

RamShield®

MASH TL3 Guardrail



SafeDirection
CRASH BARRIER SOLUTIONS

PM 020/06

safedirection.com.au



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Leading Safety

Successfully crash tested to MASH Test Level 3

Complies with AS/NZS 3845.1:2015 Road safety barrier systems and devices

Crash tested at rail heights of between 730mm and 820mm

Crash tested for bi-directional impacts

No debris from system on impact

Low Deflection

Lower deflection than cable barrier systems

Compatibility

Compatible with the MASH compliant SKT guardrail end terminal

Standard 2m post spacing

Fast Assembly

Fewer parts

Simple rail to post bolt alignment

Stiff driving post

Narrow Geometry

Just 180mm system width

Motorcycle Friendly

Post is set lower than rail to eliminate snag point

No exposed edges on the post

Available with BIKER-SHIELD™ Motorcycle Barrier





1.0 Introduction

RAMSHIELD® is the latest innovation and advancement in w-beam guardrail barrier designs. Developed by Safe Direction, RAMSHIELD® has been full-scale crash tested to MASH Test Level 3.

Providing a forgiving roadside environment reduces the consequences for vehicles leaving the safe, travelled way. Hazards such as trees, utility poles, culverts and embankments are often located adjacent to roadways and relocating them is often impractical. In these instances, shielding with a longitudinal safety barrier, such as RAMSHIELD® is the most appropriate solution.

W-beam barrier designs have developed over the years and are used to safely contain and re-direct errant vehicles away from nearby hazards. Safety barriers reduce the severity of run-off-the-road crashes and have made a significant contribution to the safety of our region's roads.

RAMSHIELD® has significantly advanced the containment level of w-beam guardrail by introducing patented technology into the behaviour of the post during impact. This results in a safer barrier design with fewer components allowing more metres of barrier to be deployed per public dollar to protect Australian motorists.

2.0 Specifications

Compliance:	MASH Test Level 3
	AS/NZS 3845.1:2015
Standard post length:	1560mm
System width:	180mm
Standard Post spacing:	2.0m centres
System mass:	19kg/m
System deflection (MASH TL3):	1.56m
Material:	350Mpa yield steel
System Finish:	Hot dip galvanised to AS/NZS 4680



3.0 How RAMSHIELD® Works

RAMSHIELD® achieves a controlled redirection of errant vehicles by releasing the rail from the post at an optimal load to retain rail height, limit dynamic deflection and to allow the post to collapse without tripping the vehicle.

The separation of the rail from the post is achieved by a release tab incorporated into the post. The tab is designed to pull forward and tear from the post and remains connected to the rail to ensure there is no debris from the system that may otherwise present as a danger to other motorists.

RAMSHIELD® uses standard w-beam guardrail and standard fasteners meaning there is very little risk of inadvertent use of non-compliant items.

The posts have been designed to collapse upon impact yielding proximate to the ground surface. This distinguishes RAMSHIELD® from heavier post systems which rely on the post rotating in the ground prior to collapse. The post collapsing near the ground surface ensures more reliable performance that is not as dependent on soil conditions. Moreover the collapse mechanism of the post makes RAMSHIELD® suitable for use in concreted mowing strips and/or deep asphalt applications which are problematic to the performance of heavier post systems.

The working mechanism of RAMSHIELD® is a patented concept designed and developed by Safe Direction. The concept is the latest innovation in guardrail design and sets a new benchmark in simplicity and performance.



Figure 1: Front view of RAMSHIELD post



Figure 2: Release tab maintains rail elevation



Figure 3: Controlled release of rail during impact

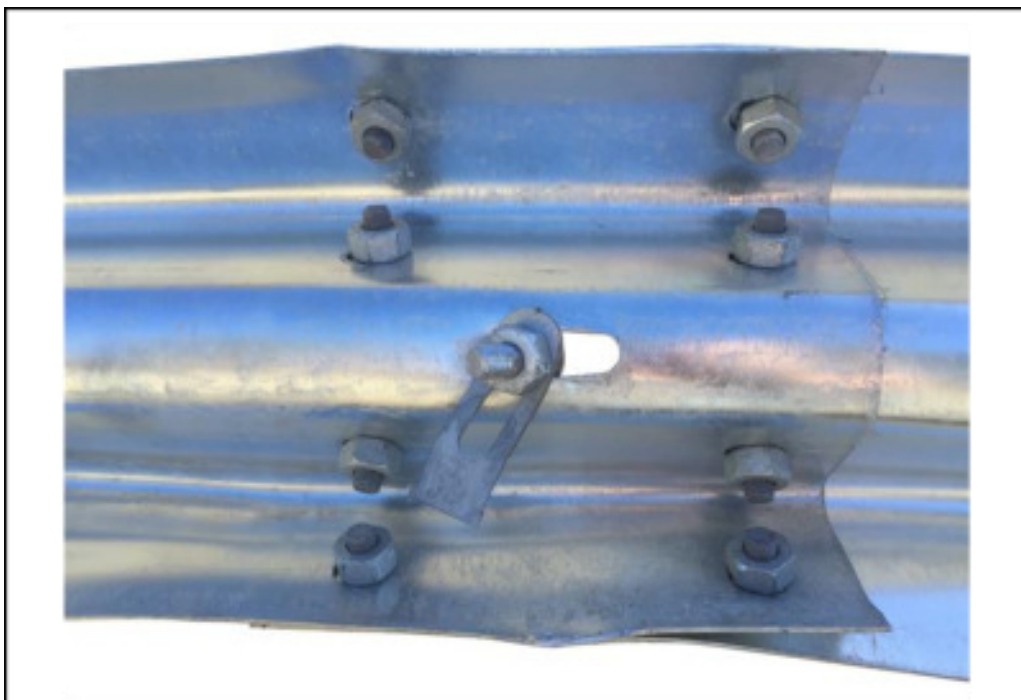


Figure 4: Release tab remains attached to back of rail



4.0 Crash Test Performance

RAMSHIELD® has been fully crash tested and evaluated according to the specifications for Test Level 3 (TL3) of the AASHTO Manual for Assessing Safety Hardware (MASH). The MASH specification is an update to and supersedes NCHRP Report 350 for the purposes of evaluating new safety hardware devices.

MASH is also the basis of testing procedures for road safety systems as stated in *AS/NZS 3845.1: 2015 Road Safety Barrier System and Devices*.

The MASH TL3 crash test matrix requires the following impacts;

- 2270kg pick-up travelling at 100km/h and 25°, and
- 1100kg car travelling at 100km/h and 25°.

In addition, RAMSHIELD® has been crash tested with a Commodore to reflect local driving conditions as follows;

- 1700kg car travelling at 110km/h and 25°.

This impact was performed using standard length posts positioned 200mm (measured from back of post) to a 2H:1V embankment representing a 'worst practical condition' for a roadside barrier impact.





5.0 Design Considerations

5.1 Advance Grading

It is recommended that the area in advance of RAMSHIELD® be limited to a grading of 10H:1V to ensure that the vehicle's suspension is neither extended nor compressed at the moment of impact with the barrier.

5.2 Clearance to Hazards

The system should be installed with sufficient clearance behind the barrier to allow for the expected deflection of the system.

System deflection is dependent upon vehicle mass, speed and angle of impact. The 1.56m deflection result recorded when impacted with a 2270kg pick-up truck travelling at 100km/h and 25 degrees represents 'worst case impact scenario'.

RAMSHIELD® may be stiffened in advance of a hazard by reducing post spacing. Please consult with Safe Direction for expected barrier deflection for various impact speeds and/or post spacing.

5.3 Adjacent to Batter Slope

State road agency guidelines provide recommended distances for the installation of guardrail barriers adjacent to an embankment slope.

