



Product Manual



Release 02/17

www.ingalcivil.co.nz

1.0 Introduction

Introducing Ezy-Guard 4, 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.

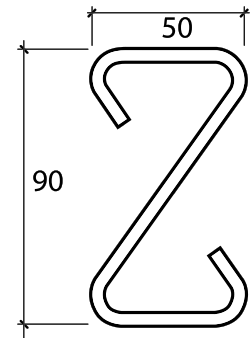
Ezy-Guard 4 is crash tested to the latest performance standard distinguishing it from the existing New Zealand public domain guardrail barrier system.

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 4 Z-Post Length:	1,650mm
Ezy-Guard 4 Z-Post Mass:	12.5kg
Ezy-Guard 4 System Mass:	18.6kg per metre
Rail Height Above Ground:	787mm
Z-Post Height Above Ground:	777mm
Post Spacing:	1,905mm
Ezy-Guard 4 System Width:	200mm
MASH TL3 Crash Test Deflection:	1.65m



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 leaving no surface untreated.



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 4 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 system has also been crashtested in accordance with NCHRP-350 Test Level 4, this is the containment of a 8000kg truck impacting the rail at 80km/h and 15°.

The MASH specification is an update to and supersedes NCHRP Report 350 for the purposes of evaluating new safety hardware devices.

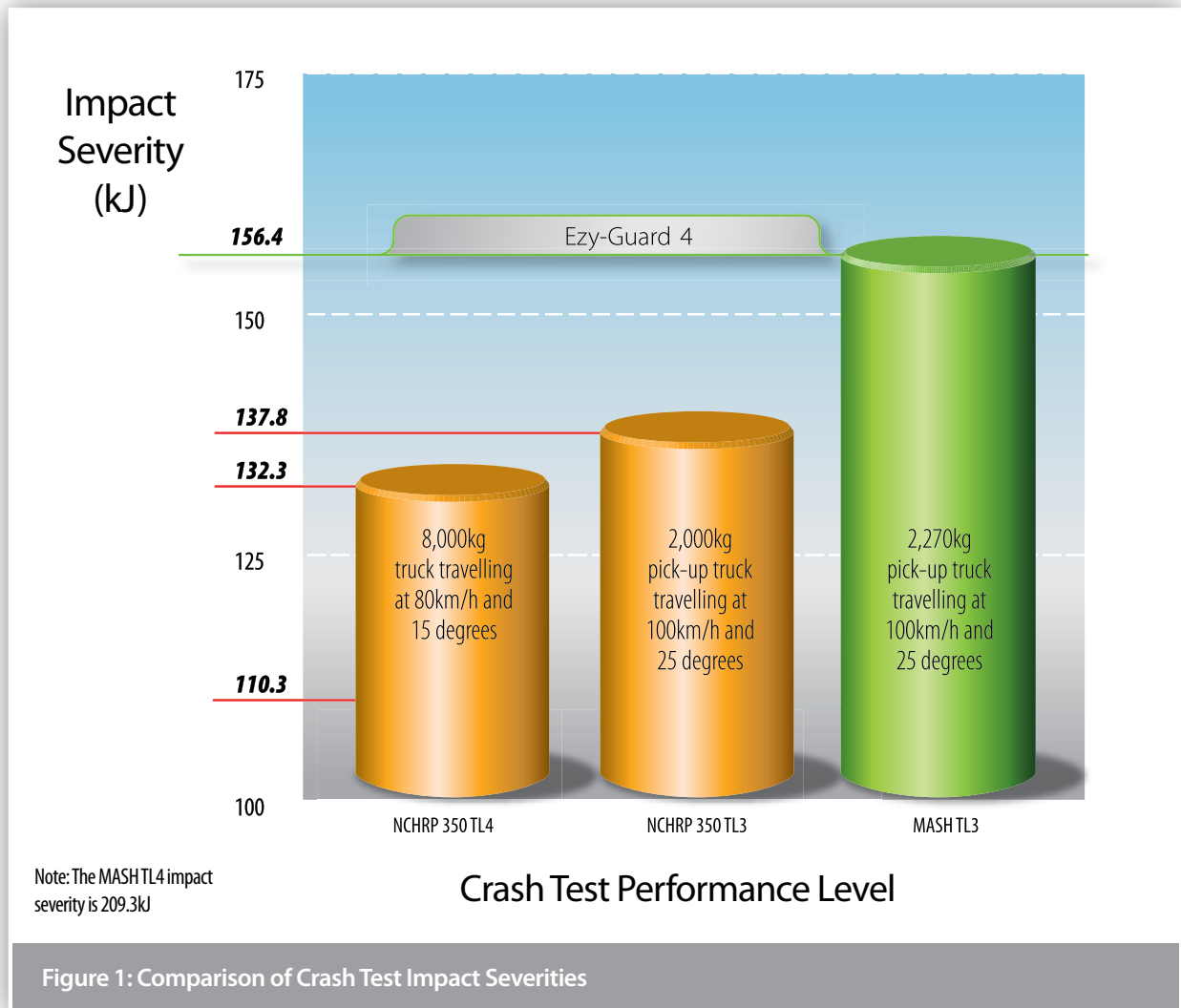
The MASH TL3 crash test matrix requires the following impacts;

- 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.



4.0 Consideration for Vulnerable Road Users

Vulnerable road users include motorcyclists, pedestrians, cyclists and other road users. Ezy-Guard 4 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.

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 4 design does not contain any elements that become projectiles and there are no aggressive edges.

Shielded Posts.

The revolutionary design of Ezy-Guard 4 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 New Zealand.

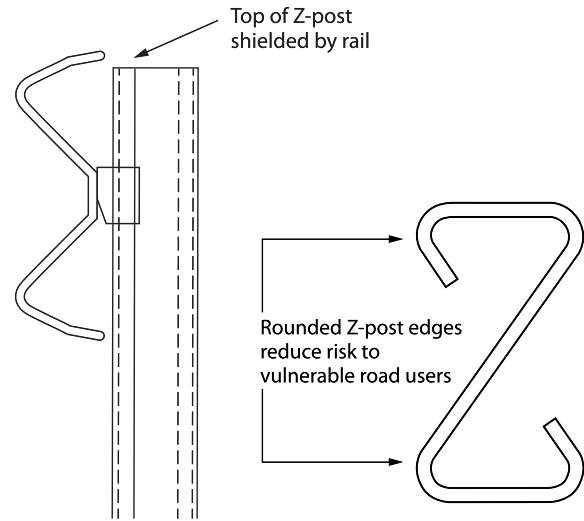


Figure 2: Ezy-Guard 4 Considerations for Vulnerable Road Users



5.0 Features and Benefits

5.1 Fully Compliant to MASH TL3 & NCHRP-350 TL4

Ezy-Guard 4, a member of the Ezy-Guard family, is fully compliant to MASH TL3 and NCHRP-350 TL4.

The MASH TL3 test condition represents a 13% increase in energy when compared to NCHRP 350 Test Level 3 impacts.

The NCHRP-350 TL4 compliance demonstrates the systems ability to contain and redirect the large 8000kg truck, which has a higher centre of gravity compared to the MASH TL3 truck.

MASH TL3 COMPLIANT

NCHRP-350 TL4 COMPLIANT

5.2 Rapid Installation & Repair

Ezy-Guard 4 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 4 design uses fewer components and features 1,650mm Z-posts that are rapidly driven into the ground. The Z-post embedment depth is just 873mm, a significant reduction when compared to other 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 4 is significantly narrower than traditional guardrail barriers that incorporate the use of blocking pieces. Ezy-Guard 4 conserves valuable formation width and allows a greater recovery width to be provided for errant vehicles.

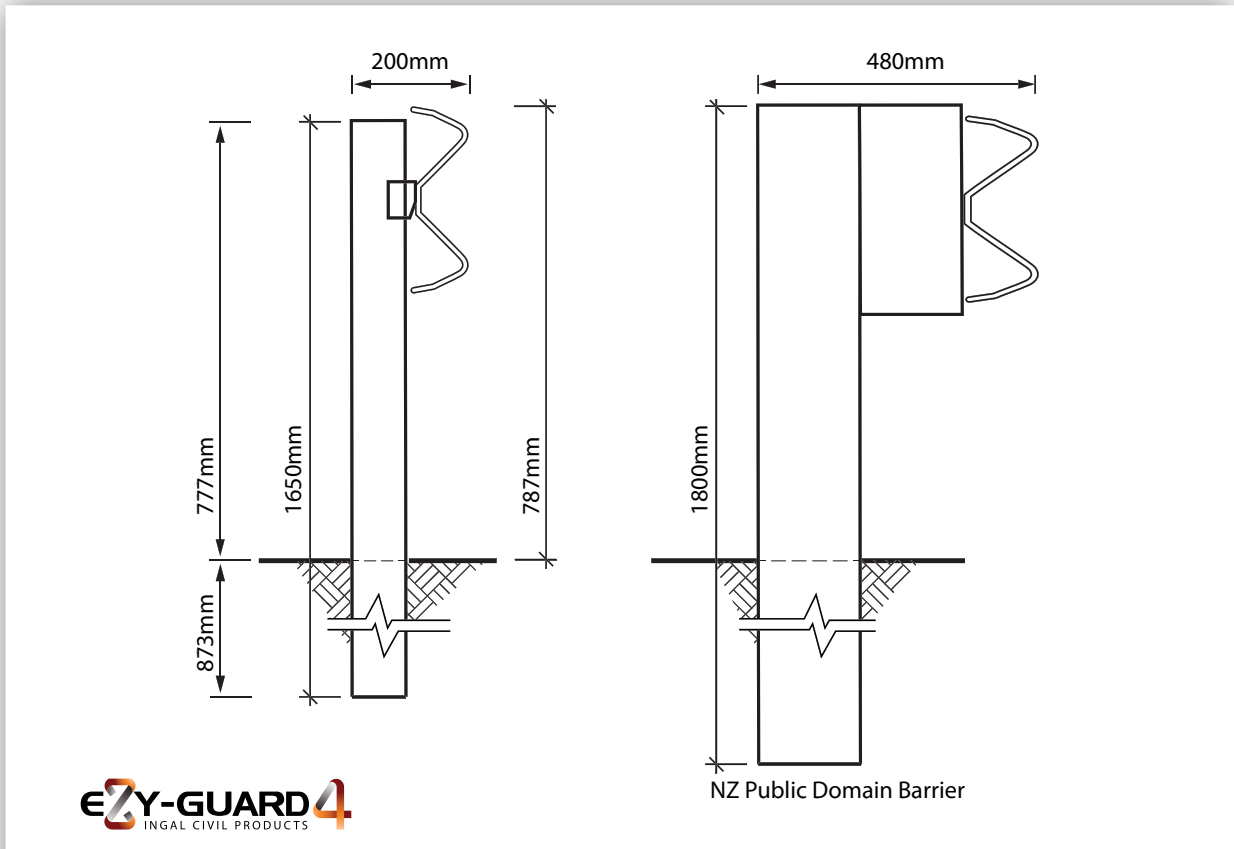


Figure 3: Ezy-Guard 4 Width Comparison

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 4 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 dependant upon the following;

- Mass of the impacting vehicle;
- Speed of the impact vehicle; and
- Angle of the vehicle impact.

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.

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). Once the angle of impact is determined, dynamic deflections for various design vehicles can be selected from Tables 1 or 2.

Example:

A barrier is to be installed on a roadway with a posted speed of 90km/h. The lateral offset to the barrier is 5m.

Step 1: Using Figure 6, the maximum attainable impact is calculated as 20 degrees.

Step 2: The design vehicle is selected as 2,000kg or 2,270kg.

