Specification for Road Safety Hardware Systems

APPENDIX A: PERMANENT ROAD SAFETY BARRIER SYSTEMS

January 2019

Prepared for NZTA by Parallaxx Ltd
INTRODUCTION AND REFERENCES

This hardware summary manual has been prepared to assist organisations and individuals who interact with Road Safety Barrier Systems and Devices. The technical details within this manual have been extracted from the respective product, installation and technical manuals of each system/device.

For more detailed information, refer to the individual manuals for each product or contact the System Supplier.

The information, commentary and details provided in this manual are collected from a variety of reliable sources however the System Owner/Supplier, and formally issued and endorsed material must still be used as reference material for products. Do not utilise a system/device listed in this manual without first consulting the System Owner/System Supplier and obtaining the correct and most recent documentation for the product.

This manual is prepared with the intention of providing basic outline detail on all permanent road safety barrier systems accepted for use by NZTA.

DOCUMENT REFERENCES

- AS/NZS 3845 Part 2:2017
- NZTA M23
- NZTA M23 Interim acceptance notices
- AUSTROADS Part 6: Roadside Design, Safety & Barriers
- AUSTROADS Part 3: Geometric Design

Safer Journeys

The NZTA is part of, and contributes to, the Safer Journeys programme. Safer Journeys is the government’s strategy to guide improvements in road safety over the period 2010–2020. The strategy’s vision is a safe road system increasingly free of death and serious injury. It is a co-ordinated effort across partner agencies to improve each aspect of road safety – better behaviors, a safer road environment, safer speeds and higher vehicle standards.

For more information visit www.transport.govt.nz/saferjourneys
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## Glossary

*(Refer also to AS/NZS 3845 Part 1 2015 and Part 2 2017)*

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<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>Anchorage</td>
<td>A barrier system may be anchored to the ground to limit deflection.</td>
</tr>
<tr>
<td>Bi-directional application</td>
<td>Two-way traffic. E.g. Barrier hardware that can be hit by both adjacent and opposing traffic.</td>
</tr>
<tr>
<td>Chevron</td>
<td>Retro-reflective chevron signs attached to the barrier units to guide drivers along a temporary barrier system (CoPTTM B12).</td>
</tr>
<tr>
<td>Clear Zone</td>
<td>A clear zone is the area adjacent to the traffic lane that should be kept free from hazards that could be impacted by errant vehicles.</td>
</tr>
<tr>
<td>CoPTTM</td>
<td>NZTA Code of Practice for Temporary Traffic Management.</td>
</tr>
<tr>
<td>Crashworthy</td>
<td>A feature that has been proven acceptable for use under specified conditions either through crash testing or in-service performance.</td>
</tr>
<tr>
<td>Crossfall</td>
<td>The transverse sloping of the road surface toward the shoulder or gutter.</td>
</tr>
<tr>
<td>Deflection</td>
<td>The horizontal displacement of the barrier when impacted.</td>
</tr>
<tr>
<td>End Terminal</td>
<td>A crashworthy end treatment must be provided when the end of a barrier is exposed to head-on impacts.</td>
</tr>
<tr>
<td>Energy Absorbing Unit</td>
<td>The individual units in a crash cushion that absorb impact energy.</td>
</tr>
<tr>
<td>FHWA</td>
<td>USA Federal Highways Administration.</td>
</tr>
<tr>
<td>Flare Rate</td>
<td>The curvature applied near the end of a road safety barrier installation. Expressed as the ratio of the longitudinal distance to the transverse offset, by which a road safety barrier flares away from the road.</td>
</tr>
<tr>
<td>Flexible Barrier</td>
<td>Barrier systems which dissipate crash impact energy largely by deflection of the barrier system. Lower impact forces are imposed on the vehicle and occupants.</td>
</tr>
<tr>
<td>F-Shape Barrier</td>
<td>Concrete barrier of the current accepted F shape cross-section.</td>
</tr>
<tr>
<td>Gating</td>
<td>A road safety barrier terminal designed to allow an impacting vehicle to pass through the device, when impacted at an angle, upstream from the point of redirection.</td>
</tr>
<tr>
<td>Impact angle</td>
<td>For a longitudinal barrier, it is the angle between the face of the barrier and the vehicle’s impact direction.</td>
</tr>
<tr>
<td>Length of need</td>
<td>The required length of barrier system that is re-directive, to shield the hazard.</td>
</tr>
<tr>
<td>MASH</td>
<td>Manual for Assessing Safety Hardware (MASH) is a Manual for Assessing Highway Safety Features.</td>
</tr>
<tr>
<td>New Jersey Barrier</td>
<td>Generally a concrete barrier of the New Jersey Barrier profile. Superseded by the F-shape.</td>
</tr>
<tr>
<td>Pinning</td>
<td>Either connecting adjacent transportable barrier sections or fastening of barrier sections to the pavement or ground.</td>
</tr>
<tr>
<td>Point of Redirection</td>
<td>That point on a barrier system downstream of which will be redirective. Previously referred to as “point of need”</td>
</tr>
<tr>
<td>Proprietary</td>
<td>A road safety barrier system that is the subject of patent or other intellectual property rights.</td>
</tr>
<tr>
<td>Directive</td>
<td>The ability of a barrier system to re-direct an impacting vehicle without barrier pocketing or rupture.</td>
</tr>
<tr>
<td>Ribbon Strength</td>
<td>The longitudinal strength of a barrier system to provide crash energy containment and redirection.</td>
</tr>
<tr>
<td>Rigid Barrier</td>
<td>Barrier system that has no deflection under impact. Higher impact energy transmitted to vehicle and occupants.</td>
</tr>
<tr>
<td>Semi-Rigid Barrier</td>
<td>Barrier system deflects during re-direction. Impact energy to vehicle and occupants is less than for a rigid system but greater than a flexible system.</td>
</tr>
<tr>
<td>Shy Line</td>
<td>The distance from the edge of the travelled way outside of which the start of a roadside object (e.g. barrier) will not cause a driver to change their vehicles lateral placement or speed.</td>
</tr>
<tr>
<td>Sight/ Anti-Gawk Screens</td>
<td>Screens to shield visual distractions from passing drivers.</td>
</tr>
<tr>
<td>Slope</td>
<td>The relative steepness of the terrain expressed as a ratio or percentage.</td>
</tr>
<tr>
<td>Test Level (TL)</td>
<td>A set of prescribed test conditions, defined in terms of vehicular mass, impact speed and angle that defines the crash energy.</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Uni-directional application</td>
<td>One-way traffic. E.g. Barrier hardware that cannot be hit by opposing traffic.</td>
</tr>
<tr>
<td>Vaulting</td>
<td>Abrupt upward movement of an impacting vehicle.</td>
</tr>
<tr>
<td>Wear and tear</td>
<td>Damage that naturally and inevitably occurs as a result of normal use or aging.</td>
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</table>
NON-PROPRIETARY ROADSIDE & MEDIAN BARRIER SYSTEMS

SEMI-RIGID ROADSIDE & MEDIAN BARRIERS

STRONG-POST W-BEAM GUARDRAIL (SGR04B)

SUMMARY

SUPPLIER: Open source - no specific supplier
TEST LEVEL / CONDITIONS: NCHRP-350 TL-3
FOR USE WITH: Attaches to compatible transition barriers (generally transitioning into a wall or Thrie-Beam)
STATUS: Legacy System, repair use only, not for new State Highway installations

Strong Post Timber W-Beam guardrail is a common type of longitudinal barrier in use along local roads and State Highways. It is a public domain (non-proprietary) system.

The wood or plastic blockouts reduce or minimise a vehicle snagging on the posts upon impact. In addition, a blockout may be used to increase the offset of guardrail with an obstacle such as a curb. The posts’ primary purpose is to maintain the height of the guardrail during the initial stages of post deflection.

Strong Post Timber W-Beam guardrail is a legacy system and may not be installed on new State Highway projects. Existing installations may be repaired/maintained until replacement with a higher performing barrier system is viable or necessary.

TECHNICAL INFORMATION

DIMENSIONS
1905mm post spacing
660mm < Height < 762mm

MINIMUM LENGTH
Unit length: 3810 mm

DEFLECTION
800mm
Minimum installation length (excluding end treatments): 30.48m (8 lengths)

OTHER RESTRICTIONS / CONSIDERATIONS
- W-Beam guardrails should be anchored and terminated using a suitable end treatment
- 2 x 16d nails per blockout to prevent rotation
- Barrier post offset to hinge point =1m (600mm minimum)
- Legacy system, not for new State Highway installations

COMMON FAULTS / OTHER CONSIDERATIONS
- W-Beam guardrail element may be considered serviceable after damage to a single rib, but non-serviceable if there is damage to 2 ribs within 2m.
- Limited ability of the system to contain and redirect modern vehicles that have a higher centre of gravity along with the increased weight of those vehicles.

FURTHER READING / REFERENCES
- Refer to AASHTO 2-Space W-Beam Guardrail (RWM02a-b) for details of W-Beam element.
STEEL POST THRIEBEAM GUARDRAIL (MODIFIED BLOCKOUT) (SGR09B)

SUMMARY

SUPPLIER: Open source - no specific supplier

TEST LEVEL / CONDITIONS: NCHRP-350 TL4

FOR USE WITH Any common W-Beam terminal can be used in conjunction with an RSB-5 transition to provide a crashworthy terminal and anchorage.

STATUS Accepted

“Modified Thrie-Beam” (SGR09b) is a modified version of the standard SGR09c Thrie-Beam with modified (notched) blockouts. It is a public domain (non-proprietary) system.

The SGR09b uses steel I-section posts with steel I-section blockouts and is a Test Level 4 barrier.

Strong post Thrie-Beam guard rails should be used in locations where there is at least 600 mm of available deflection space.

TECHNICAL INFORMATION

DIMENSIONS  
2000mm post spacing  
4000mm rail length  
Height > 838mm

MINIMUM LENGTH  
Unit length: 4000 mm  
Minimum installation length (excluding end treatments): 32m (8 lengths)

DEFORMATION  
900mm (NCHRP-350 TL4)

OTHER RESTRICTIONS / CONSIDERATIONS  
• High level of performance especially for large vehicles  
• Barrier post offset to hinge point =1m (600mm minimum)

COMMON FAULTS / OTHER CONSIDERATIONS

• Thrie-Beam guardrail element may be considered serviceable after damage to a single rib, but non-serviceable if there is damage to 2 ribs within 2m.

• Modified Thrie-Beam on baseplate mounted posts is the minimum system acceptable for use on State Highway structures. Refer M23 Appendix B for details.

• Modified Thrie-Beam blockouts must be compliant with the AASHTO PWB03 detail and fabricated from either:  
  - rolled steel section conforming to either W360x32.9 or M360x25.6 section profiles defined in AASHTO M160M, or  
  - welded steel plate to the same dimensions and strengths (continuous fillet welds with minimum 6mm leg length, Cat SP to AS/NZS1554.1)

• The “notch” must be correctly formed with no rib or residual web material remaining behind the traffic face flange to ensure the system operates as tested.

FURTHER READING / REFERENCES

• Refer to AASHTO Strong Post Thrie-Beam Guardrail (SGR09b) for details of Thrie-Beam system.
STRONGPOST W-BEAM DOUBLE-SIDED GUARDRAIL (SGM04B)

SUMMARY

**SUPPLIER:** Open source - no specific supplier

**TEST LEVEL / CONDITIONS:** TL3, NCHRP-350 TL-3

**FOR USE WITH**

W-Beam barriers should be anchored and terminated using a suitable end treatment.

**STATUS**

Legacy System, repair use only, not for new State Highway installations

Strong Post Timber W-Beam median barriers were generally used in locations where a maximum dynamic deflection of 600 mm or less was acceptable. It is a public domain (non-proprietary) system.