These distances are typically in the range of 400mm to 600mm measured from the rear of the post to the embankment rounding point. Where possible, the guidelines published by State Road Agencies should be followed for the installation of RAMSHIELD®.

RAMSHIELD® has been successfully evaluated when installed 200mm (measured from the back of the post) to the rounding point of a 2H:1V embankment slope. This impact was performed with a 1700kg Commodore travelling at 110km/h and 25 degrees.

5.4 System Installed Height

RAMSHIELD® has been crash tested at an installed rail height of between 730mm and 820mm above ground level.

A rail height of 800mm \pm 20mm above ground level provides compatibility with MASH compliant end terminals such as the MSKT.

In addition, setting the rail at a height of 820mm, combined with the adjustment available in the post slot, provides consideration for up to 100mm of future asphalt overlays.

5.5 Kerbs

Placing kerbs in front of w-beam guardrail on highspeed roads is not recommended. As an alternative, a mountable type kerb in front of the barrier or subsurface grated drainage should be considered.

If installed behind a kerb, it is recommended that the rail height of RAMSHIELD® be installed at 800mm, measured from top of kerb.

5.6 Placement in Rock or Deep Lift Asphalt

The performance of RAMSHIELD® differs from traditional w-beam barrier designs. Traditional posts will absorb some crash energy through post rotation in the surrounding soil prior to fully yielding. Setting these posts in deep lift asphalt or rock may compromise the performance of the system.

A RAMSHIELD® post yields in stiff soils by bending near ground level. This yielding behaviour is suitable for installations in rock or deep lift asphalt.

The RAMSHIELD® post may be driven directly into deep lift asphalt and/or placed within a narrow hole and backfilled.



5.7 Shy Line Offset

Drivers tend to reduce speed or laterally move their vehicles away from a road safety barrier if it is within close proximity to the edge of the travelled way.

The distance from the edge of the travelled way beyond which a safety barrier will not be perceived as an immediate hazard by the typical driver is known as the shy line offset. Recommendations for the shy line offset are contained in Table 1.

Table 1: Shy Line Offset

Design Speed (km/h)	Shy Line Offset (m)
50	1.1
60	1.4
70	1.7
80	2.0
90	2.2
100	2.4
110	2.8

Source: Austroads Design Guide 6.4

5.8 Flaring

Motorists are less likely to perceive roadside barriers to be a hazard if the barrier is introduced gradually to the roadside environment through the use of a 'flare'. The flare rate is the ratio of the length of the flared part of the barrier (measured parallel to the road) to the barrier offset.

Flaring the safety barrier system provides the following benefits;

- The end terminals can be positioned further from the travelled path reducing the potential for a head-on impact;
- The shy line effects where a hazard is close to the travelled path is minimised; and
- Flaring provides a gradual transition to a major hazard close to the roadway (such as a bridge parapet or railing).

The maximum flare rates that should be used on an approach to a road safety barrier are shown in Table 2. Following the guidelines of Table 2 ensures that the flare does not significantly increase the opportunity for high-angle impacts with the barrier.

Table 2: Flare Rate

Design Speed (km/h)	Flare Rate (within Shy Line Offset)	Flare Rate (outside Shy Line Offset)
50	13:1	7:1
60	16:1	8:1
70	18:1	10:1
80	21:1	11:1
90	24:1	12:1
100	26:1	14:1
110	30:1	15:1

Source: Austroads Design Guide Table 6.5

The flare rate for end terminals may vary from those contained in Table 2. Please refer to specific Product Guides for allowable flare rates for end terminals.



5.9 End Terminals

End terminals are designed to anchor the w-beam guardrail system and introduce the necessary tensile and flexural strength required for safe vehicle containment and re-direction throughout the length-of-need section.

Some guardrail end terminals also provide the additional feature of reducing the severity of an impact near or at the end of the system.

It is recommended that RAMSHIELD® be anchored at the leading and trailing end of the installation with MASH compliant end terminals, such as the MSKT.

The MSKT is an energy-absorbing tangential end terminal, designed to minimise the severity of impacts occurring at the end of the safety barrier system.

5.10 The Point-of-Need

RAMSHIELD® is designed to safely contain and re-direct errant vehicles away from roadside hazards. The point-of-need is the location where the barrier system becomes re-directive.

The point-of-need is typically dependent upon the end terminal selected to anchor the RAMSHIELD® system.

The point-of-need of a MSKT terminal is post location 3, a distance of 3.81m downstream from the start of the terminal.





5.11 Transitioning to a Rigid Barrier

Since the stiffness properties vary between a semi-rigid and rigid barrier, a specially designed transition is required when connecting RAMSHIELD® to a rigid barrier.

The transition gradually increases the lateral stiffness of the w-beam guardrail barrier and reduces the potential for vehicle pocketing at a connection with a rigid barrier, such as concrete.

RAMSHIELD® posts are not to be used for the assembly of the transition.

Transition designs are contained within state road agency guidelines and vary from state to state. Transitions often incorporate the use of thrie-beam (triple corrugation rail) and/or a reduction in post spacing.

5.12 Installation on Curves

W-beam guardrail barriers perform well on the outside of curves, even those of relatively small radius, as the concave shape (in plan view) supports the development of tension in the w-beam rail.

In the field, straight sections of w-beam can be used to form a radius of 45m or greater. When a radius of less than 45m is required, the w-beam rails are required to be factory curved. For ordering purposes, the orientation of curvature (i.e. concave or convex) and the radius is required by the manufacturer.

Refer to Section 13.0 for guidance on measuring curvature.

5.13 Bi-Directional Impacts

Full-scale crash testing has demonstrated that the tab release mechanism of RAMSHIELD® is not dependent upon post orientation.

This makes RAMSHIELD® a suitable solution for installation on undivided roadways where reverse direction impacts are likely.

5.14 Minimum Installation Length

The crash tested lengths of RAMSHIELD® are not meant to reflect minimum installation lengths. It is a requirement under the MASH standard to crash test long installation lengths and minimise the influence of the end terminal in providing safe containment and redirection. This is regarded as 'worst case impact scenario'.

MASH compliant end terminals, such as the MSKT are evaluated for re-directional impacts with a 2270kg pick-up travelling at 100km/h and 25 degrees. The MSKT demonstrated safe vehicle containment and redirection within the terminal section. Therefore a minimum installation may comprise back-to-back guardrail terminals.

It is recommended, where space permits, to install continuous safety barrier rather than designing a barrier to shield a specific hazard(s). A continuous safety barrier aims to protect the entire roadside and prevent vehicle rolling, impacts with hazards or head-on collisions.





5.15 BIKER-SHIELD™

BIKER-SHIELD™ is a motorcyclist safety barrier system designed to reduce the impact severity for riders when colliding with a roadside w-beam guardrail barrier.

BIKER-SHIELD™ is positioned below the RAMSHIELD® w-beam guardrail panel and prevents a dismounted motorcyclist from contacting the supporting posts of the guardrail barrier.

BIKER-SHIELD™ provides safe rider containment and redirection through the combination of spring mounting brackets and lightweight, corrugated beams. The spring brackets attach directly to the w-beam guardrail mid-span between posts and absorb the impact energy of the sliding rider.

The position of BIKER-SHIELD™ beneath the w-beam guardrail prevents rider contact with the posts and provides forgiving containment and redirection.

The BIKER-SHIELD™ mounting bracket position is an important design consideration as vertical alignment with the face of the w-beam guardrail reduces the potential for rider snagging.

BIKER-SHIELD™ has been crash tested and evaluated in accordance with the European Technical Specification EN1317-8. This crash test procedure is nominated in AS/NZS 3845.1:2015 Road safety barrier systems and devices.

In addition, BIKER-SHIELD™ has been crash tested in accordance with MASH Test Level 3 when attached to RAMSHIELD® demonstrating that safe vehicle containment and redirection is unaffected when installed with BIKER-SHIELD™.