Step 3: The deflection value from the corresponding table is selected. This is as follows;

- 2,000kg design vehicle – 0.8m
- 2,270kg design vehicle – 0.9m

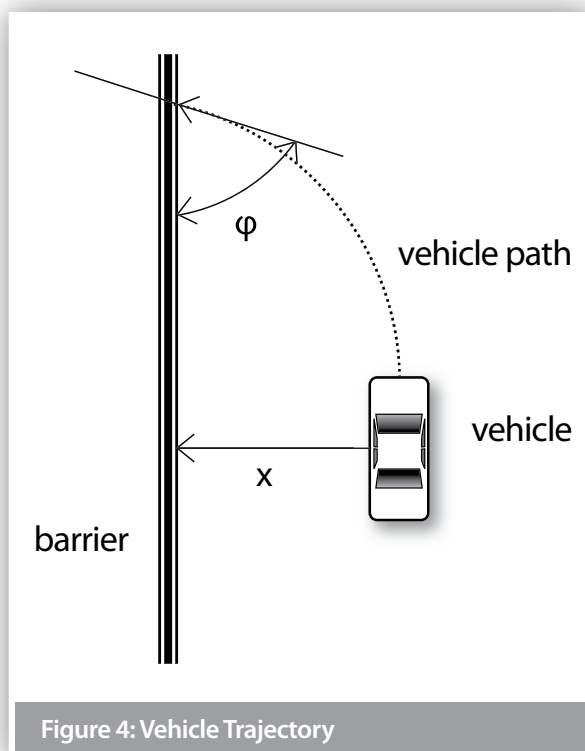


Figure 4: Vehicle Trajectory

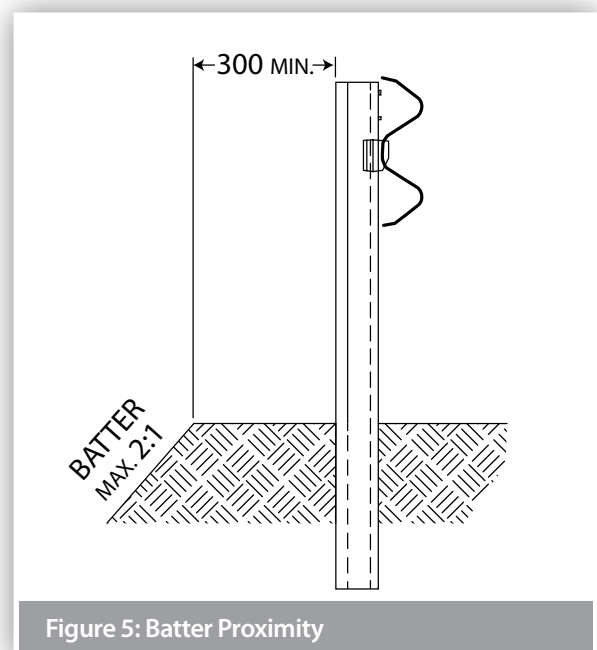


Figure 5: Batter Proximity

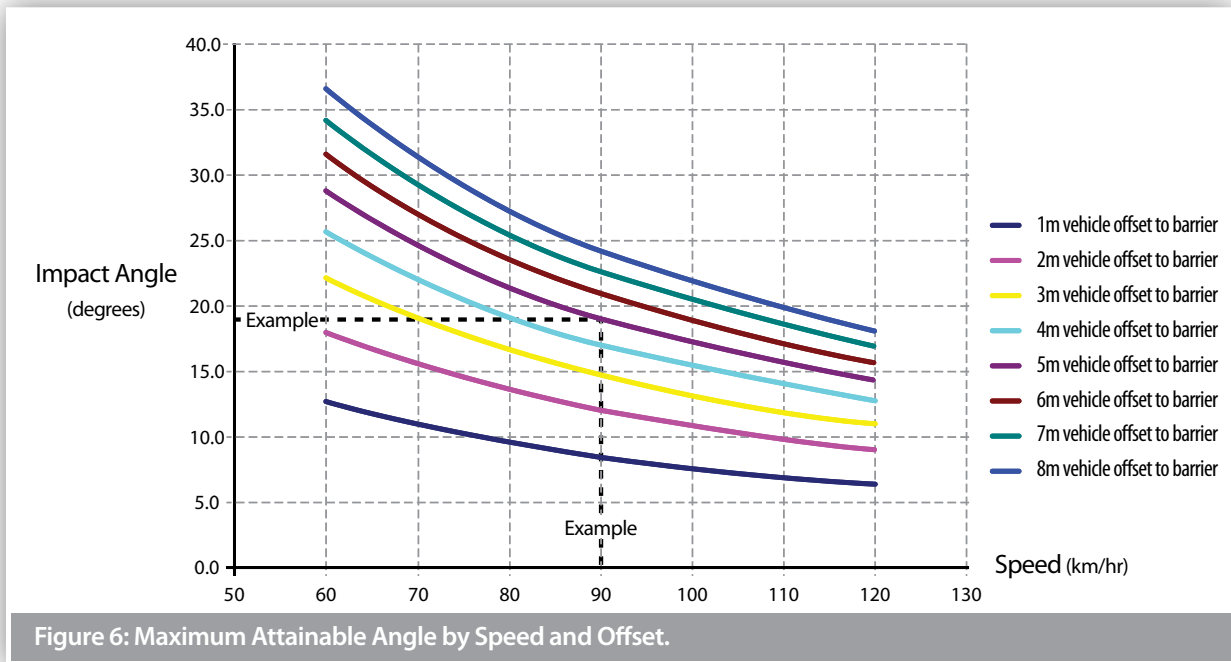


Table 1. Ezy-Guard 4 Deflections - 2,000kg Vehicle (1.905m Post Spacing)

Speed (km/h)	Dynamic Deflection (m)		
	15°	20°	25°
60	0.2	0.3	0.5
70	0.3	0.5	0.7
80	0.4	0.6	0.9
90	0.5	0.8	1.1
100	0.6	0.9	1.4
110	0.7	1.1	1.7

Table 2. Ezy-Guard 4 Deflections - 2,270kg Vehicle (1.905m Post Spacing)

Speed (km/h)	Dynamic Deflection (m)		
	15°	20°	25°
60	0.2	0.4	0.6
70	0.3	0.5	0.8
80	0.4	0.7	1.0
90	0.5	0.9	1.3
100	0.6	1.1	1.6
110	0.7	1.3	1.9

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 4 is installed at a system height of 787mm, measured to the top of the rail. This height is compatible with our range of proprietary and public domain terminals, refer to installation drawings.

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 1.905m spacing used for installation of Ezy-Guard 4. The required post spacing for terminals and transitions will be contained in the proprietor's drawings.

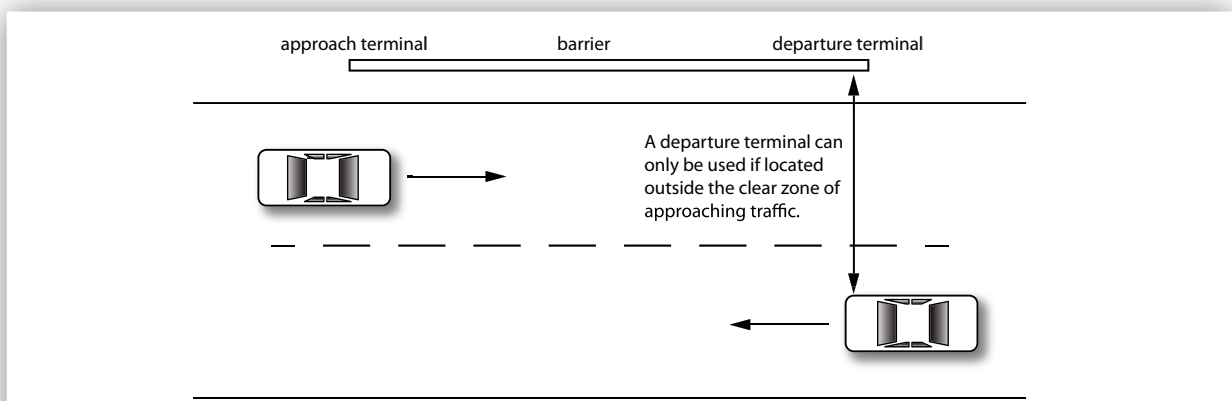


Figure 7: Clear Zone Requirement for the use of Departure Terminals



Figure 8: ET2000 Plus End Terminal

7.2 Minimum Length Requirements

The recommended minimum length of need for Ezy-Guard 4 on all installations must comply with the relevant design requirements for the road controlling authority and will include any length of need provided by the end terminals.

Approach end terminals undergo a re-directive test in order to identify the terminal point-of-need. This is the location where the terminal is capable of re-directing an errant vehicle.

The TL3 ET2000 Plus (15.24m) is re-directive from post 3. This is a distance of 3.8m downstream from the nose of the device. The remaining 11.4m can be used in length-of-need calculations.

The recommended minimum installed length of Ezy-Guard 4 is;

- *34.3m for an installation on a two-way road where the end terminals are located within the clear zone of approaching traffic (refer Figure 7).*

i.e. a 15.24m ET2000 Plus, a 3.81m Trailing Terminal, plus 9.5m of Ezy-Guard 4 joining the two. This will provide a length-of-need section measuring 20.9m.

The recommended minimum installed lengths above are based upon crash test results conducted at 100km/h. In areas where the posted speed is less than or equal to 70km/h an end terminal rated to NCHRP 350 Test Level 2 (TL2) may be considered. The TL2 ET2000 Plus is 7.62m long.

The TL2 ET2000 Plus point-of-need remains at post 3, a distance of 3.8m from the nose of the device. The remaining 3.8m can be used in length-of-need calculations.

The recommended minimum installed length using Ezy-Guard 4 where the posted speed is less than or equal to 70km/h is;

- *30.5m for an installation on a two-way road where the end terminals are located within the clear zone of approaching traffic (refer Figure 7)*

i.e. a 7.62m ET2000 Plus on both ends, plus 15.24m of Ezy-Guard 4 between both ET2000's. This will provide a length-of-need section measuring 22.9m.

- *28.5m for an installation on a road where the departure terminal is located outside the clear zone of approaching traffic (refer Figure 7).*

i.e. a 7.62m ET2000, a 3.81m Trailing Terminal, plus 17.1m of Ezy-Guard 4 joining the two. This will provide a length-of-need section measuring 21m.

7.3 Sequence of Work

Where Ezy-Guard 4 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 4 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 3.

Any modification carried out after fabrication will require repair to the galvanized coating. This is undertaken by applying two coats of an organic zinc rich epoxy paint to the repair area.

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 4 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 4 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 the rounding point on 2:1 embankment slopes.

7.5.2 Weak Soil

Ezy-Guard 4 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.

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.

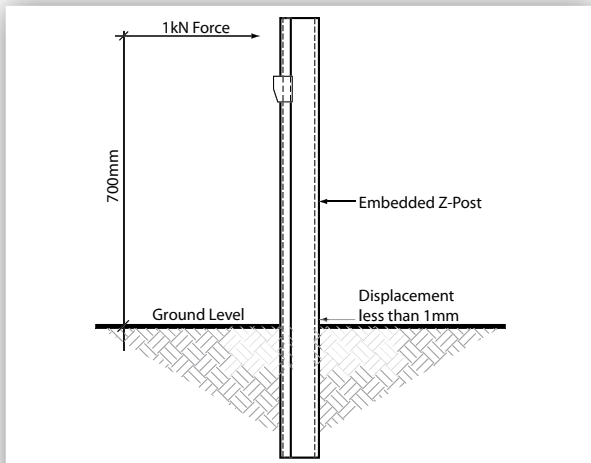


Figure 9: Z-Post Pullover Test

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

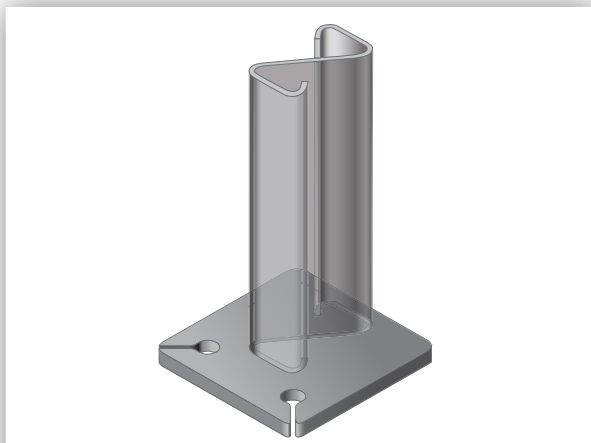


Figure 10: Z-Post on Base Plate

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 3 are applied. If required 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.