The SGM04b uses timber posts with wooden blockouts and was a Test Level 3 barrier.

Strong Post Timber W-Beam median barrier is a legacy system and may not be installed on new State Highway projects. Existing installations may be repaired/maintained until replacement with a higher performing barrier system is viable or necessary.

TECHNICAL INFORMATION

**DIMENSIONS**

- 1905mm post spacing
- 660mm < Height < 762mm

**MINIMUM LENGTH**

- Unit length: 3810 mm
- Minimum installation length (excluding end treatments): 30.48m (8 lengths)

**DEFLECTION**

- 600mm to 1200mm

**OTHER RESTRICTIONS / CONSIDERATIONS**

- W-Beam barriers should be anchored and terminated using a suitable end treatment.
- 2 x 16d nails used on each side to prevent block rotation.

COMMON FAULTS / OTHER CONSIDERATIONS

- W-Beam guardrail element may be considered serviceable after damage to a single rib, but non-serviceable if there is damage to 2 ribs within 2m.
- Legacy system, not for new State Highway installations.

FURTHER READING / REFERENCES

- Refer to AASHTO 2-Space W-Beam Guardrail (RWM02a-b) for details of W-Beam element.
STEEL POST THRIE-BEAM DOUBLE-SIDED GUARDRAIL (MODIFIED BLOCKOUT) (SGM09B)

SUMMARY

SUPPLIER: Open source - no specific supplier

TEST LEVEL / CONDITIONS: NCHRP-350 TL-4

FOR USE WITH Any common W-Beam terminal can be used in conjunction with an RSB-5 transition to provide a crashworthy terminal and anchorage.

STATUS Accepted

The SGM09b is a modified version of the SGM09a and SGM09c Thrie-Beam system and is a Test Level 4 barrier.

The SGM09b system uses steel posts and a modified Thrie-Beam blockout instead of timber post blockouts.

Strong-post Thrie-Beam median barriers should be used in locations where a maximum dynamic deflection of 500 mm is acceptable.

TECHNICAL INFORMATION

DIMENSIONS

- 2000mm post spacing
- 4000mm rail length
- Height > 838mm

MINIMUM LENGTH

- Unit length: 4000 mm
- Minimum installation length (excluding end treatments): 32m (8 lengths)

DEFLECTION

- 300mm to 900mm

OTHER RESTRICTIONS / CONSIDERATIONS

- Thrie-Beam barriers can be more effective than W-beam barriers in collisions with larger vehicles.
- This barrier system must be properly anchored and terminated.

COMMON FAULTS / OTHER CONSIDERATIONS

- Thrie-Beam guardrail element may be considered serviceable after damage to a single rib, but non-serviceable if there is damage to 2 ribs within 2m.
- Modified Thrie-Beam on baseplate mounted posts is the minimum system acceptable for use on State Highway structures. Refer M23 Appendix B for details.
- Modified Thrie-Beam blockouts must be compliant with the AASHTO PWB03 detail and fabricated from either:
  - rolled steel section conforming to either W360x32.9 or M360x25.6 section profiles defined in AASHTO M160M, or
  - welded steel plate to the same dimensions and strengths (continuous fillet welds with minimum 6mm leg length, Cat SP to AS/NZS1554.1)
- The “notch” must be correctly formed with no rib or residual web material remaining behind the traffic face flange to ensure the system operates as tested.

FURTHER READING / REFERENCES

- Refer to AASHTO Strong Post Thrie-Beam Guardrail (SGR09b) for details of Thrie-Beam system
F-SHAPE CONCRETE BARRIER

SUMMARY

SUPPLIER: Open source - no specific supplier

TEST LEVEL / CONDITIONS:
TL4 – minimum height 915mm
TL5 – minimum height 1070mm

FOR USE WITH
Used as either median barriers (doubled sided) or roadside (single sided) barriers with appropriate transition to semi-rigid barriers (RSB-5).

ACCEPTANCE NOTICE
Accepted

The barrier may be cast-in-place, slip formed or pre cast. Cast-in-place and slip formed barrier will normally be a continuous pour without transverse contraction joints. All precast or cast-in-place segments less than 12m in length must be joined to adjacent sections by at least three 25mm diameter steel dowels (TL4), at least 4 x 32mm diameter steel dowels (TL5), or an equivalent joining method approved by the NZ Transport Agency.

TECHNICAL INFORMATION

DIMENSIONS
As shown above (refer also AASHTO SGM10a-b)

MINIMUM LENGTH
Unit Length 6m (pre-cast permanent units)
Minimum installation length: 24m (4 x 6m precast units)
Maximum barrier length between anchor footings: 60m

DEFLECTION
Rigid system – designed to facilitate 0.0m deflection

OTHER RESTRICTIONS / CONSIDERATIONS
- Specification for slip formed variant provided as Appendix D of this Specification
- Reinforcing steel shall be grade 500E or 500N conforming to AS/NZS 4671 and increased from 15mm to 16mm.
- Concrete used in the construction shall comply with the requirements of NZS 3109 and shall be manufactured in accordance with NZS 3104.
- The minimum concrete cover depth is 50mm.
- The 28 day compressive strength and concrete binder type shall be in accordance with the durability requirements of NZS 3101 for the relevant exposure classification but in all cases shall be a minimum of 30 MPa.
- Open joints should be provided at least every 60m, although 6 m is more common.

COMMON FAULTS / OTHER CONSIDERATIONS
- A 3m long 250mm deep reinforced anchor footing must be provided at both ends, and every 60m, to properly secure the barrier.
- Other common methods of supporting the barrier include setting the barrier in a continuous keyed foundation or dowelling the barrier to a foundation.
- “Pin and loop” or other temporary concrete barrier joint configurations are not accepted for use as permanent barriers.
The VGAN 300 Aluminium Bridge Barrier system is a permanent aluminium barrier system comprising cast aluminium posts carrying 3 main extruded aluminium barrier rails. The posts are at nominal 3.0m centres and the nominal system height is 1.1m. The VGAN 300 Aluminium Bridge Barrier system is classed as a rigid performance level 4 barrier system in terms of the NZ Transport Agency Bridge Manual.

### TECHNICAL INFORMATION

| DIMENSIONS | Post Spacing: **3.0m centres**  
|            | System Height: **1.1m**  
|            | Two lower pedestrian rails: **152mm x 98mm**  
|            | Top pedestrian rail: **114mm x 72mm**  
|            | Rail lengths: **9.735m**  
|            | Minimum plinth width: **450mm**  |
| WEIGHT     | **28.10kg** per metre  |
| MINIMUM LENGTH | Minimum length of the bridge parapet is as follows:  
|              | **15m** for TL-3  
|              | **30m** for TL-4  |
| GRADE OR PLACEMENT RESTRICTIONS | Cannot be used where pedestrian protection has to meet the NZ Building Code unless appropriate mesh affixed to traffic face of system and RCA accepted height of system as appropriate for application.  |
| DEFLECTION | Nominal system deflection is **300mm** at NCHRP-350 TL-4.  |
| OTHER RESTRICTIONS / CONSIDERATIONS |  
|              | ▶ Mesh infill option available for pedestrian anti-climb protection.  
|              | ▶ The minimum horizontal curvature without pre-curving of main rails is 150m. Smaller radii can be accommodated with pre-curving.  
|              | ▶ Posts can accommodate vertical alignments of up to ± 2.5°. However, when the vertical alignment results in a longitudinal fall in excess of 2.5° the posts should be fixed square to the concrete plinth transversely and perpendicular to the concrete longitudinally.  |

### COMMON FAULTS / OTHER CONSIDERATIONS

- The manufacturer’s connection detail in conjunction with the NZ Transport Agency standard transition detail (RSB-5) must be used to connect the VGAN 300 Aluminium Bridge Barrier system to a semi-rigid road safety barrier on the structure approach.
- Where a rigid road safety barrier is installed on the approach, the manufacturer’s detail must be used. Where parapet meshing is required to meet Building Code and or road controlling authority requirements, the manufacturer’s detail must be used, or an alternative fixing agreed.
## SUMMARY

<table>
<thead>
<tr>
<th>SUPPLIER:</th>
<th>CSP Pacific (<a href="http://www.csppacific.co.nz">http://www.csppacific.co.nz</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST LEVEL / CONDITIONS:</td>
<td>NCHRP 350 TL-4</td>
</tr>
<tr>
<td></td>
<td>NCHRP 350 TL-3 (Local road installation only)</td>
</tr>
<tr>
<td>PRODUCT MANUAL:</td>
<td>Click for product manual download</td>
</tr>
<tr>
<td>FOR USE WITH</td>
<td>Armorwire Terminal End (A.T.E)</td>
</tr>
<tr>
<td>STATUS</td>
<td>Accepted</td>
</tr>
</tbody>
</table>

Armorwire TL-4 is a tensioned wire rope safety barrier (WRSB) system comprising oval shaped steel posts supporting 4 cables and uses the Armorwire Terminal End (A.T.E) anchor. The system has been successfully tested to both NCHRP 350 Test Level 3 and Test Level 4.

Note: Currently all compliant WRSB terminal systems available in NZ have been tested to NCHRP 350 TL-3 only.

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### TECHNICAL INFORMATION

#### DIMENSIONS

- **Cable heights:** TL-4: 530mm, 650mm and 770mm and 790mm. (± 25mm)
- **Cable:** 19mm 3 x 7 strand, pre-stretched by 35%
- **Post spacing:** 3m
- **Std concrete post footing:** 300mm diameter by 750mm deep in compacted road base.

#### MINIMUM LENGTH

Minimum barrier length is **114m** and represents the distance between the upstream and downstream Length of Need of the terminal ends. i.e. excludes the 8m of Armorwire Terminal End (A.T.E) cable at either end.

#### GRADE OR PLACEMENT RESTRICTIONS

- A maximum slope of **10H:1V** is preferable. On slopes greater than this, advice should be followed from the Road Controlling Authority’s guidelines.
- Offset to hinge point =1m (600mm minimum)

#### DEFLECTION

**1.54m at 3m post spacing** (based on NCHRP-350 TL-3 test)

#### OTHER RESTRICTIONS / CONSIDERATIONS

- Used in both median and roadside situations in either orientation as long as the slot arrangement is consistent.
- The maximum flare is 30:1 over the entire length of the terminal end.
- The 4 line posts between the terminal end ‘trigger’ post and the Armorwire cable barrier must always be at 2m spacing.
- Line post concrete foundations require sufficient strength from supporting soil to perform as designed.
- Armorwire bolt down post is available on site specific approval from NZ Transport Agency.
- Steel driven socket is available as an alternative to concrete post foundation.
- Length of need is met at Post 5 for the system.

#### CLEAR ZONE

- **6m x 22.5m** clear area directly behind the A.T.E to enable system to gate if impacted.
COMMON FAULTS / OTHER CONSIDERATIONS

- The minimum allowable horizontal curve is 150m radius.
- Minimum allowable vertical sag is 2400m radius.
- Do not cut cables that are under any tension.
- Armorwire TL-3 3 cable barrier cannot be installed on State Highway network. It is for use on local authority roads only.
BRIFEN 4 CABLE WIRE ROPE SAFETY BARRIER (WRSB)

The Brifen 4 Cable Wire Rope Safety Barrier is a 4 cable wire rope safety barrier system utilising steel posts socketed into concrete footings.

The Brifen 4 Cable Wire Rope Safety Barrier is a 4 cable wire rope safety barrier system utilising steel posts socketed into concrete footings.

The combination of the inter-woven lower ropes and the linear ‘upper’ rope delivers two energy-absorbing actions, namely:

- Linear stretching of the upper rope; and
- Mechanical action of the lower woven ropes exerting frictional force acting on the steel post and using the deformation of the posts to absorb impact energy into the fence system.

