/pavement: Completed rectification of disturbed ground/pavement surrounding posts.

## 2 Materials

### 2.1 General

#### 2.1.1 Storage and handling

Protection: Store all materials at least 200 mm above ground, including those fabricated, to prevent damage and corrosion.

Steel for rejection: Rusted, bent or damaged.

Timber posts/blockout blocks: Do not store on top of steel sections.

### 2.2 Steel components

#### 2.2.1 Properties

W-beam and thrie-beam elements: To AS/NZS 1594.

Steel components: To AS/NZS 3845.1 and as documented.

Flat washers: To AS 1237.1 and AS 1237.2.

Curving steel rail: Factory curved, as documented. Carry out curving without damaging the galvanizing.

## **2.2.2 Protective treatment**

Treatment and galvanizing: After fabrication, treat surfaces of all ferrous metal components including posts, blockout pieces, rail elements, anchor plates, connectors and terminal pieces to AS 1627.4 or AS 1627.5 and hot-dip galvanize to AS/NZS 4680, unless recommended otherwise by the barrier system or device manufacturer.

Ferrous bolts, nuts, and washers: Galvanize to AS/NZS 1214.

- High strength bolts: To AS/NZS 1252.1.

## **2.3 Wire rope safety barrier systems**

### **2.3.1 Proprietary item**

Non-rigid road safety barrier systems with tensioned wire ropes: To AS/NZS 3845.1 clause 7.2.2 and as documented.

Wire rope for post and rail end treatments: To AS 3569.

## **2.4 Plastic components**

### **2.4.1 General**

Retroreflective materials: To AS/NZS 1906.1.

Delineators: To AS/NZS 1906.2.

Other plastic components: To the manufacturer's recommendations.

## **2.5 Backfill**

Around steel posts: Clean, well-graded, granular material. Do not add cement.

Around other posts: Clean, well-graded, non-cementitious granular material or excavated material from post holes.

# **3 Execution**

## **3.1 General**

### **3.1.1 Traffic safety**

Material storage: Locate temporary stacks of new or surplus material associated with the Works clear of traffic flow and behind the line of barriers being removed or being erected.

Works program: Manage the construction sequence so that there are no traffic hazards or safety issues for road users, including exposed ends of barriers and partially completed works at the end of the day.

### **3.1.2 Installation**

Requirement: Install to AS/NZS 3845.1 Section 6 and 7 except where explicit departures are documented.

Waste disposal: Remove all waste material from the site. Do not burn, bury or dispose of other waste material on-site.

Welding or flame cutting: Do not weld or flame cut any components on-site, carry out in factory conditions to the manufacturer's recommendations where documented.

Damage to surrounding pavement: Do not damage beyond 100 mm of the post, including any soil plates attached to the post.

## **3.2 Establishment**

### **3.2.1 Existing underground services**

Services laid in close proximity to the barrier system: Locate and protect services from damage before placing footings and installing barriers.

### **3.2.2 Sequence of construction**

Requirement: Erect road safety barriers after constructing the base on concrete pavements and after placing the initial layer of asphaltic concrete or sprayed seal on a flexible pavement.

### **3.2.3 Set-out**

Location of barriers: Locate road safety barriers and terminal sections as documented. Peg or paint mark the start and finish points, line of safety barrier, transitions and terminals including the line of flare if applicable.

Post accuracy: Position posts vertical and space so that no post movement is required to align holes.

## **3.3 Erection of steel posts**

### **3.3.1 Positioning of posts**

Location: As documented.

Top of the posts: Position posts to form a smooth line both horizontally and vertically.

Level of posts: Level the posts on terminal ends to the extended crossfall of the main pavement or as documented.

Post depths: Set the posts to the full documented depth.

Spacing: posts shall stand vertical and the spacing shall be such that when the guardfence is erected no post movement is necessary in order to align holes or for any other reason.

### **3.3.2 Foundation post installation**

Steel posts erection: By driving or as documented.

