



EZY-GUARD

INGAL CIVIL PRODUCTS

SMART

Product Manual



Release 04/21

www.ezyguard.com

1.0 Introduction

Introducing Ezy-Guard Smart, a member of the Ezy-Guard family, the next generation steel guardrail barrier providing superior motorist safety and more metres of barrier for your dollar.

Ezy-Guard Smart is crash tested to the latest performance standard distinguishing it from the existing Australian public domain guardrail barriers.

The Z-post profile shields post edges from vulnerable road users and provides sectional strength when driving through difficult conditions.

An Ezy-Carriage is used to secure the w-beam rails to the posts eliminating the requirement for blocking pieces and rail stiffening plates. This unique connection provides a soft ride-down for the occupants and smooth vehicle containment and redirection.

2.0 Specifications

Ezy-Guard Smart Z-Post Length: 1,600mm

Ezy-Guard Smart Z-Post Mass: 12.3kg

Ezy-Guard Smart System Mass: 18.6kg per metre

Rail Height Above Ground: 730mm

Z-Post Height Above Ground: 720mm

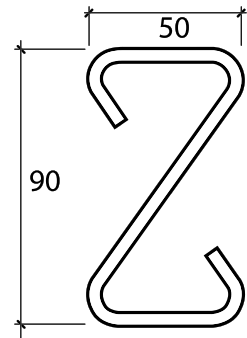
Post Spacing: 2,000mm

Ezy-Guard Smart System Width: 200mm

MASH TL3 Crash Test Deflection: 1.65m

Ezy-Guard Smart 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 leaving no surface untreated.

State specific product acceptance details are available upon request from your local Ingal representative. Acceptance of product variants should be confirmed prior to installation.



3.0 Crash Test Analysis

Crash test guidelines provide a minimum set of requirements that a roadside barrier has to meet in order to demonstrate its satisfactory impact performance.

Whilst crash test guidelines cannot include all possible impact conditions that may be experienced in the real world, the crash test matrix is selected to represent a "worst practical condition" for a roadside barrier impact.

Ezy-Guard Smart 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.

The MASH TL3 crash test matrix requires the following impacts;

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

Crash test impact conditions are defined by the mass, speed, and angle of the impacting vehicle. Crash test standards and performance levels can be compared by calculating the impact severity (IS).

$$IS = \frac{1}{2} M (V \sin \theta)^2$$

Where IS is the impact severity in joules (J), M is the test inertial mass of the vehicle in kilograms (kg), V is the impact speed in metres/second (m/s) and θ is the impact angle in degrees.

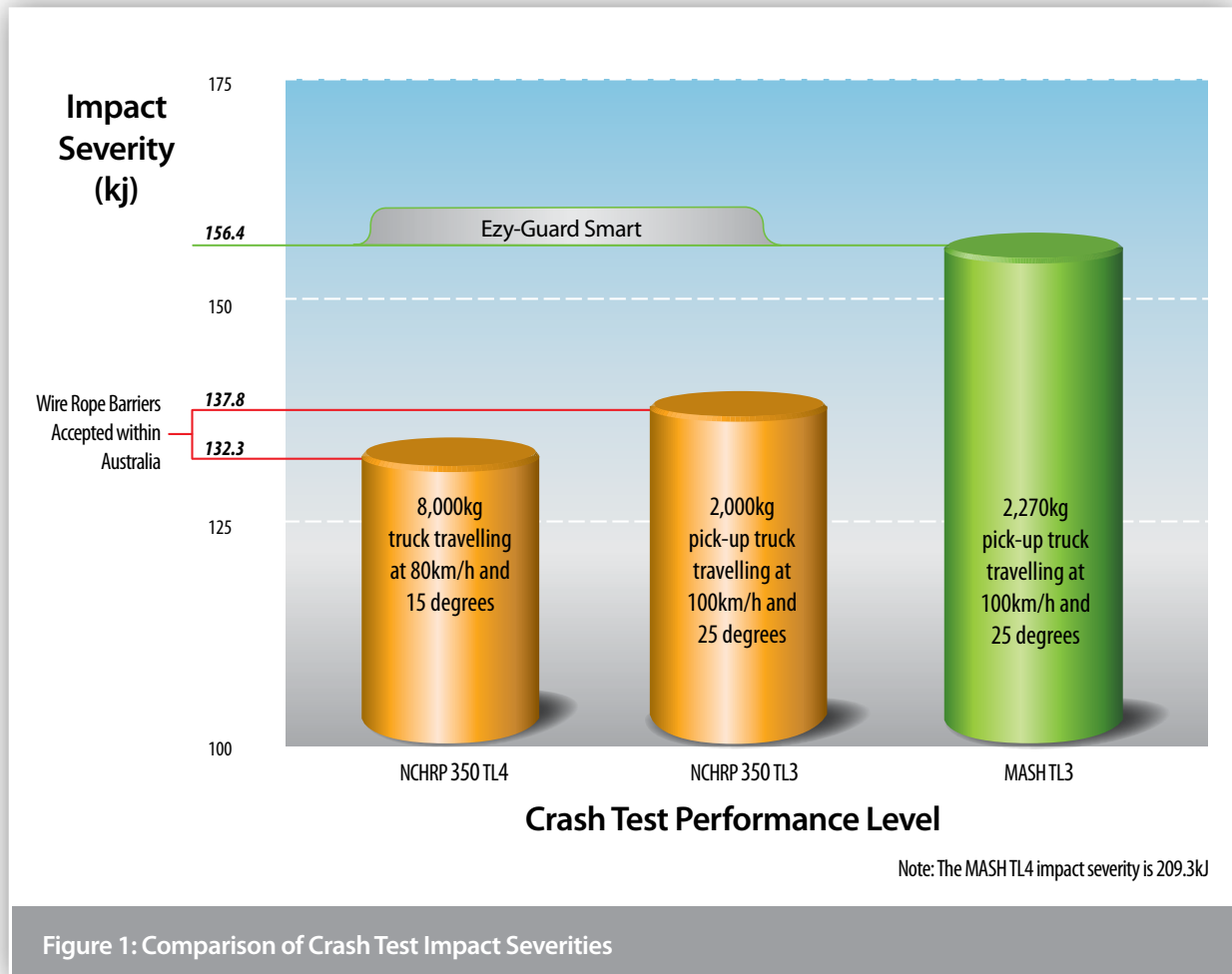


Figure 1: Comparison of Crash Test Impact Severities

4.0 Consideration for Vulnerable Road Users

Vulnerable road users include motorcyclists, pedestrians, cyclists and other road users. Ezy-Guard Smart has been designed to provide consideration to vulnerable road users as follows:

Rounded Post Corners.

The Z-post contains smooth, rounded post edges and corners mitigating the risk and severity of fractures and/or contusions.

Energy Absorbing, Ductile Z-Posts.

Unlike traditional guardrail posts, the Z-posts are designed to yield by bending near ground level. This bending action absorbs impact energy reducing the potential for post fracturing. A fractured or split guardrail post presents a significant laceration hazard to vulnerable road users.

The Ezy-Guard Smart design does not contain any elements that become projectiles and there are no aggressive edges.

Shielded Posts.

The revolutionary design of Ezy-Guard Smart shields the top of the supporting Z-posts by positioning the top of

the rail above the posts. This eliminates dangerous snag points, reducing the potential for the barrier to dismount motorcyclists or cyclists. This is a significant safety benefit compared to all guardrail and cable barrier designs currently used within Australia.

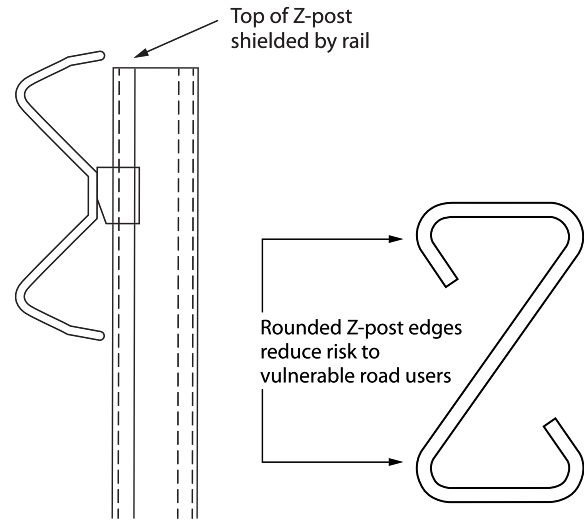


Figure 2: Ezy-Guard Smart Considerations for Vulnerable Road Users



5.0 Features and Benefits

5.1 Fully Compliant to MASH TL3

Ezy-Guard Smart, a member of the Ezy-Guard family, is Australia's only locally produced, fully compliant MASH TL3 guardrail barrier system.

The MASH TL3 test condition (2,270kg pickup travelling at 100km/h and 25 degrees) represents a 42% increase in impact energy when compared to the current Australian public domain guardrail systems using C-posts and steel blocking pieces, which has only demonstrated 1600C containment (1,600kg passenger car travelling at 100km/h and 25 degrees).

The MASHTL3 test condition also represents a 13% to 18% increase in energy when compared to the superseded NCHRP 350 Test Level 3 or Test Level 4 impacts.

5.2 Rapid Installation & Repair

Ezy-Guard Smart installation can be up to twice as fast to install than conventional guardrail barriers and unlike cable barrier systems, no concrete is required.

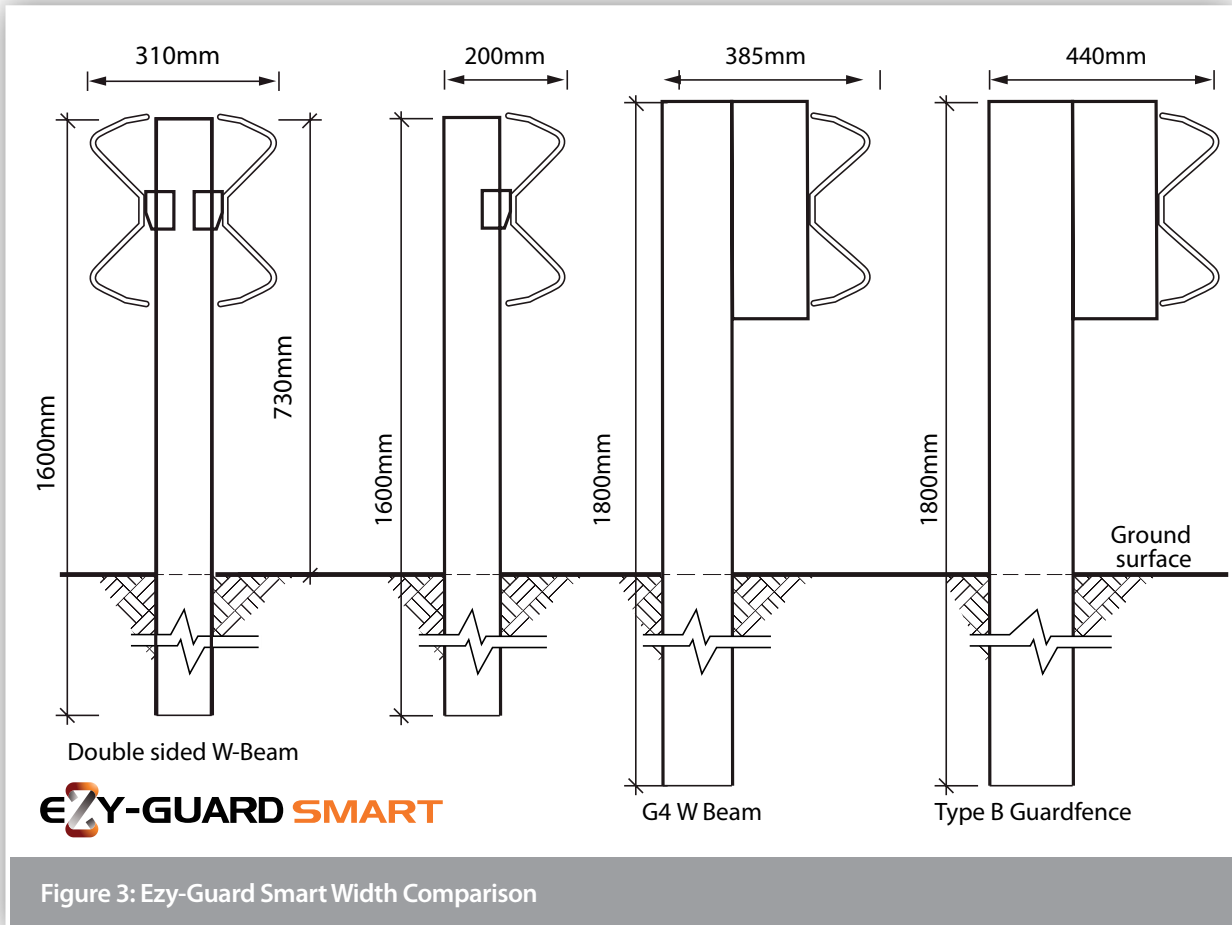
The Ezy-Guard Smart design uses fewer components and features 1,600mm Z-posts that are rapidly driven into the ground. The Z-post embedment depth is just 880mm, a reduction of 20% when compared to traditional guardrail posts. This reduces installation time providing significant cost savings.

Since the Z-posts are designed to yield by bending near ground level, damaged posts can be removed easily which reduces the time spent by work crews on the roadside.

5.3 Narrow Width

With a system width of just 200mm, Ezy-Guard Smart is up to 55% narrower than the current public domain guardrail barrier systems. Ezy-Guard Smart conserves valuable formation width and allows a greater recovery width to be provided for errant vehicles.

