

Product Manual



Release 07/21

www.ingalcivil.com.au

1.0 Introduction

Introducing Ezy-Guard HC, 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 HC is crash tested to the latest performance standard distinguishing it from all existing public domain guardrail barrier systems in Australia.

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

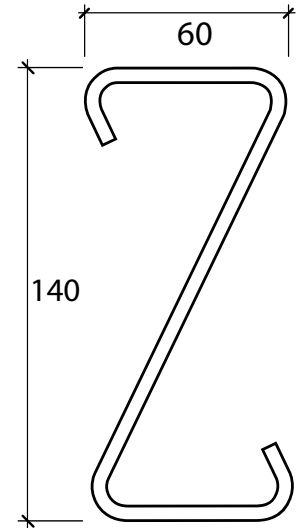
An Ezy-HC-Carriage is used to secure the Thrie-beam rails to the posts eliminating the requirement for blocking/offset pieces and rail stiffening plates. This unique connection provides a soft ride-down for the occupants and smooth vehicle containment and redirection.

2.0 Specifications

Ezy-Guard HC Z-Post Length:	2,000mm
Ezy-Guard HC Z-Post Mass:	19.5kg
Ezy-Guard HC System Mass:	28.8kg per metre
Rail Height Above Ground:	980mm
Z-Post Height Above Ground:	970mm
Post Spacing:	2,000mm
Ezy-Guard HC System Width:	245mm
MASHTL3 Crash Test Deflection:	1.16m
MASHTL4 Crash Test Deflection:	1.77m

Ezy-Guard HC Thrie-beam 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.



BARRIER SELECTION TABLE

Guardrail System	Performance Class	Deflection	Surface Mount Option	Environmental Protection
Ezy-Guard Smart	MASH TL3	1.65m	Yes	Hot Dip Galv to AS/NZS 4680
Ezy-Guard 4	MASH TL3 NCHRP-350 TL4	1.65m	Yes	Hot Dip Galv to AS/NZS 4680
Ezy-Guard HC	MASH TL4 MASH TL3 NCHRP-350 TL4	1.77m 1.16m 1.0m	Yes	Hot Dip Galv to AS/NZS 4680



Approach Transition Rail 1905mm
10001809



Departure Transition Rail 1905mm
10001811



W Beam 4000mm NLL
10000977



Thriebeam 4000mm NLL
10000837



Ezy-Guard HC Post 2000mm
10005540



Ezy-Guard 4 Post 1650mm
10007390



HC Carriage
10004116



Smart Carriage
10004115



Carriage Bolt M16 x 30mm
10001832



Splice Bolt M16 x 32
10001248



Oversized M16 Nut
10001239



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 HC has been fully crash tested and evaluated according to the specifications for Test Level 4 (TL4) of the AASHTO Manual for Assessing Safety Hardware (MASH) and also to NCHRP-350 Test Level 4.

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

In the revised standard AS/NZS 3845.1:2015, MASH has been nominated as the basis of testing procedures for road safety barrier systems.

The MASH TL4 crash test matrix requires the following impacts;

- 1,100kg car travelling at 100km/h and 25 degrees.
- 2,270kg pick-up travelling at 100km/h and 25 degrees.
- 10,000kg truck travelling at 90km/h and 15 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.

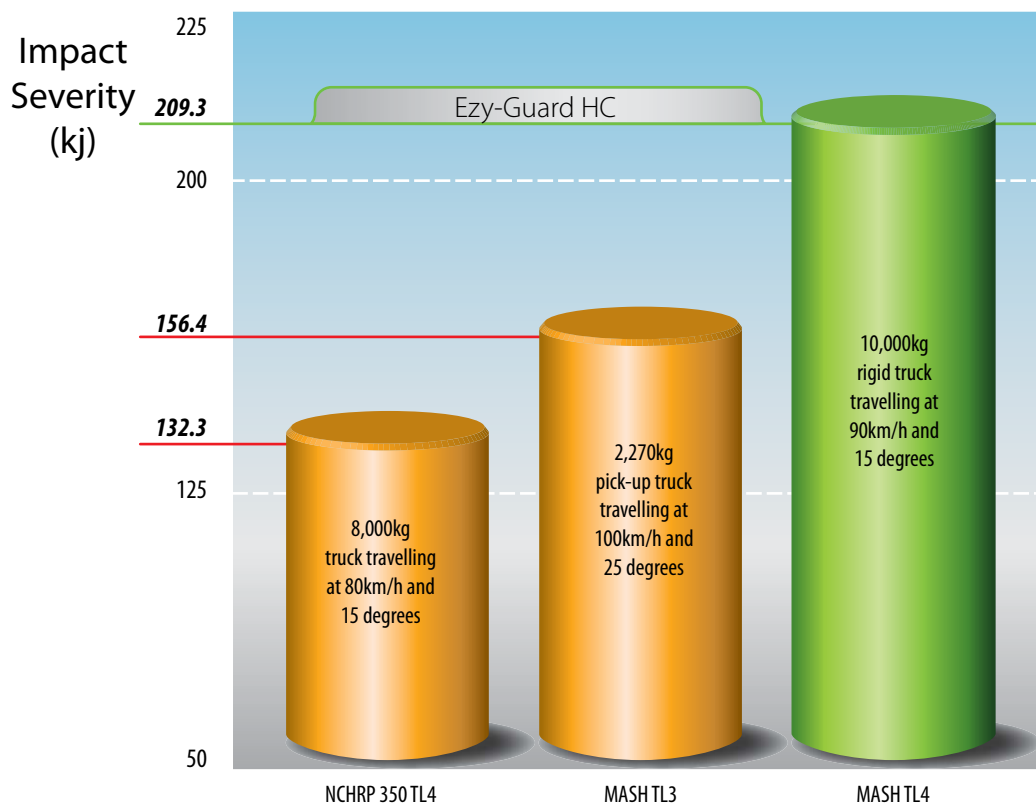


Figure 1: Comparison of Crash Test Impact Severities

4.0 Consideration for Vulnerable Road Users

Vulnerable road users include motorcyclists, pedestrians, cyclists and other road users. Ezy-Guard HC 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 HC design does not contain any elements that become projectiles and there are no aggressive edges.