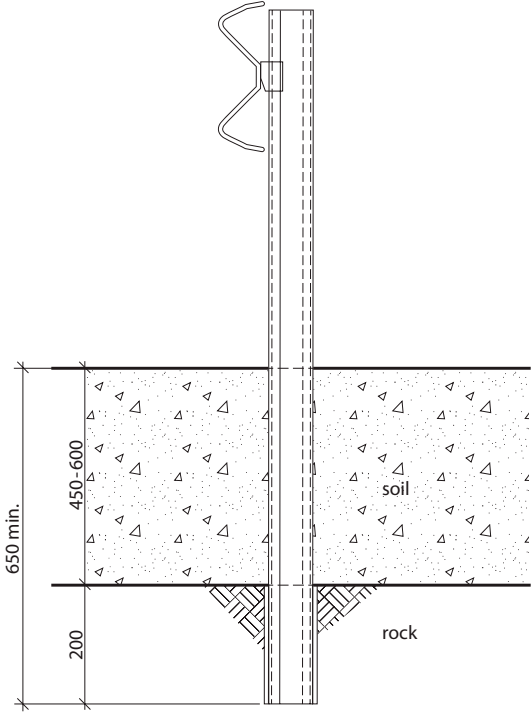
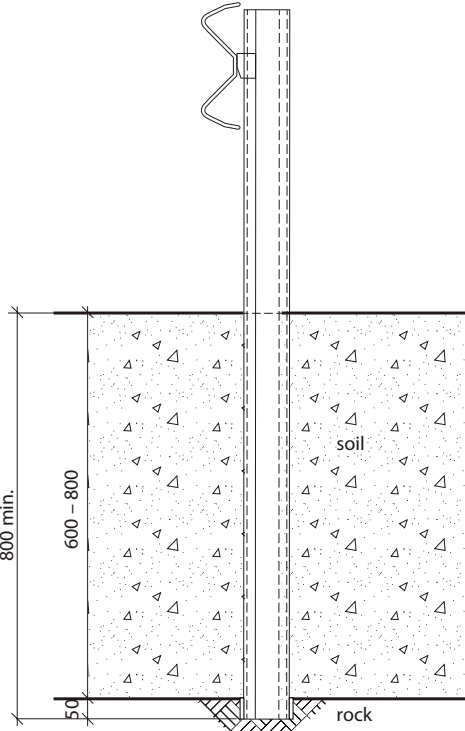
7.10 Delineation

To be in accordance with NZTA M14: 2011.



Table 3: Installation of Ezy-Guard 4 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 4 may be shop curved to fit any radius from 2.4m to 45m Convex. Curves under 25m Radius please refer to NZTA technical note TM 2008.

Ezy-Guard 4 for Concave Curves can be used from 2.4m to 45m. 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 3.81m 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 4.
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.

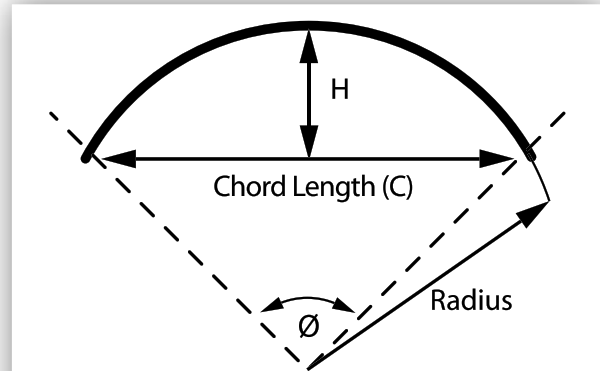


Figure 11: Curvature Measurements

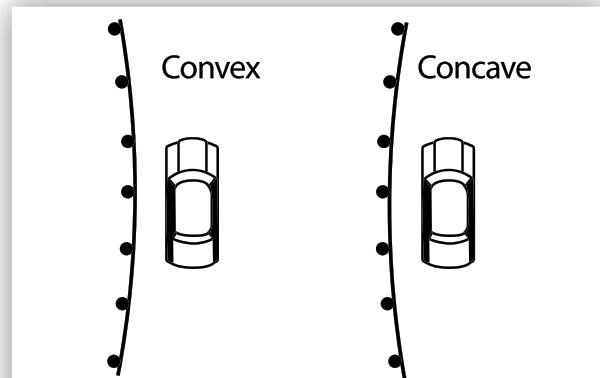


Figure 12: Curvature Orientation

Table 4: Rail Curvature Values (3.81m Arc Length)

Radius (m)	∅ Degrees	C (mm)	H (mm)
2.4	90	3422	717
3	73	3560	585
4	55	3668	445
5	43	3718	359
6	36	3746	300
7	31	3763	258
8	27	3774	226
9	24	3782	201
10	22	3787	181
12	18	3794	151
14	16	3798	129
16	14	3801	113
20	11	3804	91
24	9	3806	76
28	8	3807	65
32	7	3808	57
35	6	3808	52
40	5	3809	45
45	5	3809	40



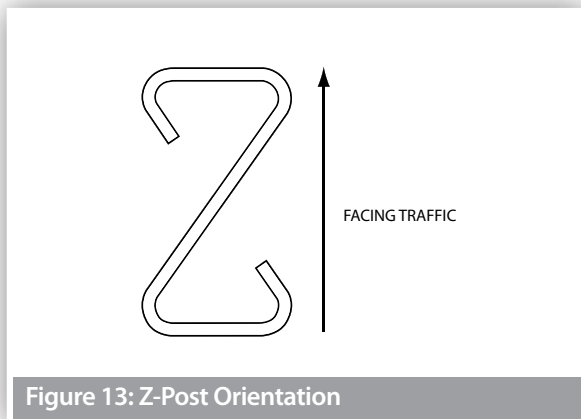
7.12 Installation Sequence

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 4.

Only items purchased from Ingal Civil Products shall be used for the construction of Ezy-Guard 4.

1. Ensure the area has been inspected for underground hazards and that suitable traffic control is in place.
2. Post locations are marked ensuring any fixed object hazard to be protected is located outside the expected dynamic deflection of the barrier.
3. The post lugs are to be at the top of the post and facing the traffic as per Figure 13 and 14.

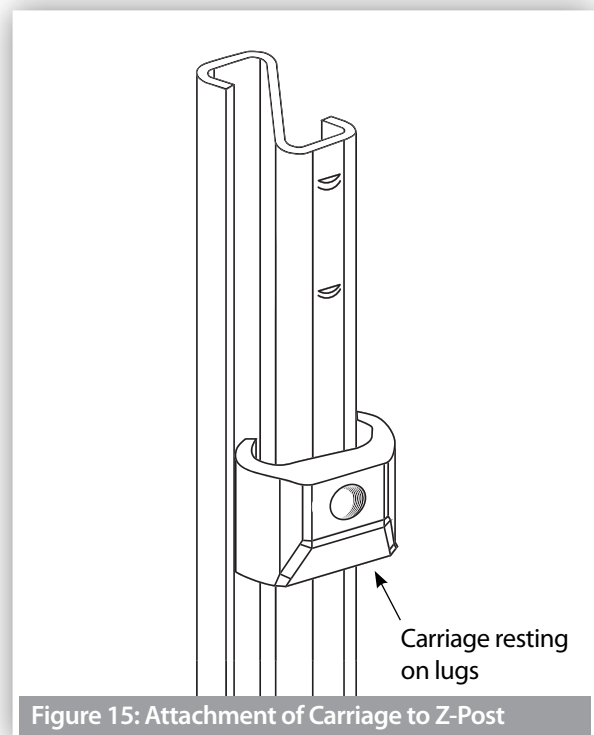
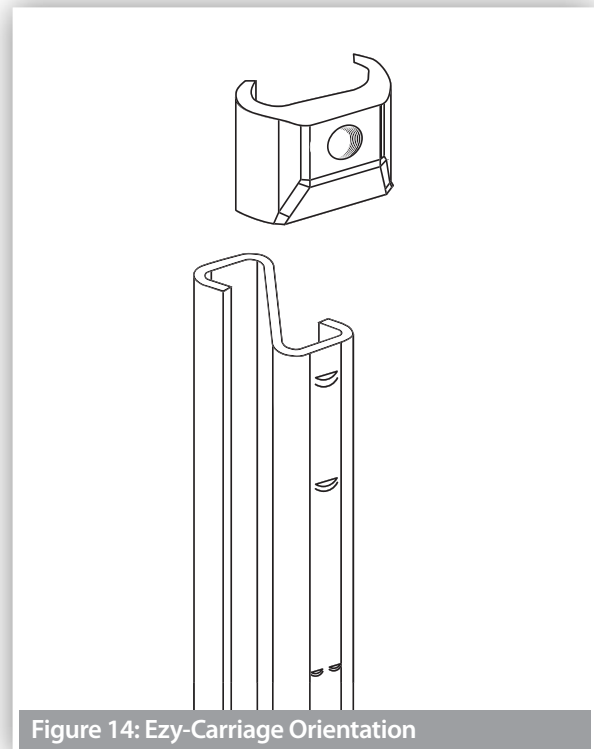


4. Posts are driven directly into the ground and should be vertical. The post installation process shall not cause damage to the post, such that it reduces the effective operation of the safety barrier or its design life, or introduces sharp tearing edges, nor shall it cause damage to pavement. If the 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.

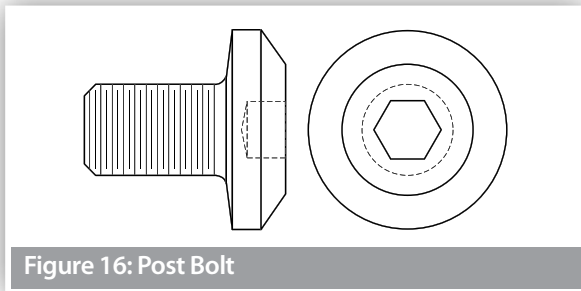
The use of a vibrating post hammer will reduce deformation to the top of the post and install the post at a controlled rate.

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. Posts are spaced at 2m – Lesser spacings are required on transitions to Thriebeam, and where requested by an engineer.

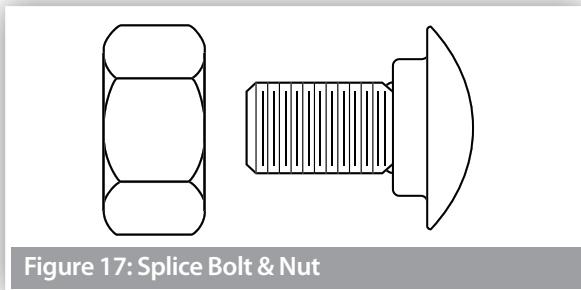
7. The height of the Z-post above ground level is 777mm.
8. The Ezy-Carriage is attached to the face of the post. The Ezy-Carriage will come to rest on the positioning lug fabricated on the Z-post.



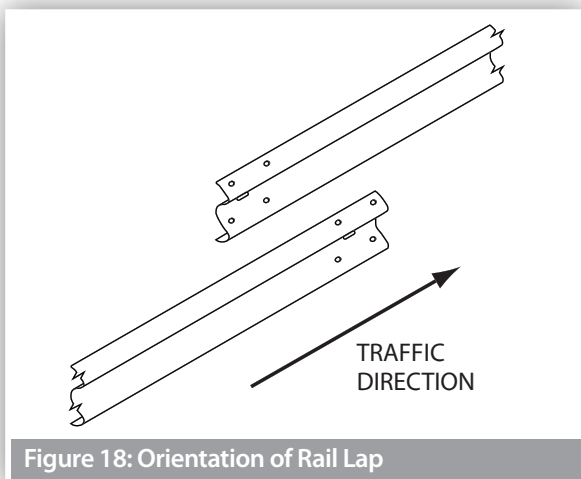
9. Rails are attached to the Ezy-Carriage using the M16x30mm post bolts. The post bolts are identified by the socket recess located in the head of the bolt. The bolts are tightened to snug tight using a 10mm hex. key.



10. 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.



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



12. 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.
13. The construction of Ezy-Guard 4 shall form a smooth line vertically and horizontally when viewed along the line of the system, free from humps, sags or other irregularities.
14. The Ezy-Guard 4 components are to be free from splits, burrs or sharp edges after installation. Any minor damage to the galvanise coating is to be repaired by applying two coats of an organic zinc rich paint.
15. 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 4 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.