MASH TL3 COMPLIANT



5.4 Installation in Rock, Asphalt or Concrete Mowing Strips

The design of the Z-post differs from traditional posts in that it relies on the yielding of the post by bending near ground level rather than the yielding of the surrounding soil during a vehicle impact. This makes the Z-post suitable for installation in rock, asphalt or concrete mowing strips.

A traditional guardrail post is designed to absorb some crash energy through post rotation in the soil prior to post failure. Restraining these traditional posts by setting them in narrow holes drilled into solid rock, by setting them in thick asphalt layers or concrete, or by placing a mowing strip around the posts can lead to a failure of the system to safely contain and redirect the errant vehicle.

5.5 Manual Handling

Ezy-Guard Smart uses fewer components than the public domain guardrail systems. Z-posts weighing just 12.3kg are 50% lighter than traditional C-posts. The lightweight Z-post reduces manual lifting by installation crews.

The rounded edges of the Z-post provides a handlelike grip when lifting, reducing the possibility of hand lacerations. The Z-profile allows the installer to maintain a firm grip and facilitates correct lifting techniques.

5.6 Locally Designed & Produced

Ezy-Guard Smart is manufactured in Australia by Ingal Civil Products using steel manufactured by BlueScope Steel. Z-posts and rail are stamped providing traceability to material mechanical and chemical analysis certificates. Hot dip galvanising is performed internally by Ingal and daily inspections ensure zinc thickness readings are in accordance with AS/NZS standards..

5.7 Soft Ride-Down Decelerations

The Ezy-Carriage controls the release of the w beam rail from the Z-posts. This controlled release reduces the potential for vehicle pocketing and provides a soft ridedown for vehicle occupants.



6.0 Performance

Ezy-Guard Smart provides protection from roadside hazards located close to the edge of the travelled way. The sectional strength of the 4 Z-post reduces lateral deflection whilst providing controlled containment and redirection.

Crash testing guidelines provide a set of requirements that is “worst practical conditions” in order to demonstrate the barriers impact performance. When the combined effects of vehicle mass, impact speed and angle of impact are considered, the testing criteria represents the extremes of impact conditions to be expected in real-world situations.

6.1 Deflection

The transverse deflection of a barrier during a crash is dependent upon many factors, including mass, speed, and impact angle of the errant vehicle.

Since crash testing typically represents the extremes of these parameters, a review of the proposed barrier location can be undertaken to assess the following;

- Maximum attainable impact angle;
- Design speed; and
- Design vehicle.

Figure 4 illustrates the vehicle trajectory when turned towards the barrier. The maximum attainable angle, ϕ is limited by the speed of the vehicle and the lateral offset, x to the barrier.

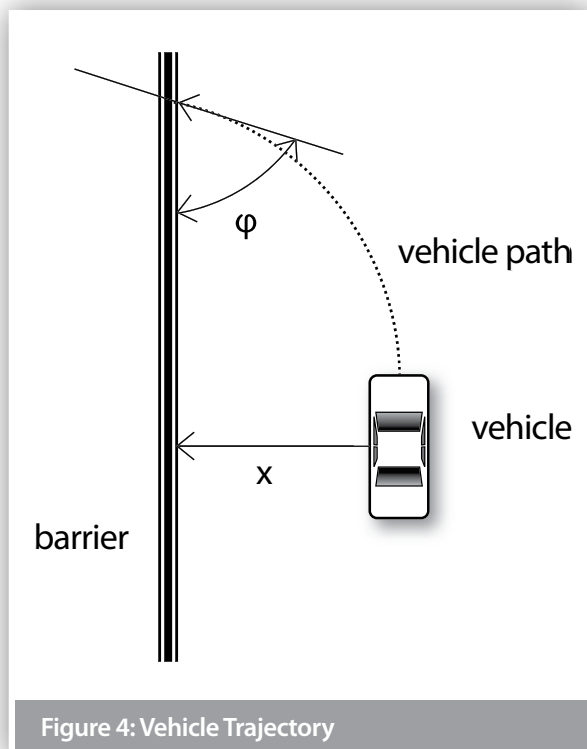


Figure 4: Vehicle Trajectory

The maximum attainable angle for various speeds and offsets is shown in Figure 6 and is derived using a point mass model and assumes maximum steering and a coefficient of friction of 0.7 (dry pavement).

If the deflection needs to be reduced due to the proximity of a road side hazard, this can be achieved by reducing the post spacing. Refer Table 2 for deflections with post spacing reduced to 1m. The reduced post spacing should be initiated 10m upstream and returned to standard spacing 10m downstream of the hazard.

6.2 Slopes

The maximum cross fall for an installation of Ezy-Guard is 10H:1V (10%).

6.3 Batter Hinge Proximity

Installations of safety barriers in close proximity to a batter hinge point should be considered within the requirements of the road controlling authority Extended Design Domain.

Ezy-Guard Smart has been successfully crash tested to MASH TL3 with posts installed on the rounding point of a 2H:1V batter. The batter was comprised of AASHTO M147-65 Standard Soil.

Suitability of the ground conditions and/or erosion of the batter should be considered by the installation designer prior to installation of a safety barrier near a batter slope. It is recommended the barrier be installed with the maximum offset to hinge point possible.

As the proximity of the batter slope may reduce the soil support to the post, the designer should also consider the use of an increased post embedment, refer section 7.5.2.

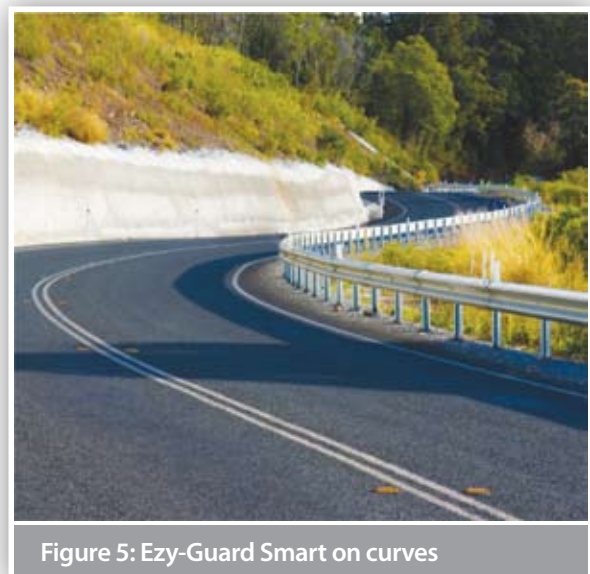


Figure 5: Ezy-Guard Smart on curves

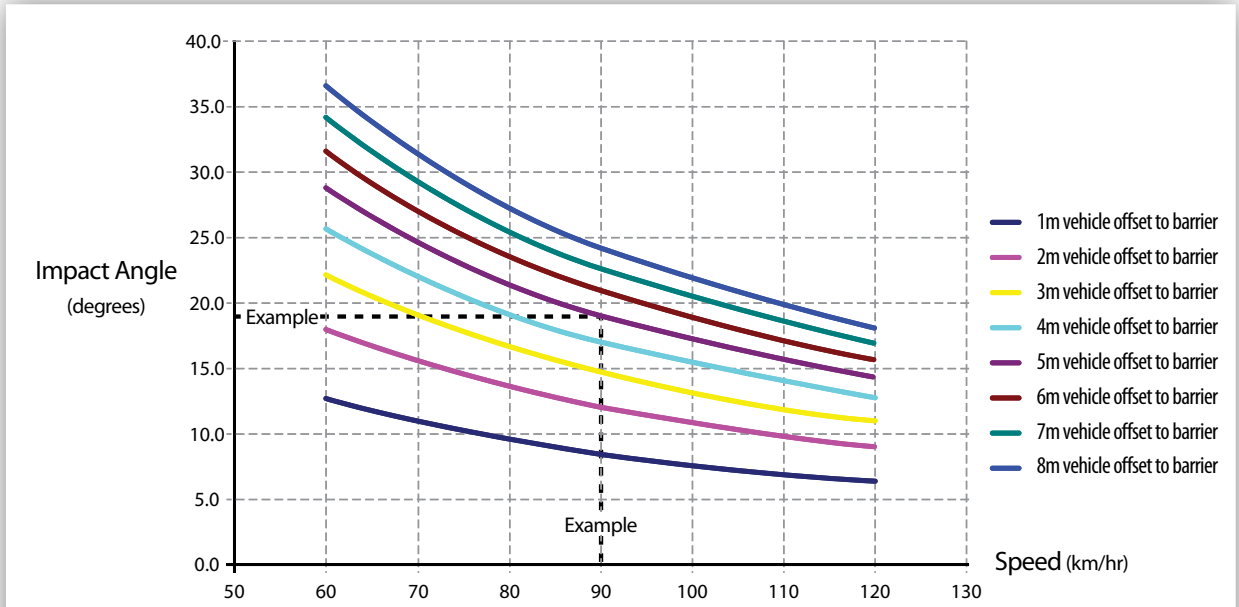


Figure 6: Maximum Attainable Angle by Speed and Offset.

Table 1. Ezy-Guard Smart Deflections

Speed (km/h)	Dynamic Deflection (m)		
	Post Spacing	Test Standard	Dynamic Deflection
70	2m	NCHRP-350 TL2	0.89
100	1m	NCHRP-350 TL3	1.04
100	2m	MASH TL3	1.65

* If further reduction of the deflection is required, please contact your local Ingal Civil Products representative.



7.0 Installation

7.1 Terminals

Guardrail end terminals are designed to provide a soft gating impact preventing the end rail from spearing an impacting vehicle. Terminals also introduce tensile and flexural strength necessary to ensure redirection performance of the length-of-need section.

Ezy-Guard Smart is installed at a system height of 730mm, measured to the top of the rail. This height is compatible with the ET2000 Plus and public domain terminals such as the MELT (NSW, Qld, SA).

Departure terminals should only be installed if they are located outside the clear zone of approaching traffic. See Figure 7. The clear zone is the horizontal width of space available for the safe use of an errant vehicle.

The clear zone is dependant upon the speed of the vehicle. Guidelines are contained with regulatory publications.

Terminals should be installed in accordance with the proprietor's drawings and specifications. Z-posts are not to be used in the terminals unless approved by the proprietor.

The installation of terminals will typically incorporate the use of blocking pieces positioned between the posts and rail. This will require the supporting posts to be offset from the set-out line used for the installation of the Z-posts which do not require blocking pieces.

In addition, the post spacing used in the terminals and transitions may vary from the 2m spacing used for installation of Ezy-Guard Smart. The required post spacing for terminals and transitions will be contained in the proprietor's drawings.

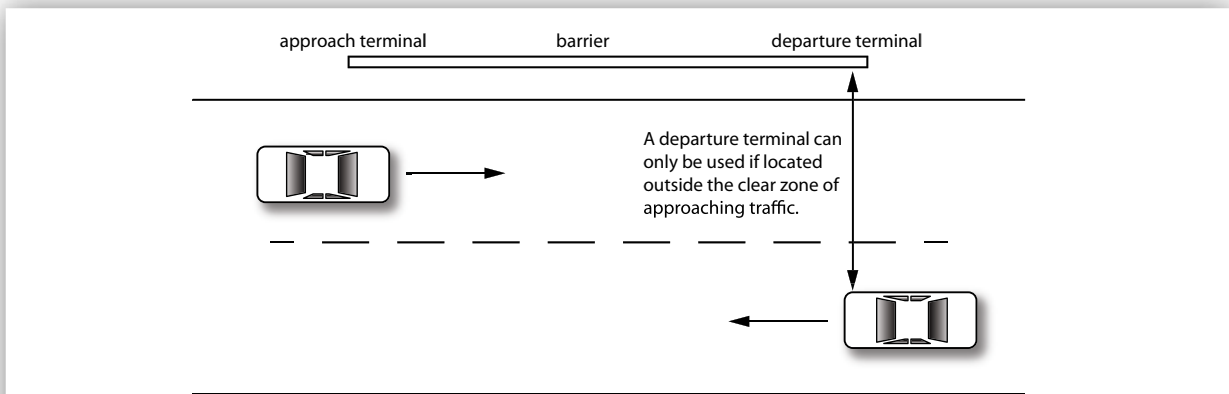


Figure 7: Clear Zone Requirement for the use of Departure Terminals



Figure 8: ET-SS End Terminal

7.2 Minimum Length Requirements

There are two geometric methods used to determine the likely trajectory of a vehicle that leaves the road in the vicinity of a roadside hazard and the minimum length of barrier required to protect from this hazard. The most common method is the run-out length method and an alternative is a method based on angle of departure.

Prior to design or installation, designers should consult the relevant road authority to establish the local jurisdictional practice as the methods may result in different lengths. Both methods are detailed in the Austroads Guide to Road Design – Part 6.3.

For instances where geometric constraints limit the installation of the recommended length under the above design methods, the absolute minimum length of minimum length of need for Ezy-Guard Smart is dependent on the design containment level.

- For a Test Level 2 containment, where the design vehicle is a 2,000kg pick-up, the minimum length of Ezy-Guard Smart between terminals is 12m.
- For a MASH Test Level 3 containment, where the design vehicle is a 2,270kg pick-up, the minimum length of Ezy-Guard Smart is 20m between terminals.

7.3 Sequence of Work

Where Ezy-Guard Smart is being constructed on a road open to traffic, it is recommended that the work commence at the end closest to the approaching traffic. Leading terminals and transitions shall be commissioned at the earliest practical time.