6.0 Component Identification



RAMSHIELD® Post



M16 x 32mm Bolt

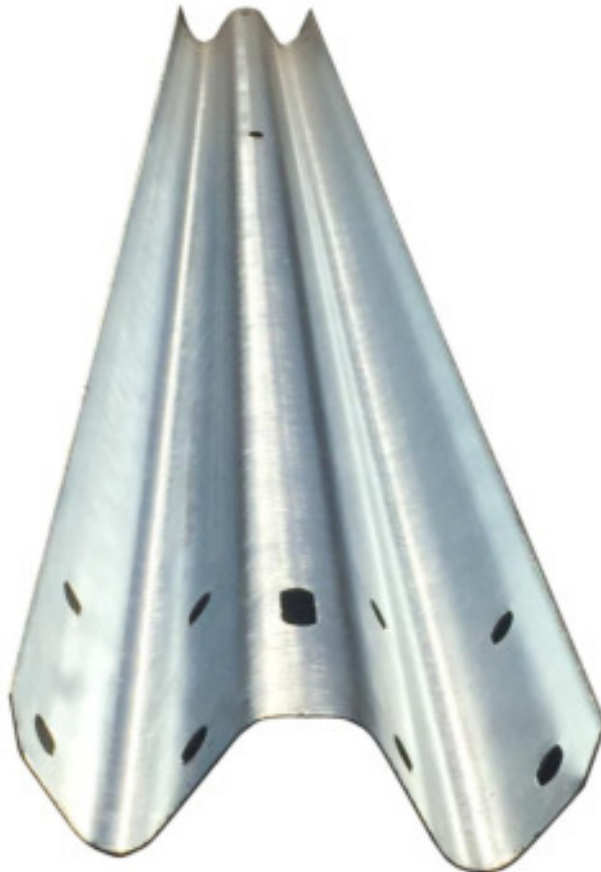


M16 Standard Nut



M16 Oversize Nut

W-Beam Guardrail



Delineator



7.0 Tools Required

Tools required for the installation of RAMSHIELD® are the same as those used for the installation of public domain guardrail. This includes;

- Post driving equipment or auger;
- Air compressor;
- Pneumatic drill driver with 32mm attachment;
- Hand socket with 24mm attachment;
- Metal snips;
- String line;
- Tape measure;
- Hammer;
- 12mm diameter pinch bar; and
- Slings or chains.

7.1 Recommended PPE

It is recommended that the following personal protective equipment (PPE) be provided for the safe installation of RAMSHIELD®;

- Safety footwear;
- Gloves;
- Hearing protection;
- High visibility clothing; and
- PPE as required for the use of post driving equipment or auger.

8.0 Site Establishment

8.1 Traffic Control

Prior to the commencement of any work, the site should be evaluated for risks to workers, pedestrians and other road users. The establishment of traffic control should provide safe travel for passing vehicles and/or pedestrians and appropriately protect workers near the roadside.

8.2 Underground Services

The installation of RAMSHIELD® requires the supporting posts to be embedded into the ground. Prior to the installation of posts an investigation for potential underground hazards is recommended.

8.3 Overhead Obstructions

The site should be evaluated for potential overhead obstructions that may present a risk during the installation process. These obstructions typically include power lines, signage or trees.

8.4 Unloading Exclusion Zone

Only appropriate load-rated slings or chains should be used for safe unloading. It is recommended that an exclusion zone be maintained around the unloading process. This provides distance between moving machinery and workers in the event that goods or the machinery move unexpectedly.

Unloading and the storing of the product on a level surface is recommended. Storing product adjacent to the installation area eliminates the requirement for workers to carry items over long distances.

9.0 Installation Sequence

The major steps in the installation of RAMSHIELD® are as follows;

- Set-out;
- Installing the approach terminal;
- Installing the RAMSHIELD® posts;
- Attachment of the w-beam guardrail;
- Installing the departure terminal or transition to rigid barrier; and
- Attachment of delineation (if required).

10.0 Set-Out

It is recommended that a string line be used to establish the alignment of the post locations. When establishing the post locations, take care to note the following;

- RAMSHIELD® does not use offset blocks. The width of the system is just 180mm.
- The standard post spacing of RAMSHIELD® is 2.0m;
- The 2.0m post spacing of RAMSHIELD® may differ from the post spacing of the end terminals or transitions.
- The system width of RAMSHIELD® may differ from the system width of the end terminals and transitions.
- The RAMSHIELD® posts are not to be installed within the terminal or transition region.



11.0 Post Installation

Potential Hazards: Use of post driving equipment or auger, contact with underground hazards, excessive noise, hand injury from pinch points and injury from movements and posture.

Recommended Control Measures: Observe the safe work instructions as per machinery requirements, ensure the area has been inspected for underground hazards, wear appropriate hearing protection, wear gloves and observe correct techniques when lifting (bend at the knees).

The posts may be installed by;

- Driving with an appropriate driving head to the required depth, approximately 810mm, or
- Auguring a minimum 200mm diameter hole approximately 810mm deep, placing the post in the hole and backfilling. The backfill material is to be placed in 150mm lifts and compacted with tamping equipment.

Once installed, the top of the post should measure 750mm above ground level.

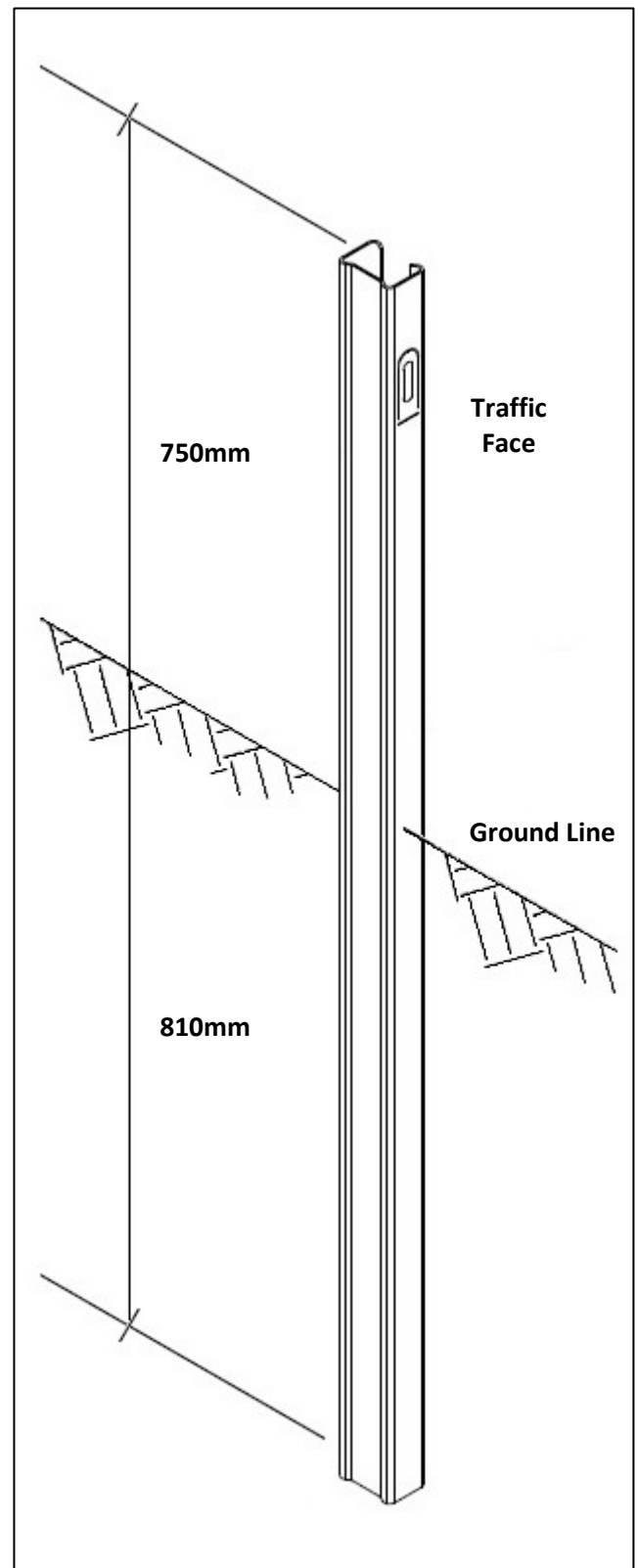


Figure 2: Post Installation

11.1 Post Orientation

RAMSHIELD® posts are installed with the release tab positioned on the traffic side of the barrier. The system has been crash tested for bi-directional impacts. When installed on an undivided roadway with 2-way traffic, the posts are orientated as shown in Figure 6.