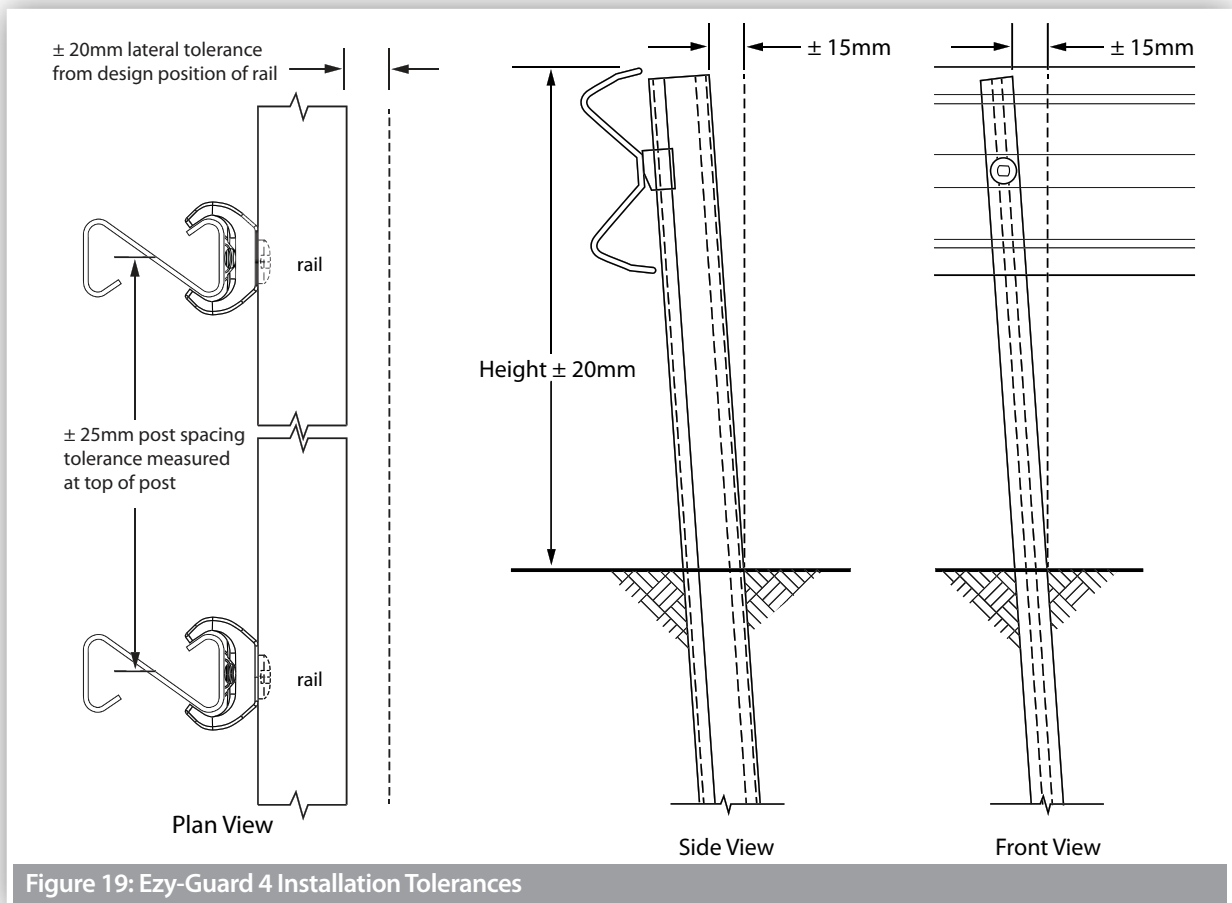
7.14 Installation Tolerances

- The tolerance on height of the barrier shall be plus 25mm / minus 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

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.



Ezy-Guard 4 Installation Checklist

Customer:

Project:

Barrier ID:

Barrier Length:

Checked By:

Signed:

Date

Have the Z-posts been positioned every 1.905m	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Carriages are positioned on the posts between the retaining lugs and the resistance tabs	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Posts are installed to the correct height (777mm) and within the tolerances of section 7.14	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have the Ezy-Carriages been correctly orientated (as per EZY-SM-034)	<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 4 suitably anchored with approved terminals	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Are the cables in the terminals tensioned to their nominated torque where required	<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
Does the barrier form a smooth line vertically and horizontally when viewed along the system	<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 (in-ground only)	<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

Surface Mount Variant:

Are the footing dimensions as per EZY-SM-102	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Is the cast-in assembly arranged as per EZY-SM-125	<input type="checkbox"/> Yes	<input type="checkbox"/> No

Disclaimer:

Important Note: The conformity of the installation is the responsibility of the installation contractor, and Ingal Civil Products accepts no liability for or in connection with any installation that is outside of the specifications of this manual or the NZTA. For more information, please refer to our Standard Terms and Conditions of Sale available on our website: www.ingalcivil.co.nz.

9.0 Repair

9.1 Damage Assessment

In the event of a vehicle impact, damage to the barrier is to be assessed in accordance with Table 5.

A Safe Work Method Statement is available from Ingal Civil Products upon request to assist in the safe repair of Ezy-Guard 4.

Any item that is replaced is to be reinstated observing the installation tolerances nominated in Section 7.14.

Only items purchased from Ingal Civil Products shall be used for the repair of Ezy-Guard 4.

9.2 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.

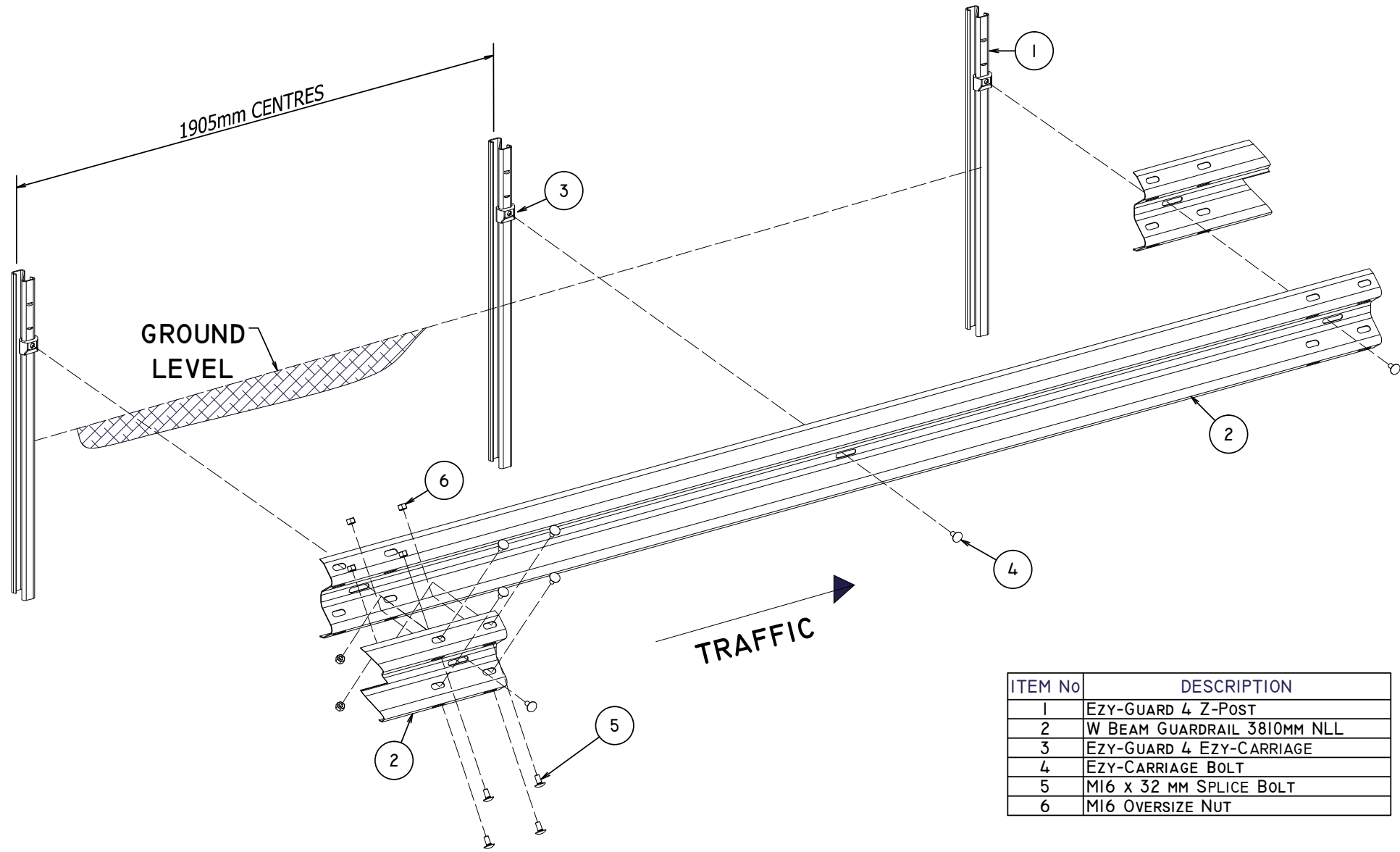
During a vehicle impact, the rail will disengage from the posts as they yield by bending at ground level.

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 5: Damage Assessment of Ezy-Guard 4

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	EZY-GUARD 4 Z-POST
2	W BEAM GUARDRAIL 3810MM NLL
3	EZY-GUARD 4 EZY-CARRIAGE
4	EZY-CARRIAGE BOLT
5	M16 x 32 MM SPLICE BOLT
6	M16 OVERSIZE NUT

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
0	18/08/15	ISSUED FOR INFORMATION	MC	LG	LG

DRAWING NUMBER	REFERENCE DRAWINGS

NAME	DATE
DRAWN MC	18/08/15
CHECKED LG	25/08/15
APPROVED LG	25/08/15
SCALE N.T.S. @ A3	
ISSUE FOR INFORMATION ONLY	

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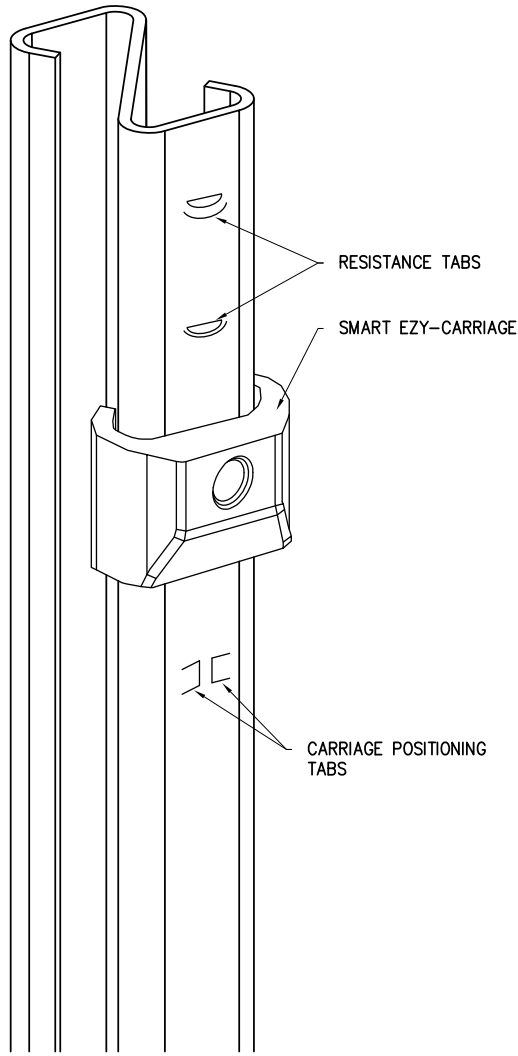
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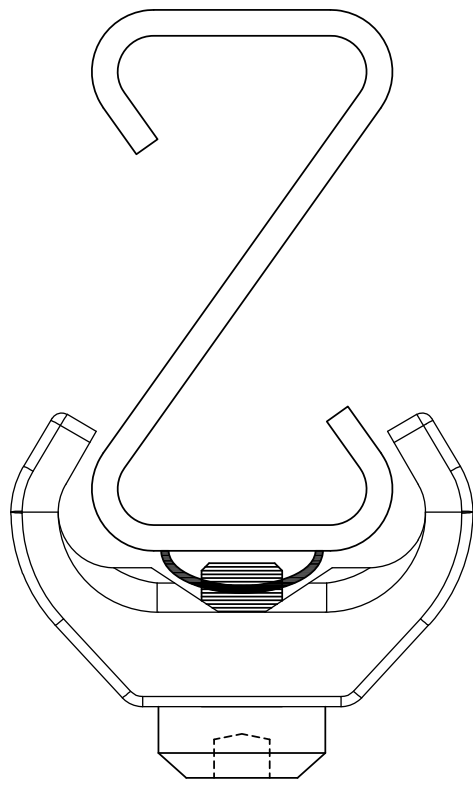
PROJECT	
TITLE	EZY-GUARD 4 ASSEMBLY DETAIL - SHEET 1 of 2