7.4 Modifications

Ezy-Guard Smart shall be constructed in the configuration as detailed in Ingal Civil Products' drawings. This is the configuration in which the system has been crash tested. No modifications shall be made to the system unless verified by Ingal Civil Products.

Flame cutting of rails or posts is not permitted. Saw cutting and drilling is permitted in the event that a post is to be installed at an irregular spacing and/or rock is encountered and the post embedment depth has been modified in accordance with Table 4.

Any modification carried out after fabrication will require repair to the galvanized coating. A corrosion resistant treatment shall be applied to the freshly cut surface, ICP recommend a Zinc metal spray in accordance with ISO 2063 or AS/NZS 2312.



7.5 Soil Requirements & Embedment Depth

The Z-post is designed to yield by bending near ground level during impact. Provided the post is embedded in material that allows this failure mechanism to be replicated, the Ezy-Guard Smart functionality will be retained. The Z-posts will provide lateral resistance until the impacting vehicle causes deformation of the posts. At this point the Ezy-Carriages will provide a controlled release of the rail from the Z-posts resulting in safe vehicle containment and redirection.

7.5.1 Standard Soil

Ezy-Guard Smart has been evaluated for installation in standard soil in accordance with AASHTO standard specifications for 'Materials for Aggregate and Soil Aggregate Subbase, Base and Surface Courses,' designation M 147.

When installed in standard soil, the 880mm embedment depth of the Z-post is sufficient for installation up to 300mm from the rounding point on 2:1 embankment slopes.

Installations within 300mm from the hinge point should be considered within the requirements of Section 6.3 and the road controlling authority Extended Design Domain requirements.

7.5.2 Weak Soil

Ezy-Guard Smart has been evaluated for installation in weak soil in accordance with AASHTO standard specification for 'Fine Aggregate for Hydraulic Cement Concrete,' designation M 6.

When installed in weak soil, the 880mm embedment depth of the Z-post is sufficient for installation up to 500mm of the rounding point on 2:1 embankment slopes. If installation is required within 500mm of the rounding point, the post embedment depth is required to be increased to 1,050mm. A longer Z-post is available from Ingal for these applications.

Installations within 300mm from the hinge point should be considered within the requirements of Section 6.3 and the road controlling authority Extended Design Domain requirements.

7.6 Post Pullover Test

In the event that the soil type cannot be verified, the suitability of the post foundation can be established through a post pullover test.

This is undertaken by applying a 1kN load to the post, 700mm above ground level. The load is applied prior to the attachment of the rail. Displacement at the base of the post shall not exceed 1mm whilst the load is applied.

An alternative post pull over test can be achieved via a more destructive means, whereby a load of 1.2 tonnes is applied to the test post at a height of 700mm. This loading approximates the probable capacity of the post and should be able to be maintained with minimal rotation of the post in the soil. At the completion of the testing the post should be removed from the test location and should not be used in the installation.

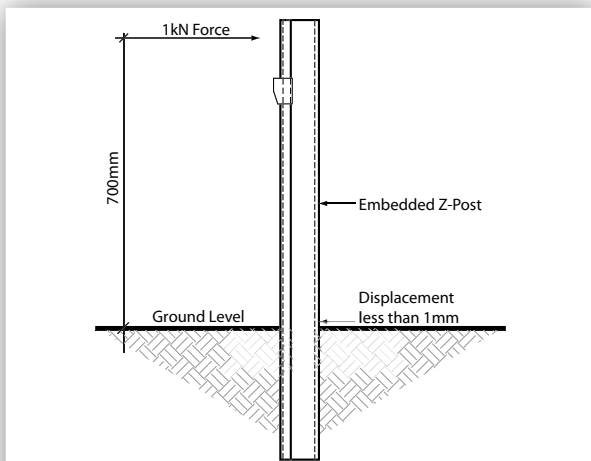


Figure 9: Z-Post Pullover Test

7.7 Posts on Base Plates

In the event that the Z-post cannot be installed to the required in-ground depth, the use of a base plate

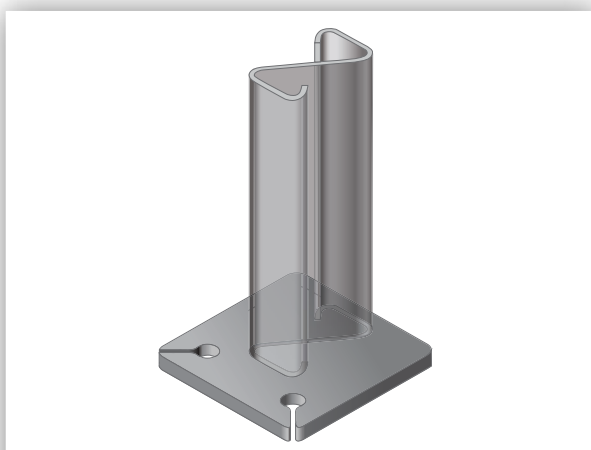


Figure 10: Z-Post on Base Plate

mounted on a suitable foundation can be adopted. Posts on base plates are typically used at culvert locations, and in areas where underground services restrict posts from being driven into the ground. Refer to Ingal Civil Products drawings for the installation of posts on base plates.

7.8 Z-Posts in Rock

Traditional guardrail posts are designed to yield in the surrounding soil and their placement in rock or concrete is problematic. Restraining the traditional posts by setting them in narrow holes drilled into rock, setting them in concrete or placing a mowing strip around the posts can lead to a failure of the system to safely contain and redirect the errant vehicle.

The specially engineered Z-post dissipates energy by yielding through bending near ground level. This means that typical recommendations for the installation of a traditional guardrail post in rock are not applicable to the Z-post. When rock is encountered, the installation guidelines as detailed in Table 4 are applied. If required the bottom of the post may be cut onsite by a disc grinder or equivalent steel cutting tool. A corrosion resistant treatment will need to be applied to the freshly cut surface, ICP recommend a Zinc metal spray in accordance with ISO 2063 or AS/NZS 2312.

7.9 Non-Standard Post Spacing

Occasionally, a roadside hazard may prevent a post from being installed at the recommended spacing. In these instances it may be possible to stiffen the barrier with reduced post spacing on the approach and trailing side of the hazard, we would recommend you discuss these options with your local Ingal Civil Products representative.

7.10 Delineation

A specially designed delineator is attached to the Z-post. Typically, delineation is arranged so that drivers approaching from either direction will see only;

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

The spacing of delineators is dependant upon driver line of sight. As a general rule delineators are provided for installation every 20m on straight alignments. Installation on curves will require a closer spacing dependant upon the radius of the roadway.

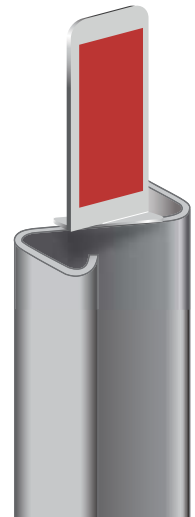
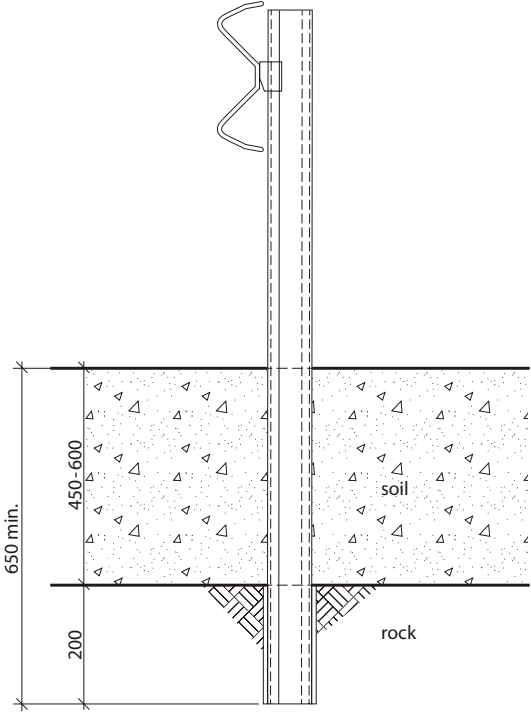
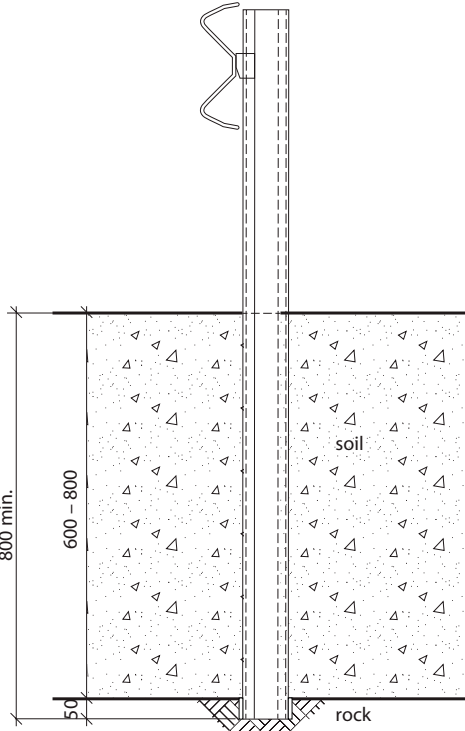


Table 4: Installation of Ezy-Guard Smart Z-Posts in Rock

Site Condition	Installation Requirements	
<p>Rock is encountered at the surface.</p>	<p>Drill a 110-300mm diameter hole to a depth of 450mm, install the post in the hole and backfill.</p>	
<p>Rock is encountered within 450mm of the surface.</p>	<p>Drill a 110-300mm diameter hole 450mm into the rock or to a minimum total post embedment depth of 650mm, whichever comes first, install the post and backfill.</p>	

Site Condition	Installation Requirements	
<p>Rock is encountered 450mm to 600mm below ground.</p>	<p>Drill a 110-300mm diameter hole 200mm into the rock or to a minimum total post embedment depth of 650mm, whichever comes first, install the post and backfill.</p>	
<p>Rock is encountered 600mm to 800mm below ground.</p>	<p>Drill a 110-300mm diameter hole 50mm into the rock or to a minimum total post embedment depth of 800mm, whichever comes first, and install the post and backfill.</p>	

7.11 Curving of Rails

Guardrail used for the assembly of Ezy-Guard Smart may be shop curved to fit any radius from 2.4m to 45m Convex. Curves in excess of 45m do not require shop curving as the rail can be field installed to suit. Guardrail may be curved either concave or convex to the traffic face and can be part-curved along its length to suit site requirements.

7.11.1 Measuring Curvature

1. Mark along the arc of the curve at 4m intervals.
2. Measure the corresponding chord length (C) - refer to Figure 11.
3. Measure the corresponding centre offset (H) - refer to Figure 11.
4. Use the values for C & H to select the radius from Table 5.
5. Determine the curvature orientation from Figure 12.

7.11.2 Identification of Curved Rails

Where a rail has been factory curved by Ingal, the radius of curvature is marked on the rear face of the rail.

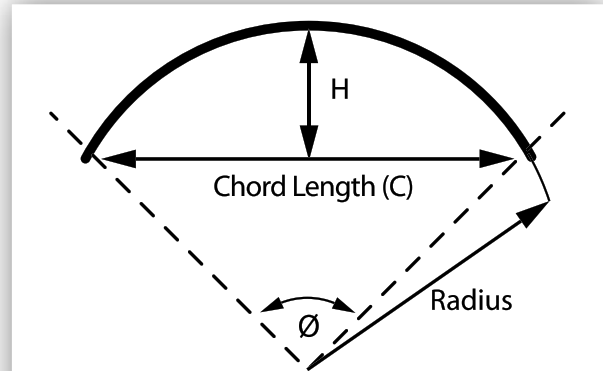


Figure 11: Curvature Measurements

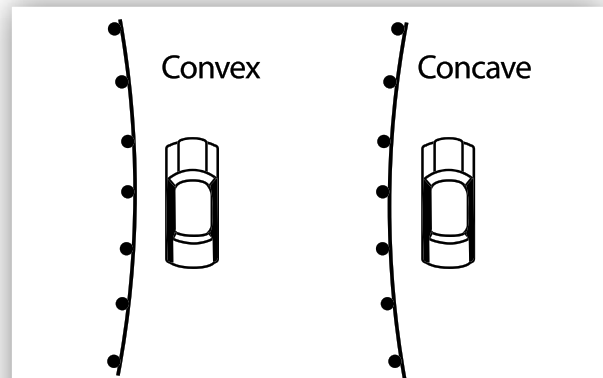


Figure 12: Curvature Orientation

Table 5: Rail Curvature Values

Radius (m)	∅ Degrees	C (mm)	H (mm)
2.4	95	3553	786
3	76	3710	642
4	57	3835	490
5	45	3894	395
6	28	3926	330
7	33	3946	284
8	29	3958	249
9	26	3967	221
10	23	3973	199
12	19	3982	166
14	16	3986	143
16	15	3990	125
20	12	3993	100
24	10	3995	83
28	8	3997	71
32	7	3997	62
35	7	3998	57
40	5	3998	50
45	5	3999	44



7.12 Installation Sequence

The following written instructions should be read in conjunction with Ingal Civil Products' drawings.

A generic Safe Work Method Statement is available from Ingal Civil Products to assist in the safe installation of Ezy-Guard Smart. Suitable traffic control should be in place before any works.

Only items purchased from Ingal Civil Products shall be used for the construction of Ezy-Guard Smart.

1. Ensure the area has been inspected for underground hazards and where a service clash has been identified, the barrier should be adjusted longitudinally if possible.
2. Post locations are marked ensuring any fixed object hazard is located outside the expected dynamic deflection of the barrier
3. The post in relation to the direction of traffic as per orientated as per Figure 13.