The Brifen 4 cable has also been tested for installation on a 1V:4H slope at NCHRP350 Test Level 3.

Note: Currently all compliant WRSB terminal systems available in NZ have been tested to NCHRP 350 TL-3 only

**TECHNICAL INFORMATION**

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>Cable: Pre-stretched 19mm 4 x 7 strand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cable heights (to the centre): 930mm, 780mm, 630mm and 480mm</td>
</tr>
<tr>
<td></td>
<td>Std concrete post footing: 300mm diameter X 750mm in compacted road base</td>
</tr>
<tr>
<td></td>
<td>Post spacing: 3.2m</td>
</tr>
<tr>
<td>MINIMUM LENGTH</td>
<td>The minimum length of the TL-4 system is 78m.</td>
</tr>
<tr>
<td>GRADE OR PLACEMENT RESTRICTIONS</td>
<td>Offset to hinge point =1m (600mm minimum)</td>
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<tr>
<td></td>
<td>Can be used on a slope as a maximum 1V:4H at NCHRP-350 TL-3 only with site specific acceptance by Lead Advisor Safety (Roads &amp; Roadsides).</td>
</tr>
<tr>
<td>DEFLECTION</td>
<td>2.21m at 3.2m post spacing (based on NCHRP-350 TL-4 test)</td>
</tr>
<tr>
<td>OTHER RESTRICTIONS / CONSIDERATIONS</td>
<td>Can be used in median with S shaped posts and roadside situations with Z shaped posts Line post concrete foundations require sufficient strength from supporting soil to perform as designed</td>
</tr>
<tr>
<td></td>
<td>Point of Need is 9.6m from the anchor.</td>
</tr>
</tbody>
</table>

**COMMON FAULTS / OTHER CONSIDERATIONS**

- The minimum installation radius is 200m unless site specific acceptance is sought (and given) by the Lead Advisor Safety (Roads & Roadsides)
- The minimum vertical sag curve is 3000m.
- For Brifen WRSB systems installed pre-2014: the anchor blocks are required to be upgraded to TL-3 tested specification if impacted, or installation is being upgraded or modified.
SAFENCE SLOPE WRSB

SUMMARY

SUPPLIER: Ingal Civil NZ (http://www.ingalcivil.co.nz)

TEST LEVEL / CONDITIONS: Tested to European Standard EN1317 Parts 1 & 2 testing criteria

FOR USE WITH: Wires anchored using Safence End Terminals.

ACCEPTANCE NOTICE: Accepted (Site Specific Approval required from Lead Advisor Safety (Roads & Roadsides)

The Safence Slope Barrier is a four cable wire rope barrier system designed specifically for retrofit installations on sloping shoulders. It has been tested in accordance with European Standard EN1317 Parts 1 & 2 testing criteria which are lower than the current NZ Transport Agency requirement of NCHRP 350 TL-3 for side protection.

This system is a non-standard system considered appropriate for retro-fit situations where shoulder widths are limited, but a side protection barrier is desired. A standard wire rope barrier system must be used for all new sites and retrofit sites where shoulder width can reasonably be provided.

TECHNICAL INFORMATION

DIMENSIONS

Steel Wire Rope: Right Hand Lay, 19.0mm Diameter
3x7 strands (1 x 3.15mm + 6 x 3.0mm)
Posts: 2100mm long
Cable Heights: Varies with road geometry, refer product manual.

WEIGHT

Steel Wire Rope: Mass – 1.21kg/m
Ultimate Tensile Strength – 165.5kN

MINIMUM LENGTH

The recommended minimum length needed for a Slopefence installation is 40m.

GRADE OR PLACEMENT RESTRICTIONS

Steepest gradient: 1V:2H

DEFLECTION

TB-11: 900kg small car impacting at an angle of 20° and a nominal speed of 100km/h.
TB32: 2m - 1500kg large car impacting at an angle of 20° and a nominal speed of 110km/h.

OTHER RESTRICTIONS / CONSIDERATIONS

- This configuration is only to be considered for retro-fit situations where shoulder widths are limited, but a side protection barrier is desired.
- Because the European Standard EN1317 Parts 1 & 2 testing criteria is lower than those of NCHRP 350 Test Level 3, site specific approval is required from the Lead Advisor Safety (Roads & Roadsides) prior to specification or installation.
- Used for constrained environments only.
- Designed specifically for installation on sloping shoulders as a side protection system on retrofit projects.

COMMON FAULTS / OTHER CONSIDERATIONS

- Drive-by system inspections are recommended at least monthly, and hands-on inspections are recommended at least yearly.
- If temperatures can reach as low as zero degrees Celsius, the minimum allowable curve is 200m radius.
- All cable barrier systems are checked after impacts to ensure that the tension is maintained.
SAFENCE TL4 WRSB

SUMMARY

SUPPLIER: Ingal Civil NZ (http://www.ingalcivil.co.nz)

TEST LEVEL / CONDITIONS: TL3 and TL4, NCHRP-350

PRODUCT MANUAL Click for product manual download

FOR USE WITH Wires attach to posts socketed into the ground, which lead into 12m long NCHRP 350 TL3 tested anchor system.

STATUS Accepted

The Safence TL4 Wire Rope Safety Barrier (WRSB) is a 4 cable wire rope barrier system utilising “C” profile steel posts socketed into concrete footings. The cables are tensioned to 25kN at installation.

The accepted anchor for the system is the 12m long NCHRP 350 TL3 tested anchor system comprising a concrete anchor block and 10 shortened posts at 1m centres.

Note: Currently all compliant WRSB terminal systems available in NZ have been tested to NCHRP 350 TL-3 only

TECHNICAL INFORMATION

DIMENSIONS

Steel Wire Rope: Right Hand Lay, 19.0mm Diameter
3x7 strands (1 x 3.15mm + 6 x 3.0mm)
Sigma Posts: 1230mm long
Cable Heights: Varies with road geometry, refer product manual.

WEIGHT

Steel Wire Rope: Mass – 1.21kg/m
Ultimate Tensile Strength – 165.5kN

MINIMUM LENGTH

The recommended minimum length-of need for a Safence installation is 40m.

GRADE OR PLACEMENT RESTRICTIONS

Steepest gradient: 1V:10H.
Offset to hinge point =1m (600mm minimum)

DEFLECTION

1.60m at 3m post spacing (based on NCHRP-350 TL-3 test)

OTHER RESTRICTIONS / CONSIDERATIONS

- The maximum allowable post spacing for this system is 3.0m. Closer post spacings are acceptable in order to accommodate installation on curves
- The Safence 4 Cable Wire Rope Safety Barrier system must be terminated using the 12m long Type 3 end anchor treatment tested to the NCHRP350 TL3 protocol with the minimum block dimensions to be 1100mm x 800mm x 3000mm (DxWxL).
- The recommended maximum run length of a Safence installation is 1200m.
- The minimum allowable sag vertical curve for wire rope barriers is ≥ 30m.

COMMON FAULTS / OTHER CONSIDERATIONS

- Drive-by system inspections are recommended at least monthly, and hands-on inspections are recommended at least yearly.
- If temperatures can reach as low as zero degrees Celsius, the minimum allowable curve is 150m radius.
- All cable barrier systems are checked after impacts to ensure that the tension is maintained.
The Biker-Shield™ motorcyclist safety barrier is designed to be fitted below the W-Beam element of the Ramshield road safety barrier system to reduce the impact severity for motorcyclists and pillion passengers in run-off-road accidents.

Biker-Shield™ comprises an under-run rail position below the W-Beam guardrail element on spring mounting brackets. Upon impact, the spring bracket deflects, absorbing some of the impact energy from the motorcyclist or pillion, while the under-run rail contains and re-directs the motorcyclist/pillion away from the posts and other hazards.

The rail height ensures a uniform distance from the ground throughout the run and compensating for uneven terrain and height differences in the existing barriers.
INGAL MOTORCYCLIST PROTECTION RAIL

The Ingal Motorcyclist Protection Rail (Ingal MPR) is a protective enhancement installed on existing four wheel vehicle restraint systems to reduce the chances of serious injury to motorcyclists and pillion passengers in run-off-road accidents.

The Ingal MPR consists of an under-riding rail which is mounted on a spring bracket. Upon impacting this rail, the spring bracket deflects back absorbing some of the impact energy from the motorcyclist, whilst the rail contains and re-directs the motorcyclist away from the rigid posts and hazards.

The dummy tests recorded an impact severity of Level 1 which is the lowest severity for this testing standard.

### TECHNICAL INFORMATION

#### DIMENSIONS

- **Rail Height:** 60mm clearance underneath
- **Post Spacing:** 3.81m

#### WEIGHT

- **Ingal MPR System Mass:** 4.65kg per metre

#### MINIMUM LENGTH

- **Unit length of Ingal MPR Rail:** 3.81m
- **Minimum length of installation should match associated installation of supporting W-Beam system**

#### PERFORMANCE

- Tested to EN1317-8 Impact Severity Level 1 for following tests:
  - TM 1.60: Dummy to post, 60 km/h 30° angle of impact.
  - TM 3.60: Dummy to point on barrier midway between posts, 60 km/h 30° angle of impact.
  - TB11: 900 kg car at 100 km/h and 20° angle of impact.
  - TB32: 1,500 kg car at 110 km/h and 20° angle of impact

#### OTHER RESTRICTIONS / CONSIDERATIONS

- Quick installation on new or retrofit projects.
- Special post bracket allows for easy height adjustment for uneven/obstructed terrain.
- Can be applied to curved W-Beams with radii down to 26m.
- 60mm height allows for easy drainage of the road.

### COMMON FAULTS / OTHER CONSIDERATIONS

- The motorcyclist rail can be assembled and raised without the need to modify the traditional vehicle barrier system.
- The rail height ensures a uniform distance from the ground throughout the run and compensating for uneven terrain and height differences in the existing barriers.
**SUMMARY**

**SUPPLIER:** CSP Pacific [http://www.csppacific.co.nz]

**TEST LEVEL / CONDITIONS:** Discontinuous Motorcyclist Protection System (DMPS) under AS/NZS3845.1:2015 Headform Drop Test achieved acceptable HIC values at an impact speed of 30km/h.

**FOR USE WITH**

Attaches to the posts of Armorwire and Nu-Guard® 31 barrier systems.

**ACCEPTANCE NOTICE**

Accepted

ImpactProtect Motorcyclist Protection System provides padding to roadside safety barrier system posts reducing the risk of serious injuries to motorcyclists and cyclists during an impact with the post. ImpactProtect incorporates a fitted inner layer followed by a series of standard sized protectors (fitted annuli) each of standard thickness and composition.

This system reduces the risk of serious injuries to motorcyclists sliding and impacting barrier posts at an impact speed of 30km/h or less.

**TECHNICAL INFORMATION**

**DIMENSIONS**

- Height: 400mm
- Diameter: 280mm
- Recess: 110 x 60mm

**OTHER RESTRICTIONS / CONSIDERATIONS**

- Will not affect the crash tested barrier system performance.
- Can be installed on new and existing barrier installations.
- Can protect high risk areas of a barrier installation without having to fit on the whole length of the barrier.
- 27-37mm overhang over guardrail for Nu-Guard® 31 barrier.
- 95-107mm overhang from post for Armorwire barrier.

**COMMON FAULTS / OTHER CONSIDERATIONS**

- Accepted for use in New Zealand by the NZTA for use with Armorwire and Nu-Guard® 31 barriers only.
EZY-GUARD 4 W-BEAM GUARDRAIL

The Ezy-Guard 4 W-Beam barrier system has been tested to MASH TL3 and NCHRP 350 TL4. Ezy-Guard 4 rails and Z-posts are manufactured from hot-rolled steel flat products in accordance with AS/NZS 1594. These items are hot dip galvanised in accordance with AS/NZS 4680 after fabrication.