Shielded Posts.

The innovative design of Ezy-Guard HC 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 traditional guardrail and cable barrier systems.

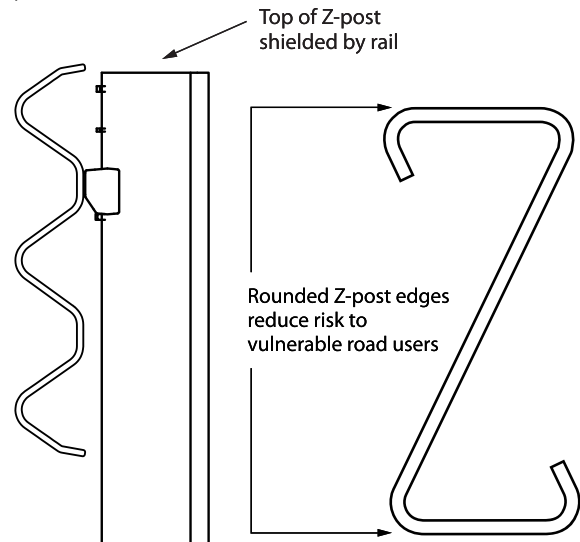


Figure 2: Ezy-Guard HC Considerations for Vulnerable Road Users



5.0 Features and Benefits

5.1 Fully Compliant to MASH TL4

Ezy-Guard HC, a member of the Ezy-Guard family, is fully compliant to MASH TL4.

The MASH TL4 test condition represents a larger impact energy when compared to NCHRP 350 Test Level 4 impacts.

The MASH TL4 compliance demonstrates the systems ability to contain and redirect the 10,000kg truck which is 2000kg heavier than the NCHRP-350 TL4 truck.

MASH TL3 COMPLIANT

NCHRP-350 TL4 COMPLIANT

MASH TL4 COMPLIANT

5.2 Rapid Installation & Repair

Ezy-Guard HC 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 HC design uses fewer components and features 2,000mm Z-posts that are rapidly driven into the ground. The Z-post embedment depth is just 1,030mm, a significant reduction when compared to other Thrie-beam 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 245mm, Ezy-Guard HC is significantly narrower than the traditional guardrail barriers that incorporate the use of blocking pieces. Ezy-Guard HC conserves valuable formation width and allows a greater recovery width to be provided for errant vehicles.

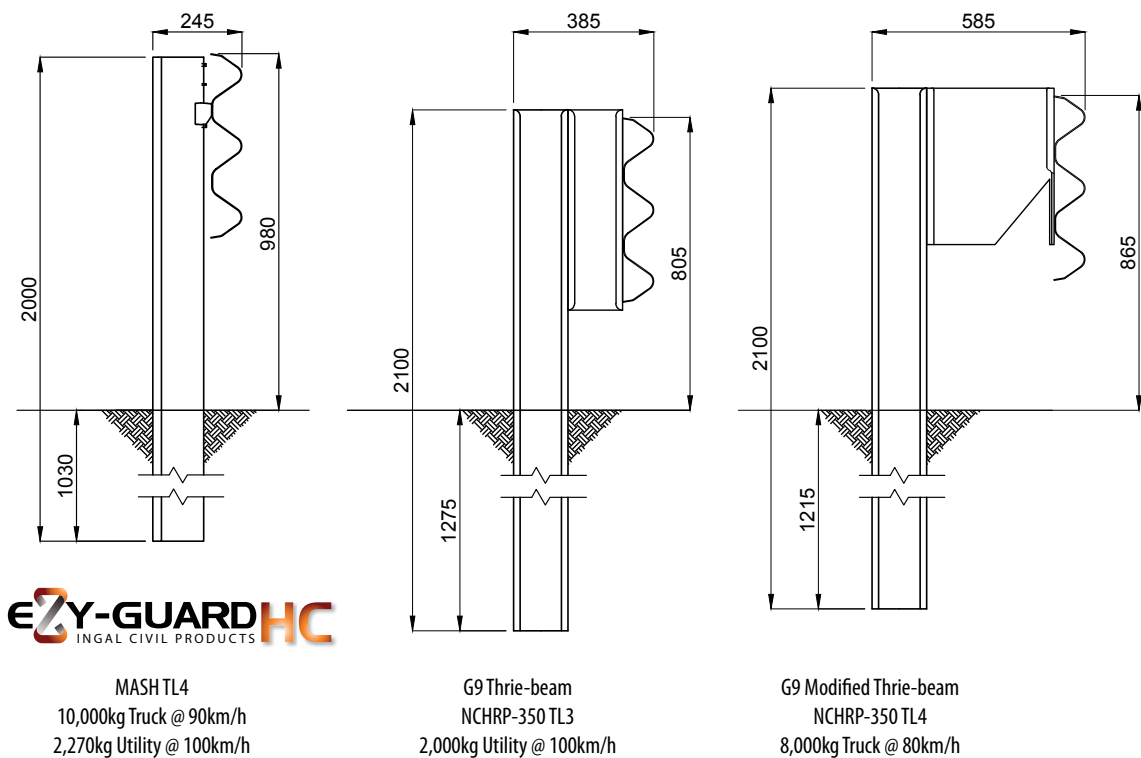


Figure 3: Ezy-Guard HC Width Comparison

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 HC uses fewer components than the public domain guardrail systems. Z-posts weighing just 19.5kg are lighter than traditional Thrie-beam 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 HC 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-HC-Carriage controls the release of the Thrie-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 HC provides protection from roadside hazards located close to the edge of the travelled way. The sectional strength of the 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 realworld situations.