Open section of posts: Point in the same direction as adjacent traffic.

Post holes: Compact bottom of holes to achieve the same density as the surrounding soil.

Backfilling around posts: Support the posts true to line and level whilst the holes are backfilled.

Compact backfill to achieve the same density as the surrounding material tested to RMS T166.

### **3.3.3 Damage to posts**

Acceptable condition: No obvious deformation as a result of driving.

Damage to galvanizing: Repair within 24 hours of damage to AS/NZS 4680 clause 8, using an organic zinc-rich primer.

Posts deemed excessively damaged: Replace. Replacement shall be at contractor's expense.

## **3.4 Erection of road safety barrier rails**

### **3.4.1 Blockouts, rail laps and stiffening pieces**

Steel blockout pieces: Erect with the open section or concave face pointing in the same direction as adjacent traffic.

Rail laps: Arrange in the same direction as adjacent traffic so that approach rail ends are not exposed to traffic.

Stiffening pieces: 300 mm long on intermediate posts.

### **3.4.2 Damages to galvanizing**

Handling and erecting: Prevent damage to the galvanizing of road safety barrier rails and blockout pieces.

Repairs of galvanizing: Repair within 24 hours of damage to AS/NZS 4680 clause 8, using an organic zinc-rich primer.

Rail or blockout pieces deemed excessively damaged: Replace. Replacement shall be at contractor's expense.

### **3.4.3 Erection procedure**

Rail attachment bolts and splice bolts: Initially tighten so that barriers can be erected.

Levelling rails: Make adjustments to rails using the slotted holes provided to produce a smooth regular line without any kinks or bumps.

Overall line of top of rails: Conform to the vertical alignment of the road pavement.

Splice bolt tightening: When vertically and horizontally aligned, fully tighten the splice bolts so that bolt head (not the shoulder) is in full bearing with the rail. The recess in the nut should face the bolt shoulder, otherwise the splice will not be tight.

## **3.5 End treatment of road safety barriers**

### **3.5.1 Terminal sections**

Leading and trailing terminals: Construct at both approach and departure ends of the road safety barrier, as documented.

Double sided road safety barriers: Construct terminal sections at the approach and departure ends, as documented.

### **3.5.2 MELT**

Requirement: Locate as follows:

- At the approach end locations of road safety barriers as documented.
- If departure end of a road safety barrier is within the clear zone of opposing traffic, construct a MELT in place of a trailing terminal section.

## **3.6 Wire rope safety barrier systems Installation**

### **3.6.1 General**

Installation: To the manufacturer's recommendations.

Post installation: Install posts in concrete footings with appropriate sockets including covers to the sockets.

Intermediate blocks or tension bays: Install at the dimensions recommended by the manufacturer.

Footing installation: Install footing of uniform shape to the manufacturer's recommendations.

Wire rope tension testing: On completion of installation, test wire rope tension to verify it conform to the manufacturer's published requirements.

## **3.7 Delineators**

### **3.7.1 Fixing and location**

Fixing: Fix delineators to road safety barriers with brackets.

Locations: As documented, starting at the first post.

Arrangement and colour: Arrange the delineators so that drivers approaching from either direction will see only red reflectors on their left side, and white reflectors on their right.



Circular corner cube delineators, complying with as 1906.2 shall be fixed to the brackets.

### 3.7.2 Delineators spacing table

Radius of curve (m)	Spacing of reflectors on barrier every
30 – 90	3rd post
90 – 180	5th post
180 – 275	8th post
275 – 365	11th post
Over 365 (including straight road)	16th post

## 3.8 Existing safety barrier systems

### 3.8.1 Removal of existing safety barrier systems

Removal and disposal: Conform to the following:

- Dismantle, extract and dispose of safety barriers and other components and materials including posts, transitions, end treatments, anchors and in-ground components, as documented.
- Remove and dispose of components and waste materials from site.
- Clean, backfill and mechanically compact excavations and holes formed by the extraction of posts, anchors and other in-ground components and materials.