This system can be installed on the roadside or in the median (double-sided variant).

The Ezy-Guard 4 W-Beam barrier system must be terminated using an accepted 790mm (31’’) end treatment.

The Ezy-Lift carriage may be used with this system where the road surface has been overlaid.

### TECHNICAL INFORMATION

| DIMENSIONS | Z-Post Length: 1650mm  
| System Width: 200mm  
| Rail Height: 790mm  
| Post spacing: 1.905m |
| WEIGHT | Post mass: 12.5kg (2 posts required per guardrail panel)  
| W-Beam guardrail: 47kg (per panel) |
| MINIMUM LENGTH | MASH TL3 system 34.3m (excluding terminals) |
| DEFLECTION | MASH TL3 Crash test deflection: 1.65m |
| WORKING WIDTH | 2.50m at MASH TL3 |

### OTHER RESTRICTIONS / CONSIDERATIONS

- Accepted M23-compliant end terminals must be used to terminate and anchor the Ezy Guard 4 W-Beam barrier system.
- The Z-post embedment depth is 873mm.
- Ezy-Guard 4 can be used for curves with radius ranging from 2.4m to 45m. Curves in excess of 45m do not require shop curving as the rail can be field installed to suit. If the curve is less than 25m, refer to NZTA technical note TM-2008.

### COMMON FAULTS / OTHER CONSIDERATIONS

- W-Beam guardrail element may be considered serviceable after damage to a single rib, but non-serviceable if there is damage to 2 ribs within 2m.
- All new installations of Ezy-Guard are to be of the Ezy-Guard 4 W-Beam barrier system variant only.
- Ezy-Guard 4 posts require sufficient strength from the supporting soil to function as required and remain at the correct height. If it is determined that soil conditions on site are not equivalent to the as-tested requirements, alternative installation options will need to be considered.
- Can be used for long term or temporary work area protection.
**SUMMARY**

**SUPPLIER:**
CSP Pacific [http://www.csppacific.co.nz]

**TEST LEVEL / CONDITIONS:**
MASH TL3 (also NCHRP 350 TL4)

**PRODUCT MANUAL:**
Click for product manual download

**FOR USE WITH**
X-350:31 (all variants) or X-TENuator crash cushion

**STATUS**
Accepted

Nu-Guard® 31 is a W-Beam guardrail barrier comprising of ‘U’ shaped steel posts. The posts are driven and connected to W-Beam guardrail panels on one side with a M16 x 90 bolt and oversized washer at a height of 787mm.

From December 2017, all Nu-Guard® 31 installations must have top of post 10mm below top edge of W-Beam element. Existing installations may be retrospectively adjusted to new configuration. Top of W-Beam element unchanged at 790mm.

This system can be installed on the roadside or in the median.

The system has been crash tested to MASH TL3 and NCHRP-350 TL4 testing criteria.

**TECHNICAL INFORMATION**

**DIMENSIONS**
- Post Length: 1980mm
- System Width: 0.61mm
- System Height: 787mm
- Post spacing: 1.905m

**WEIGHT**
- Post: 14.78kg (2 posts required per guardrail panel)
- W-beam guardrail: 47kg

**MINIMUM LENGTH**
34.3m (excluding terminals)

**GRADE OR PLACEMENT RESTRICTIONS**
A maximum approach and cross slope of 1V:10H is preferable. On slopes greater than this, approval is required from the road controlling authority.

**DEFLECTION**
MASH TL3 Crash test deflection: 1.30m

**WORKING WIDTH**
1.33m at MASH TL3

**OTHER RESTRICTIONS / CONSIDERATIONS**
- For radii below 25m, refer to NZTA technical note TM-2008.
- Transitions to other barrier types available.

**COMMON FAULTS / OTHER CONSIDERATIONS**

- W-Beam guardrail element may be considered serviceable after damage to a single rib, but non-serviceable if there is damage to 2 ribs within 2m.
- Can be used for long term or temporary work area protection.
- NU-GUARD® 31 posts require sufficient strength from the supporting soil to function as required and remain at the correct height. If it is determined that soil conditions on site are not equivalent to the as-tested requirements, alternative installation options will need to be considered.
RAMSHIELD® W-BEAM GUARDRAIL

SUMMARY

SUPPLIER: Steelgal NZ Ltd [http://www.steelgal.co.nz/]

TEST LEVEL / CONDITIONS: MASH TL3

PRODUCT MANUAL: Click for product manual download

FOR USE WITH MSKT (MASH Sequentially Kinking Terminal – Steel post variant)

STATUS Accepted

RAMSHIELD® is a W-Beam guardrail barrier comprising of sigma section steel posts with an integral tear tab for post release. The posts are driven and connected to W-Beam guardrail panels on one side with a M16 x 50 post bolt and washer at a height of 730mm (top of rail). The post top is 50mm below the top of the rail.

This system can be installed on the roadside or in the median (single sided).

The system has been crash tested to MASH TL3 testing criteria.

TECHNICAL INFORMATION

DIMENSIONS

Post Length: 1560mm
System Width: 183mm
System Height: 800mm
Post spacing: 1.905m

WEIGHT

Post: 15kg (2 posts required per guardrail panel)
W-beam guardrail: 47kg

MINIMUM LENGTH 66m (excluding terminals)

GRADE OR PLACEMENT RESTRICTIONS

A maximum approach and cross slope of 1V:10H is preferable. On slopes greater than this, approval is required from the road controlling authority.

DEFLECTION

MASH TL3 Crash test deflection: 1.56m

WORKING WIDTH 1.63m at MASH TL3

OTHER RESTRICTIONS / CONSIDERATIONS

- Any increase in height to match W-Beam terminal end must occur over a minimum of 2 lengths (7.62m)
- For radii below 25m, refer to NZTA technical note TM-2008.
- Transitions to other barrier types available.

COMMON FAULTS / OTHER CONSIDERATIONS

- W-Beam guardrail element may be considered serviceable after damage to a single rib, but non-serviceable if there is damage to 2 ribs within 2m.
- Can be used for long term or temporary work area protection.
- RAMSHIELD® posts require sufficient strength from the supporting soil to function as required and remain at the correct height.

If it is determined that soil conditions on site are not equivalent to the as-tested requirements, alternative installation options will need to be considered.
Ezy-Guard HC Thrie Beam Guardrail

Summary

Supplier: Ingal Civil NZ  [www.ingalcivil.co.nz]
Test Level / Conditions: MASH TL4
Product Manual: Click for product manual download
For Use With: SoftStop or ET-2000 PLUS terminals
Status: Accepted

The Ezy-Guard HC (High Containment) Thrie-Beam barrier system has been tested to MASH TL4.

Ezy-Guard HC rails and Z-posts are manufactured from hot-rolled steel flat products in accordance with AS/NZS 1594. These items are hot dip galvanised in accordance with AS/NZS 4680 after fabrication.

This system can be installed on the roadside or in the median (double-sided variant).

Technical Information

Dimensions
- Z-Post length: 2000mm
- System Width: 245mm
- Rail Height: 980mm
- Post spacing: 2000mm

Weight
- Post mass: 19.5kg (2 posts required per guardrail panel)
- Thrie-Beam guardrail: 72kg (per panel)

Minimum Length
- MASH TL4 system 54m (excluding transitions and terminals)

Grade or Placement Restrictions
- A maximum approach and cross slope of 1V:10H is preferable. On slopes greater than this, approval is required from the road controlling authority.

Deflection
- MASH TL4 Crash test deflection: 1.77m
- NCHRP350 TL4 Crash test deflection: 1.00m

Working Width
- Not determined. Roll allowance to be calculated in accordance with Austroads Part 6

Other Restrictions / Considerations
- Accepted M23-compliant end terminals must be used to terminate and anchor the Ezy Guard 4 W-Beam barrier system.
- The Z-post embedment depth is 873mm.
- Ezy-Guard 4 can be used for curves with radius ranging from 2.4m to 45m. Curves in excess of 45m do not require shop curving as the rail can be field installed to suit. If the curve is less than 25m, refer to NZTA technical note TM-2008.
COMMON FAULTS / OTHER CONSIDERATIONS

- Thrie-Beam guardrail element may be considered serviceable after damage to a single rib, but non-serviceable if there is damage to 2 ribs within 2m.

- Ezy-Guard HC posts require sufficient strength from the supporting soil to function as required and remain at the correct height. If it is determined that soil conditions on site are not equivalent to the as-tested requirements, alternative installation options will need to be considered.

- Can be used for long term or temporary work area protection.
TIMBER FACED GUARDRAIL G4M AND G2M

SUMMARY

SUPPLIER: Commodore Trading (www.guadrailnz.com)

TEST LEVEL / CONDITIONS: NCHRP 350 TL2 (Tested to EN1317 N2 - 1500kg car at 110km/h and 20°)

PRODUCT MANUAL: Click for product manual download

FOR USE WITH: Attaches to C100 anchor with terminal end rail.

STATUS: Accepted (Not for use on State Highways)

Aesthetic semi-rigid barrier system comprising round timber facings over steel “C” section rails and driven steel posts.

The Timber Faced Guardrail G4m and G2m systems are considered suitable for use on local road networks with vehicle operating speeds up to 70km/h (equivalent to NCHRP Report 350 Test Level 2 (TL2) crash test conditions) at the discretion of the road controlling authority.

Not for use on State Highway network.

TECHNICAL INFORMATION

DIMENSIONS

Post Spacing: 4m or 2m
Rail Height: 700mm ± 20mm above ground level height

MINIMUM LENGTH: 60m (excluding terminals)

OTHER RESTRICTIONS / CONSIDERATIONS

- Posts can be moved along the rail without affecting the rail integrity, if required to avoid underground services, boulders or tree roots, on installation.
- The Timber Faced Guardrail G4m and G2m are considered as visually appealing systems.
- The crash testing performance has been assessed as equivalent to MASH TL2 and therefore it may not be installed on State Highways.
- The Timber Faced Guardrail is suitable where vehicle operating speeds do not exceed 70km/h.
- The Timber Faced Guardrail G4m & G2m is terminated using a proprietary sloping end which should be flared away from traffic, wherever possible, to mitigate risk of end-on impact.

COMMON FAULTS / OTHER CONSIDERATIONS

- Recommended installation is that the terminal end should be flared away from the road approximately +300mm.
- Whenever practical consider extending the rail and terminal end to achieve a greater flare.
- Currently no MASH or NCHRP 350 crash tested end terminal available.
- Handrail systems can be added at any height required for cyclists and pedestrians at discretion of road controlling authority.
- Back masks for the rail and posts are available to cover steel components at the rear of the Timber Faced Guardrail.
## TIMBER FACED GUARDRAIL GRP

**Summary**

**Supplier:** Commodore Trading  
([www.guardrailnz.com](http://www.guardrailnz.com))

**Test Level / Conditions:**
- NCHRP 350 TL-2  
  Tested to EN1317 N2 - 1500kg car at 110km/h and 20° with 1.5, 2, 3, 4 & 6m post spacing  
  Tested as EN1317 H1 - 10000kg truck at 70km/h and 15° with 1.5m post spacing

**Product Manual:** Click for product manual download

**For Use With:**
- Tested with a proprietary sloping end anchored to the ground.

**Status:** Accepted (Not for use on State Highways)

Aesthetic semi-rigid barrier system comprising round timber facings (“masks”) over steel W-Beam guardrail and “C” section steel posts.