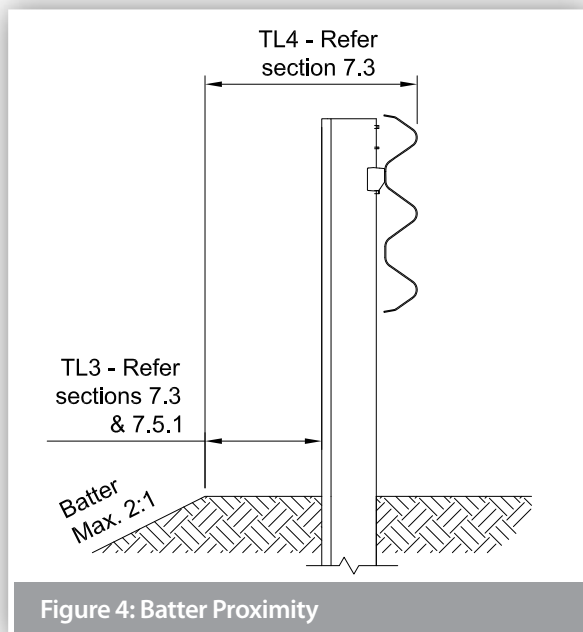


Figure 4: Batter Proximity

6.1 Deflection

The transverse deflection of a barrier during a crash is dependent upon a number of factors, including the following:

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

The MASH TL3 deflection for Ezy-Guard HC is 1.16m and the MASH TL4 deflection is 1.77m. The NCHRP-350 TL4 deflection is 1.0m. A range of deflections for TL2 and TL3 can be found in Table 1a, whilst Table 1b shows deflection and working widths for the MASH TL4 10,000kg truck with various post spacings.

6.2 Slopes

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

Proximity to a batter slope will depend on the required containment level. For TL3 containment, the recommended minimum offset from hinge point to back of post is 300mm for a 2H:1V slope. For a TL4 containment, the offset from face of rail to the hinge point should be equal to the expected deflection, refer section 6.1.



Table 1a: Dynamic deflections under various post spacing and impact speeds

Containment Level		Vehicle: 2,270 kg		Impact Angle: 25°	
		Speed (km/h)	Post Spacing (m)		
			2	1	0.5
Dynamic Deflection (m)	MASHTL3	100	1.16	0.81	0.53
		80	0.8	0.6	*
	MASHTL2	70	0.69	0.5	0.27
		60	0.59	0.35	*

* Not currently available. Please contact your local Ingal Civil representative for more information.

Table 1b: MASH TL4 working width and dynamic deflections under various post spacing

		Vehicle: 10,000 kg	Impact Angle: 15°	Speed: 90 km/h
Post Spacing (m)		2	1	0.5
Deflection (m)		1.77	1.27	0.5
Working Width (m)		2.46	1.88	1.16

7.0 Installation

7.1 Terminals

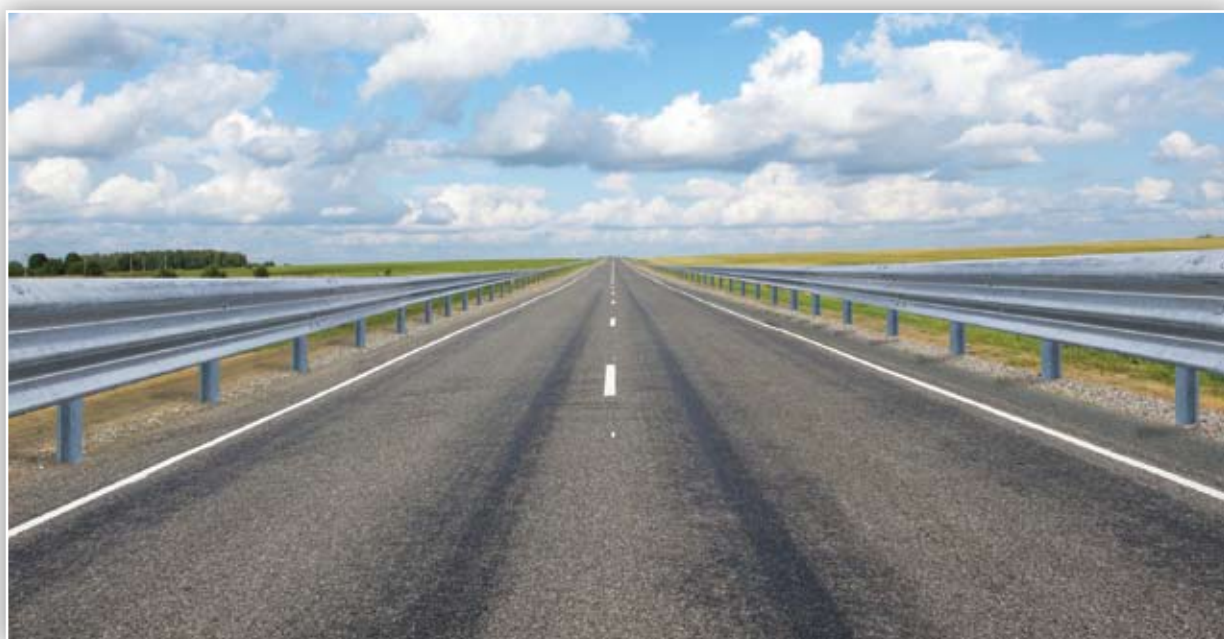
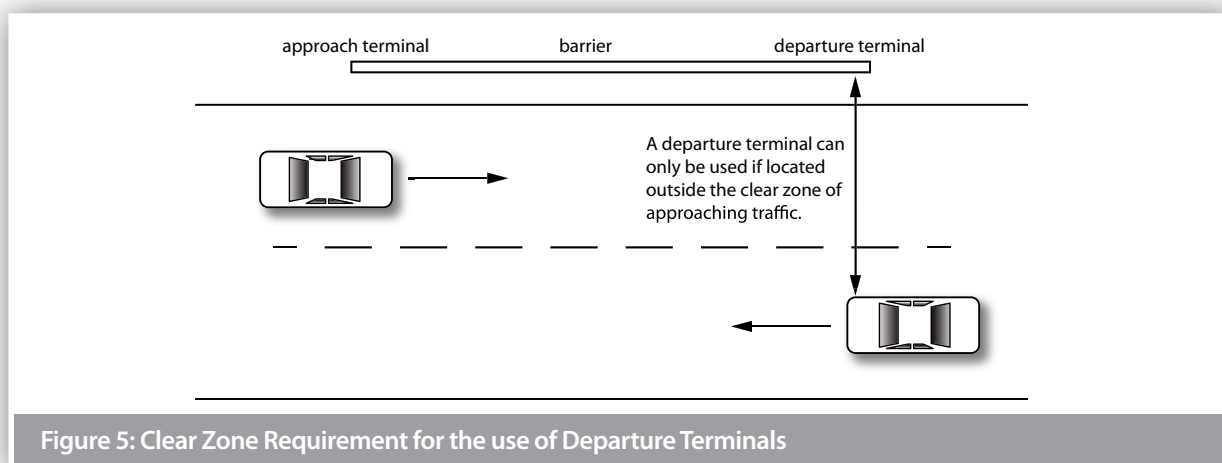
Guardrail end terminals are installed at the beginning and end of a run of guardrail. Their primary purpose is to anchor the longitudinal barrier and to minimise deflection. Crashworthy terminals are typically used in locations where they can be impacted end-on as they are designed to provide a soft gating impact if impacted near the end rail. This prevents any spearing of an errant vehicle. Part of the end-terminal may also be redirective.