INGAL CIVIL PRODUCTS PART No.	
DRAWING No.	EZY-SM-116
Rev.	0

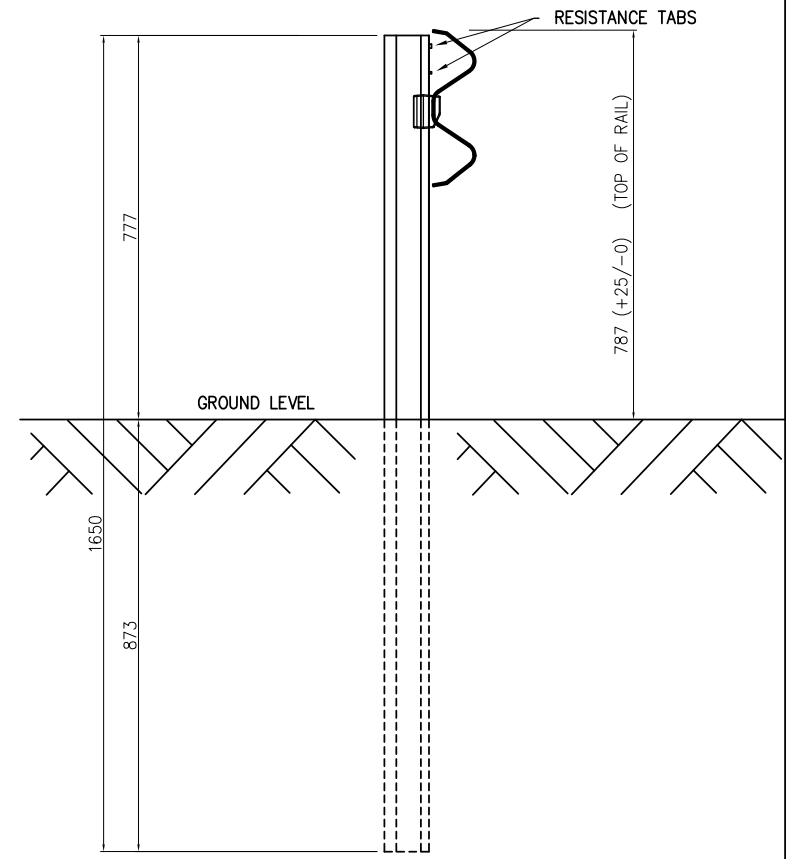
J:\MISC\DRAWINGS\EZY-GUARD ASSEMBLY\EZY-SM-116 - EZY-GUARD 4 ASSEMBLY.DWG



Z-POST & CARRIAGE ASSEMBLY
ISOMETRIC VIEW




Z-POST & CARRIAGE ASSEMBLY
PLAN VIEW

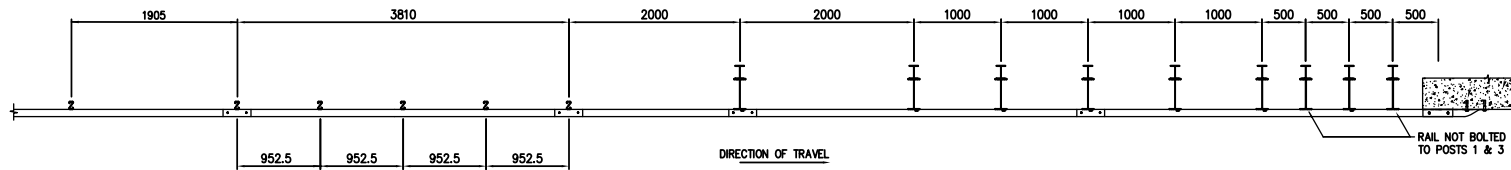


Z-POST & CARRIAGE ASSEMBLY
SIDE VIEW

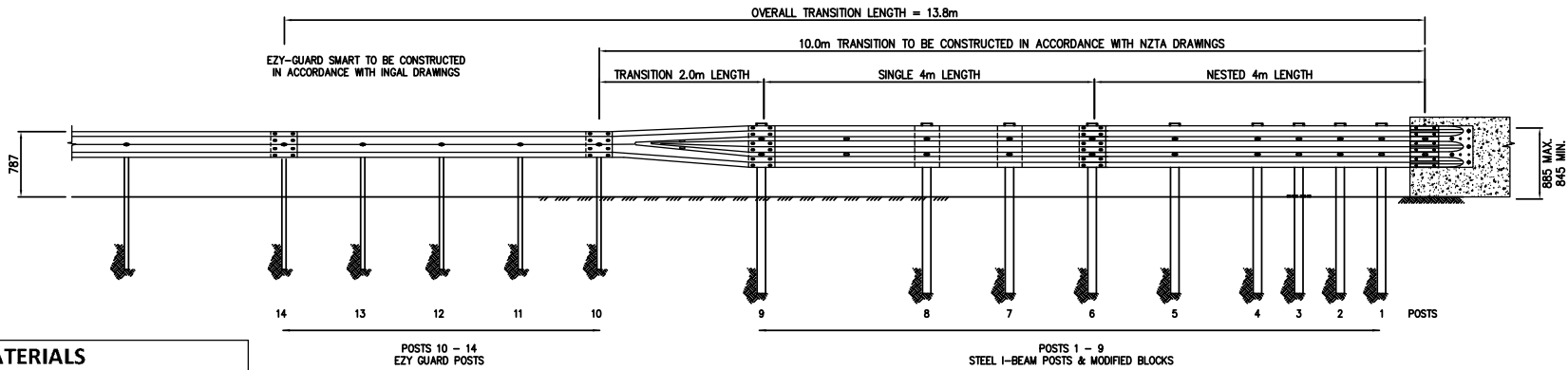
TO BE READ IN CONJUNCTION WITH EZY-SM-121

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	 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	INGAL CIVIL PRODUCTS REFERENCE No.		
4	02-09-2016	TOLERANCE ADDED		LG				DRAWN	DJB		01/12-2014	EZY-GUARD 4		
3	01-04-2015	NAME CHANGE (4)		LG	LG	LG		CHECKED	LG		10/12/2014			
2	13-01-2015	DM MCD		DJB	LG	LG		APPROVED						
1	11-12-2014	DM CORRECTION		DJB	LG	LG		SCALE	NTS					TITLE
								SIZE	A1		ASSEMBLY DETAIL 787mm RAIL HEIGHT			EZY-SM-034

REV. 4



PLAN SCALE



BILL OF MATERIALS		
PART NO	DESCRIPTION	QTY
10004016	THRIEBEAM STEEL POSTS	9
10004017	MODIFIED STEEL BLOCKS - THRIEBEAM	9
10001346	M16 X 50 MM HEX HEAD BOLT AND NUT	19
10001255	M16 X GALV SPRING WASHER	19
10000853	4.00M X 2.7 MM APPROACH THRIEBEAM RAIL	3
10000871	STIFFENER 300 MM THRIEBEAM RAIL	2
10000869	2M TRANSITION THRIEBEAM	1
10001233	M16 X 50 MM POST BOLTS	10
10001248	M16 X 32 MM SPLICE BOLTS	24
10001239	M16 OVERSIZE NUTS	34
10004528	M16 - 50 X 50 MM SQUARE FLAT WASHER	10

REVISIONS

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
D	18/08/2015	BOM ADDED	MC	LG	LG
C	09/12/2015	SMART = 4	LG	SE	LG
B	08/10/2012	ISSUED FOR INFORMATION	DM	TC	
A	16/12/2011	ISSUED FOR INFORMATION	DJB	TC	

REFERENCES

DRAWING NUMBER	REFERENCE DRAWINGS

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CHECKED	TC	
APPROVED		
SCALE	NTS	
SIZE	A1	

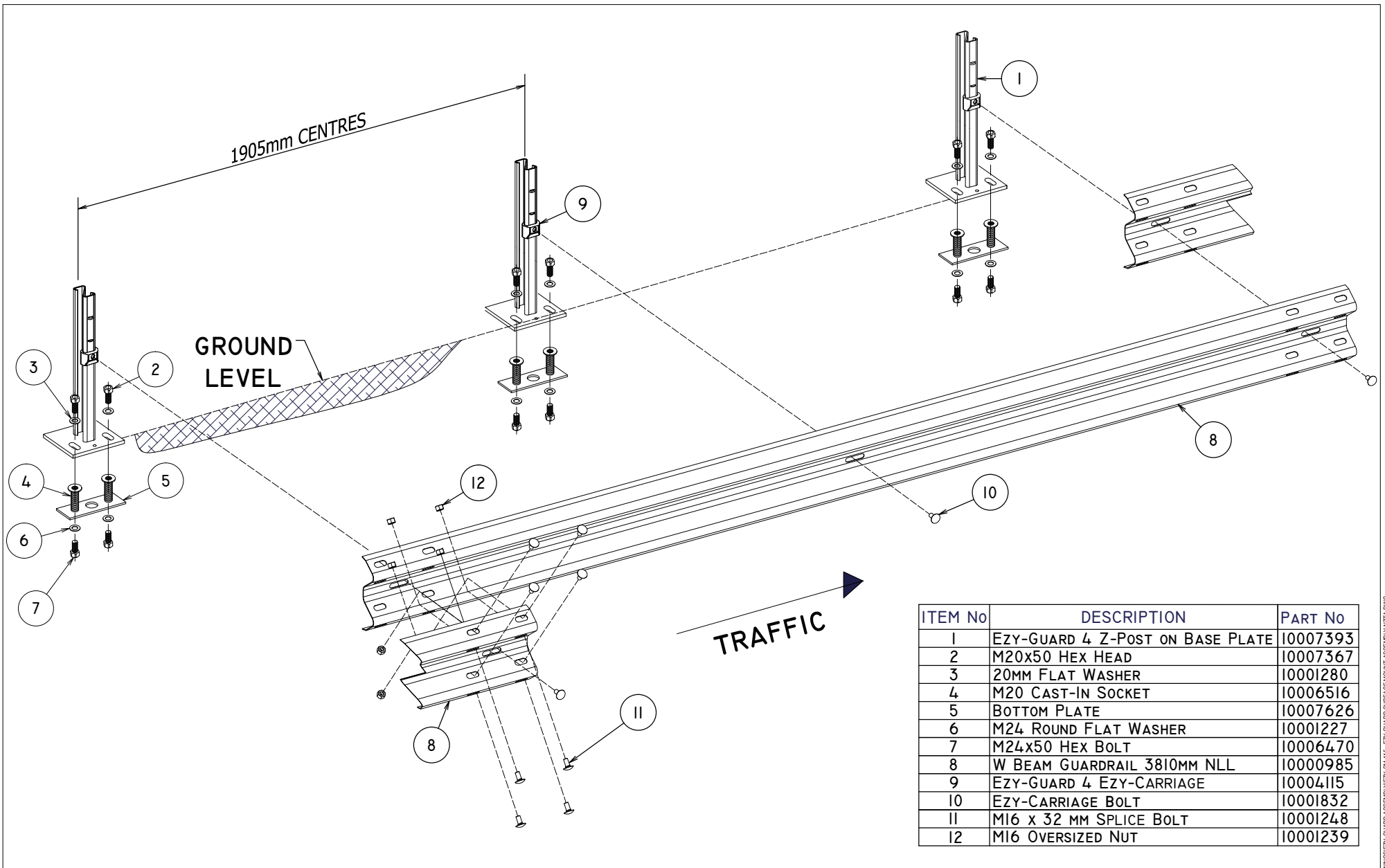
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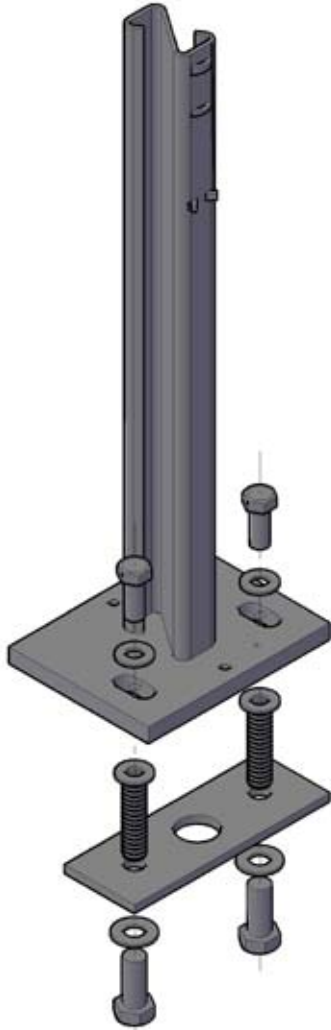
PROJECT EZY-GUARD	TITLE CONNECTION TO NZTA TL4 10m TRANSITION
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INGAL CIVIL PRODUCTS REFERENCE No.	DRAWING No. EZY-SM-025
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REV. D