Timber Faced Guardrail GRP system is considered suitable for use local road networks with vehicle operating speeds up to 70km/h (equivalent to NCHRP Report 350 Test Level 2 crash test conditions) at the discretion of the road controlling authority.

Not for use on State Highway network.

### Technical Information

| Dimensions | Post Spacing: 1.5, 2, 3 or 6m  
Rail Height: 781mm ± 20mm above ground level height |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Length</td>
<td>84m (excluding terminals)</td>
</tr>
</tbody>
</table>

**Other Restrictions / Considerations**
- The Timber Faced Guardrail GRP is considered as a visually appealing system.
- The crash testing performance has been assessed as equivalent to MASH TL2 and therefore it may not be installed on State Highways.
- The Timber Faced Guardrail is suitable where vehicle operating speeds do not exceed 70km/h.
- The Timber Faced Guardrail GRP is terminated using a proprietary sloping end which should be flared away from traffic, wherever possible, to mitigate risk of end-on impact.

### Common Faults / Other Considerations

- Recommended installation is that the terminal end should be flared away from the road approximately +300mm.
- Whenever practical consider extending the rail and terminal end to achieve a greater flare.
- This flare will mitigate the risk of end-on impact as there is currently no MASH or NCHRP 350 crash tested end terminal available.
LOGRAIL T18 4M/4MS2

Aesthetic semi-rigid barrier system comprising round timber facings over steel “C” section rails and driven steel posts.

The Lograil 4m and 4MS2 systems are considered suitable for use on local road networks with vehicle operating speeds up to 70km/h (equivalent to NCHRP Report 350 Test Level 2 (TL2) crash test conditions) at the discretion of the road controlling authority.

Not for use on State Highway network.

**SUMMARY**

<table>
<thead>
<tr>
<th>SUPPLIER:</th>
<th>CSP Pacific [<a href="http://www.csppacific.co.nz">www.csppacific.co.nz</a>]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST LEVEL / CONDITIONS:</td>
<td>NCHRP 350 TL2 (Tested to EN1317 N2 - 1500kg car at 110km/h and 20°)</td>
</tr>
<tr>
<td>PRODUCT MANUAL:</td>
<td>Click for product manual download</td>
</tr>
<tr>
<td>FOR USE WITH</td>
<td>Tested with a proprietary 4m sloping end anchored to the ground.</td>
</tr>
<tr>
<td>STATUS</td>
<td>Accepted (Not for use on State Highways)</td>
</tr>
</tbody>
</table>

**TECHNICAL INFORMATION**

| DIMENSIONS          | Post Spacing: **4m (4M)** or **2m (4MS2)**  
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rail Height: <strong>700mm ± 20mm</strong> above ground level height</td>
</tr>
<tr>
<td>MINIMUM LENGTH</td>
<td><strong>60m</strong> (excluding terminals)</td>
</tr>
</tbody>
</table>

**OTHER RESTRICTIONS / CONSIDERATIONS**

- Posts can be moved along the rail without affecting the rail integrity, if required to avoid underground services, boulders or tree roots, on installation.
- The crash testing performance has been assessed as equivalent to MASH TL2 and therefore it may not be installed on State Highways.
- The Lograil 4m and 4MS2 systems are suitable where vehicle operating speeds do not exceed 70km/h.
- The Lograil 4m and 4MS2 systems are terminated using a proprietary 4m sloping end which should be flared away from traffic, wherever possible, to mitigate risk of end-on impact.

**COMMON FAULTS / OTHER CONSIDERATIONS**

- Recommended installation is that the terminal end should be flared away from the road approximately +300mm.
- Whenever practical consider extending the rail and terminal end to achieve a greater flare.
- Currently no MASH or NCHRP 350 crash tested end terminal available.
- Handrail systems can be added at any height required for cyclists and pedestrians at discretion of road controlling authority.
- Back masks for the rail and posts are available to cover steel components at the rear of the Timber Faced Guardrail.
The ET-2000 PLUS guardrail end terminal is used to absorb the kinetic energy of an impacting vehicle at a controlled rate. Upon impact, the extruder head travels horizontally along the guardrail Beams, flattening the W-profile of the Beam and extruding the flattened section away from the traffic face.

This system has been used in New Zealand as an end terminal for permanent road safety barrier systems for over 10 years. The ET-2000 PLUS End Terminal system, comprising of SYT Posts, has been tested in accordance with NCHRP Report 350 and is considered to comply with the required evaluation criteria for Test Level 3 (TL3).

TL2 variant is available on request (not for use on State Highways).

### TECHNICAL INFORMATION

| DIMENSIONS | 7.62m (TL-2)  
7.62m (TL-3)  
15.24m (TL-3)  
Post Height: 730mm +/- 20mm above ground level  
SYT Post Spacing: 1905mm centres |
|---|---|
| WEIGHT | TL2 Package Mass: 330kg  
TL3 Package Mass: 540kg |
| MINIMUM LENGTH | TL-2 system (70km/h) – 7.62m  
TL-3 system (100km/h) – 15.24m |
| GRADE OR PLACEMENT RESTRICTIONS | Maximum approach and cross slope of 10H:1V  
When installed at the end of guardrail following a curved alignment (offsets measured to the face of the rail):  
Outside of Curve: maximum offset 610mm from the curve.  
Inside of Curve: maximum offset 305mm (curve radius of 300m or less)  
maximum offset 610mm (curve radius greater than 300m)  
Terminal grading in accordance with NZTA RSB-3 |
| POINT OF REDIRECTION | Length of need measured from point of redirection at Post #3 |
| CLEAR AREA | 6m x 22.5m clear area to enable the system to gate if impacted downstream from head |
| OTHER RESTRICTIONS / CONSIDERATIONS | ET-2000 Plus is a tangential end treatment installed on a straight alignment.  
Cannot be installed in front, on top or behind a kerb. |

### COMMON FAULTS / OTHER CONSIDERATIONS

- The first two posts from the end of the terminal have no offset blocking piece.
- The 200mm offset block used in the terminal is wider than conventional W-Beam offset blocking pieces.
- Provides redirection for side on impacts.
**MSKT END TERMINAL**

**SUMMARY**

<table>
<thead>
<tr>
<th>SUPPLIER:</th>
<th>Steelgal (<a href="http://www.steelgal.co.nz">www.steelgal.co.nz</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST LEVEL / CONDITIONS:</td>
<td>MASH TL3</td>
</tr>
<tr>
<td>PRODUCT MANUAL:</td>
<td>Click for product manual download</td>
</tr>
<tr>
<td>FOR USE WITH</td>
<td>W-beam guardrail</td>
</tr>
<tr>
<td>STATUS</td>
<td>Accepted</td>
</tr>
</tbody>
</table>

The MSKT (MASH Sequential Kinking Terminal) is a tangential W-Beam end treatment that has been tested to meet the MASH crash test protocol. It may also be installed on a shallow (600mm) flare.

The MSKT comprises W-Beam profile rail elements supported on steel breakaway posts using composite blockouts. The initial guardrail length is specially slotted to aid extrusion. When impacted at the leading end, the guardrail extrudes to the rear of the installation.

**TECHNICAL INFORMATION**

| DIMENSIONS | Length: **14.29m** (TL-3)  
|            | Rail height: **790mm**  
|            | Post Spacing: **1905mm** centres |
| MINIMUM LENGTH | TL-3 system (100km/h) **14.29m** |
| GRADE OR PLACEMENT RESTRICTIONS | A maximum approach and cross slope of **10H:1V**  
|            | Terminal grading in accordance with NZTARS5B-3 |
| POINT OF REDIRECTION | Length of need measured from point of redirection at Post #3 |
| CLEAR AREA | **6m x 22.5m** clear area to enable the system to gate if impacted downstream from head |
| OTHER RESTRICTIONS / CONSIDERATIONS |  
|            | • First Rail used must be a special kinking rail with slotted holes  
|            | • **600mm** Maximum flare at impact head  
|            | • Any reduction in height to match W-Beam barrier must occur over a minimum of 2 lengths (7.62m) |

**COMMON FAULTS / OTHER CONSIDERATIONS**

- Drive-by system inspections are recommended at least monthly, and hands-on inspections are recommended at least yearly.
FLEAT 350 & SKT 350 END TERMINALS

SUMMARY

SUPPLIER: Steelgal [www.steelgal.co.nz]

TEST LEVEL / CONDITIONS: NCHRP 350 TL2 and TL3

PRODUCT MANUAL:
- Click for product manual download – FLEAT 350
- Click for product manual download – SKT 350
- Click for product manual download – SKT-SP and FLEAT-SP
- Click for product manual download – FLEAT MT

FOR USE WITH W-beam guardrail

STATUS Accepted

The FLEAT 350 is a flared-only, energy absorbing end terminal that meets NCHRP 350 TL3. When impacted, the extruded guardrail curls toward the traffic face.

The SKT 350 is a tangential-only, sequential kinking end terminal that also meets NCHRP 350 TL3. When impacted, the extruded guardrail curls behind the barrier line.

The SKT-SP and FLEAT-SP are accepted variants of the SKT/ FLEAT 350 end terminals, using steel breakaway posts rather than timber posts.

The FLEAT-MT is a median terminal variation of the FLEAT 350 end terminal. It is available as wood or steel post options.

TL2 variants are available on request (not for use on State Highways).

TECHNICAL INFORMATION

DIMENSIONS

<table>
<thead>
<tr>
<th>TL2</th>
<th>7.6m</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL3</td>
<td>11.43m</td>
</tr>
<tr>
<td>Post Spacing:</td>
<td>1905mm centres</td>
</tr>
</tbody>
</table>

MINIMUM LENGTH

| TL-2 System(70km/h) | 7.6m |
| TL-3 system (100km/h) | 11.43m |

GRADE OR PLACEMENT RESTRICTIONS

A maximum approach and cross slope of 10H:1V
Terminal grading in accordance with NZTARSB-3

POINT OF REDIRECTION

Length of need measured from point of redirection at Post #3

CLEAR AREA

6m x 22.5m clear area to enable the system to gate if impacted downstream from head

OTHER RESTRICTIONS / CONSIDERATIONS

FLEAT350
- First Rail used must be a special kinking rail with slotted holes
- 760 to 1220mm offset needed for NCHRP 350 TL-3.
- 500 to 820mm offset needed for NCHRP 350 TL-2.

SKT350
- First Rail used must be a special kinking rail with slotted holes

COMMON FAULTS / OTHER CONSIDERATIONS

- Drive-by system inspections are recommended at least monthly, and hands-on inspections are recommended at least yearly.
- Breakaway posts may be wood or steel, both are tested to NCHRP-350.
The SoftStop is an all-steel tangent end terminal for use with W-Beam guardrail systems. Using a proprietary head that flattens and extrudes W-Beam guardrail upon end-on impacts within the MASH testing criteria, the SoftStop dissipates energy while guiding flattened rail through the mouth at the bottom of the unit. The SoftStop end terminal is MASH Test Level 3 compliant as a re-directive, gating end terminal.

The SoftStop End Terminal can be assembled with a flare to offset the Head 600mm for the TL-3 system (300mm for the TL-2 system). The flare must be over the length of the system. The maximum flare rate is 1:25.

**TECHNICAL INFORMATION**

| DIMENSIONS | TL-2 length: 7.89m  
|            | TL-3 length: 15.48m  
|            | System width: 180mm  
|            | System height: 787mm  
|            | Post Spacing: 1905mm centres  
| MINIMUM LENGTH | TL-2 system (70km/h): 7.89m  
|               | TL-3 system (100km/h): 15.48m  
| POINT OF REDIRECTION | Length of need measured from point of redirection at Post #3  
| CLEAR AREA | 6m x 22.5m clear area to enable the system to gate if impacted downstream from head  
| GRADE OR PLACEMENT RESTRICTIONS | Maximum approach and cross slope of 10H:1V  
|               | Flared or tangential terminal layouts acceptable.  
|               | Terminal grading in accordance with NZTA RSB-3  
| OTHER RESTRICTIONS / CONSIDERATIONS | The core mechanism for dissipation of end impact energy is through anchorage and extrusion of the W-Beam element.  