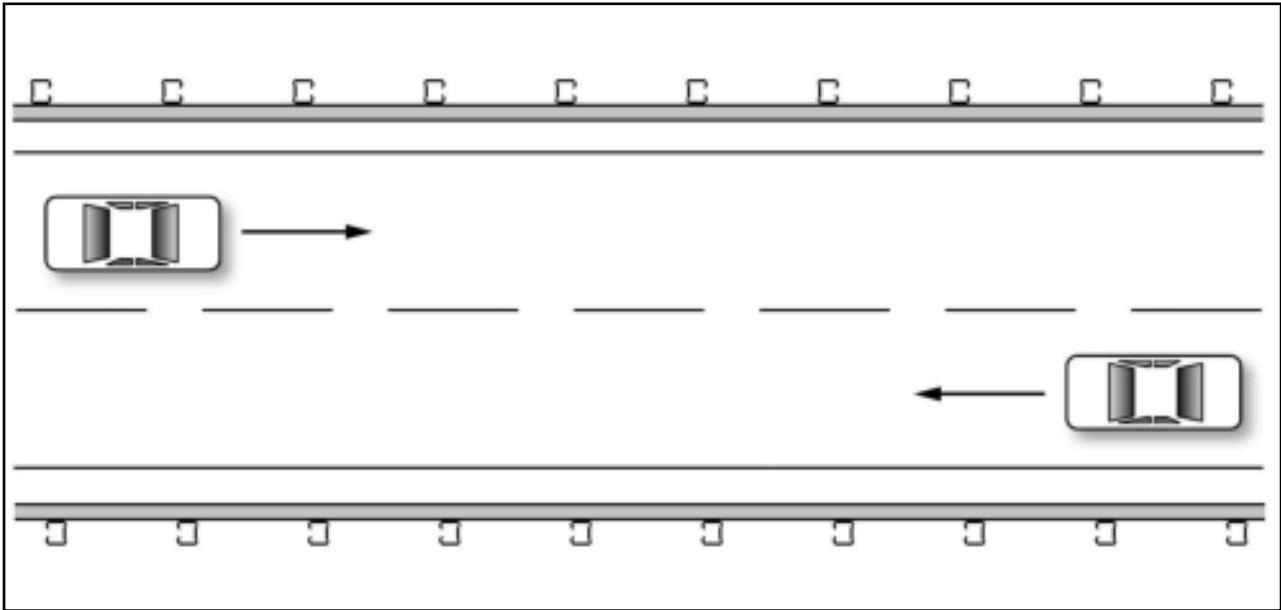


Figure 3: RAMSHIELD® Post Orientation for 2-Way Traffic

When the RAMSHIELD® posts are installed on a divided roadway i.e. 1-way traffic, the posts are orientated as shown in Figure 7.

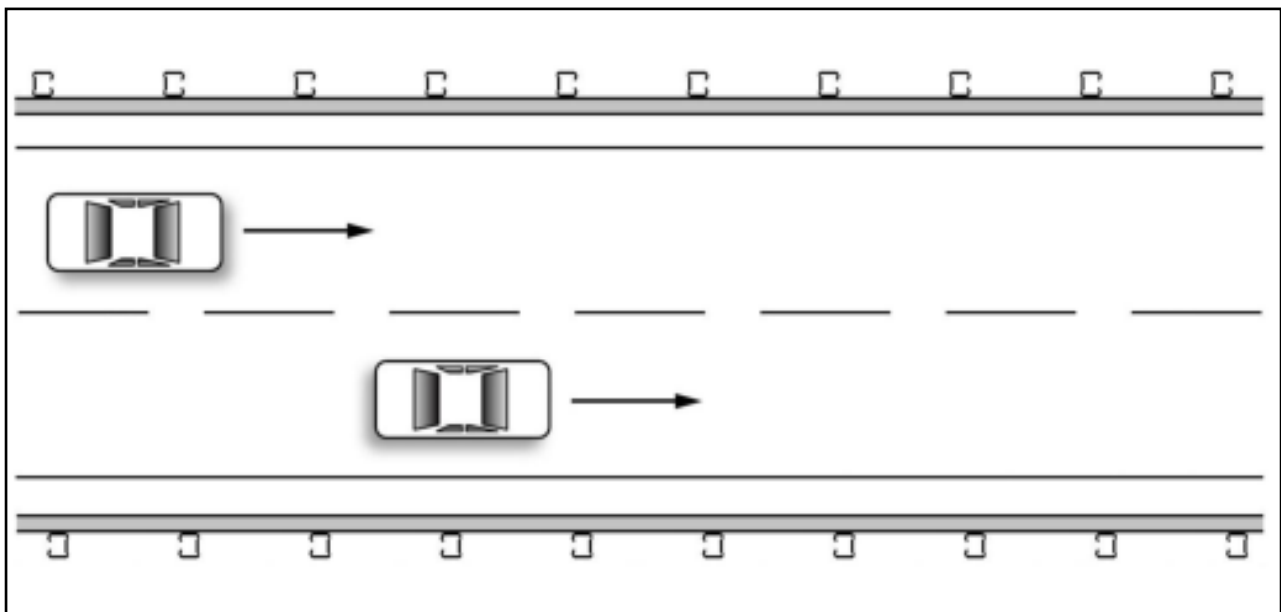


Figure 4: RAMSHIELD® Post Orientation for 1-Way Traffic

12.0 Attaching the W-Beam Rails

Potential Hazards: Injury from movements and posture, hand injury from pinch points, strain to wrists from tightening bolts and excessive noise from use of impact driver.

Recommended Control Measures: Observe correct techniques when lifting rails (bend at the knees), wear gloves, use a pinch bar to align holes, use an impact drill to tighten bolts and wear appropriate hearing protection.

Standard 4m w-beam guardrails are used throughout the RAMSHIELD® system. The rails are secured to the posts using a M16 x 32mm mushroom head bolt and standard nut. The standard nut is tightened using a hand socket and 24mm attachment.

The guardrail lap is orientated so that the leading edge of the splice is shielded from the nearside approaching traffic. Rails are spliced together using eight (8) standard M16 x 32mm mushroom head bolts and oversize nuts. The oversize nuts are tightened using a pneumatic drill driver and 32mm attachment.

The use of a pinch bar will assist in aligning the splice holes as the bolts are inserted. The use of a driving pin to elongate the splice holes is NOT permitted.

There is no torque requirement for the tightening of the post bolts or splice bolts. They should be tightened to a snug position.

Once secured to the posts, the finishing height of the guardrail will be approximately 50mm above the top of the posts.

Note: A M16 x 50mm mushroom head bolt may be used as an alternative to secure the rails to the posts.



13.0 Curving of W-Beam Rails

W-beam guardrail barriers perform well on the outside of curves, even those of relatively small radius, as the concave shape (in plan view) supports the development of tension in the w-beam rail.

In the field, straight sections of w-beam can be used to form a radius of 45m or greater. When a radius of less than 45m is required, the w-beam rails are required to be factory curved.