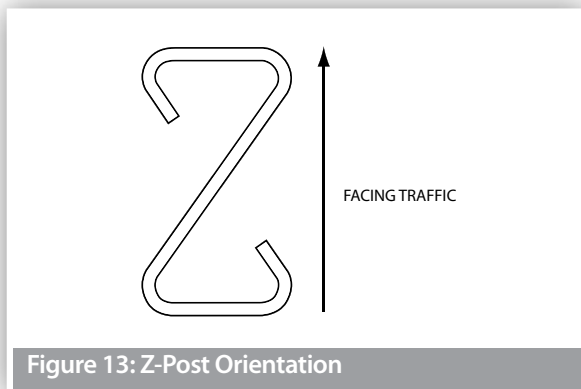


Figure 13: Z-Post Orientation

4. Posts are spaced every 2m and are driven directly into the ground and should be vertical. The post installation process shall not cause damage to the post, such that it reduces the effective operation of the safety barrier or its design life, or introduces sharp tearing edges, nor shall it cause damage to pavement. If the Ezy-Carriage cannot freely move as it is attached to the post as a result of deformation of the post during installation, then the post shall be replaced. The use of a vibrating post hammer will reduce deformation to the top of the post and install the post at a controlled rate.
5. Alternate to driving the posts, a minimum 110-300mm hole can be augured and the post placed in the hole. The posthole is then backfilled with the material that was excavated. If installing in soil, the material should be placed in layers of 150mm and suitably compacted to not less than the density of the surrounding layers

6. The height of the Z-post above ground level is 720mm.
7. The Ezy-Carriage is attached to the face of the post. The Ezy-Carriage will come to rest on the positioning lug fabricated on the Z-post.

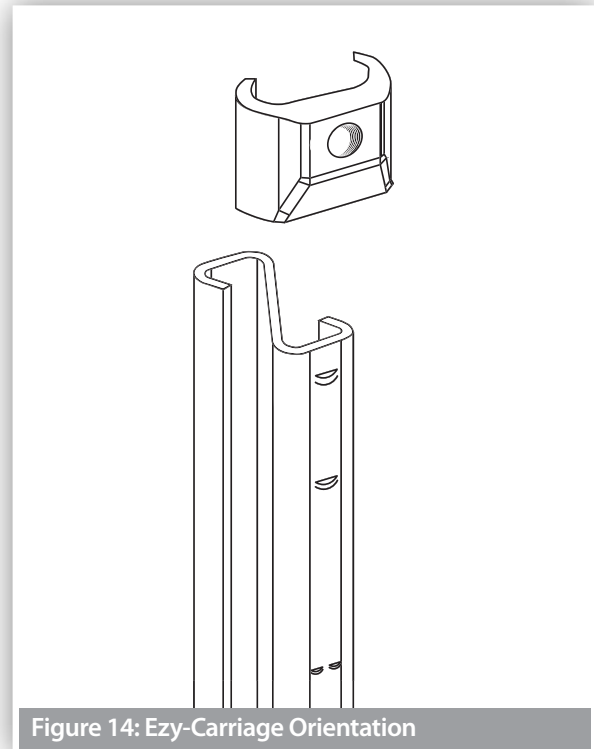


Figure 14: Ezy-Carriage Orientation

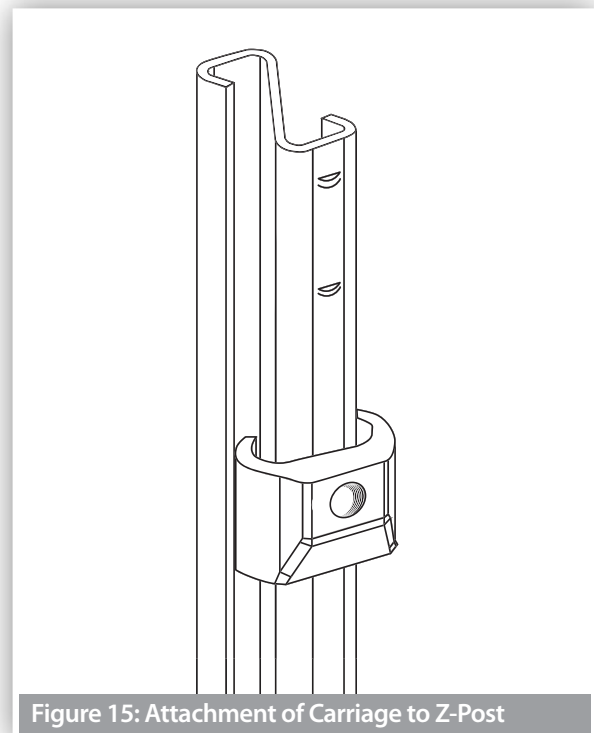
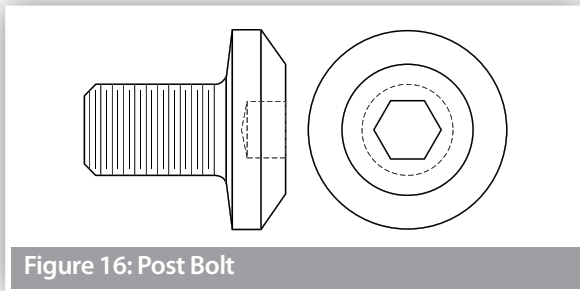
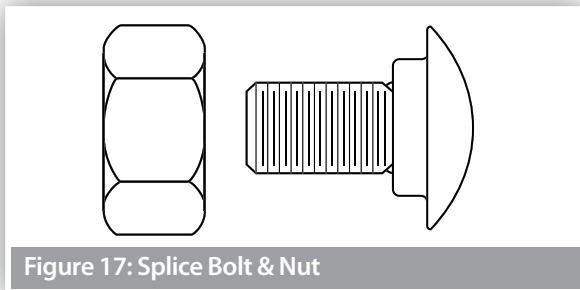


Figure 15: Attachment of Carriage to Z-Post

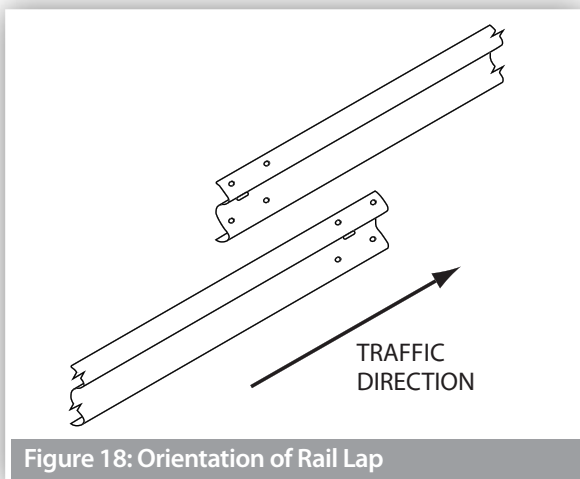
8. Rails are attached to the Ezy-Carriage using the M16x30mm post bolts. The post bolts are identified by the socket recess located in the head of the bolt. The bolts are tightened to snug tight using a 10mm hex. key.



9. Rails are spliced together at every second post using M16x32mm mushroom head bolts and oversized nuts. There are 8 bolts required per splice connection. A pinch bar may be used to assist in the alignment of splice holes. The use of a driving pin to elongate the slots is NOT to be used since this may cause tearing of the rail at the slot location. The bolts are tightened to snug tight.



10. Rails are orientated so that no leading edge is presented to the traffic face as shown in Figure 18.



11. It is recommended that posts be installed only a few metres ahead of rail assembly to ensure correct post spacing and alignment. On curves, the rails can be used as a template and laid on the ground to determine post locations.
12. Where possible, the barrier should form a smooth line vertically and horizontally when viewed along the line of the system, free from humps, sags or other irregularities.
13. The Ezy-Guard Smart components are to be free from splits, burrs or sharp edges after installation. Any minor damage is to be repaired by applying two coats of an organic zinc rich paint.
14. Any disturbed pavement or material around a post shall be left dense, tight, and smooth so that resistance to water penetration is similar to that of the adjacent surface.

7.13 Back to Back W-Beam Installation

The Ezy-Guard Smart system can also be used in median applications where the W-Beam is installed on both sides of the post. This configuration requires a special post with resistance tabs on both sides of the post. The installation procedure is the same as for a single sided installation with steps 8 thru 15 repeated on the opposite side of the post. Refer drawing Ezy-SM-035 for further assembly detail.

7.14 Installation Tolerances

- The tolerance on height of the barrier shall be +25mm/-0mm.
- The tolerance for the line of the barrier shall be plus or minus 20mm in plan view.
- The tolerance for departure from the upright axis shall be plus or minus 15mm at the top of the barrier.
- The tolerance on post spacing shall be plus or minus 25mm.

8.0 Maintenance

8.1 Preventative Maintenance

It is recommended that annual inspections be performed to ensure the following;

- The system is appropriately delineated;
- Debris has not accumulated around the system that may impede the performance of the barrier or the trajectory of an impacting vehicle;
- The system is suitably anchored with appropriate terminals and/or transitions. If the system is anchored with terminals, the cable assembly shall be taut and tensioned to its recommended value; and
- All splice bolts and post bolts are snug tight.

8.2 Ezy-Lift for Maintenance Overlays

For existing Ezy-Guard installations where the road surface has been overlaid or resurfaced, resulting in the barrier height being outside of the installation tolerance, the Ezy-Lift carriage is available to bring the W-Beam back to the appropriate height. The carriage gives the option to lift the W-Beam by +50, +100, +150 and +180mm. Refer assembly drawing EZY-SM-137 for further detail.

Installation sequence:

1. Unbolt M16x32 Splice Bolts at splice joint at either end of W-Beam rail.
2. Unbolt each carriage bolt on W-Beam rail. Exercise caution on removal of carriage bolts as rail will be unsupported after removal and may fall to the ground.
3. Lay W-Beam on ground adjacent to original position.
4. Remove carriage from post and replace with Ezy-Lift Carriage.
5. Reinstall carriage bolt and M16 washer into lowest hole in carriage and tighten to snug tight using a 10mm hex key. Refer to Detail A on drawing.
6. Repeat steps 1 through 5 until required W-Beam rail has been disassembled.
7. Determine the required lift by measuring the height of overlay. The nominal W-Beam height of Ezy-Guard Smart is 730mm.

8. Rails are to be re-attached to the Ezy-Lift carriage using a M16x30mm post bolts and 75x45mm rectangular washer at each post.
9. Rails are overlapped so that no leading edge is presented to the traffic face as shown in Figure 18.
10. Rails are spliced together at every second post using M16x32mm splice bolts and oversized nuts. There are 8 bolts required per splice connection. A pinch bar may be used to assist in the alignment of splice holes. The use of a driving pin to elongate the slots is NOT to be used since this may cause tearing of the rail at the slot location. The bolts are tightened to snug tight.

9.0 Product Storage

All posts and rails are hot dip galvanized in accordance with AS/NZS 4680. It is important that stored galvanized work is stacked so that each item is well ventilated and can adequately drain rainwater from its surfaces.

Poor storage can give rise to wet storage stain (white rust) which is caused by water (rain or condensation) in badly drained or ventilated conditions. This can occur very quickly, particularly in warm, humid conditions.



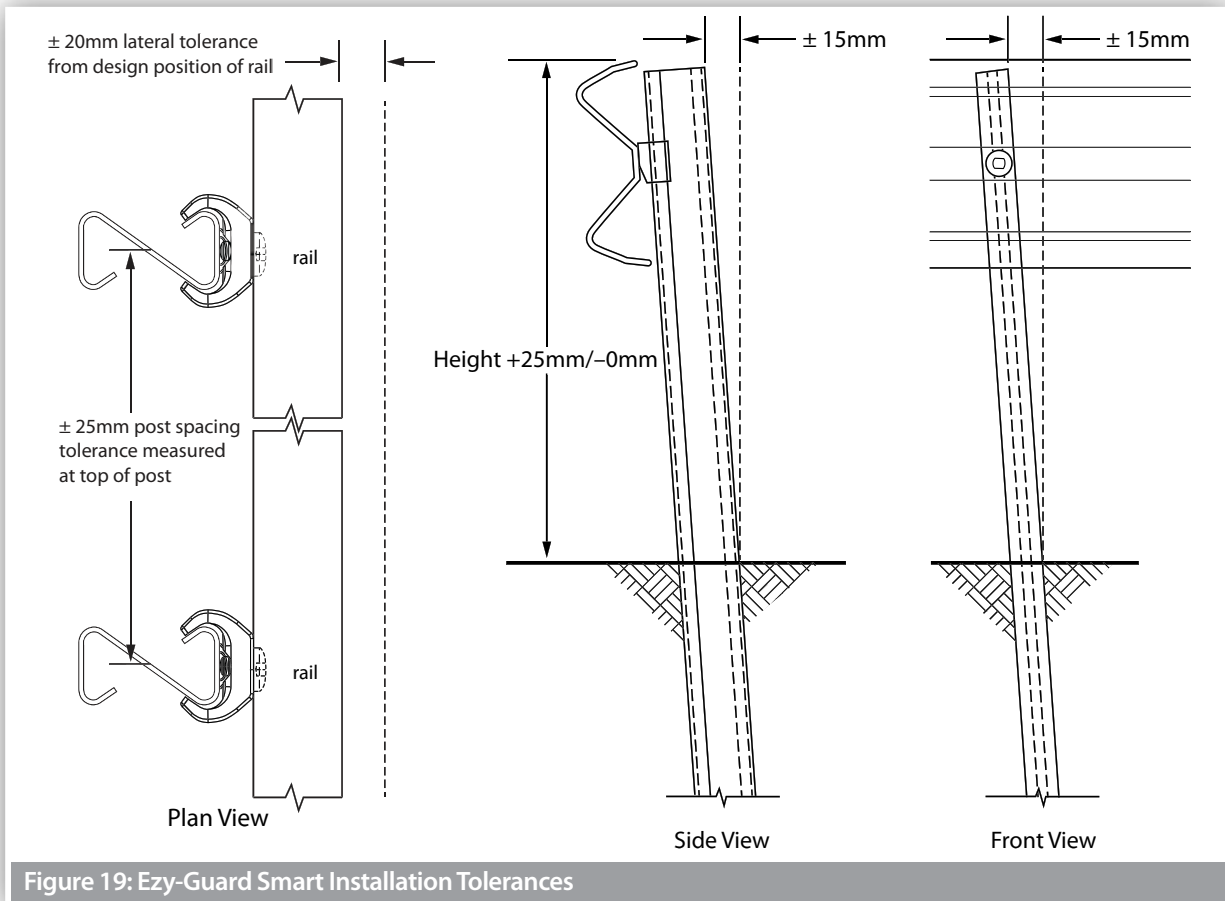


Figure 19: Ezy-Guard Smart Installation Tolerances

Ezy-Guard Smart Installation Checklist

Customer:

Project:

Barrier ID:

Barrier Length:

Checked By:

Signed:

Date

Have the Z-posts been positioned every 2m	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have the Z-posts been correctly orientated in relation to the direction of traffic	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Is the construction of Ezy-Guard Smart within the allowable tolerances as detailed in Section 7.14	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have the Ezy-Carriages been correctly orientated	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have the rails been attached to the Ezy-Carriages using the post bolts with the socket recess	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have the rails been spliced observing the correct lap	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have the rails been spliced with M16x32mm mushroom head bolts	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Are all splice bolts and post bolts snug tight	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Is Ezy-Guard Smart appropriately delineated	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Is Ezy-Guard Smart suitably anchored with approved terminals	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Are the cables in the terminals tensioned to their nominated torque	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Has any minor damage been repaired using two coats of an organic zinc rich paint	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Is the barrier system free from humps, sags or other irregularities	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Has the ground or pavement around the post been left dense, tight and smooth	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Are the barrier components free from splits, burrs or sharp edges after installation	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Has the top of the post been cut or otherwise altered?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

10.0 Repair

10.1 Bush Fire Damage

Ezy-Guard Smart does not contain any plastic, timber or rubber components that will burn.

The performance of galvanised coatings when subjected to fires depends upon a number of factors, such as flame duration, intensity and the characteristics of the galvanised coating.

Typical bushfire conditions may expose steel structures to an air temperature of 800°C for periods of up to 120 seconds, however zinc coatings are generally reflective and will not absorb heat at the same rate as an uncoated steel surface. Depending on the section thickness of the steel, the actual steel surface temperature may not exceed 350°C.

Typically, the bushfire flame duration and intensity are not high enough to compromise the structural strength of the steel. The hot dip galvanized coating will also typically remain unaffected through a bushfire event. If the bushfire causes damage to the galvanized surface, then the item(s) shall be replaced.

10.2 Damage Assessment

In the event of a vehicle impact, damage to the barrier is to be assessed in accordance with Table 6.

A Safe Work Method Statement is available from Ingal Civil Products upon request to assist in the safe repair of Ezy-Guard Smart.

Any item that is replaced is to be reinstated observing the installation tolerances nominated in Section 7.13. Only items purchased from Ingal Civil Products shall be used for the repair of Ezy-Guard Smart.

10.3 Dismantling Sequence

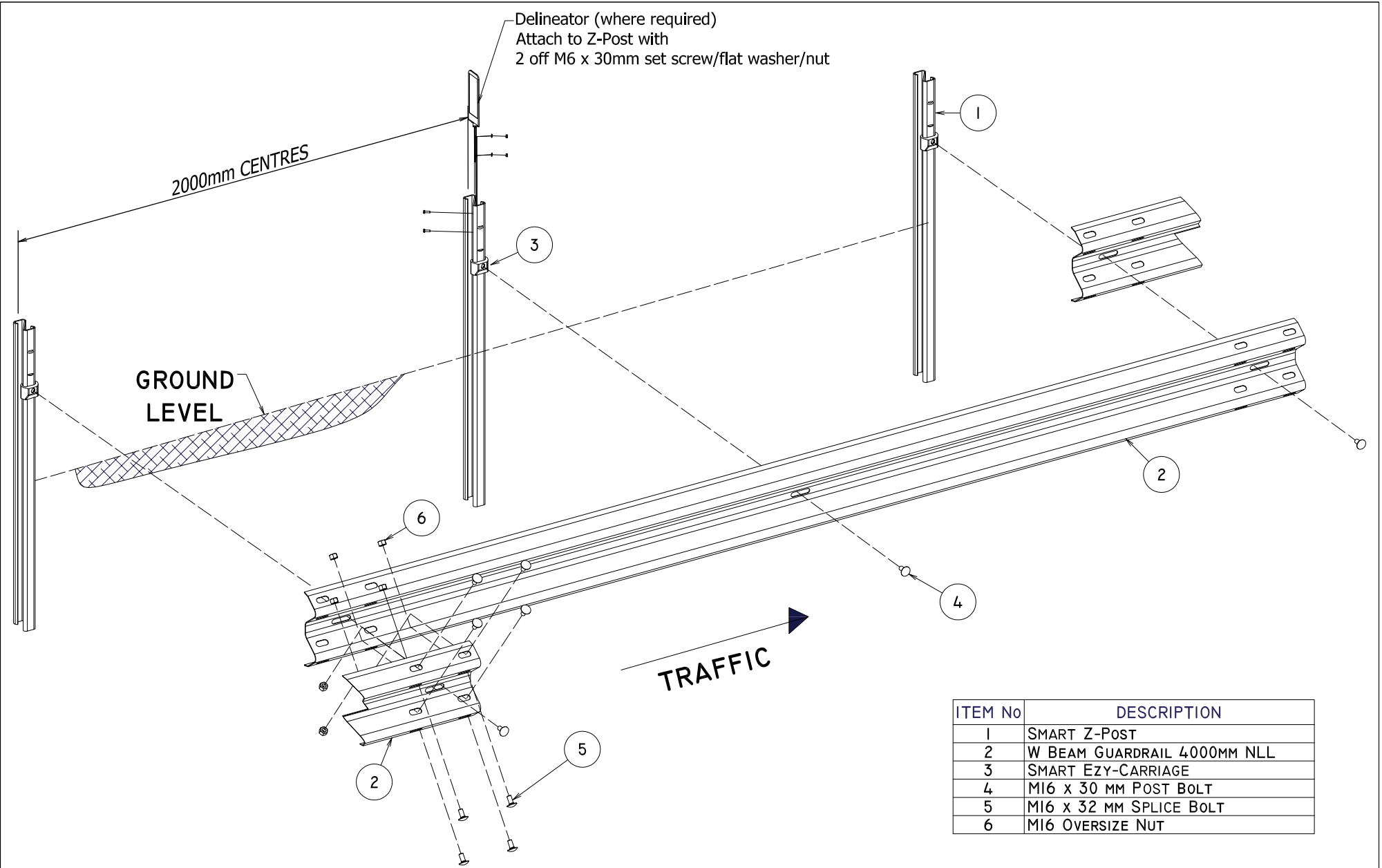
Prior to undertaking dismantling due to a vehicle impact, the area should be assessed for hazards. These include trip hazards, sharp edges and snag points.

During a vehicle impact, the rail will disengage from the posts as they yield by bending at ground level. The recommended dismantling sequence is as follows;


1. Dismantle the rail splice by removing the M16x32mm mushroom head bolts and nuts. There are 8 bolts located at each splice location.
2. Rails that are still attached to posts outside the impact area are disconnected by removing the M16x30mm post bolts. A 10mm hex key is required.
3. Once the area is clear of damaged rail, the posts can be removed. Since the posts yield by bending near ground level, a sling or chain can be attached below the bent section.
4. The damaged post can be lifted using a backhoe or post extractor attachment.
5. Any disturbed pavement material shall be left dense, tight, and smooth prior to the installation of replacement posts.

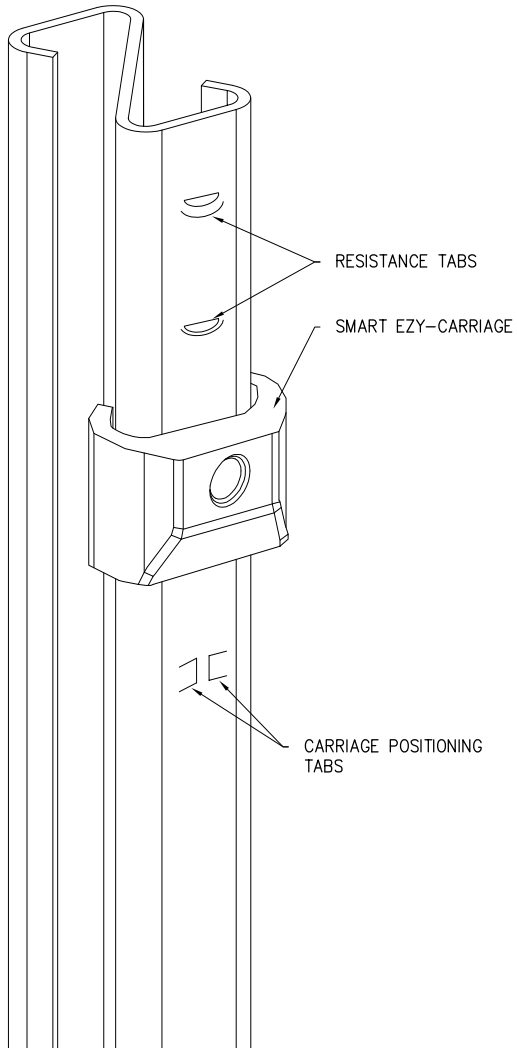
Table 6: Damage Assessment of Ezy-Guard Smart

Type of Defect	Description of the Defect	Action to be Taken
Galvanizing damage on Z-Posts.	The sum total of the damaged area does not exceed 35cm ² (0.5% of the total surface area). The sum total of the damaged area exceeds 35cm ²	An organic zinc rich epoxy paint is to be applied to the repair area in two coats. The Z-post is to be replaced.
Galvanizing damage on 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 does not exceed 40cm ² . The sum total of the damaged area exceeds 200cm ² (0.5% of the total surface area) and/or an individual damaged area exceeds 40cm ² .	An organic zinc rich epoxy paint is to be applied to the repair area in two coats. The rail is to be replaced.
Mechanical damage on Ezy-Carriages.	The Ezy-Carriage has chips or cracks.	The Ezy-Carriage is to be replaced.
Mechanical damage on Z-Posts.	The post is bent. The Ezy-Carriage cannot travel freely along the post due to distortion.	The post is to be replaced. The post is to be replaced.
Mechanical damage on rail.	The rail is dented, twisted or flattened. There are tears in any part of the rail. The slots in the rail are distorted.	The rail is to be replaced. The rail is to be replaced. The rail is to be replaced.
Mechanical damage on bolts.	The body of the bolt is distorted. The thread of the bolt is damaged.	The bolt is to be replaced. The bolt is to be replaced.
Disturbance of material around posts	The material around the post is loose or uncompacted.	Any disturbed pavement or material around a post shall be left dense, tight and smooth so that resistance to water penetration is similar to that of the adjacent surface.