**COMMON FAULTS / OTHER CONSIDERATIONS**

- The frequency of drive-by inspections is dependent on the traffic volume and the impact history of the system. Drive-by inspections are recommended at least monthly.
- Hands-On inspections are recommended at least yearly.
- Splices at mid-span of the posts.
- Extruded rail is flattened and maintains connection to unit.
- Posts 2 through 8 should be the correct height of 813mm ± 20mm above ground level.
X-350 END TERMINAL SYSTEM

SUMMARY

SUPPLIER: CSP Pacific (www.csppacific.co.nz)

TEST LEVEL / CONDITIONS: TL3, NCHRP-350 TL-3

PRODUCT MANUAL: Click for product manual download

FOR USE WITH All semi-rigid longitudinal barrier systems.

STATUS Accepted

The X-350 End Terminal system is a re-directive guardrail terminal end that can be used in Median, Tangent or Flared (up to 1200mm) installations.

The X-350 End Terminal system can be installed in the following configurations:

• Single-sided, installation height of 690mm (X-350), breakaway timber or steel posts;
• Single-sided, installation height of 790mm (X-350:31), breakaway steel posts only;
• Median (double-sided), installation height of 690mm (X-350 Median), breakaway timber or steel posts;
• Median (double-sided), installation height of 790mm (X-350:31 Median) breakaway steel posts only

The X-350 is considered redirective from post #1, but is classed as a gating terminal due to presence of ground strut upstream of post #1.

TECHNICAL INFORMATION

DIMENSIONS

11.43m (3 rails)
690mm or 790mm to suit guardrail system

WEIGHT

Impact Head weight: 25kg

MINIMUM LENGTH

TL-3 system (100km/h): 11.43m

GRADE OR PLACEMENT

RESTRICTIONS

Maximum approach and cross slope of 10H:1V
Flared or tangential terminal layouts acceptable.
Terminal grading in accordance with NZTA RSB-3

POINT OF REDIRECTION

Length of need measured from point of redirection at Post #1

CLEAR AREA

6m x 22.5m clear area to enable the system to gate if impacted downstream from head

OTHER RESTRICTIONS / CONSIDERATIONS

• X-350:31 must be used with Nu-Guard® 31
• Site specific grading must be provided in accordance with NZTA detail RSB-3 to ensure that there are no “humps” or “hollows” that may significantly alter stability of the impacting vehicle.
• Impact force held in tension.
• Gating and Re-directive system.
• 0 – 1200mm offset for all variations of the end terminal.

COMMON FAULTS / OTHER CONSIDERATIONS

• When a X-350 End Terminal is installed in a trailing/exit location, where the terminal head is facing away from the direction the vehicle is travelling, the splice join at rails 1, 2 and 3 of the terminal will be against the direction of traffic.
• Nut Protectors are available.
• Plastic Front End Cover is available for both roadside and median terminal ends.
TRAILING TERMINAL

SUMMARY

SUPPLIER: Open source – no specific supplier
Proprietary variants available for Ezy-Guard 4 and Nu-Guard® 31

TEST LEVEL / CONDITIONS: n/a (non-crashworthy, anchorage only)

PRODUCT MANUAL: Click for product manual download

FOR USE WITH: Only to be used to anchor the end of a semi-rigid W-Beam barrier system.

STATUS: Accepted

The purpose of the Trailing Terminal is to anchor the end of a flexible rail system to keep the tensile strength in the rail.

Trailing Terminals are intended to provide anchorage for the barrier. They are not crashworthy terminals when struck head-on, since they are not designed to absorb energy or break away. They must not be installed where there is a likelihood they could be impacted head-on by an errant vehicle.

The Curved Trailing End Terminal (CTT) should be used as the default. The Straight Trailing End Terminal (STT) should only be used where space constraints prevent use of a CTT.

TECHNICAL INFORMATION

DIMENSIONS

- Length of terminal: 3.81m
- System Height: 706mm for public domain or 787mm for proprietary variants
- Post Depth: 1100mm minimum
- Post Spacing: 1905mm

MINIMUM LENGTH

- 3.81m

OTHER RESTRICTIONS / CONSIDERATIONS

- Bullnose required on CTT and STT. Rolled end fitting not allowed
- Minor site grading may be necessary for guardrail installations beyond the edge of the shoulder to prevent the steel posts from extending more than 100mm above the ground.
- The CTT has an offset at the bullnose of 335mm.

COMMON FAULTS / OTHER CONSIDERATIONS

- The CTT used in a leading situation does not comply with any current NZ Transport Agency standards and can only be used in special cases for low volume, low speed with permission of road controlling authority.
BURIED IN BACKSLOPE ANCHOR

SUMMARY

SUPPLIER: Open source – no specific supplier

TEST LEVEL / CONDITIONS: TL3 or TL4. NCHRP-350 TL-3 or TL-4 (depending on rail height)

FOR USE WITH Anchor attaches to W-beam barrier using a TL-4 transition.

STATUS Accepted (Site Specific Approval required from Lead Advisor Safety (Roads & Roadsides)

This non-gating end and re-directive end treatment was developed as an end treatment for W-Beam barrier where the road is transitioning from cut to fill. The buried in backslope anchor requires a TL-4 transition to connect the anchor block to the guardrail (refer NZTA Standard Detail RSB-5). In areas of cut sections on the roadway, or where the road is transitioning from cut to fill, it is sometimes possible to terminate a W-Beam guardrail installation by burying the anchor block at the end in backslope. When properly designed and located this system provides full shielding of the identified hazard, eliminates the possibility of any end-on impact with the terminal, and minimises the likelihood of the vehicle passing behind the rail.

Due to the criticality of the ground conditions to the safe performance of the Buried In Backslope anchor, a site specific acceptance is require for its use. Application for use must include geotechnical assessment of the ground conditions at the proposed location including consideration of the system specific requirements (ability to form the necessary excavation for construction, competency of soil/rock, erosion risk, etc). The Installation Designer must satisfy themselves that the ground into which the anchor is to be installed is capable of supporting the anchor block under the design impact loads imposed.

TECHNICAL INFORMATION

DIMENSIONS Barrier Height (to centre): 610mm

MINIMUM LENGTH Minimum Transition Length: 10m

GRADE OR PLACEMENT RESTRICTIONS The natural backslope needs to be reasonably close to the beginning or end of the semi-rigid barrier system. The approach grading should provide an unobstructed guardrail contact face at the correct height. The grading through the transition length should not ramp the vehicle.

OTHER RESTRICTIONS / CONSIDERATIONS

- This end treatment is only to be considered where the ground condition are suitable and shoulder width is limited, but a side protection barrier is desired
- Steepness of the slope covers the end of the barrier
- Ideal slope is one that is near-vertical
- Slope effectively becomes an extension of the barrier face and motorist can’t physically get behind the terminal.
- Length of need begins at the point where the installation crosses the ditch bottom.
- Concrete anchor block must have a minimum strength of 28MPa.
- Must design for erosion of the backslope.
- The standard transition should be substantially exposed to at least Post 2, and present the correct barrier height of 610 mm to the centre of the guardrail.
- The anchorage of the system must be able to develop the full tensile strength of the W-Beam.

COMMON FAULTS / OTHER CONSIDERATIONS

- Ground conditions are critical, anchor block must be embedded in competent natural soil/rock. Backfilling over a concrete block will be considered a non-compliant installation.
- Do not use where there is a risk of erosion exposing the concrete block over time.
- Careful consideration needs to be given to foreslope, backslope and ditch configurations. Ideally used at locations where a natural backslope is reasonably close to point where barrier is introduced.
CAT 350 CRASH CUSHION

SUMMARY

SUPPLIER: Ingal Civil NZ (http://www.ingalcivil.co.nz)

TEST LEVEL / CONDITIONS: TL3. NCHRP-350 TL-3

PRODUCT MANUAL: Click for product manual download

FOR USE WITH CAT 350™ can be used as a longitudinal barrier end treatment and as a crash cushion either in the median or on the shoulder.

STATUS Accepted

CAT 350 crash cushion is an energy absorbing attenuator available for use where blunt ends of rigid barriers and fixed objects are in the median or on the shoulder.

This system is a three stage system using energy absorbing W-Beam elements, breakaway wood posts and a cable anchorage system.

The W-Beam element is a slotted W-Beam that telescopes backward during impact. The shearing of the steel rail between the slots as the sections are moved back dissipates the kinetic energy of impact.

TECHNICAL INFORMATION

| DIMENSIONS       | 9.52m system length  
|                  | 610mm width          
|                  | 705mm height         |
| MINIMUM LENGTH   | TL-3 system (100km/h) – 9.52m |
| CLEAR AREA       | 6m x 22.5m clear area to enable the system to gate if impacted downstream from the head |
| OTHER RESTRICTIONS / CONSIDERATIONS |
|                  | Can be used as a longitudinal barrier end treatment and as a crash cushion either in the median or on the shoulder. |
|                  | Various post and post/sleeve options are available. |
|                  | Available in weathering steel. |
|                  | Requires no concrete pads. |
|                  | Foundations and deadmen anchors are not required. |
|                  | Functions as either a unidirectional and bidirectional device. |
|                  | Length of Need begins at Post #4 from the nose. |

COMMON FAULTS / OTHER CONSIDERATIONS
The Quad-Guard is a potentially reusable, re-directive, non-gating crash cushion for hazards ranging in width from 610 mm to 3200 mm. It consists of energy-absorbing cartridges surrounded by a framework of Quad-Beam Panels.

During head-on impacts, the Quad-Guard II System telescopes rearward and crushes to absorb the energy of impact. When impacted from the side, it safely redirects the vehicle back toward its original travel path and away from the hazard.

A bay describes a section of the Quad-Guard System consisting of an energy absorbing cartridge, a diaphragm, two fender panels and fasteners. The Quad-Guard System is capable of redirecting 820 to 2000 kg vehicles which impact the sides of the system at speeds up to 100 km/h at angles of 20° for both right-way and wrong-way impacts. For head on impacts into the nose, a Quad-Guard is capable of meeting the occupant risk criteria as recommended in NCHRP 350.

### TECHNICAL INFORMATION

#### DIMENSIONS

- Available in seven widths:
  - 610 mm, 760 mm, 915 mm, 1219 mm, 1755 mm, 2285 mm, 3200 mm

#### GRADE OR PLACEMENT RESTRICTIONS

- Should be assembled only on an existing or freshly placed and cured concrete base (28 MPa minimum).
- May be assembled on a non-reinforced concrete roadway (minimum 200 mm thick).
- Cross-slope shall not exceed 8% and should not twist more than 2% over the length of the system.
- The foundation surface shall have a light broom finish.

#### OTHER RESTRICTIONS / CONSIDERATIONS

- The system must be anchored.
- As a general rule, selection of the narrowest width that adequately shields the hazard is recommended.
- System length is specified by the number of bays the system includes. The number of bays required is a function of the design speed of the roadway, as specified in the product manual.
- When there is an existing guardrail or median barrier at the site, the backup of the Quad-Guard System should tie into it when possible.
- Able to shield hazards up to 3200mm wide.

### COMMON FAULTS / OTHER CONSIDERATIONS

- Visual Drive-By Inspections are recommended at least once a month. Walk-Up Inspections are recommended at least once a year for Quad-Guard systems on asphalt.
SCI-100 SMART CUSHION

The Smart Cushion Innovations (SCI) crash attenuator is a fully re-directive, non-gating bi-directional crash cushion. SCI-100GM crash cushion ion was successfully tested as a concrete barrier end terminal system under the NCHRP 350 Test Level 3 (100 km/h).