For ordering purposes, the orientation of curvature and radius is required. Alternately, providing the chord length (C), the height of rise (H) or angle (ϕ) will allow Safe Direction to calculate the radius of curvature.

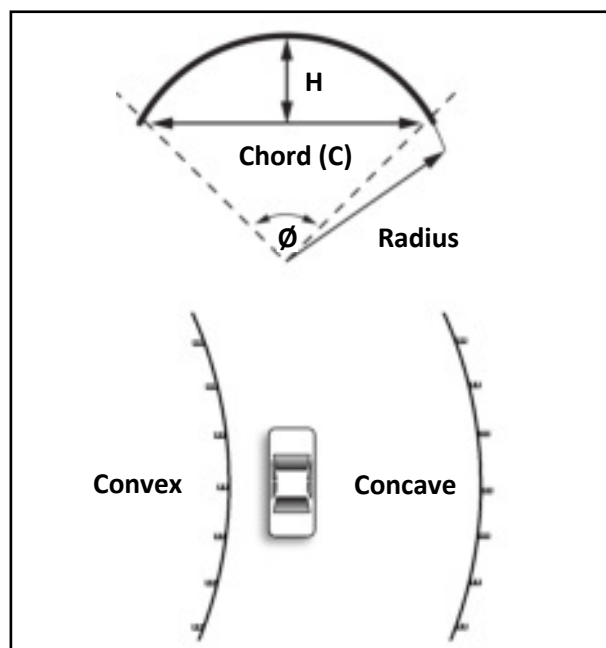


Figure 5: Curving Orientation



14.0 Installation Tolerances

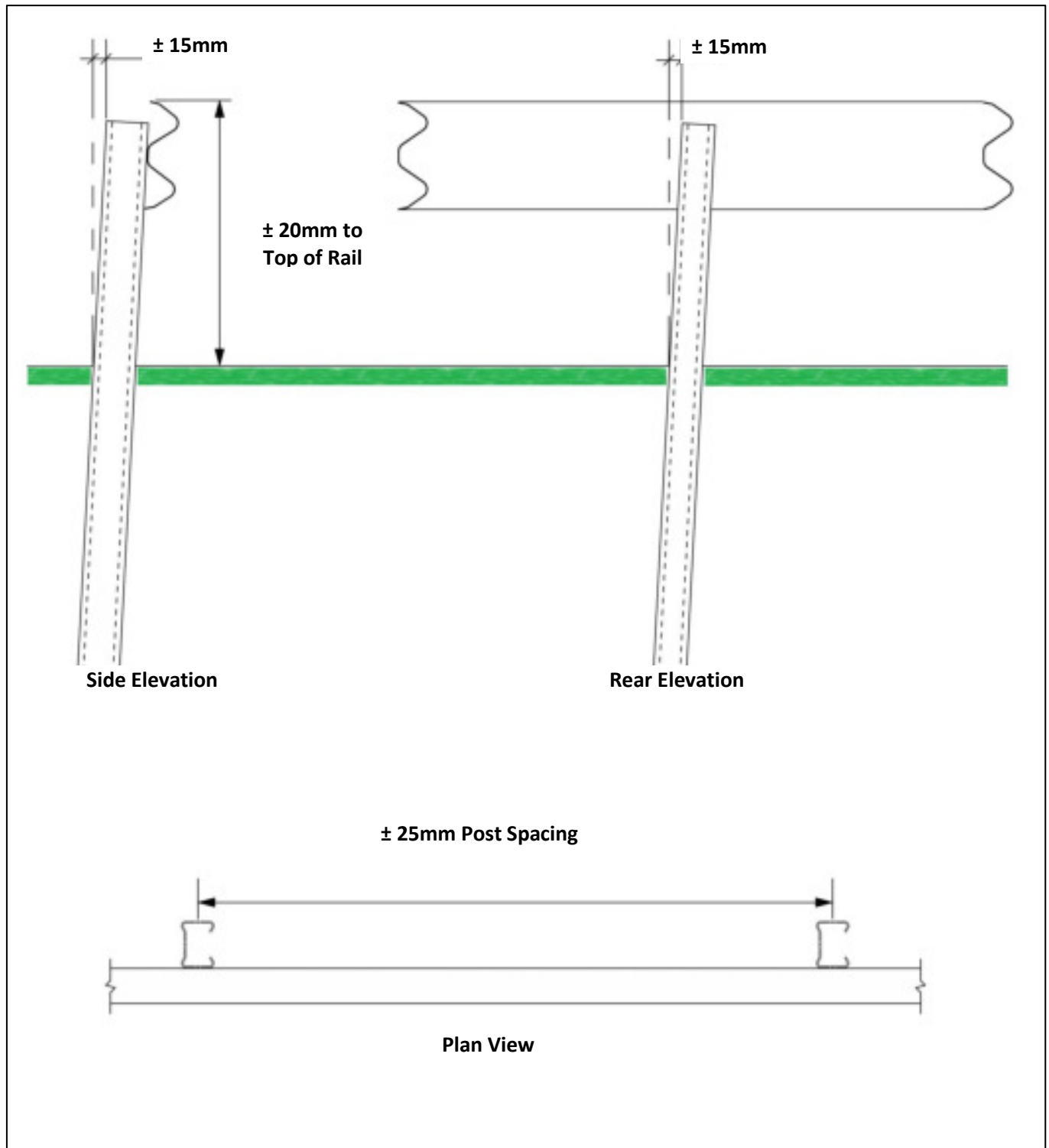


Figure 6: Installation Tolerances

15.0 Delineation

The spacing of delineators is variable and takes into consideration line of sight (curves) and location of other hazards e.g. culverts.

For motorcyclist safety the RAMSHIELD® delineator is manufactured from impact resistant nylon, fitted with a recessed retro reflective tape and rounded corners.

The delineator is secured to the web of the post with two (2) M6x25mm B/N/W and orientated so that drivers will see;

- Red retro-reflectors on their left;
- White retro-reflectors on their right on a two-way carriageway, and
- Yellow retro-reflectors on their right on one-way carriageways and medians separating traffic in opposing directions.





RAMSHIELD® Inspection Form

Inspection Date	
Client	
Project Reference	
Name of Inspector	
Company	

<input type="checkbox"/> Yes <input type="checkbox"/> No	The system is suitably anchored with approved state road agency end terminals.
<input type="checkbox"/> Yes <input type="checkbox"/> No	The posts are spaced at maximum 2.0m centres.
<input type="checkbox"/> Yes <input type="checkbox"/> No	The height measured to the top of the posts is 750mm ± 20mm.
<input type="checkbox"/> Yes <input type="checkbox"/> No	The posts are correctly orientated with the release tab on the traffic side.
<input type="checkbox"/> Yes <input type="checkbox"/> No	The height measured to the top of the rails is 800mm ± 20mm.
<input type="checkbox"/> Yes <input type="checkbox"/> No	The rail is secured to each post with a M16 x 32mm (or 50mm) mushroom head bolt & standard nut.
<input type="checkbox"/> Yes <input type="checkbox"/> No	The rails are spliced with eight (8) M16 x 32mm mushroom head bolt & oversized nuts.
<input type="checkbox"/> Yes <input type="checkbox"/> No	The rail lap is orientated so that the leading edge of the splice is shielded from approaching traffic.
<input type="checkbox"/> Yes <input type="checkbox"/> No	All bolts are tightened.
<input type="checkbox"/> Yes <input type="checkbox"/> No	The fill material around the posts is suitably compacted.
<input type="checkbox"/> Yes <input type="checkbox"/> No	Any minor damage to the galvanised finish is repaired using two coats of an organic zinc rich paint.
<input type="checkbox"/> Yes <input type="checkbox"/> No	The barrier is appropriately delineated (if required).
<input type="checkbox"/> Yes <input type="checkbox"/> No	The area around the barrier is free of debris.