Ezy-Guard HC is installed at a system height of 980mm, measured to the top of the rail. This height is compatible with our asymmetric 1,905mm transition bracket and the TREND-350 terminal, refer to installation drawings.

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/offset 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 HC. The required post spacing for terminals and transitions will be contained in the proprietor's drawings.



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 controlling 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 HC is dependent on the design containment level. For measurement of minimum installed length, refer Figure 7 below.

- MASH Test Level 3 containment, where the design vehicle is a 2,270kg pick-up, the minimum length of Ezy-Guard HC is 20m.
- MASH Test Level 4 containment, where the design vehicle is a 10,000kg truck, the minimum length of Ezy-Guard HC is 26m.

7.3 Sequence of Work

Where Ezy-Guard HC 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 HC 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.

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 complying with AS/NZS 3750.9. This is to be applied to the repair areas in two coats. Each coat shall have a minimum dry film thickness of 50 µm.

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 HC 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-HC-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 HC 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 weak soil, the 1,030mm 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 1,350mm. A longer Z-post is available from Ingal Civil for these applications.

For a TL4 containment level, installations within 1.7m from the hinge point should be considered within the requirements of the road controlling authority Extended Design Domain requirements.

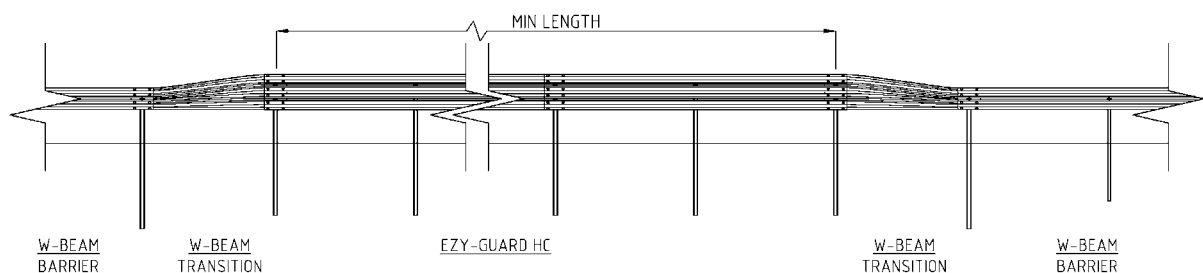


Figure 6: Minimum length measurement

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.

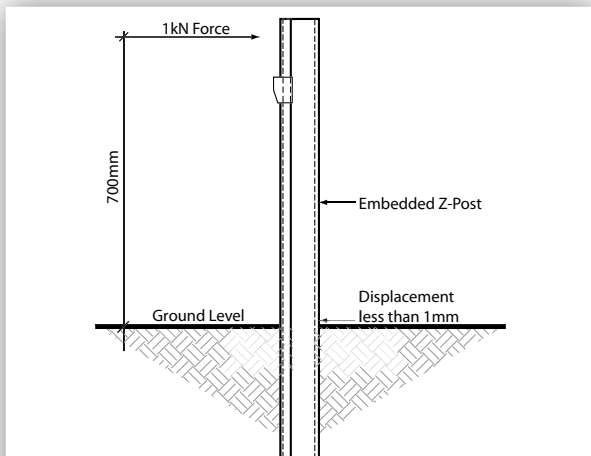


Figure 7: Z-Post Pullover Test

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 mounted post 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 and to your local Ingal representative for appropriate footing design conditions.

7.8 Non-Standard Post Spacing

Occasionally, an underground services or obstruction may prevent a post from being installed at the recommended spacing. In these instances, there are a number of options:

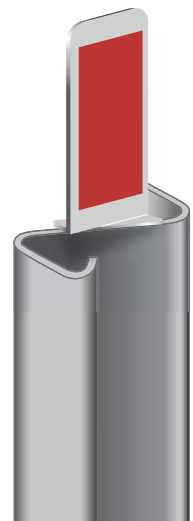
- Omit the post and leave a 4m gap. This will result in an 11% increase in deflection if impacted in that location. For bidirectional traffic, this increase in deflection is applicable for 4m upstream and downstream of the omitted post. A single post omission is permissible for no more than one location in 30m of Ezy-Guard HC.
- If the underground conflict is short in length, the post can be moved 1m upstream or downstream from the original position. Special rails are available from Ingal with slots at 1m intervals. Alternatively, the rail can be drilled to take the M16 carriage bolt. The drilled hole should have the galvanized coating repaired in accordance with section 7.4.
- A concrete foundation can be installed and a post on baseplate can be anchored to the foundation. Refer section 7.7 for further details.