### TECHNICAL INFORMATION

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>TL2: 4m long, 609.6mm wide, 863.6mm high</th>
<th>TL3: 6.55m long, 609.6mm wide, 863.6mm high</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEIGHT</td>
<td>TL2: 1120.4kg (for attenuators only)</td>
<td>TL3: 1564.9kg (for attenuators only)</td>
</tr>
<tr>
<td>GRADE OR PLACEMENT RESTRICTIONS</td>
<td>» Foundations must be a flat surface with longitudinal and cross slopes of 10:1 or less.</td>
<td></td>
</tr>
<tr>
<td>OTHER RESTRICTIONS / CONSIDERATIONS</td>
<td>» Smart Cushion system should not be placed directly behind raised curbs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>» Smart Cushion system should be connected to barriers that are as high as or higher than the cushion to provide proper support and attachment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>» Smart Cushion allows for connection to many barrier shapes. A rectangular concrete block provides the most economical and simplest shape to connect to.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>» Foundation concrete should reach full cure strength before use (28MPa minimum)</td>
<td></td>
</tr>
</tbody>
</table>

### COMMON FAULTS / OTHER CONSIDERATIONS

- SCI attenuators come fully assembled for a pick-and-set install. The units require no backstops for permanent or temporary construction applications.
- Must check to make sure there are no drains, expansion joints, or buried cables and utility lines in the footprint space where the units will be placed. Remove any curbs or obstacles in front of or beside where the units will be installed for a minimum distance of 3.66m from any edge of the unit.
- Prior to installing the crash cushion on an existing foundation, the concrete must be thoroughly inspected for slope, signs of cracking, surface wear, shifting from original position or any other sign of deterioration. If any of these signs are evident, the foundation must be removed and a new one must be installed.
- Installation of the front delineation plate will be determined by the location of the attenuator and state regulations.

### SUMMARY

<table>
<thead>
<tr>
<th>SUPPLIER:</th>
<th>Tauren Barriers Ltd.</th>
<th><a href="http://www.taurenbarriers.co.nz">http://www.taurenbarriers.co.nz</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST LEVEL / CONDITIONS:</td>
<td>TL3. NCHRP-350 TL-3</td>
<td></td>
</tr>
<tr>
<td>PRODUCT MANUAL:</td>
<td>Click for product manual download</td>
<td></td>
</tr>
<tr>
<td>FOR USE WITH</td>
<td>W-beam and permanent or temporary concrete barriers.</td>
<td></td>
</tr>
<tr>
<td>STATUS</td>
<td>Accepted</td>
<td></td>
</tr>
</tbody>
</table>
The TAU-II system is fully redirective and non-gating, suitable for narrow hazards such as the ends of rigid barriers, bridge piers, utility poles, etc. The TAU-II crash cushion can be installed with either a freestanding “Compact Backstop” or a “P.C.B. Backstop” that can be attached to properly reinforced concrete barrier.

### TECHNICAL INFORMATION

#### DIMENSIONS

- TL2: length: 4 bays. 3.78m (P.C.B Backstop) or 4.28m (Compact Backstop)
- TL3: length: 8 bays. 7.25m (P.C.B Backstop) or 7.75m (Compact Backstop)
- 762mm width, 829mm height

#### GRADE OR PLACEMENT RESTRICTIONS

Cross slopes of up to 8% (5 degrees) can be accommodated with the standard hardware and with the instructions provided with the system. If there are cross slopes in excess of 8%, contact CSP Pacific to obtain engineering advice and assistance.

#### OTHER RESTRICTIONS / CONSIDERATIONS

- The approved anchoring foundation is a solid concrete pad over the length of the system.
- The concrete foundation must be a minimum of 150mm thick, reinforced 28 MPa Portland Cement Concrete (PCC) or 200mm non-reinforced 28MPa PCC.
- All curbs, islands and elevated objects greater than 100mm high that would be beneath, beside or less than 15m in front of a TAU-II crash cushion should be removed prior to installation.
- Transitions to concrete, W-Beam and Thrie-Beam.
- Hazard widths: 1000mm – 2440mm max.
- Design speeds: 50km/h – 100km/h.

### COMMON FAULTS / OTHER CONSIDERATIONS

- An anchoring package is supplied with the TAU-II system and contains the necessary threaded rods and epoxy needed to install the system.
The TRACC crash-cushions are fully re-directive, non-gating, bi-directional energy-absorbing, designed to protect motorists from impacting the end of concrete barriers, toll plazas, bridge piers and other hazards in both temporary and permanent work area locations.

Installation of the TRACC system and its transitions depends on the traffic pattern and the backup structure at the particular location. Unidirectional traffic (one side or both) requires no transition provided the unit is installed beyond the clear area of opposing traffic. The WideTRACC offers options for protection of wide hazards and gore areas. The WideTRACC can be flared down its right side only (R), its left side only (L) or down both sides simultaneously (B).

Configuration Options:

<table>
<thead>
<tr>
<th>System</th>
<th>Test Level</th>
<th>Width</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACC</td>
<td>3</td>
<td>610mm</td>
<td>6.5m</td>
</tr>
<tr>
<td>ShorTRACC</td>
<td>2</td>
<td>610mm</td>
<td>4.3m</td>
</tr>
<tr>
<td>WideTRACC - B</td>
<td>3</td>
<td>1470mm**</td>
<td>6.5m**</td>
</tr>
<tr>
<td>WideTRACC - L</td>
<td>3</td>
<td>1040mm***</td>
<td>6.5m***</td>
</tr>
<tr>
<td>WideTRACC - R</td>
<td>3</td>
<td>1040mm***</td>
<td>6.5m***</td>
</tr>
</tbody>
</table>

** The width of the WideTRACC – B can be further increased by adding wing extensions on both sides. The extensions will add 710mm of length and 175mm of system width per extension added.

*** The width of the WideTRACC – L and – R can be further increased by adding wing extensions on one side. The extensions will add 710mm of length and 87mm of system width per extension added.

** TECHNICAL INFORMATION**

**GRADE OR PLACEMENT RESTRICTIONS**

It is recommended that the TRACC system should not be placed directly behind a raised kerb. The approach area in front of the system should slope at a rate no greater than 10H:1V in the direction of traffic flow. The cross slope should be no more than 12H:1V.

**OTHER RESTRICTIONS / CONSIDERATIONS**

- The TRACC can be anchored to a combination of asphalt, concrete and compacted sub base.
- TRACC units are supplied with four pieces of delineation tape that can be customised to create any of three delineation designs.
- A plastic nose cone that is supplied with the system should be attached to the front of the TRACC.
- TRACC units are delivered pre-assembled to site to facilitate rapid installation and minimise disruption to traffic flow.
- TRACC systems can be lifted as complete units.
- Holes should be drilled 40mm less than the overall length of the anchor studs to ensure proper embedment to the foundation.

**COMMON FAULTS / OTHER CONSIDERATIONS**

- Field repair is to be limited to minor end-on impacts that stroke the system less than 1350mm.
**RAPTOR CRASH CUSHION**

The Raptor is a fully recyclable protector that wraps around utility poles or trees reducing the impact severity of crashes. It serves as a highly compact alternative solution to a full scale crash cushion, especially at sites where space is limited. It offers vehicle control and energy absorbing capabilities in head-on impacts (where the energy is absorbed by internal plastic cartridges) and in side-on, angled impacts where the vehicle is redirected safely.

### TECHNICAL INFORMATION

#### DIMENSIONS
- Raptor 300 length: **2460mm**
- Raptor 600 length: **2760mm**
- System Widths: **1150mm**
- System Heights: **1050mm**

#### WEIGHT
- Weight Per Shell: **110kg**

#### OTHER RESTRICTIONS / CONSIDERATIONS
- Two sizes available; Raptor 300 and Raptor 600
- The Raptor can be placed on any foundation
- The Raptor must always be parallel to the direction of travel.
- When a utility pole protected by a Raptor is impacted head on with a 900kg vehicle at 80km per hour, the impacting vehicle is brought to a controlled stop. When impacted side on at the same speed, the Raptor redirects the impacting vehicle by up to 20 degrees in a safe manner.

### COMMON FAULTS / OTHER CONSIDERATIONS

- Used when it is not economically practical to go out and relocate or remove potential hazards such as utility poles and trees.
The ArmorGuard Gate is a heavily reinforced steel barrier system that is designed to provide emergency openings in median barriers. It is suitable, as a permanent or temporary work area barrier where emergency vehicles, maintenance crews and emergency evacuation access may be needed.

The ArmorGuard Gate system is normally in the closed position. In this condition the system functions as a roadside barrier up NCHRP-350 TL-3. The system is designed to be able to be opened for incident management to allow emergency vehicle access or rerouting traffic to the other side of the highway.

### DIMENSIONS
- Unit Length: 8, 12 and 16m
- Width: 700mm
- Height: 830mm

### MINIMUM LENGTH
- 8m

### GRADE OR PLACEMENT RESTRICTIONS
- Maximum site gradient limits of 3% (1V:33H) apply to both side slope and longitudinal slopes at the proposed installation location which must be within a straight alignment.

### DEFLECTION
- Minimum in-service impact deflection of up to 0.6m should be allowed for irrespective of configuration

### OTHER RESTRICTIONS / CONSIDERATIONS
- Assembled at installation point or offsite.
- Hinges from either end, can be unpinned for complete removal.
- Must be within a straight alignment of both carriageway and median barrier.
- The maximum clear opening is 16m.

### COMMON FAULTS / OTHER CONSIDERATIONS
- Suitable as a permanent or temporary work area barrier.
- Transitions available to most median barrier systems.
- Manually operated opening system.
- The installation designer (not the system supplier) must write a standard operating procedure (SOP) for each installation to ensure safe operation of the gate. The SOP must include clear indication of the site gradients and require opening of the gate at the upslope end only, with a suitable restraint system detailed.
BARRIERGUARD 800 GATE STEEL MEDIAN GATE SYSTEM

SUMMARY

SUPPLIER: Ingal Civil Products (http://www.ingalcivil.co.nz)

TEST LEVEL / CONDITIONS: TL3. NCHRP-350 TL-3

PRODUCT MANUAL: Click for product manual download

FOR USE WITH The BarrierGuard 800 Gate Steel Median Gate System installation may only be installed between anchored BarrierGuard 800 “gate post” connecting sections transitioning to anchored lengths of BarrierGuard 800 steel median barrier or F-shape concrete median barrier.

STATUS Accepted

The BarrierGuard 800 Gate Steel Median Gate System is a steel median gate system fabricated from galvanised steel panels joined using a proprietary connection system with clear opening spans of between 6m and 30m, transitioning to anchored BarrierGuard 800 steel barrier or anchored F-shape concrete median barrier at either end. Larger openings may be permitted at the discretion of the Lead Advisor Safety (Roads & Roadsides).

The BarrierGuard 800 Gate system is a modular system made of special sections: Gate post sections, Gate hinge sections and Gate sections. Common uses for the gate system include: emergency vehicle access, work area access, contraflow opportunities and controlled access points.

TECHNICAL INFORMATION

DIMENSIONS

Unit Length: 6m or 12m

Width: 540mm

Height: 800mm

WEIGHT

1080kg per 12m section

MINIMUM LENGTH

6m

GRADE OR PLACEMENT RESTRICTIONS

BarrierGuard 800 Gate should not be installed where there are ditches or kerbs that may affect operation of the gate. It is recommended that the gate is installed on straight sections but slight curves can be accommodated.