RAMSHIELD® has been crash tested in accordance with MASH Test Level 3 at rail heights of between 730mm and 820mm. An installed rail height of 800mm ± 20mm provides compatibility with MASH compliant guardrail end terminals.

Comments/Notes



16.0 Maintenance

RAMSHIELD® is a low maintenance barrier. Except for repairs due to impacts, it is recommended that an annual inspection be undertaken to assess the following;

- The barrier is appropriately delineated (if required);
- Debris has not accumulated around the barrier which may impede the function of the barrier;
- Vegetation around the barrier is appropriately maintained;
- Nuisance impacts have not gone undetected; and
- The anchor assembly at the end terminals is taut and the bearing plate is correctly aligned.

17.0 Repair

In the event of a vehicle impact, damage to the barrier is to be assessed in accordance with Table 3. Typically, impacts with RAMSHIELD® will require replacement of damaged sections of rails and posts. It is also recommended that new bolts be used where rails and posts have been replaced.

Additional tools required for repair include;

- Acetylene torch to cut away damaged rail;
- Heavy duty chain to remove damaged posts;
- Sledge hammer; and
- Post extractor.

Similar to the installation sequence, it is recommended that the guidelines contained in Section 8.0 be observed in the establishment of traffic control and an unloading exclusion zone in addition to investigation for underground services and overhead obstructions.

17.1 Removal of Damaged Posts

Potential Hazards: *Hand injury from pinch points, hand injury from damaged edges and injury from sudden movement as the posts are released.*

Recommended Control Measures: *Wear gloves and maintain an appropriate exclusion zone around the post until removed.*

Damaged posts should be removed using an appropriate post extractor. Once the damaged post is removed, the ground material should be suitably compacted before a replacement post is installed.

17.2 Removal of Damaged Rails

Potential Hazards: *hand injury from pinch points, hand injury from damaged edges, injury from sudden movement as rails are released and excessive noise from use of impact drill.*

Recommended Control Measures: *Wear gloves and wear appropriate hearing protection.*

Using an impact drill, remove the splice bolts at the rail connection. Rails that have twisted or bent during impact may need to be cut into manageable sections using an acetylene torch.



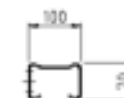
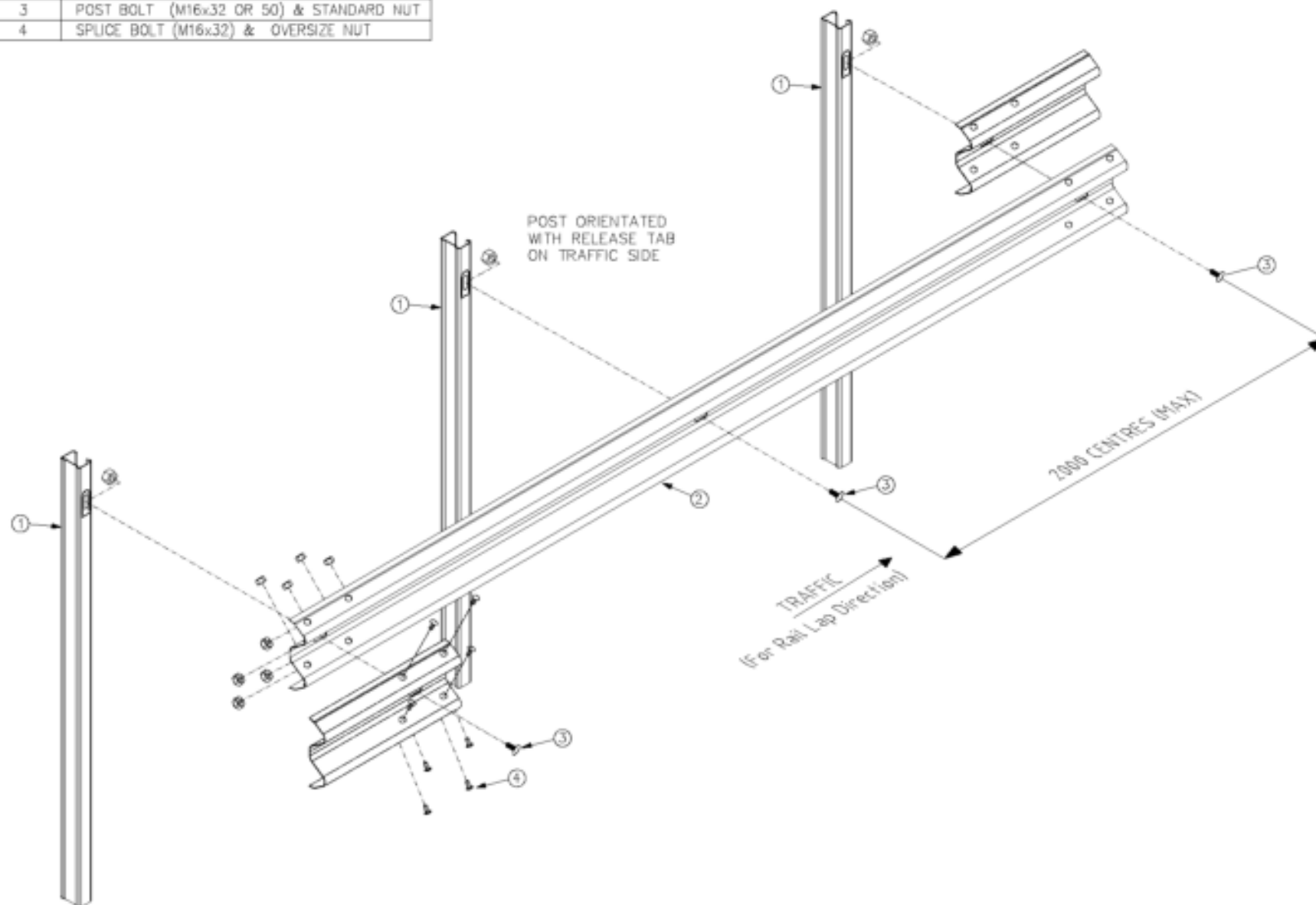
Table 3: Damage Assessment Guidelines

Type of Damage	Description of the Damage	Remedial Action
Damage to the galvanised coating on the posts.	The sum total of the damaged area does not exceed 40cm ² (0.5% of the total surface area).	An organic zinc rich paint is to be applied to the repair area in two coats.
	The sum total of the damaged area exceeds 40cm ² (0.5% of the total surface area).	The post is to be replaced.
Damage to the galvanised coating on the rails.	The sum total of the damaged area does not exceed 200cm ² (0.5% of the total surface area) and no individual damaged area exceeds 40cm ² .	An organic zinc rich paint is to be applied to the repair area in two coats.
	The sum total of the damaged area exceeds 200cm ² (0.5% of the total surface area) or an individual damaged area exceeds 40cm ² .	The rail is to be replaced.
Damage to the posts.	The post is bent.	The post is to be replaced.
Damage to the post tab.	The post tab has pulled forward by breaking the top connection and/or there is tearing evident in either of the two bottom connections.	The post is to be replaced.
	The post tab has become detached from the post.	
Damage to the rails.	The rail is dented, twisted or flattened.	The rail is to be replaced.
	There are nicks in any part of the rail.	
	The slots in the rail are distorted.	
Damage to bolts.	The body of the bolt is distorted.	The bolt is to be replaced.
	The thread of the bolt is damaged.	
Disturbance of material around the posts.	The material around a post is loose.	The material is to be suitably compacted.