Coordination and sequence of work: Minimise the exposure of incomplete safety barrier system to traffic. If practicable, start removal of barrier system from the departure end.

Backfilling and compaction of holes: In 150 mm layers using materials similar to existing surrounding layers. Compact backfill to not less than the density of the surrounding layers.

## 3.9 Completion

### 3.9.1 Rectification of ground/pavement

Disturbed ground or pavement around post: Trim and compact to a dense, tight, smooth and sealed condition so that resistance to water penetration is similar to that of the adjacent surface.

## 4 Annexures

### 4.1 Annexure – Summary of hold and witness points

Reference No:	Clause description and	Type*	Submission/Inspection	Submission/Notice details	Process held
C21-HP01	SUBMISSIONS, Products and materials  Evidence of conformance	H	Evidence of material and component conformance.	2 weeks before erection	Material ordering and delivery
C21-HP02	SUBMISSIONS, Products and materials  Galvanized steel components	H	Evidence of zinc coating conforming to AS/ZS 4680.	2 weeks before erection	Material ordering and delivery
C21-HP03	INSPECTIONS, Notice  Set-out	H	Set-out for safety barriers and terminal sections.	5 days before inspection	Barrier erection
C21-HP04	SUBMISSIONS, Execution details  Alternative methods of setting posts	H	Details of proposed alternative post setting method if required depth cannot be achieved.	5 days before erection	Setting of posts
C21-HP05	SUBMISSIONS, Execution details  Steel post driving details	H	Details for driving steel posts.	2 weeks before erection	Erection of steel posts
C21-WP06	INSPECTIONS, Notice  Erection of barrier systems	W	Completed post installation, rectification of damaged posts and completed barrier system.	3 days before inspection	-
C21-WP07	INSPECTIONS, Notice  Removal of existing safety barrier systems	W	Removal and disposal of barrier system and reinstated surrounding material.	3 days before removal of barrier system	-
C21-WP08	INSPECTIONS, Notice  Rectification of ground/pavement	W	Disturbed ground/pavement surround posts.	3 days before inspection	-

Reference No:	Clause description and	Type*	Submission/Inspection	Submission/Notice details	Process held
C21-HP09	SUBMISSIONS, Work as Executed details and Road Asset attribute schedule	H	Submit details showing locations of new guardrail	2 weeks after completion of works.	Completion
*H = Hold Point, W = Witness Point					

## 4.2 Annexure - Referenced documents

The following documents are incorporated into this worksection by reference:

AS/NZS 1214	2016	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
AS 1237		Tolerances for fasteners - Washers for bolts, screws and nuts
AS 1237.1	2002	General plan
AS 1237.2	2016	Product grades A, C and F
AS/NZS 1252		High-strength steel fastener assemblies for structural engineering - Bolts, nuts and washers
AS/NZS 1252.1	2016	Technical requirements
AS/NZS 1594	2002	Hot-rolled steel flat products
AS 1627		Metal finishing - Preparation and pretreatment of surfaces
AS 1627.4	2005	Abrasive blast cleaning of steel
AS 1627.5	2003	Pickling
AS 1906		Retroreflective materials and devices for road traffic control purposes
AS/NZS 1906.1	2017	Retroreflective sheeting
AS/NZS 1906.2	2007	Retroreflective devices (non-pavement application)
AS/NZS 2311	2017	Guide to the painting of buildings
AS 3569	2010	Steel wire ropes
AS 3730		Guide to the properties of paints for buildings
AS 3730.10	2006	Latex - Exterior - Gloss
AS 3730.18	2006	Undercoat/sealer - Latex - Interior/exterior
AS/NZS 3845		Road safety barrier systems and devices
AS/NZS 3845.1	2015	Road safety barrier systems
AS/NZS 4680	2006	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AP-T309-18	2018	Asset Management Strategy for Road -Related Assets (Safety Infrastructure)
RMS T166	2012	Relative compaction of road construction materials RMS Specifications