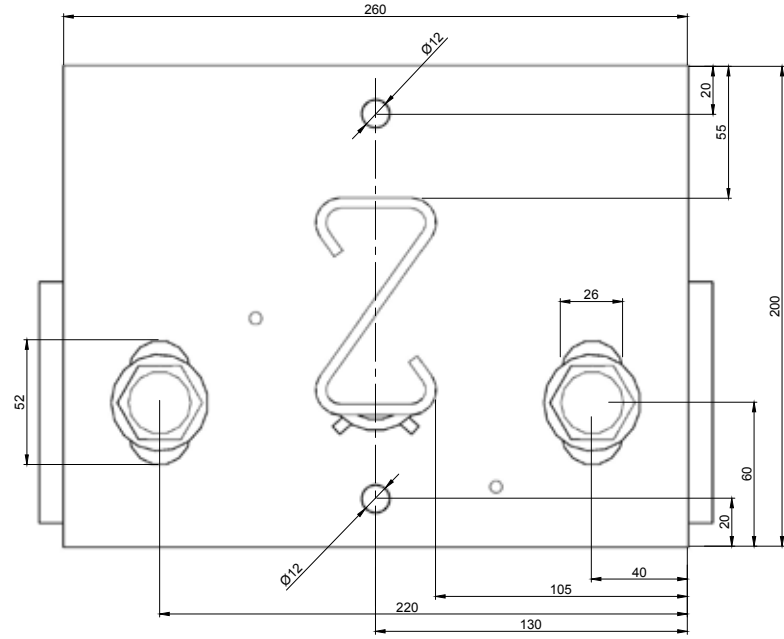
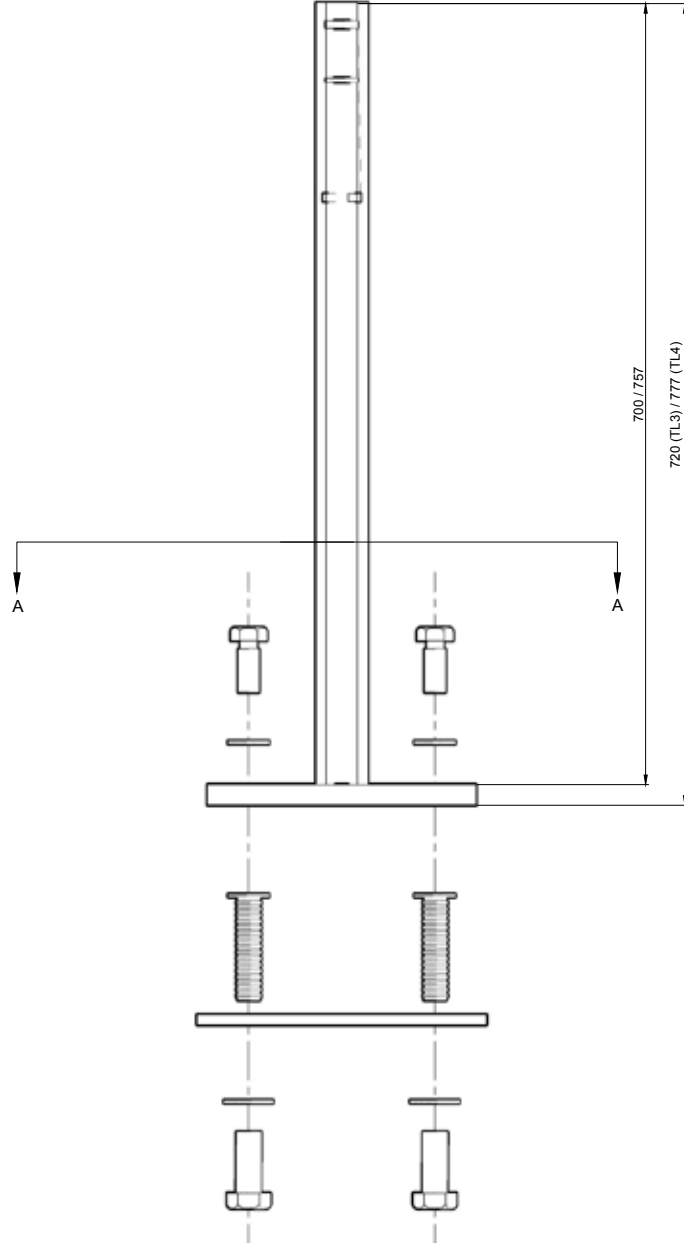


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1	31-03-16	CAST-IN ASSEMBLY REDRAWN, BOM UPDATED	MC	SE	LG			INFORMATION ONLY	MC	25-08-15	N.T.S. @ A3	INGAL CIVIL PRODUCTS	EZY GUARD 4 NZTA SURFACE MOUNT ASSEMBLY DETAIL 1 OF 2		EZY-SM-115	1
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NOTES

1. MMAW: E49xx electrode (AS/NZS 4855)
GMAW: B-T49 wire (AS/NZS ISO 17632)
2. H.D. GALV TO AS/NZS 4680
3. POST BASE PLATE: HA250
4. BLACK BASEPLATE: 10007391



BILL OF MATERIALS		
PART DESCRIPTION	QTY	PART NO.
Z-Post on B/P (720mm) OR Ezy-Guard 4 Z-Post (777mm)	1	10007408
M20 X 50 HEX HEAD	2	10006180
M20 X 3mm WASHER	2	10001280
BOTTOM PLATE	1	10007626
M20 CAST-IN SOCKET	2	10006516
M24 X 50 HEX BOLT	2	10006470
M24 ROUND FLAT WASHER	2	10001227

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	ISSUE FOR	NAME	DATE	PROJECT	TITLE	DRAWING No.
5	08-04-2016	CAST-IN BRACKET REPLACED, BOM ADDED	MC	SE	LG								
3	03-03-2016	WAS 777mm OA DRAWING	LG	MC	LG								
4	13-01-2016	DIM ADDITION	LG	SE	LG								
3	21-01-2015	PART NUMBERS ADDED & HEIGHT INCREASE	LG	SE	LG								
2	12-01-2015	DIMENSION ADD	LG	SE	LG								
1	12-01-2015	WELD DETAIL ADDED	LG	SE	LG								
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	ISSUE FOR	NAME	DATE	PROJECT	TITLE	DRAWING No.
								INFORMATION ONLY				EZY-GUARD SMART NZTA Z-POST ON BASE PLATE CAST-IN ASSEMBLY DETAIL	EZY-SM-125



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PROJECT

TITLE

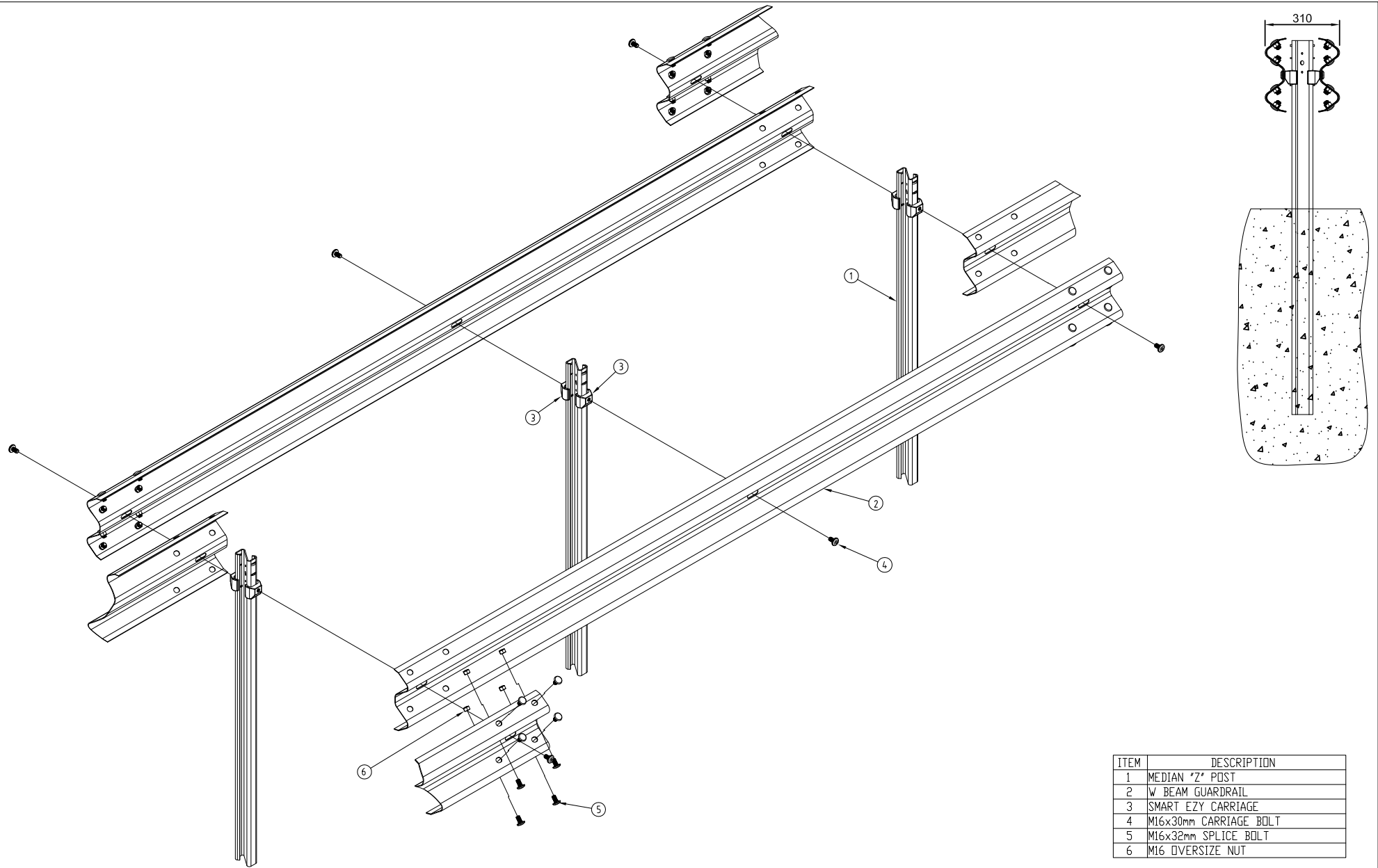
EZY-GUARD SMART
NZTA Z-POST ON BASE PLATE
CAST-IN ASSEMBLY DETAIL

INGAL CIVIL PRODUCTS
PART No.