7.9 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.



7.9 Curving of Rails

Guardrail used for the assembly of Ezy-Guard HC may be shop curved to fit any radius from 2.4m to 45m Convex. Ezy-Guard HC 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.

7.9.1 Measuring Curvature

1. Mark along the arc of the curve at 4m intervals.
2. Measure the corresponding chord length (C) - refer to Figure 9.
3. Measure the corresponding centre offset (H) - refer to Figure 9.
4. Use the values for C & H to select the radius from Table 2.
5. Determine the curvature orientation from Figure 10.

7.9.2 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.

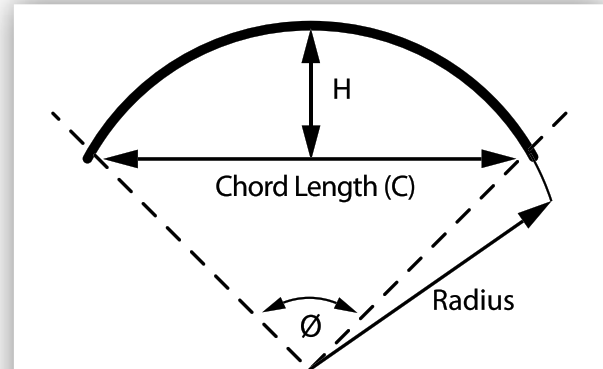


Figure 8: Curvature Measurements

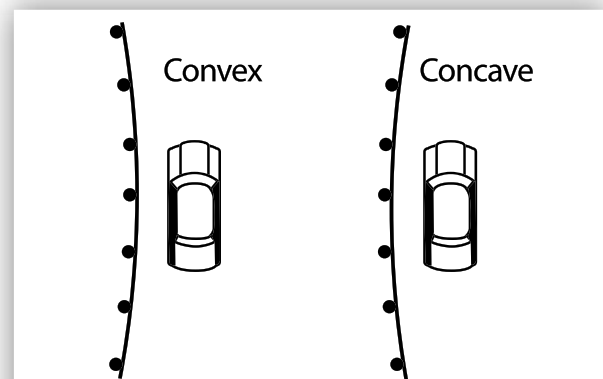


Figure 9: Curvature Orientation

Table 2: Rail Curvature Values

Radius (m)	Ø 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



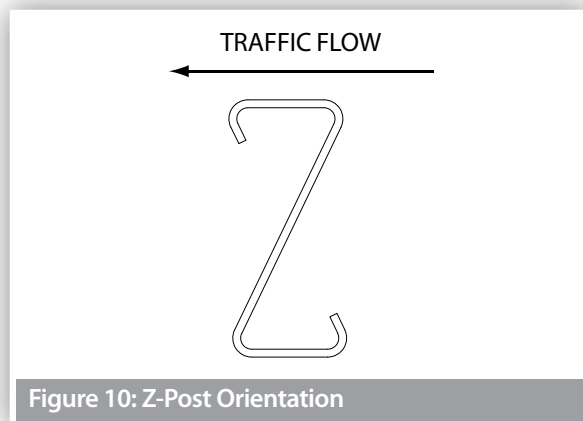
7.10 Installation Sequence

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 HC.

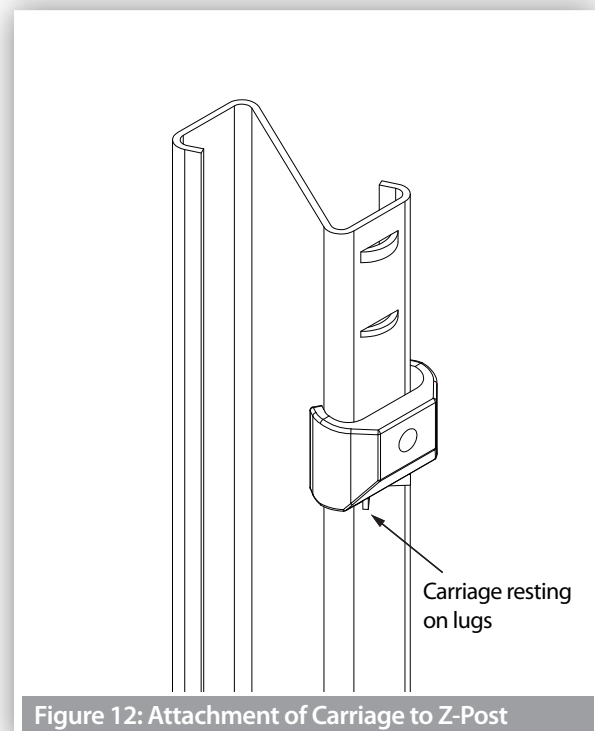
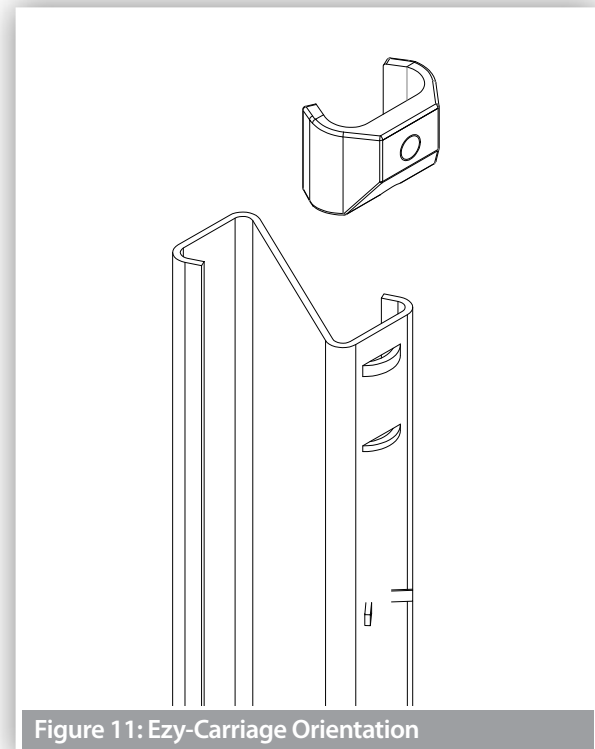
Only items purchased from Ingal Civil Products shall be used for the construction of Ezy-Guard HC.