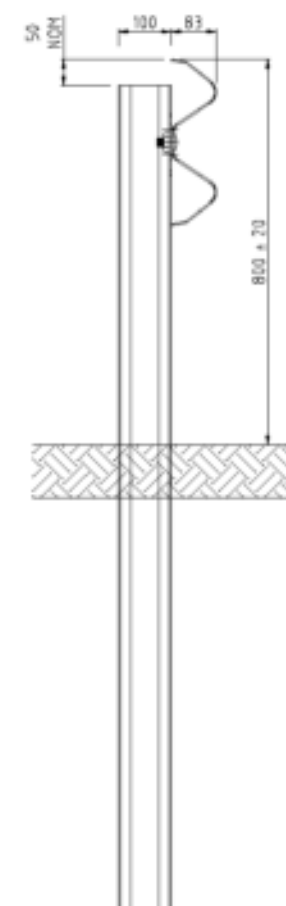


BILL OF MATERIALS

ITEM	DESCRIPTION
1	1560mm RAMSHIELD POST
2	W-BEAM GUARDRAIL
3	POST BOLT (M16x32 OR 50) & STANDARD NUT
4	SPLICE BOLT (M16x32) & OVERSIZE NUT



POST PLAN



POST ELEVATION

NOTES:

- Ramshield Guardrail has been crash tested in accordance with MASH Test level 3 at rail heights of between 730mm & 820mm
- An installed rail height of 800mm ± 20mm provides compatibility with MASH guardrail end terminals

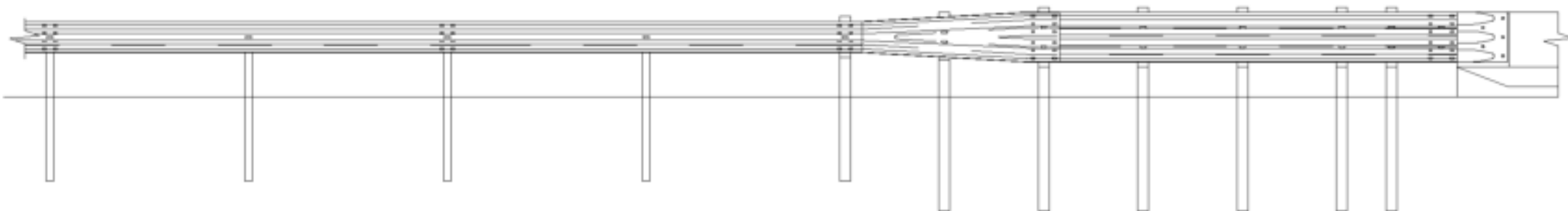
REV	DATE	DESCRIPTION	DRAWN	APPROD.	REV	DATE	DESCRIPTION	DRAWN	APPROD.
C	02.04.19	ASSEMBLY HEIGHT CHANGED	HS	TC					
B	18.07.17	ITEM DESCRIPTIONS CHANGED	HS	TC					
A	06.11.16	INITIAL ISSUE	DB	TC					



DRAWING DESCRIPTION	RAMSHIELD ASSEMBLY			
DRAWING REFERENCE	GR-WB-060	DRAWN BY	H. SEAL	DIMENSIONS
		CHECKED	H. WALLACE	SCALE
		APPROVED	T. COLEMAN	mm
				NTS



PLAN VIEW



RAMSHIELD TO BE CONSTRUCTED IN ACCORDANCE WITH SAFE DIRECTION
ASSEMBLY DRAWING GR-WB-060

6M BRIDGE TRANSITION TO BE CONSTRUCTED IN ACCORDANCE
WITH STATE ROAD AGENCY SPECIFICATIONS

ELEVATION VIEW

NOTE: FOR BRIDGE APPROACH SPECIFICATIONS
PLEASE READ IN ACCORDANCE WITH:
NSW - MD.R132.H01.B
QLD - SD1475
VIC - SD4071
SA - S-4050.37
WA - 200331-021-3