The BarrierGuard 800 Gate works on slopes, but it is recommended that the cross fall does not exceed 2.5% to allow controlled manual operation. (Back to front not to vary more than 2%.)

Maximum site gradient limits of 3% (1V:33H) apply to both side slope and longitudinal slopes at the proposed installation location which must be within a straight alignment.

DEFLECTION

1.19M (NCHRP 350 TEST LEVEL 3 (2,000 KG AT 100 KM/H AND 25°).

OTHER RESTRICTIONS / CONSIDERATIONS

- All installations require site specific acceptance on a case-by-case basis from the National Traffic & Safety Manager to ensure safe operation.
- Standard metric gate lengths are 6m, 12m, 18m, 24m, 30m and 36m. These gate sizes provide openings of 4.67m, 10.67m, 16.67m, 22.67m, 28.67m and 34.67m respectively.
COMMON FAULTS / OTHER CONSIDERATIONS

- The BarrierGuard 800 Gate can be utilised as a permanent or temporary application.
- The BarrierGuard 800 Gate can be impacted from either side of the barrier with no difference in performance levels. Therefore, the barrier can be used in both median and road side situations in either orientation.
- Both ends of the F-shape concrete median barrier (attached to the gate system) must have base thickening and additional end reinforcement to tolerate the anchorage loads imposed by an impact with the gate system.
- To speed up installation time, it is recommended that as many BarrierGuard 800 Gate sections as possible, are pre-assembled before delivery to site.
- Drive-by system inspections are recommended at least monthly, and hands-on inspections are recommended at least yearly.
- The installation designer (not the system supplier) must write a standard operating procedure (SOP) for each installation to ensure safe operation of the gate. The SOP must include clear indication of the site gradients and require opening of the gate at the upslope end only, with a suitable restraint system detailed.
The Ironman Median Gate is a steel median gate system comprising up to five unanchored Ironman barrier units with hinge units and fully pinned transitions to anchored concrete median barrier at each end. It meets TL-2 and TL-3 test requirements as a longitudinal redirecting barrier. The Ironman Median Gate provides a method for emergency access or construction access in long stretches of concrete median barriers.

The Ironman Median Gate uses a vertical steel pivot pin to interlink each module allowing the system to follow curves of up to 6° per 4m segment.

### TECHNICAL INFORMATION

#### DIMENSIONS

- **Unit Length:** 4m, 8m or 12m
- **Width:** 530mm
- **Height:** 820mm

#### WEIGHT

- 400kg (4m Length) 800kg (8m Length) 1200kg (12m Length)

#### MINIMUM LENGTH

4m

#### GRADE OR PLACEMENT RESTRICTIONS

Maximum site gradient limits of 3% (1V:33H) apply to both side slope and longitudinal slopes at the proposed installation location which must be within a straight alignment.

#### DEFLECTION

Impact deflection of up to 0.6m

#### OTHER RESTRICTIONS / CONSIDERATIONS

- The maximum length of any Ironman Median Gate System installation is 25.31m with a clear opening of 20.57m (5 unit configuration).
- The Ironman can be deployed as a free standing system or used with a range of end treatments.

### COMMON FAULTS / OTHER CONSIDERATIONS

- All installations require site specific acceptance on a case-by-case basis from the National Traffic & Safety Manager to ensure safe operation.
- Both ends of the F-shape concrete median barrier must have base thickening and additional end reinforcement to tolerate the anchorage loads imposed by an impact with the gate system.
- The F-shape barrier installation must be integral with, or structurally connected to, the concrete anchor foundations for the Ironman Median Gate steel transition sections.
- The installation designer (not the system supplier) must write a standard operating procedure (SOP) written for each installation to ensure safe operation of the gate. The SOP must include clear indication of the site gradients and require opening of the gate at the upslope end only, with a suitable restraint system detailed.
NZTA SEMI-RIGID TO RIGID THRIE-BEAM TRANSITION

SUMMARY

SUPPLIER: Open source – no specific supplier
TEST LEVEL / CONDITIONS: TL4. NCHRP-350 TL-4
FOR USE WITH Transition from W-Beam (semi-rigid) barrier to Thrie-Beam (semi-rigid) or concrete (rigid) barrier
STATUS Accepted

The RSB-5 Thrie-Beam Transition provides transition from a W-Beam (semi-rigid) to Thrie-Beam (semi-rigid) or Concrete (rigid) barrier in median and side protection situations, such as approaching a bridge structure or sign gantry.

TECHNICAL INFORMATION

OTHER RESTRICTIONS / CONSIDERATIONS

- The transition advice (above) should be followed unless approval of any alternative solution has been given by the National Traffic & Safety Manager.
- The rigid barrier for a median system must extend beyond the hazard (e.g. bridge pier or gantry leg) by a minimum of 18m in both directions.
- The minimum transition length for W-Section to concrete is 10.0m.
- All transition posts to be steel with modified blockouts as per NZ Transport Agency drawing B3.
- Where proper post embedment cannot be achieved, standard ‘I’ beam bridge steel posts on steel base plates (as per Appendix B NZ Transport Agency Bridge Manual) can be bolted to a concrete beam.
- Thrie-Beam rail & post bolt holes are to be at 1000mm centers.
- Post 7 & 8 need to have backing pieces.
- Trailing transitions installed on roads divided by median barrier may have the ENTIRE nested Thrie-Beam section with posts 1 thru 6 omitted.
- Thrie-Beam structure connector to be fixed using 6 x grade 8.8/S M24 bolts through 30mm diameter holes in concrete barrier with a full bolt pattern backing plate (16mm thick 250MPa PL) for cast-in bracket, refer to NZ Transport Agency standard detail B8-3.
- For Thrie-Beam across structures refer to NZ Transport Agency drawing B3.

COMMON FAULTS / OTHER CONSIDERATIONS

- On State Highway projects where the design guidance given above cannot be applied for any particular reason, the proposed solution and supporting rationale should be referred to the local NZTA Principal Safety Engineer for resolution or escalation.
**WIRE ROPE SAFETY BARRIER (WRSB) TRANSITIONS**

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**Drawing RSB-7a - Wire Rope Safety Barrier (WRSB) to W-Beam for shoulder/verge**

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**Drawing RSB-7b - Wire Rope Safety Barrier (WRSB) to Concrete (rigid) barrier for shoulder/verge**

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**Drawing RSB-7c - Wire Rope Safety Barrier (WRSB) to Concrete for a median installation**

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**SUMMARY**

<table>
<thead>
<tr>
<th>SUPPLIER:</th>
<th>Open source – no specific supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST LEVEL / CONDITIONS:</td>
<td>TL3. NCHRP-350 TL-3</td>
</tr>
<tr>
<td>FOR USE WITH</td>
<td>Transition from a wire rope safety barrier (WRSB) to a W-Beam (semi-rigid) or Concrete (rigid) barrier</td>
</tr>
<tr>
<td>STATUS</td>
<td>Accepted</td>
</tr>
</tbody>
</table>

The Wire Rope Safety Barrier (WRSB) transition provides transition from a WRSB to a W-Beam (semi-rigid) or Concrete (rigid) barrier in median and side protection situations, such as approaching a bridge structure or sign gantry.

The problem of transitioning from flexible barrier systems (WRSB) to rigid barrier systems is commonly encountered where structural elements, such as bridge parapets/piers or gantry supports, are placed in close proximity to the travelled way, either in a median of shoulder/verge situation.
The recommended practice for the following situations is given below:

**Shoulder/Verge:**
- Wire Rope Safety Barrier (WRSB) to W-Beam
- Wire Rope Safety Barrier (WRSB) to Concrete (rigid) barrier

**Median:**
- Wire Rope Safety Barrier to Concrete

### TECHNICAL INFORMATION

<table>
<thead>
<tr>
<th>OTHER RESTRICTIONS / CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The transition advice (above) should be followed unless approval of any alternative solution has been given by the National Traffic &amp; Safety Manager.</td>
</tr>
<tr>
<td>• The point of redirection of the WRSB median system must be positioned to provide protection for an errant vehicle departure angle of 15°.</td>
</tr>
<tr>
<td>• The rigid barrier for a median system must extend beyond the hazard (e.g. bridge pier or gantry leg) by a minimum of 18m in both directions.</td>
</tr>
<tr>
<td>• Initial 825mm offset from the rigid barrier system and the WRSB system</td>
</tr>
</tbody>
</table>

### COMMON FAULTS / OTHER CONSIDERATIONS

- On State Highway projects where the design guidance given above cannot be applied for any particular reason, the proposed solution and supporting rationale should be referred to the local NZTA Principal Safety Engineer for resolution or escalation.
**CURVED BARRIER INSTALLATIONS**

**CURVED W-BEAM GUARDRAIL TERMINAL (RSB2, RSB2A)**

**SUMMARY**

| SUPPLIER: | Open source – no specific supplier |
| TEST LEVEL / CONDITIONS: | TL3. NCHRP-350 TL-3 |
| FOR USE WITH | Transition from a wire rope safety barrier (WRSB) to a W-Beam (semi-rigid) or Concrete (rigid) barrier |
| STATUS | Accepted |

The RSB-2 curved W-Beam guardrail terminal is installed for curved W-Beams with radii between 5m, 10m, 15m, 20m and 25m. This design has been developed from crash tested systems and is acceptable for new installations, as well as for improving safety at existing sites. These designs are most appropriate for use on low volume highways.

Side roads or driveways commonly intersect a highway close to the end of a bridge or other immovable, restrictive feature. To shield both the end of the bridge and the steep embankment, a strong post W-Beam guardrail curved around the radius is typically used.

Often, these installations have not been effective when the curved section of the barrier has been impacted at higher speeds. A vehicle which impacts the barrier under such conditions will generally vault over or penetrate the guardrail; or, in the event that the vehicle is contained by the guardrail, the resulting decelerating forces often exceed the recommended limits for occupant safety. In many of these situations, it is not practical to change the site conditions by relocating the intersecting roadway further away from the bridge end in order to allow room for a standard approach guardrail. Therefore, a curved guardrail installation which would substantially improve the safety at these sites is required.
The RSB-2A curved W-Beam guardrail is a continuous guardrail variation of the RSB-2 where the radius is less than 25m.

### TECHNICAL INFORMATION

| DIMENSIONS       | Curved W-beam radii: 5m, 10m, 15m, 20m, 25m  
|                  | Post Spacing: **1905mm** centres  |
| GRADE OR PLACEMENT RESTRICTIONS | The approach grading is **10H:1V** or flatter, and is to be maintained free of obstructions.  |
| CLEAR AREA       | A minimum clear area of **22m X 6m** with a maximum slope of 6H:1V is to be provided behind the curved rail.  |
| OTHER RESTRICTIONS / CONSIDERATIONS |  
  - A substandard clear area area requires the approval of the Road Controlling Authority. For State Highways this is the NZTA Regional Safety Engineer.  
  - Factory (or “shop”) curved W-Beam guardrail is to be used for all curved guardrail elements.  
  - Sight distances must be maintained in accordance with the Austroads Guide to Road Design.  
  - These designs are most appropriate for use on low volume highways.  
  - Where the approach speed on the side road is exceeds 70km/h, accepted Test Level 3 end terminals should be installed where practicable.  
  - The location of the 3 apex posts depend on the most likely directions of impact.  |

### COMMON FAULTS / OTHER CONSIDERATIONS

- The standard detail given for RSB-2/ RSB-2A is applicable to non-proprietary timber post semi-rigid W-Beam barrier systems only. For proprietary semi-rigid guardrail systems, refer to the manufacturer to confirm if equivalent NZ Transport Agency accepted details are available.
- The rail at the apex posts is not bolted through, but sits on shelf angles to maintain the correct height.