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 in relation to the direction of traffic is orientated as per Figure 11 and 12.



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-HC-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 200-300mm 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 – 1,905mm spacings are required on transitions to w-beam - and reduced spacings are required where requested by engineer.

7. The height of the Z-post above ground level is 970mm.
8. The Ezy-HC-Carriage is attached to the face of the post. The Ezy-HC-Carriage will come to rest on the positioning lug fabricated on the Z-post.



9. Rails are attached to the Ezy-HC-Carriage using the M16x30mm carriage 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 12 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.

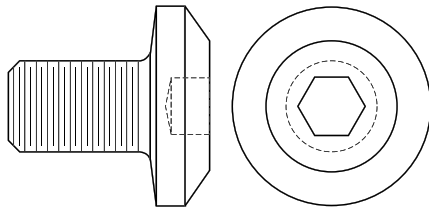


Figure 13: Carriage Bolt

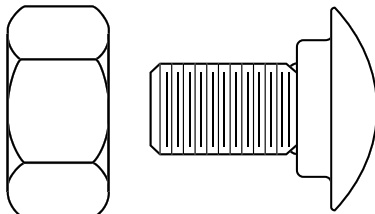


Figure 14: Splice Bolt & Nut

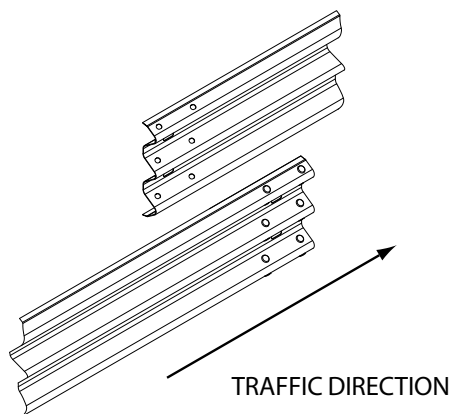


Figure 15: Orientation of Rail Lap

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 HC 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 HC components are to be free from splits, burrs or sharp edges after installation. Any minor damage is to be repaired in accordance with section 7.4.
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.

7.11 Installation Tolerances

- The tolerance on height of the barrier shall be plus or minus 20mm.
- 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.

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.

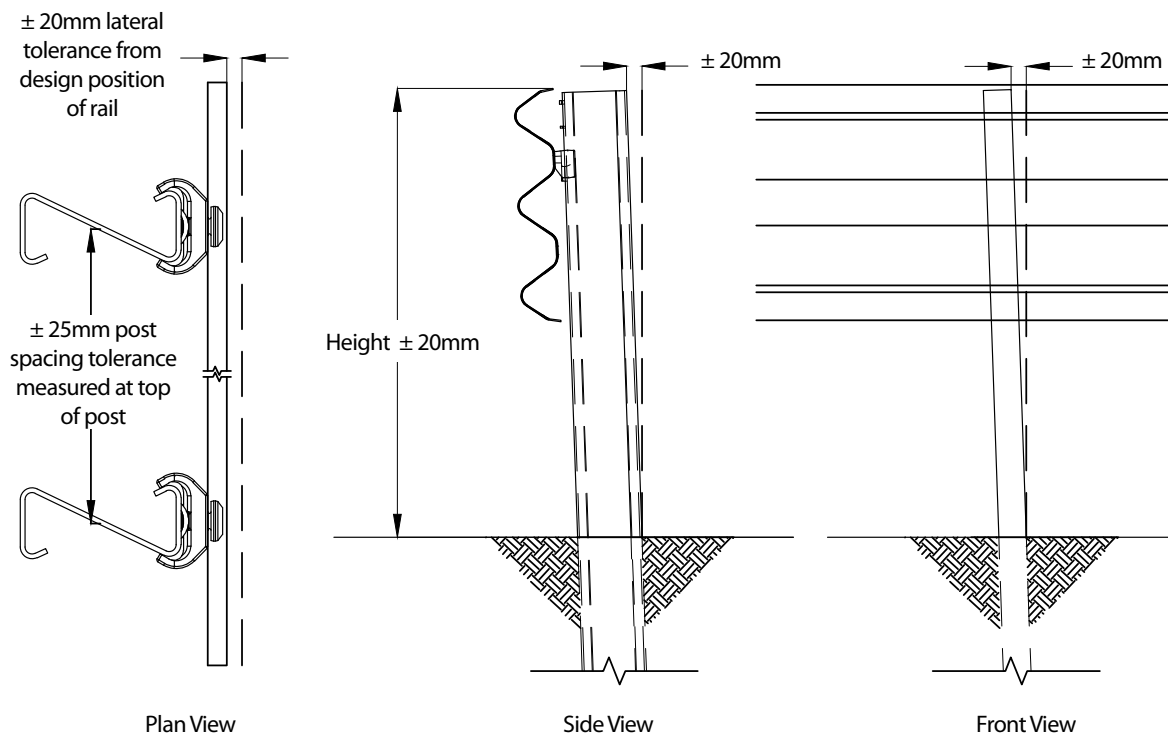


Figure 16: Ezy-Guard HC Installation Tolerances

Ezy-Guard HC Installation Checklist

Customer:

Project:

Barrier ID:

Barrier Length:

Checked By:

Signed:

Date

Have the Z-posts been positioned every 2m	☐ Yes	☐ No
Carriages are positioned on the posts between the retaining lugs and the resistance tabs	☐ Yes	☐ No
Posts are installed to the correct height (970mm) and within the tolerances of section 7.14	☐ Yes	☐ No
Have the Ezy-HC-Carriages been correctly orientated	☐ Yes	☐ No
Have the rails been attached to the Ezy-HC-Carriages using the appropriate carriage bolt	☐ Yes	☐ No
Have the rails been spliced observing the correct lap	☐ Yes	☐ No
Have the rails been spliced with M16x32mm mushroom head bolts	☐ Yes	☐ No
Are all splice bolts and post bolts snug tight	☐ Yes	☐ No
Is the Ezy-Guard HC attached to suitable transition rails then anchored with approved terminals	☐ Yes	☐ No
Are the cables in the terminals tensioned to their nominated torque (taut)	☐ Yes	☐ No
Has any minor damage been repaired using two coats of an organic zinc rich paint	☐ Yes	☐ No
Does the barrier form a smooth line vertically and horizontally when viewed along the system	☐ Yes	☐ No
Is the barrier system free from humps, sags or other irregularities	☐ Yes	☐ No
Has the ground or pavement around the post been left dense, tight and smooth	☐ Yes	☐ No
Are the barrier components free from splits, burrs or sharp edges after installation	☐ Yes	☐ 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 Road Controlling Authority. For more information, please refer to our Standard Terms and Conditions of Sale available on our website: www.ingalcivil.com.au.

10.0 Repair

10.1 Bush Fire Damage

Ezy-Guard HC 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 and intensity.

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 3.

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

Any item that is replaced is to be reinstated observing the installation tolerances nominated in Section 7.11. Only items purchased from Ingal Civil Products shall be used for the repair of Ezy-Guard HC.

10.3 Dismantling Sequence

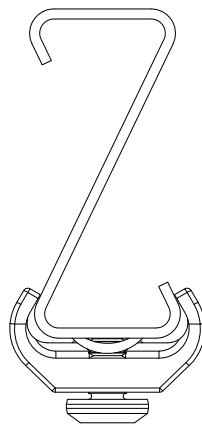
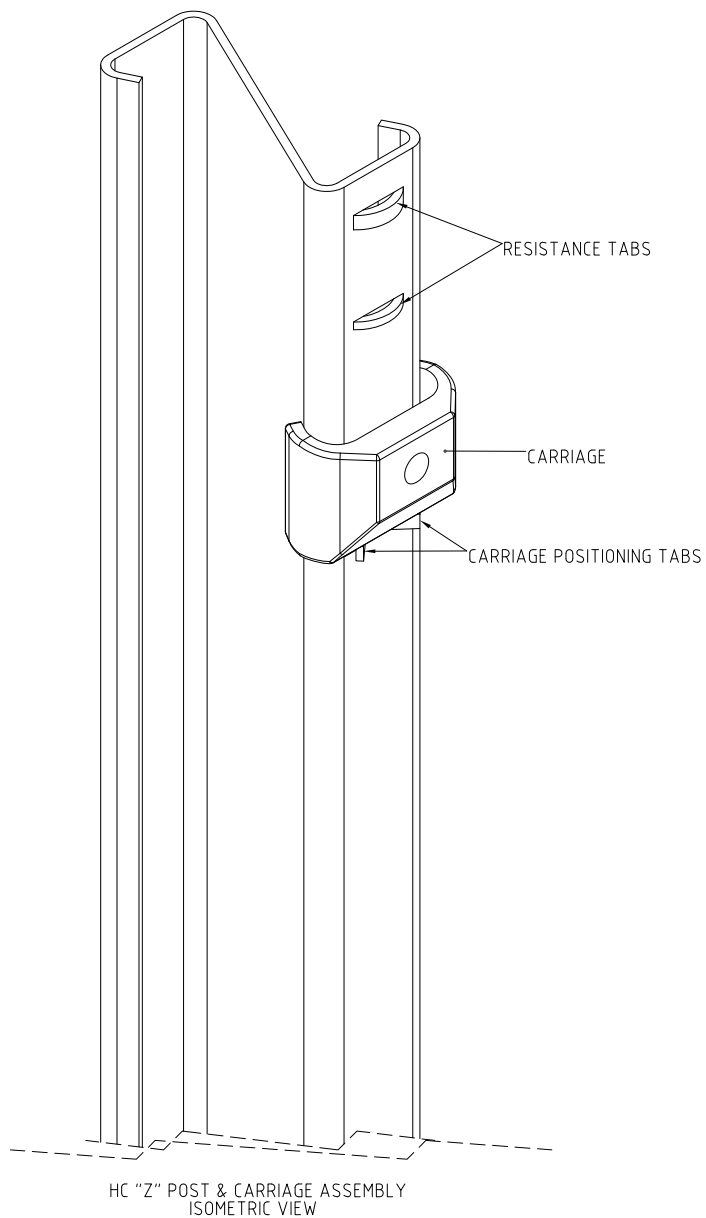
Prior to undertaking dismantling due to a vehicle impact, the area should be assessed for hazards. These include trip hazards, sharp edges and snag points.