DRAWING No.
EZY-SM-125

Rev. 6

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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

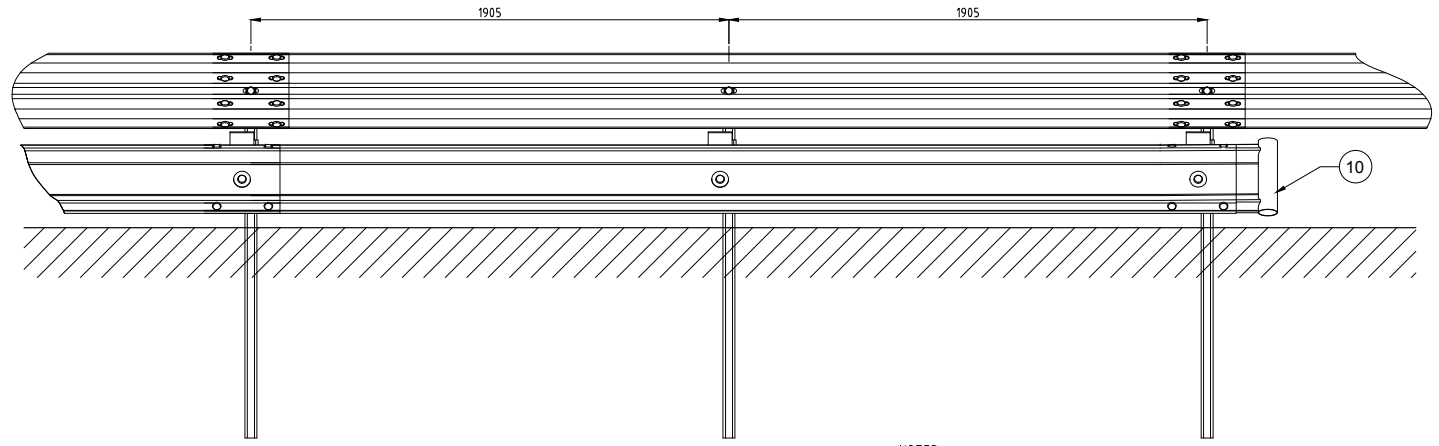
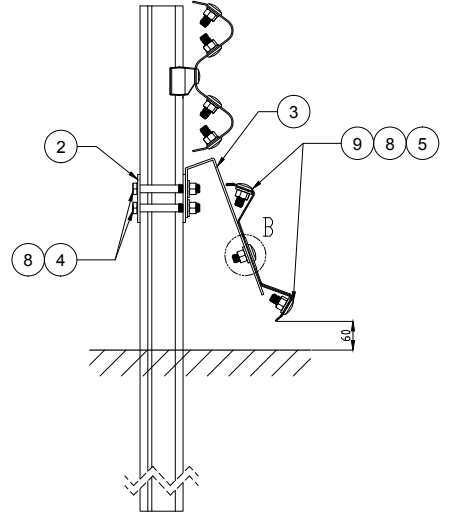
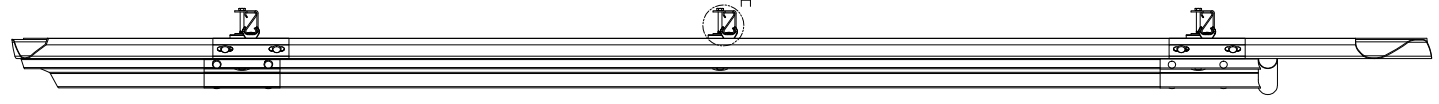
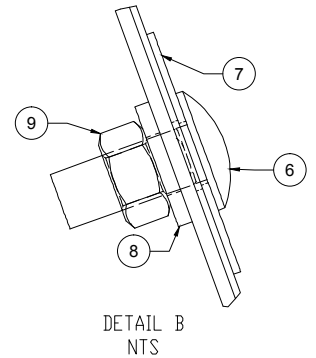
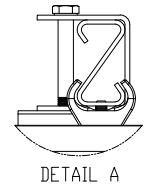
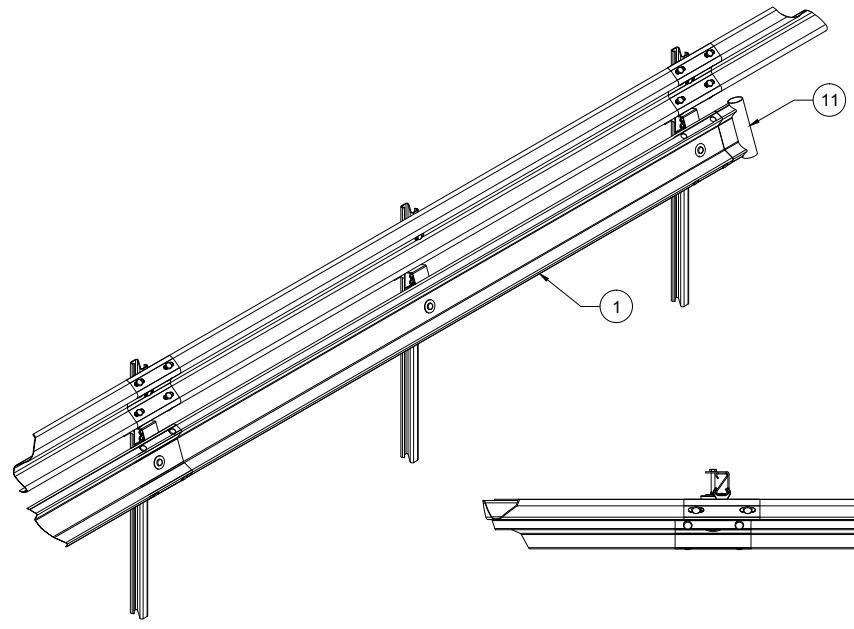
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4	02-03-2016	FOOTPRINT DIM ADDED			LG			AUSCOL	03-02-2015		EZY-GUARD 4 MEDIAN CONFIGURATION	N/A
3	03-12-2015	AU REFERENCE REMOVED			LG			LG	04-02-2015			
2	10-04-16	TITLE CHANGE			LG			LG	04-02-2015			
1	01-04-16	TITLE CHANGE			LG							
REVISIONS			REFERENCES			DRAWING NUMBER		SCALE		DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS		DRAWING No.
								N.T.S. @ A3				EZY-SM-035
								ISSUE FOR				Rec: 4
								INFORMATION ONLY				



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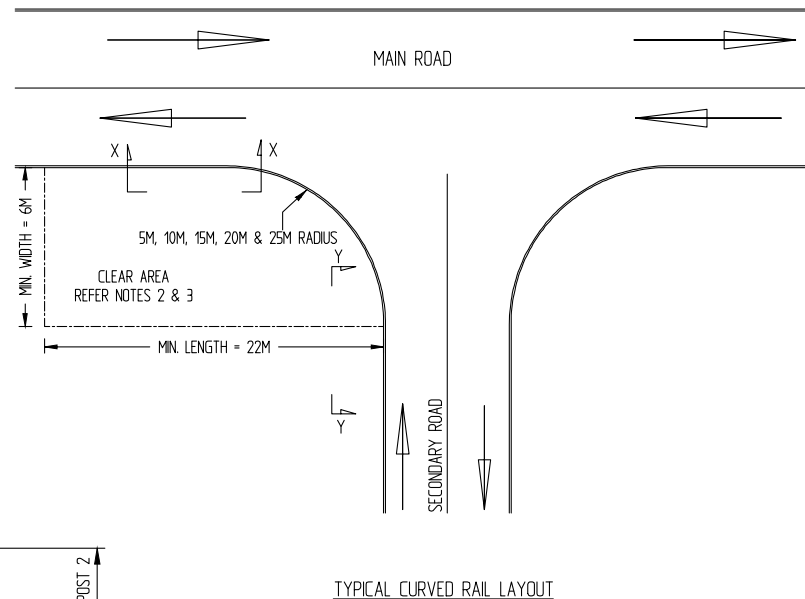
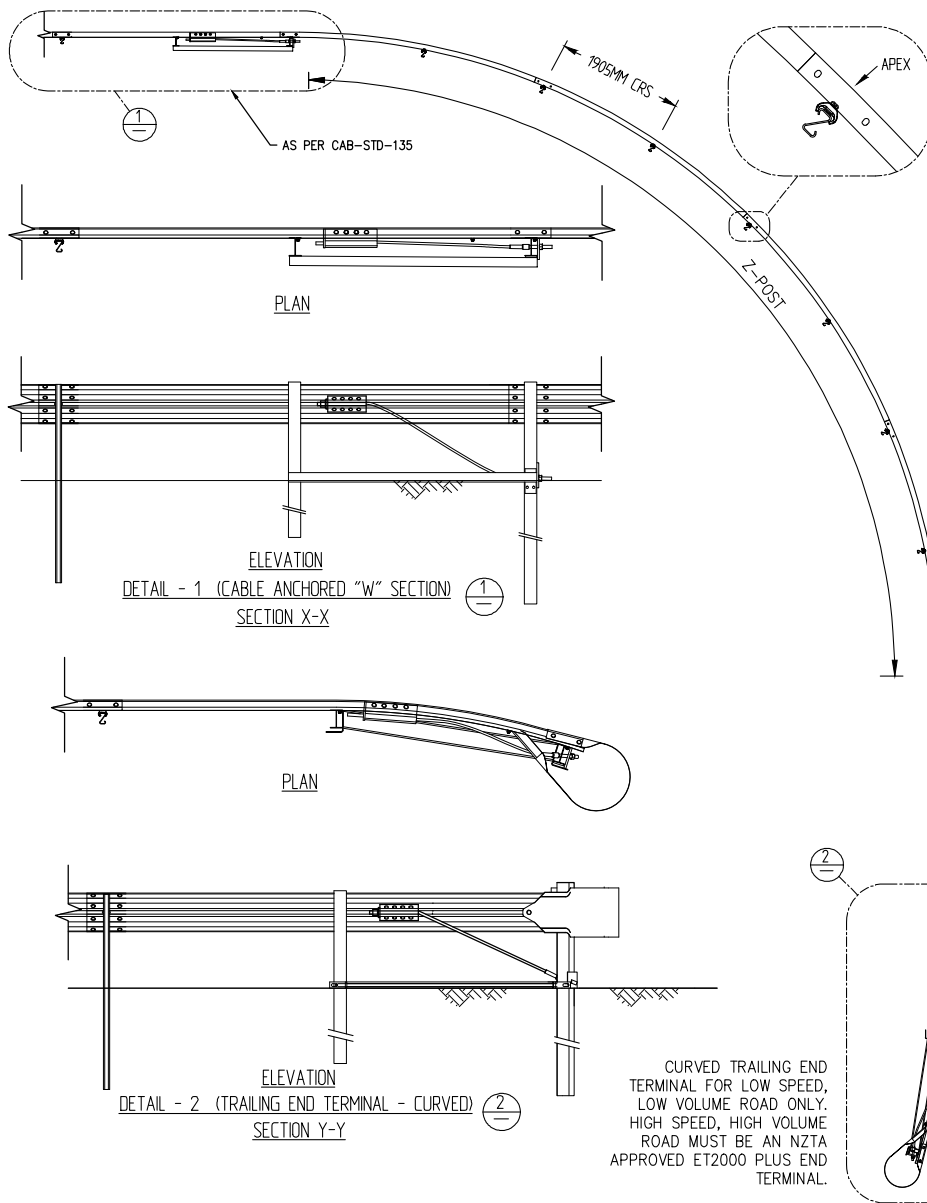
EZY-GUARD CONFIG - MPR BILL OF MATERIALS (3.81m)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	10007769	Motorcyclist protection beam
2	2	10007332	Z-Post Bracket
3	2	10006772	Rail mounting bracket
4	4	10003618	M16x130 Hex bolt/nut
5	4	10001248	Round head bolt M16x32
6	2	10006769	Round head bolt M16x40
7	2	10006771	Slot Washer ø70x2
8	6	10006770	Washer ø35x17x4
9	6	10007834	M16 nut
10		10006767	MPR END TERMINAL



NOTES:
 1. ALL STEELWORK TO BE HOT DIP GALVANISED AFTER FABRICATION TO AS/NZS 4680 AND STRAIGHTENED AFTER GALVANISING IF REQUIRED.
 2. TO BE READ IN CONJUNCTION WITH EZY-GUARD PRODUCT MANUAL

REVISIONS						REFERENCES						DRAWING INFORMATION			PROJECT			DRAWING INFORMATION			
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	SCALE	NAME	DATE	TITLE	PROJECT	INGAL CIVIL PRODUCTS PART No.	DRAWING No.	ISSUE FOR	INFORMATION ONLY	TITLE	PROJECT	INGAL CIVIL PRODUCTS PART No.	DRAWING No.	
3	22-11-16	WASHER QTY REDUCED	MC	LG	MC																
2	31-08-16	PART NUMBERS AND LABELS ADDED TO DRAWING	MC	LG	MC																
1	20-07-2015	BOM CORRECTION - ITEM 10	LG	LG	MC																

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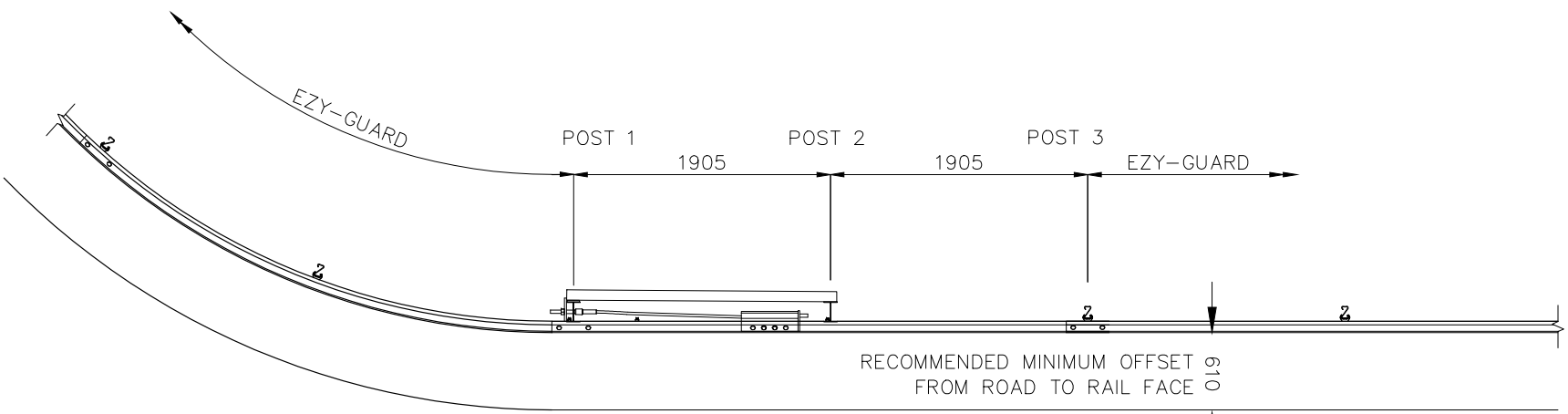
- NOTES:**
1. APPROACH GRADING IS TO BE 10H:1V OR FLATTER. MAINTAIN FREE OF OBSTRUCTIONS.
 2. A MINIMUM CLEAR ZONE OF 22m x 6m TO BE PROVIDED BEHIND THE GUARDRAIL.
 3. CLEAR ZONE BEHIND GUARDRAIL TO BE 6H:1V OR FLATTER AND MAINTAINED FREE OF OBSTRUCTIONS.
 4. FASTENER CONFIGURATION OF CURVED TERMINAL POSTS TO BE IDENTICAL TO LONGITUDINAL BARRIER POSTS.