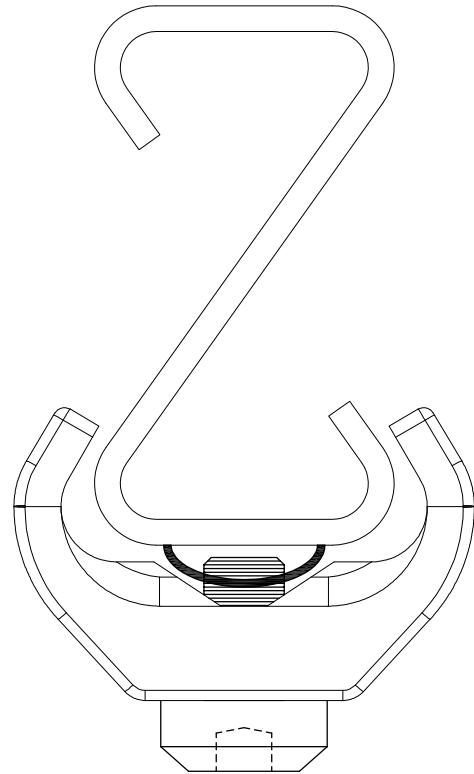


ITEM No	DESCRIPTION
1	SMART Z-Post
2	W BEAM GUARDRAIL 4000MM NLL
3	SMART EZY-CARRIAGE
4	M16 x 30 MM POST BOLT
5	M16 x 32 MM SPLICE BOLT
6	M16 OVERSIZE NUT

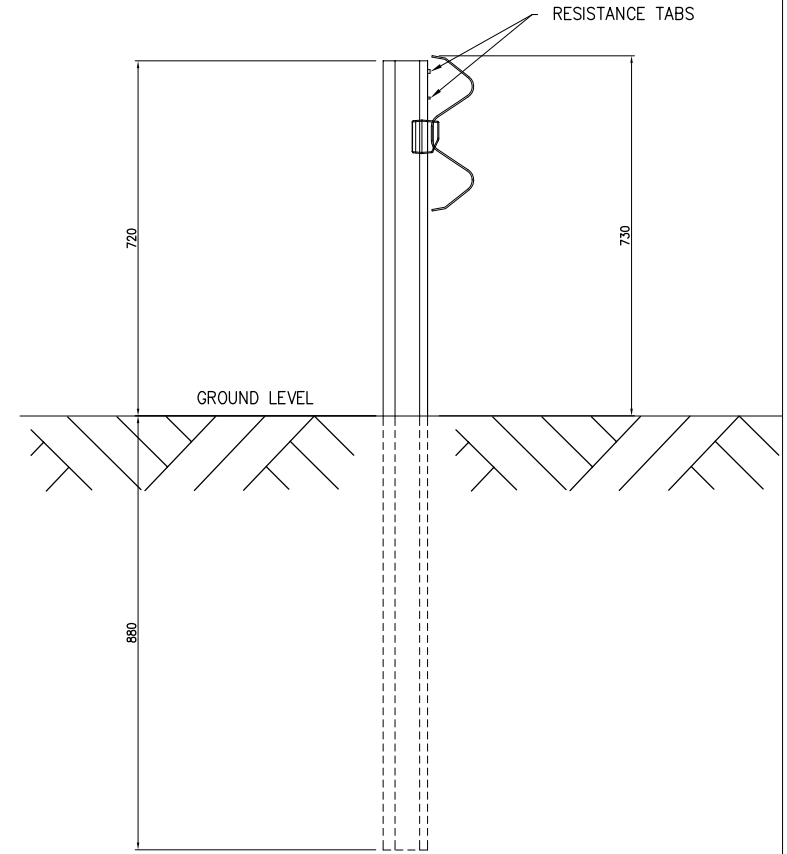
REVISIONS <table border="1"> <tr> <th>REV</th> <th>DATE</th> <th>DESCRIPTION</th> <th>DRAWN</th> <th>CHECKED</th> <th>APPROVED</th> </tr> <tr> <td>0</td> <td>01/04/11</td> <td>ISSUED FOR INFORMATION</td> <td>DJB</td> <td>TC</td> <td></td> </tr> </table>			REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	0	01/04/11	ISSUED FOR INFORMATION	DJB	TC		REFERENCES <table border="1"> <tr> <th>DRAWING NUMBER</th> <th>REFERENCE DRAWINGS</th> </tr> <tr> <td></td> <td></td> </tr> </table>			DRAWING NUMBER	REFERENCE DRAWINGS			<table border="1"> <tr> <th>NAME</th> <th>DATE</th> </tr> <tr> <td>DJB</td> <td>01/04/2011</td> </tr> <tr> <td>TC</td> <td>01/04/2011</td> </tr> <tr> <td colspan="2">APPROVED</td> </tr> <tr> <td>SCALE</td> <td>NTS</td> </tr> <tr> <td>SIZE</td> <td>A1</td> </tr> </table>		NAME	DATE	DJB	01/04/2011	TC	01/04/2011	APPROVED		SCALE	NTS	SIZE	A1	 <p>INGAL CIVIL PRODUCTS 57-65 AIRDS ROAD MINTO, N.S.W AUSTRALIA 2566 PH: +61 2 9827 3333 FAX: +61 2 9827 3300 www.ingalcivil.com.au</p>		<table border="1"> <tr> <td>PROJECT</td> <td>EZY-GUARD SMART</td> </tr> <tr> <td>TITLE</td> <td>ASSEMBLY DETAIL - SHEET 1 of 2</td> </tr> </table>		PROJECT	EZY-GUARD SMART	TITLE	ASSEMBLY DETAIL - SHEET 1 of 2	<table border="1"> <tr> <td>INGAL CIVIL PRODUCTS REFERENCE No.</td> <td></td> </tr> <tr> <td>DRAWING No.</td> <td>EZY-SM-005</td> </tr> </table>		INGAL CIVIL PRODUCTS REFERENCE No.		DRAWING No.	EZY-SM-005
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Z-POST & CARRIAGE ASSEMBLY
ISOMETRIC VIEW

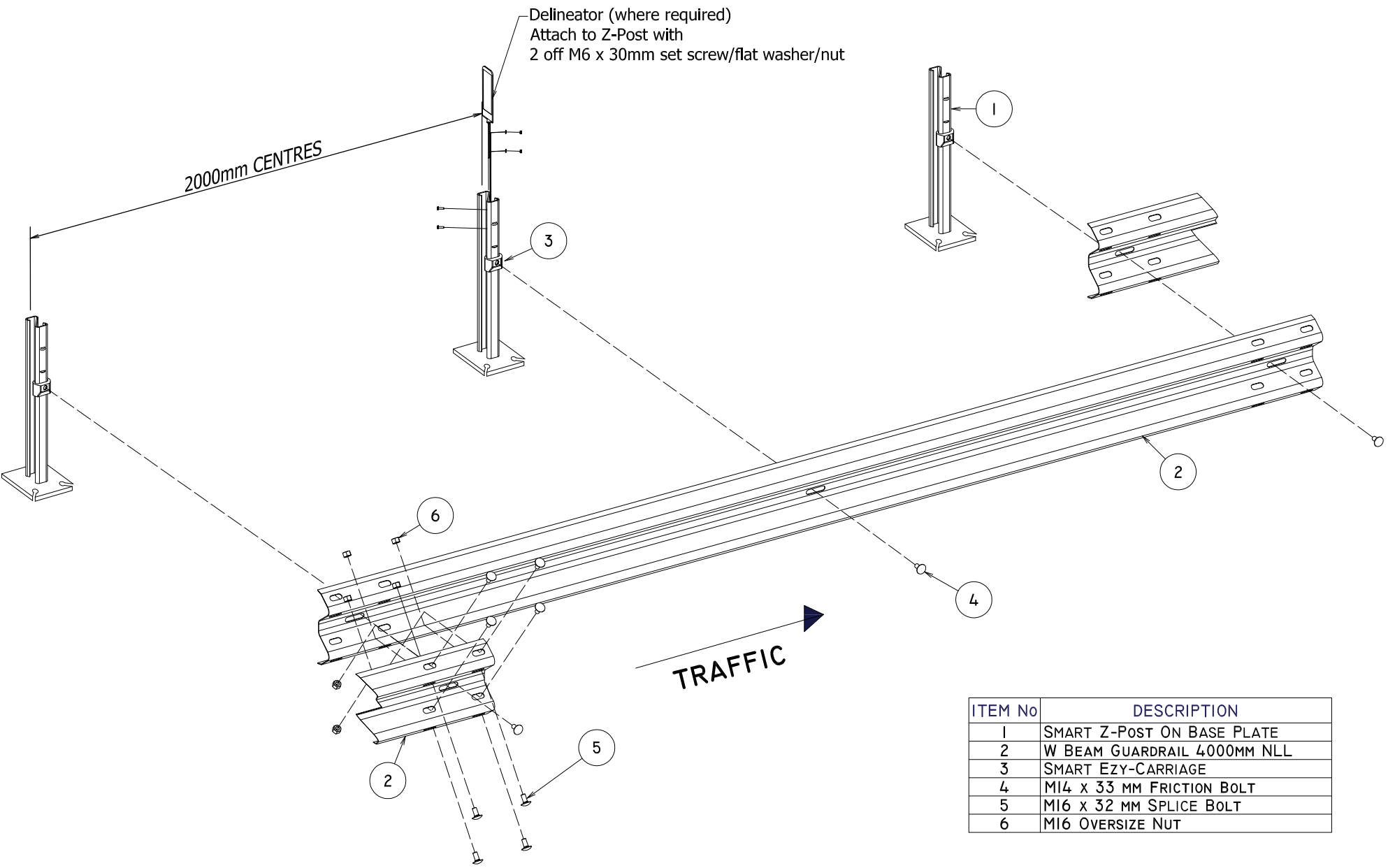


Z-POST & CARRIAGE ASSEMBLY
PLAN VIEW



Z-POST & CARRIAGE ASSEMBLY
SIDE VIEW

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												 INGAL CIVIL PRODUCTS 57-65 AIRDS ROAD MINTO, N.S.W AUSTRALIA 2566 PH. +61 2 9827 3333 FAX +61 2 9827 3300 www.ingalcivil.com.au				PROJECT EZY-GUARD SMART				INGAL CIVIL PRODUCTS REFERENCE No.			
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																REV. 0							



ITEM No	DESCRIPTION
1	SMART Z-Post ON BASE PLATE
2	W BEAM GUARDRAIL 4000MM NLL
3	SMART EZY-CARRIAGE
4	M14 x 33 MM FRICTION BOLT
5	M16 x 32 MM SPLICE BOLT
6	M16 OVERSIZE NUT

REVISIONS

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
0	01/04/11	ISSUED FOR INFORMATION	DJB	TC	

REFERENCES

DRAWING NUMBER	REFERENCE DRAWINGS

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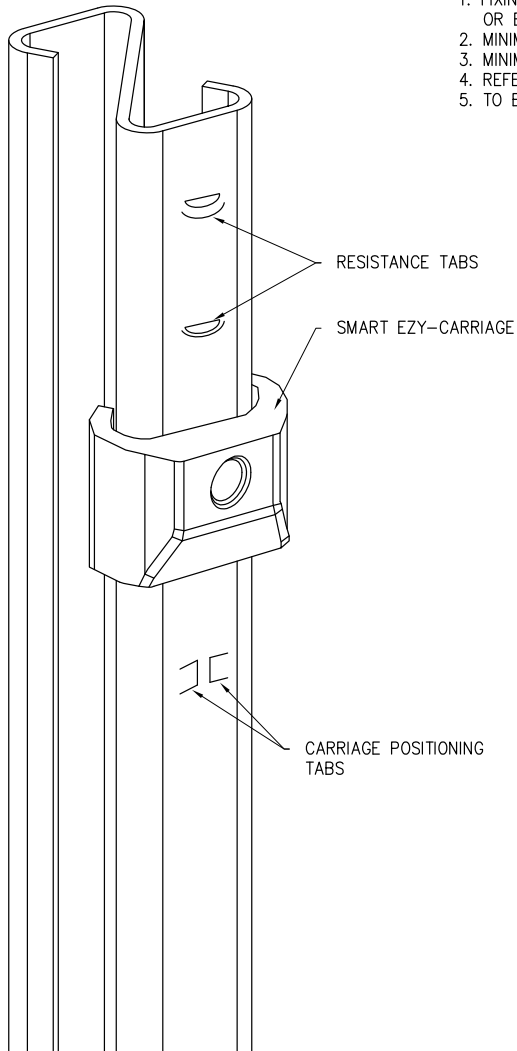
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PROJECT	TITLE
EZY-GUARD SMART POSTS ON BASE PLATES	ASSEMBLY DETAIL - SHEET 1 of 2

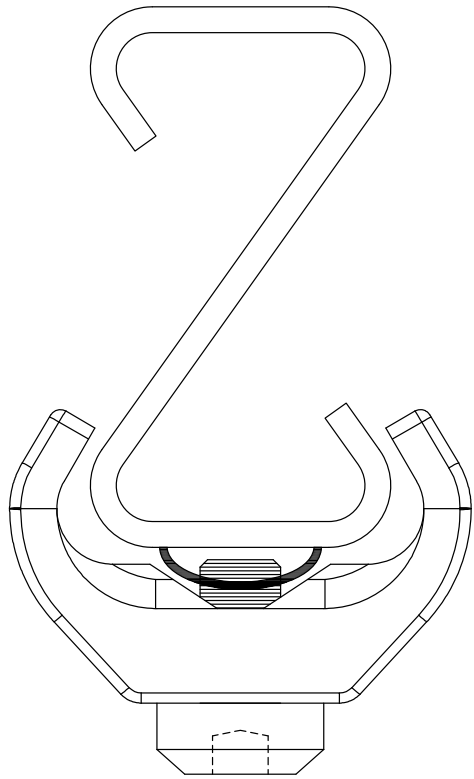
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	EZY-SM-007

REV. 0

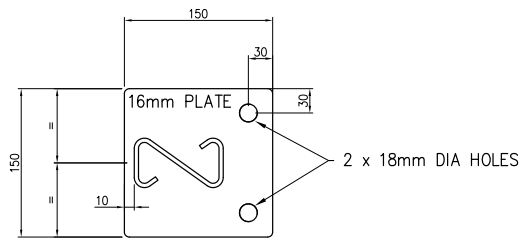


Z-POST & CARRIAGE ASSEMBLY ISOMETRIC VIEW

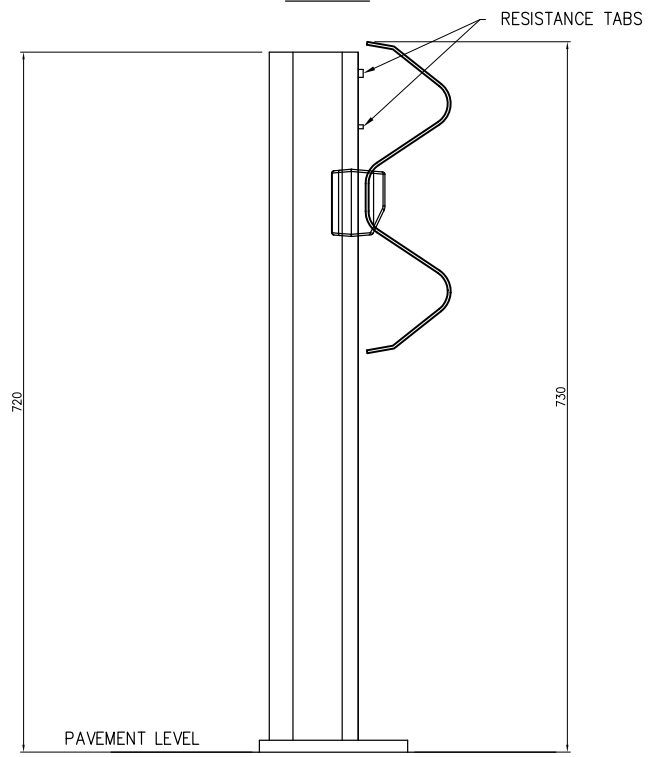
- NOTES:
1. FIXING BOLTS TO BE M16 G8.8 THREADED RODS FIXED WITH HILTI RE-500 EPOXY, OR EQUIVALENT
 2. MINIMUM FIXING BOLT EMBEDMENT DEPTH - 210mm
 3. MINIMUM CONCRETE SUBSTRATE THICKNESS - 270mm
 4. REFER GROUND BEAM DETAIL IN DRAWING EZY-SM-102.
 5. TO BE READ IN CONJUNCTION WITH THE EZY-GUARD PRODUCT MANUAL.