REV	DATE	DESCRIPTION	DRAWN	APPROD.	REV	DATE	DESCRIPTION	DRAWN	APPROD.
A	02.11.15	INITIAL ISSUE	HS	TC					



DRAWING
DESCRIPTION

**RAMSHIELD ASSEMBLY
CONNECTION TO BRIDGE**

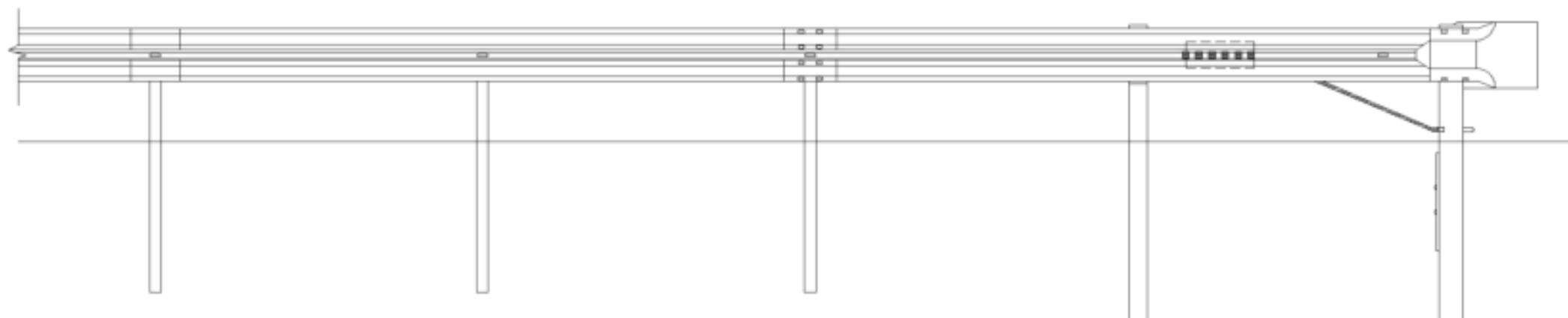
DRAWING
REFERENCE

GR-WB-065

DRAWN BY	H. SEAL	DIMENSIONS	mm
CHECKED	H. WALLACE	SCALE	NTS
APPROVED	T. COLEMAN		



PLAN VIEW



RAMSHIELD TO BE CONSTRUCTED IN ACCORDANCE
WITH SAFE DIRECTION ASSEMBLY DRAWING GR-WB-060

4M TRAILING TERMINAL TO BE CONSTRUCTED IN ACCORDANCE
WITH STATE ROAD AGENCY SPECIFICATIONS

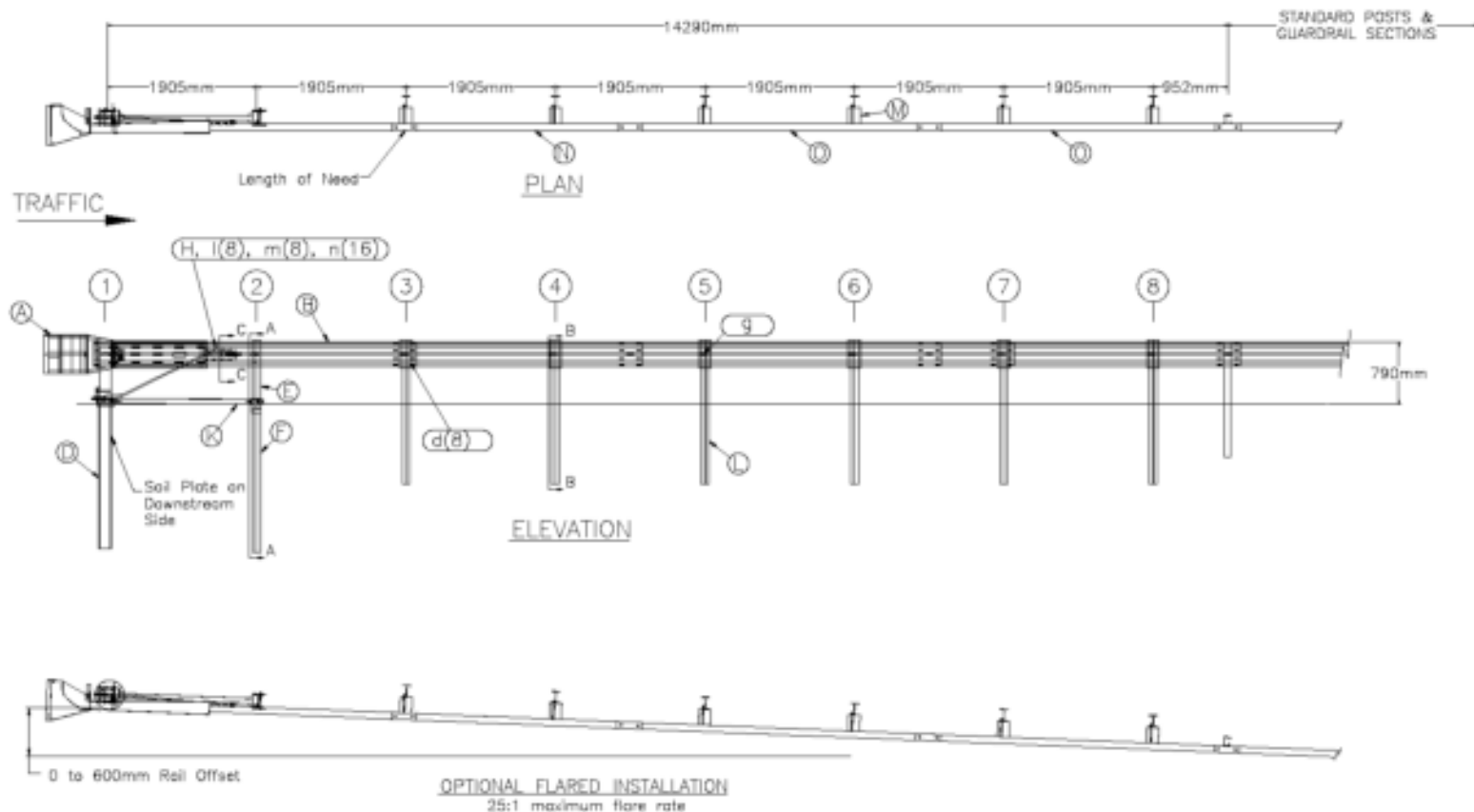
ELEVATION VIEW

NOTE: FOR TRAILING TERMINAL SPECIFICATIONS
PLEASE READ IN ACCORDANCE WITH:
NSW - MD.R132.G03.A.2
QLD - SD1474
VIC - SD3544
SA - S-4050
WA - 200331-0011-5

REVISIONS				REVISIONS			
REV	DATE	DESCRIPTION	DRAWN	APPROVED	REV	DATE	DESCRIPTION
A	02/11/15	INITIAL ISSUE	HS	TC			



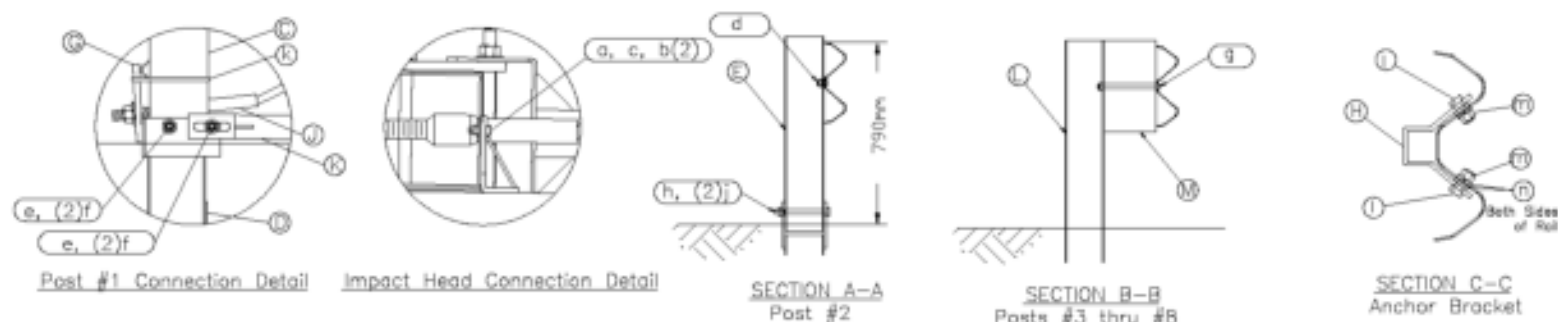
DRAWING DESCRIPTION		RAMSHIELD ASSEMBLY CONNECTION TO TRAILING TERMINAL			
DRAWING REFERENCE		GR-WB-064	DRAWN BY	R. SEAL	DIMENSIONS
			CHECKED	R. WALLACE	SCALE
			APPROVED	T. COLOUNDON	mm
					NTS



ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	SKT IMPACT HEAD	GE-EF-MX-3333-BG
B	1	SLOTTED ANCHOR RAIL 3810	GE-WB-SR-3810-BG
C	1	TOP POST 1	GE-PG-IS-0659-CG
D	1	BOTTOM POST 1	GE-PG-IS-1998-CG
E	1	TOP POST 2	GE-PG-IS-0869-AG
F	1	BOTTOM POST 2	GE-PG-IS-1958-AG
G	1	BEARING PLATE	GE-EF-MX-0911-AG
H	1	ANCHOR CABLE BRACKET	GE-EF-MX-0915-AG
J	1	CABLE ASSEMBLY	GE-EF-MX-2000-AG
K	1	GROUND STRUT	GE-EF-MX-4670-BG
L	6	STEEL LINE POST	GE-PG-IS-1838-CG
M	6	COMPOSITE BLOCK	GE-BL-SS-6110-AS
N	1	W-BEAM GUARDRAIL 2860mm	GE-WB-SR-2860-AG
D	2	W-BEAM GUARDRAIL 3810mm	GE-WB-SR-3810-CG
HARDWARE			
a	2	M8 x 25mm HEX BOLT	GE-FS-08-0025-HG
b	4	M8 WASHER	GE-FS-08-0003-AG
c	2	M8 NUT	GE-FS-08-0003-HG
d	33	M16 x 32mm SPLICE BOLT / NUT	SH-FS-16-3832-HG
e	2	M16 x 220mm BOLT / NUT	GE-FS-16-0220-HG
f	4	M16 WASHER	GE-FS-16-0003-CG
g	6	5/8" x 18" POST BOLT / NUT	GE-FS-58-0018-MG
h	1	M20 x 220mm BOLT / NUT	GE-FS-20-0220-HG
j	1	M20 WASHER	GE-FS-20-0003-BG
k	1	BEARING PLATE RETAINER TR	GE-MX-MX-0011-AS
l	8	1/2" x 1 1/4" SHOULDER BOLT	GE-FS-12-0114-HG
m	8	1/2" SHOULDER BOLT NUT	GE-FS-12-0003-HG
n	16	1/2" SHOULDER BOLT WASHER	GE-FS-12-0003-AG

NOTES:

1. THE LOWER SECTIONS OF POSTS 1 & 2 SHALL NOT PROTRUDE MORE THAN 100mm ABOVE GROUND.
2. THE CABLE ASSEMBLY MUST BE TAUT.



SAFE DIRECTION

DRAWING DESCRIPTION

MASH TL3 SKT TERMINAL (MSKT)

DRAWING REFERENCE

K-MSKT TL3

DRAWN BY	H. SEAL	DIVISIONS	mm
CHECKED	H. WALLACE	SCALE	NTS
APPROVED	T. COLQUHOUN		

REV	DATE	DESCRIPTION	DRAWN	APPROD.	REV	DATE	DESCRIPTION	DRAWN	APPROD.
A	210817	INITIAL ISSUE	HS	TC					



SafeDirection

CRASH BARRIER SOLUTIONS

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ABN 53 156 459 684