CURVED TRAILING END TERMINAL FOR LOW SPEED, LOW VOLUME ROAD ONLY. HIGH SPEED, HIGH VOLUME ROAD MUST BE AN NZTA APPROVED ET2000 PLUS END TERMINAL.

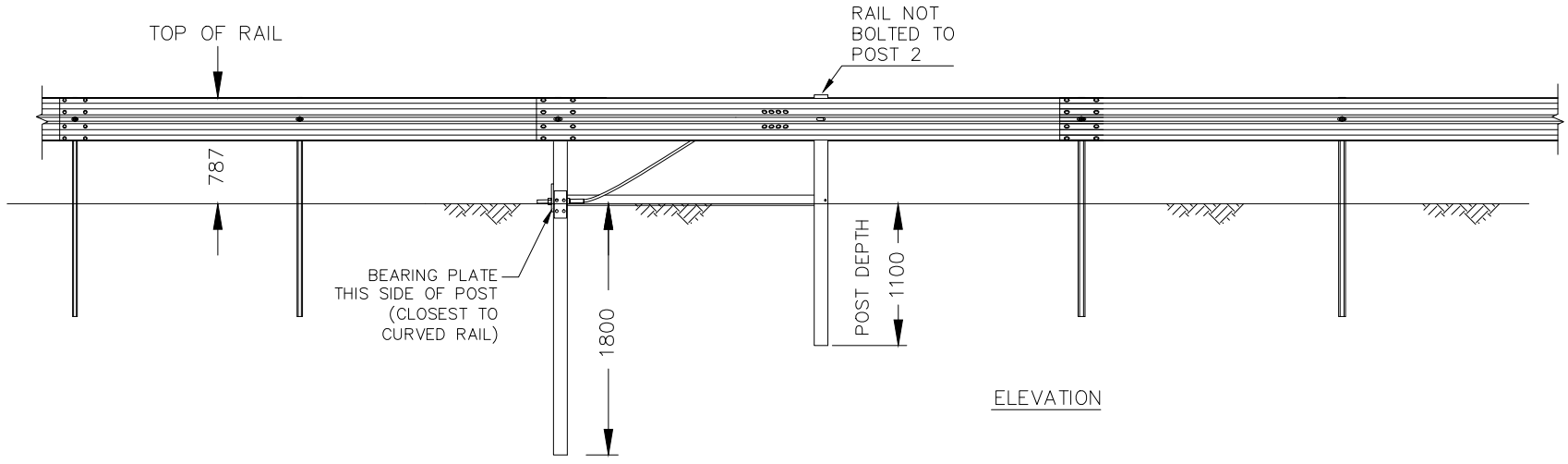
AS PER CAB-STD-132

REVISIONS 0 ORIGINAL ISSUE REV DATE DESCRIPTION DRAWN CHECKED APPROVED			REFERENCES DRAWING NUMBER REFERENCE DRAWINGS			NAME DATE DRAWN MC 18-04-16 CHECKED SE 18-04-16 APPROVED LG 18-04-16	IN GAL 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 TITLE EZY-GUARD 4 NZTA CURVED TERMINAL GENERAL ARRANGEMENT	IN GAL CIVIL PRODUCTS PART No. EZY-SM-126 DRAWING No. EZY-SM-126
						SCALE N.T.S. @ A3 ISSUE FOR		DRAWING AND CONTENTS ARE COPYRIGHT TO IN GAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM IN GAL CIVIL PRODUCTS	Rev. 0

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PLAN VIEW



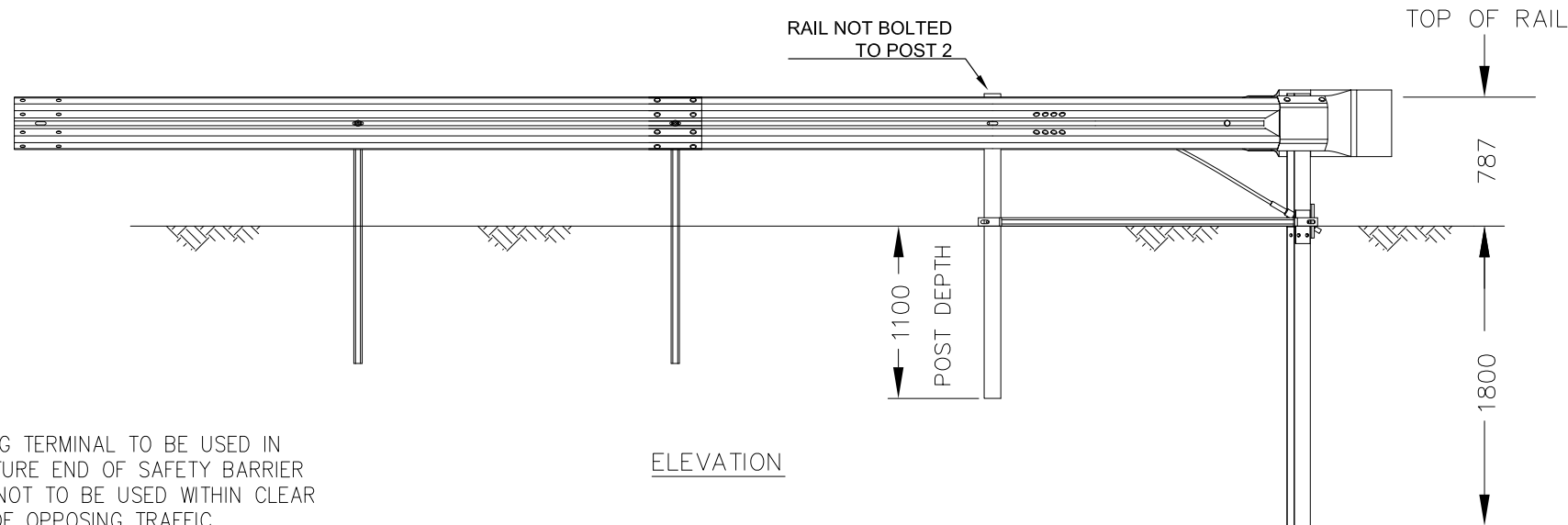
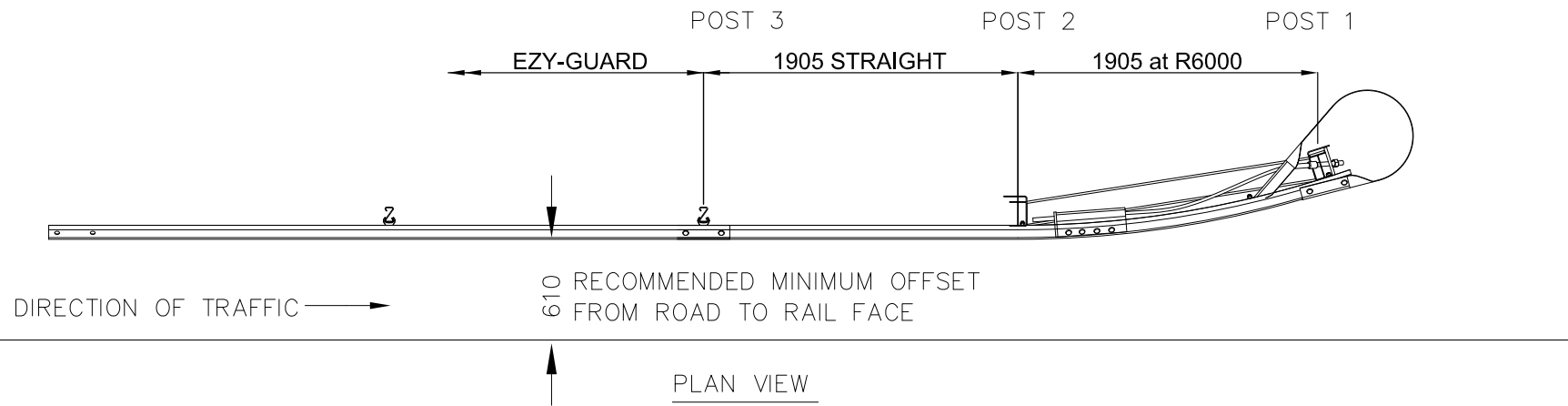
ELEVATION

NOTE

- DRAWING TO BE READ IN CONJUNCTION WITH CAB-STD-134 AND THE EZY-GUARD 4 MANUAL.

REVISIONS			REFERENCES			DRAWING NUMBER		REFERENCE DRAWINGS		DRAWN		NAME		DATE		PROJECT		INGAL CIVIL PRODUCTS PART No.	
4	28-11-2016	CURVED RAIL ADDED	MC	LG						DRAWN	AR	01-09-2015	 <small>DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS</small> <small>57-65 AIRDS ROAD MINTO, N.S.W 2566 PH. +61 2 9827 3333 www.ingalcivil.com.au</small>		TITLE EZY-GUARD 4 - INTERMEDIATE ANCHOR ELEVATION ASSEMBLY VIEW NZ SPEC		DRAWING No. CAB-STD-135		
3	19-04-2015	NAME CHANGE	MC	LG					CHECKED	MC	16-09-2015								
2	23-11-2015	POST 2 - BOLT REMOVED	MC	LG					APPROVED	LG	16-09-2015								
1	23-11-2015	CABLE ASSEMBLY REDRAWN	MC	LG					SCALE	N.T.S. @	A3								
									ISSUE FOR										

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- NOTE**
1. TRAILING TERMINAL TO BE USED IN DEPARTURE END OF SAFETY BARRIER ONLY. NOT TO BE USED WITHIN CLEAR ZONE OF OPPOSING TRAFFIC.
 2. DRAWING TO BE READ IN CONJUNCTION WITH CAB-STD-129

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	INGAL CIVIL PRODUCTS PART No.	
2	25-11-2015	POST 2 - BOLT REMOVE	MC	LG	LG			AR	01-09-2015	<p>DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS</p> <p>57-65 ARDS ROAD PH. +61 2 9827 3333 MINTO, N.S.W 2566 www.ingalcivil.com.au</p>	NZ TRAILING TERMINAL CURVED TERMINAL ASSEMBLY DETAIL	
1	25-11-2015	CABLE ASSEMBLY REDRAWN	MC	LG	LG			MC	16-09-2015			INGAL CIVIL PRODUCTS PART No.
								LG	16-09-2015			DRAWING No.
												CAB-STD-132
								SCALE	N.T.S. @ A3			
								ISSUE FOR				

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INGAL
CIVIL PRODUCTS
A valmont  COMPANY

For more information

contact us on the web

www.ingalcivil.co.nz

Auckland

12 Offenhauser Drive, East Tamaki,
Auckland 2013, New Zealand
Ph: 09 920 838
Email: sales@ingalcivil.co.nz

Christchurch

Ph: 0211 983 311

Wellington

Ph: 021 504 870