Z-POST & CARRIAGE ASSEMBLY PLAN VIEW

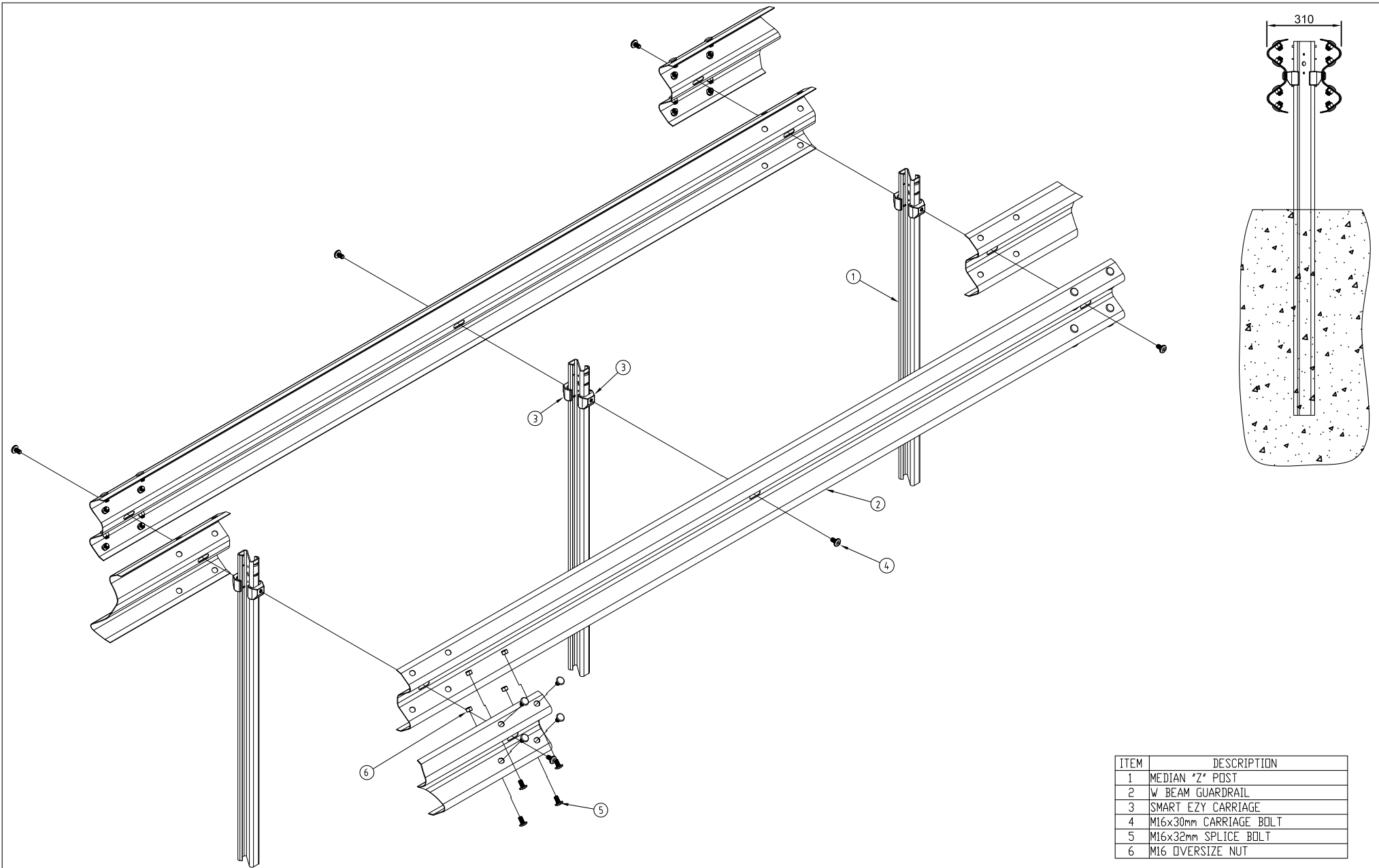


Z-POST ON BASE PLATE PLAN VIEW



Z-POST & CARRIAGE ASSEMBLY SIDE VIEW

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1	03/06/2015	KEY HOLES REMOVED	LG								
0	04/04/11	ISSUED FOR INFORMATION	DJB	TC							
								DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS		REV. 2	



ITEM	DESCRIPTION
1	MEDIAN "Z" POST
2	W BEAM GUARDRAIL
3	SMART EZY CARRIAGE
4	M16x30mm CARRIAGE BOLT
5	M16x32mm SPLICE BOLT
6	M16 OVERSIZE NUT

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS
4	02-23-2016	FOOTPRINT DIM ADDED			LG		
3	03-12-2015	AU REFERENCE REMOVED			LG		
2	15-04-16	TITLE CHANGE			LG		
1	01-04-16	TITLE CHANGE			LG		

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS

NAME	DATE
AUSCOL	03-02-2015
LG	04-02-2015
LG	04-02-2015
N.T.S.	@ A3
INFORMATION ONLY	



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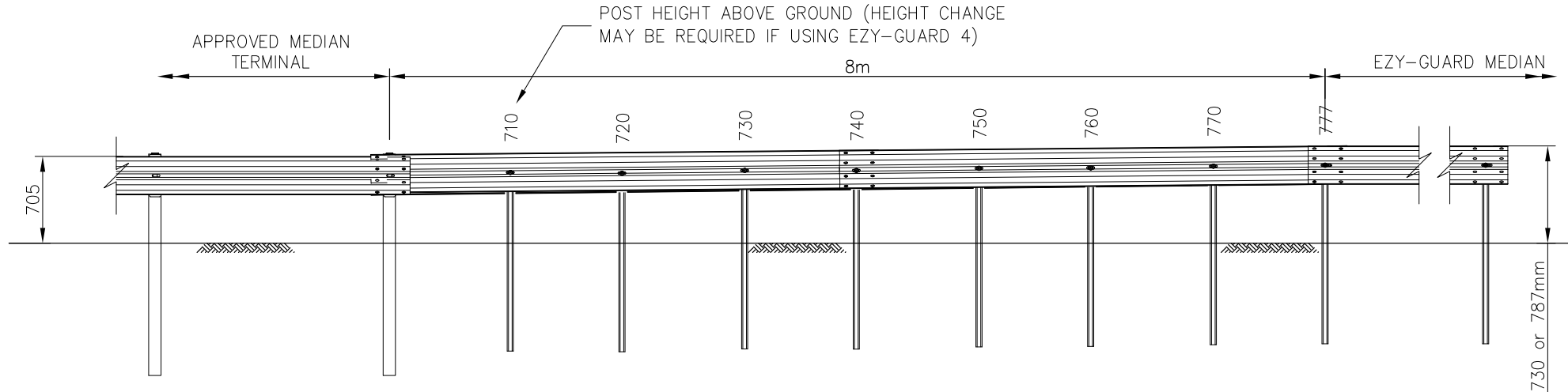
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	EZY-GUARD MEDIAN CONFIGURATION

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N/A	EZY-SM-035

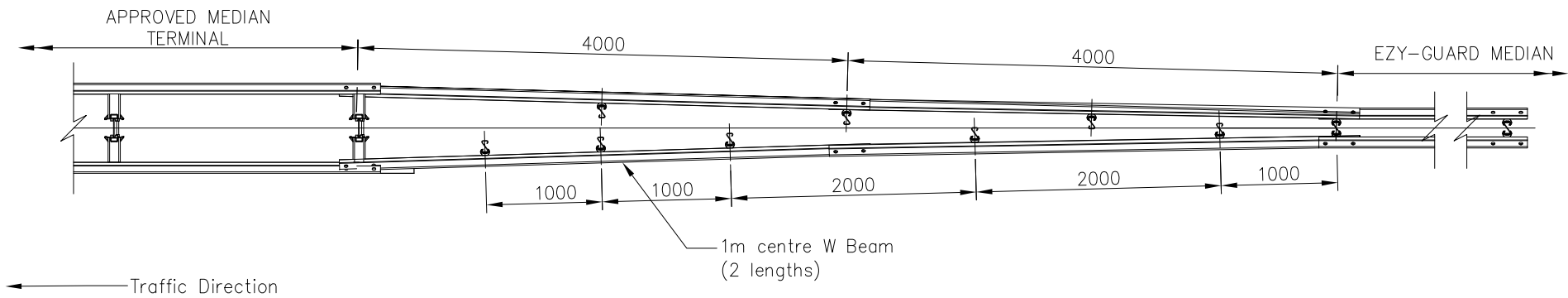
Rev 4

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Release 04/21



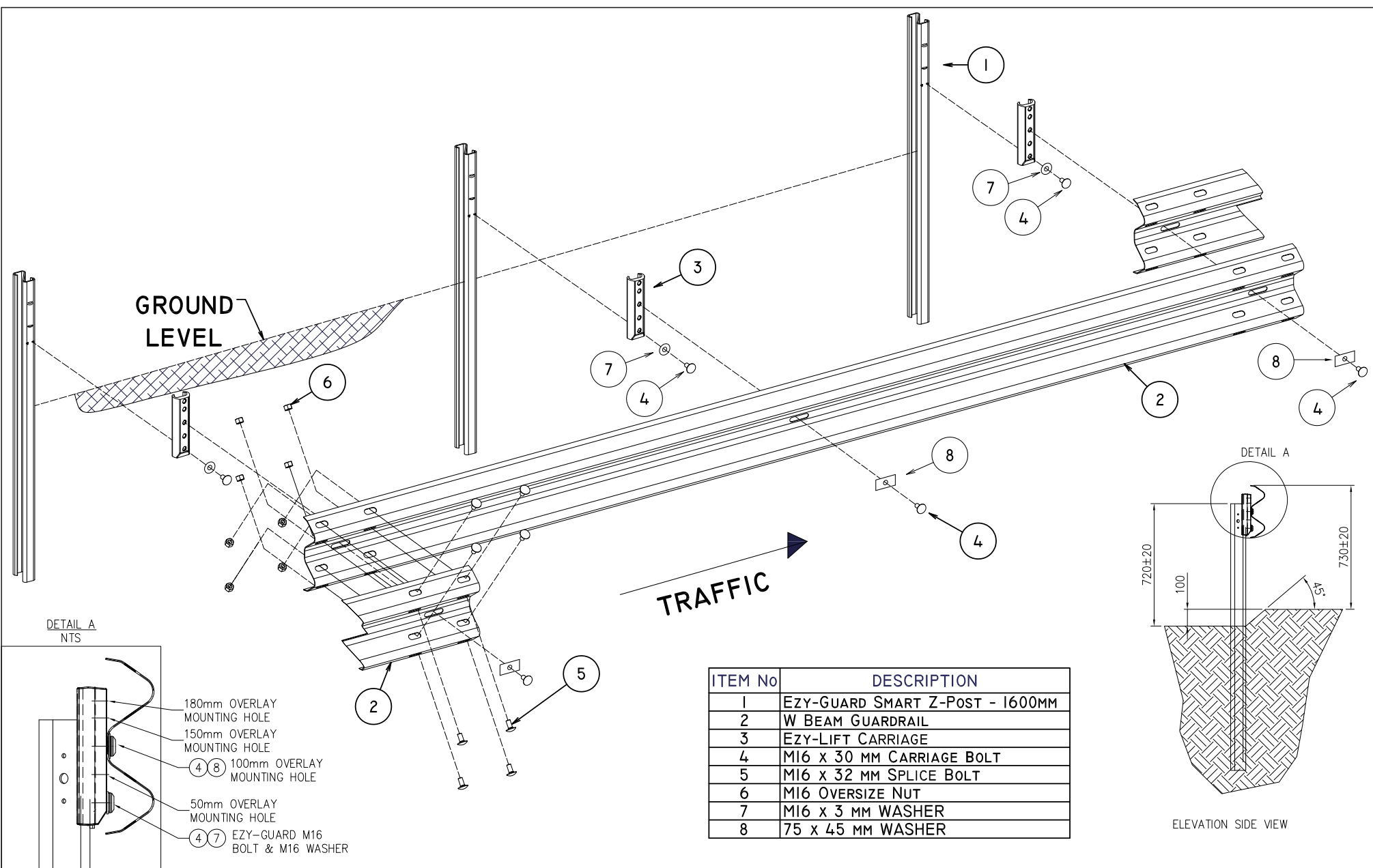
Traffic Direction →



← Traffic Direction

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										 INGAL CIVIL PRODUCTS 57-65 AIRDS ROAD MINTO, N.S.W. AUSTRALIA 2566 PH. +61 2 9827 3333 FAX +61 2 9827 3300 www.ingalcivil.com.au		DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS				

J:\MS\DRAWINGS\EZY-GUARD ASSEMBLY\EZY-SM-110 - EZY-GUARD BBB TRANSITION.DWG



ITEM No	DESCRIPTION
1	EZY-GUARD SMART Z-Post - 1600MM
2	W BEAM GUARDRAIL
3	EZY-LIFT CARRIAGE
4	M16 x 30 MM CARRIAGE BOLT
5	M16 x 32 MM SPLICE BOLT
6	M16 OVERSIZE NUT
7	M16 x 3 MM WASHER
8	75 x 45 MM WASHER

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
1	29-03-2017	DRAWING TITLE UPDATED	MC	LG	
1	15-02-2017	PART NUMBERING CORRECTION - LOWER CARRIAGE BOLT	LG	MC	

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED

NAME	DATE
DRAWN MC	13-12-16
CHECKED LG	13-12-16
APPROVED LG	13-12-16
SCALE	N.T.S. @ A3
ISSUE FOR	INFORMATION ONLY

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a valmont COMPANY

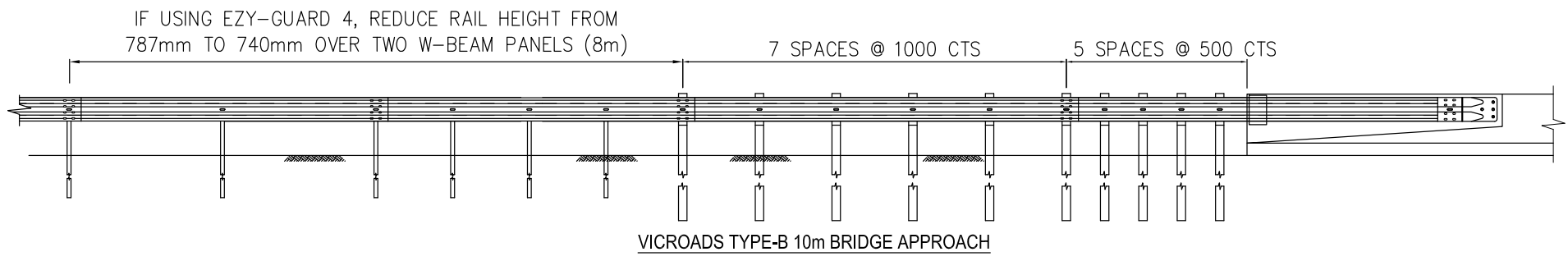
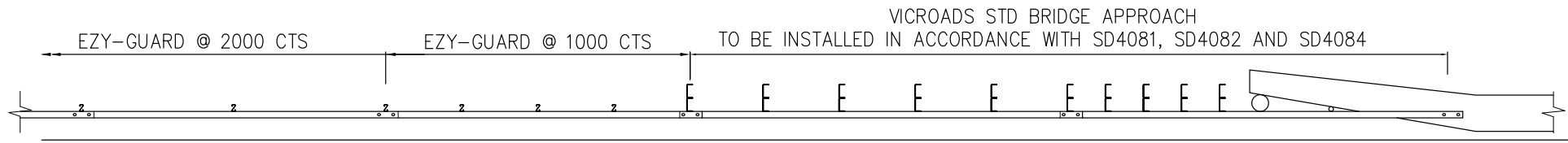
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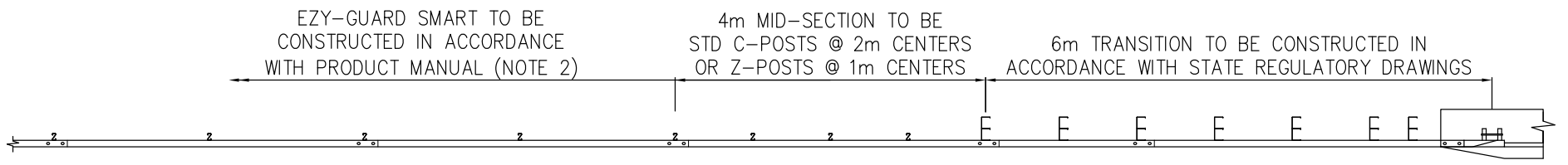
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TITLE	EZY-GUARD SMART WITH EZY-LIFT CARRIAGE EXPLODED ASSEMBLY DETAIL

INGAL CIVIL PRODUCTS PART No.	EZY-SM-137
DRAWING No.	EZY-SM-137

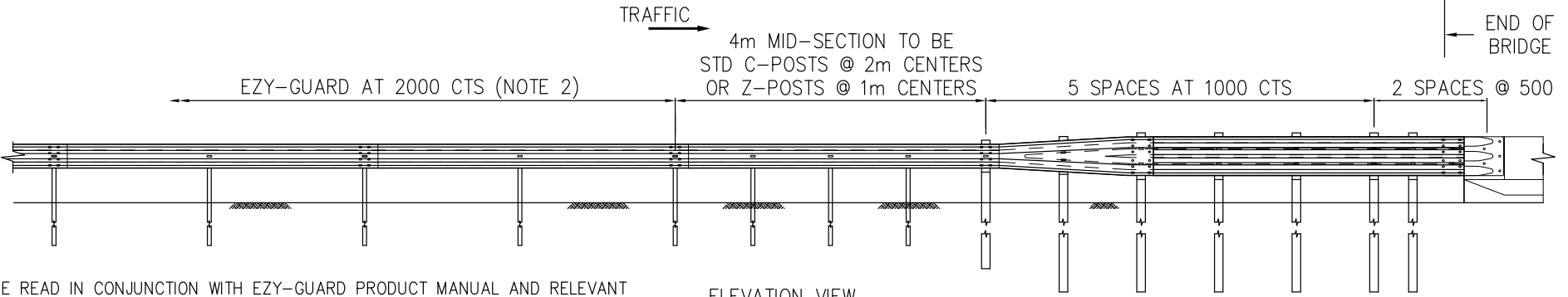
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VICROADS TYPE-B 10m BRIDGE APPROACH



PLAN VIEW

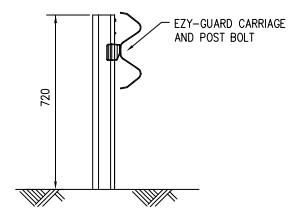
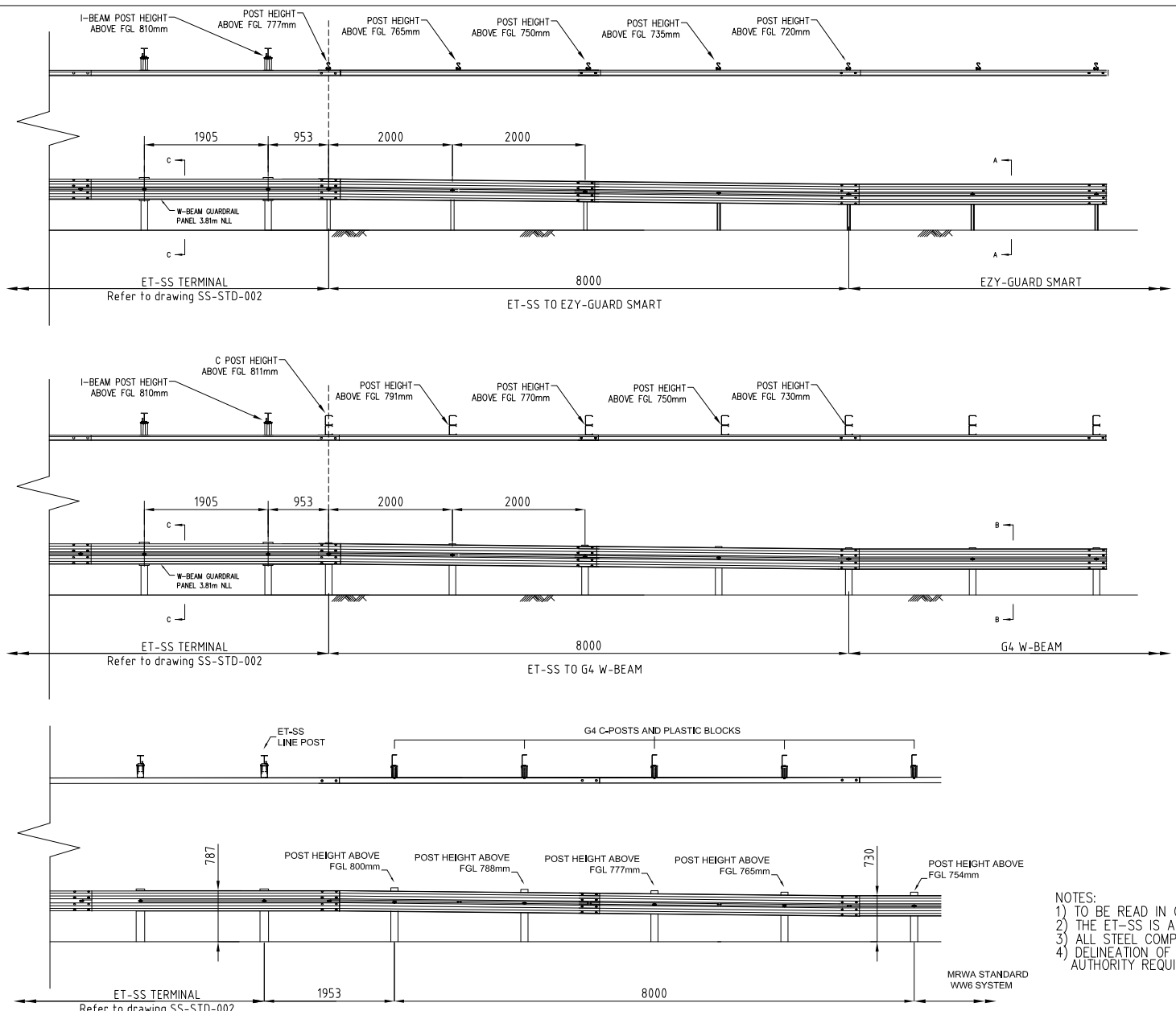


ELEVATION VIEW

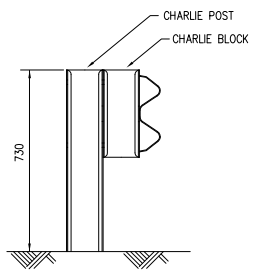
NSW / QLD STD 6m BRIDGE APPROACH

- NOTE:**
1. TO BE READ IN CONJUNCTION WITH EZY-GUARD PRODUCT MANUAL AND RELEVANT STATE ROAD AUTHORITY SPECIFICATIONS AND DRAWINGS.
 2. FOR EZY-GUARD 4 NSW/QLD TRANSITION, REFER EZY-GUARD 4 PRODUCT MANUAL.

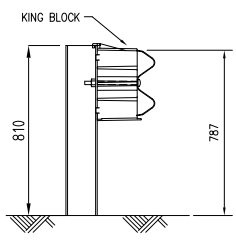
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	SCALE	SIZE	NAME	DATE	INGAL CIVIL PRODUCTS 57-ES AIRDS ROAD MINTO, N.S.W AUSTRALIA 2566 PH. +61 2 9827 3333 FAX +61 2 9827 3300 www.ingalcivil.com.au	PROJECT EZY-GUARD	INGAL CIVIL PRODUCTS REFERENCE No.	
3	26-09-2020	MID SECTION DETAIL UPDATED	VB	LG	LG					DRAWN	DJB	05/09/2011			
2	11-05-2017	EZY-GUARD 4 DETAIL ADDED	MC	LG	LG					CHECKED	TC	05/09/2011			
1	18-05-2017	TYPE B TRANSITION ADDED	MC	IT	LG					APPROVED	TC	05/09/2011			
0	05/09/11	ISSUED FOR INFORMATION	DJB	TC	TC										
										DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS		TITLE CONNECTION TO BRIDGE DETAIL 6m STD BRIDGE APPROACH & VICROADS 10m TYPE-B BRIDGE APPROACH		DRAWING No. EZY-SM-020	



SECTION "A-A"



SECTION "B-B"



SECTION "C-C"

- NOTES:
- 1) TO BE READ IN CONJUNCTION WITH THE ET-SS PRODUCT MANUAL.
 - 2) THE ET-SS IS A MASH TL-3 AND TL-2 END TREATMENT.
 - 3) ALL STEEL COMPONENTS HDG TO AS/NZS4680.
 - 4) DELINEATION OF TERMINAL TO BE IN ACCORDANCE WITH LOCAL AUTHORITY REQUIREMENTS

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
2	08-09-2020	WINN DETAIL ADDED	VB	LG	LG
1	21-06-2019	PRODUCT NAME UPDATED	VB	LG	LG

DRAWING NUMBER	REFERENCE DRAWINGS

NAME	DATE
DRAWN VB	21-01-2019
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PROJECT	TITLE
GUARDRAIL END TERMINALS	MASH ET-SS TRANSITION TO W-BEAM GUARDRAIL GENERAL ARRANGEMENT

INGAL CIVIL PRODUCTS PART No.	DRAWING No.
	SS-STD-005

Rev: 2

J:\SALES & MARKET\DRAWINGS\ET-SS\SS-STD-005-ET-SS TRANSITION TO EZY-GUARD SMART AND G4.DWG

Notes:



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