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;

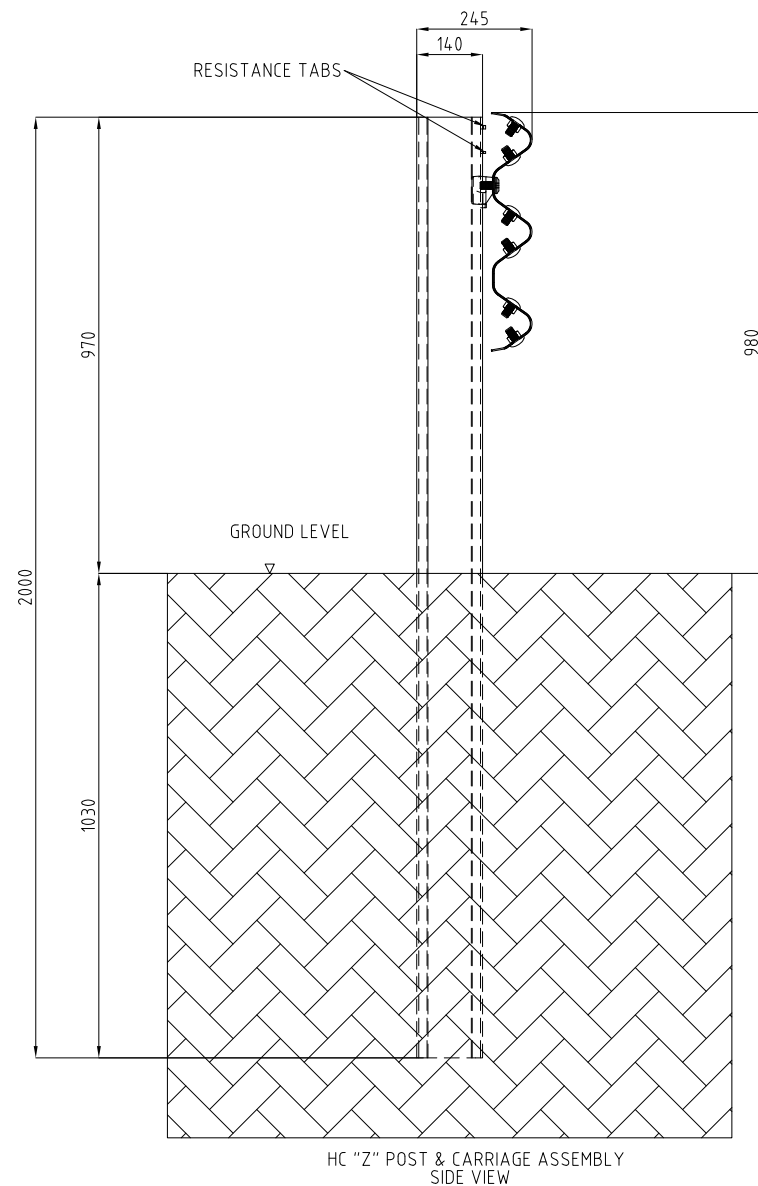
1. Dismantle the rail splice by removing the M16x32mm mushroom head bolts and nuts. There are 8 bolts located at each splice location.
2. Rails that are still attached to posts outside the impact area are disconnected by removing the carriage bolts. A 10mm hex key is required.
3. Once the area is clear 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.
6. Rails, posts and carriages to be disposed of, should be recycled at a ferrous scrap recycling facility.

Table 3: Damage Assessment of Ezy-Guard HC

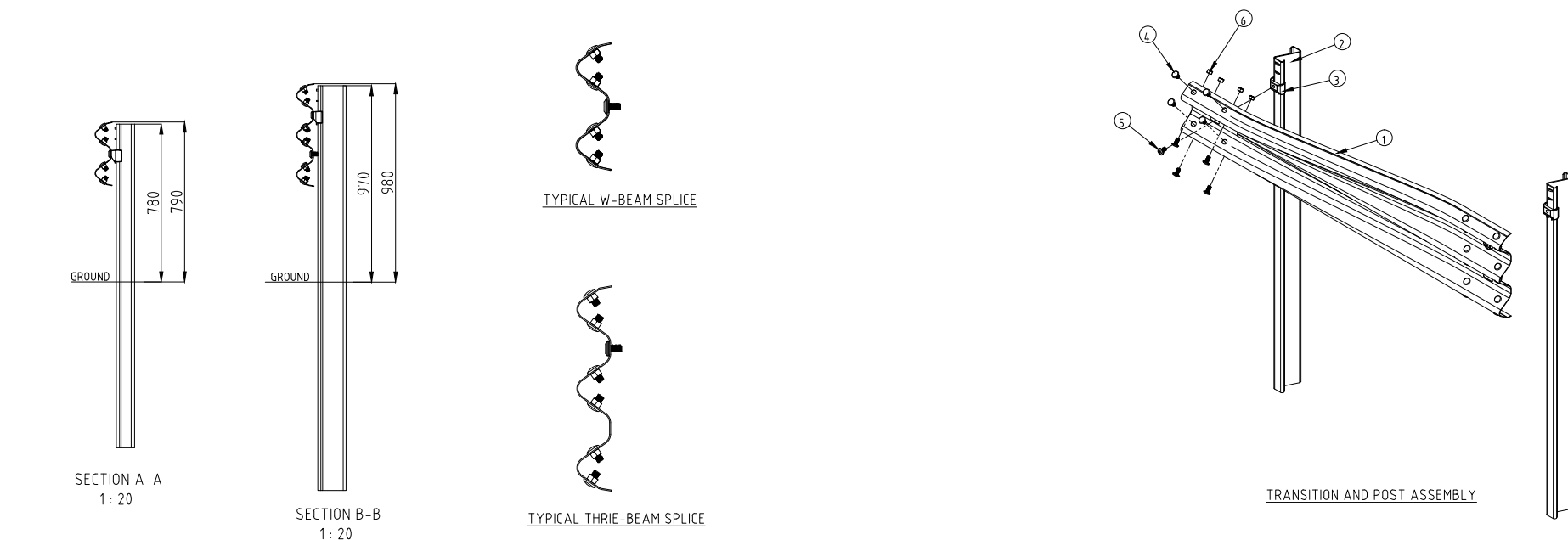
Type of Defect	Description of the Defect	Action to be Taken
Galvanizing damage on Z-Posts.	The sum total of the damaged area does not exceed 35cm ² (0.5% of the total surface area). The sum total of the damaged area exceeds 35cm ²	An organic zinc rich epoxy paint is to be applied to the repair area in two coats as per section 7.4. 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 as per section 7.4. The rail is to be replaced.
Mechanical damage on Ezy-HC-Carriages.	The Ezy-HC-Carriage has chips or cracks.	The Ezy-HC-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.



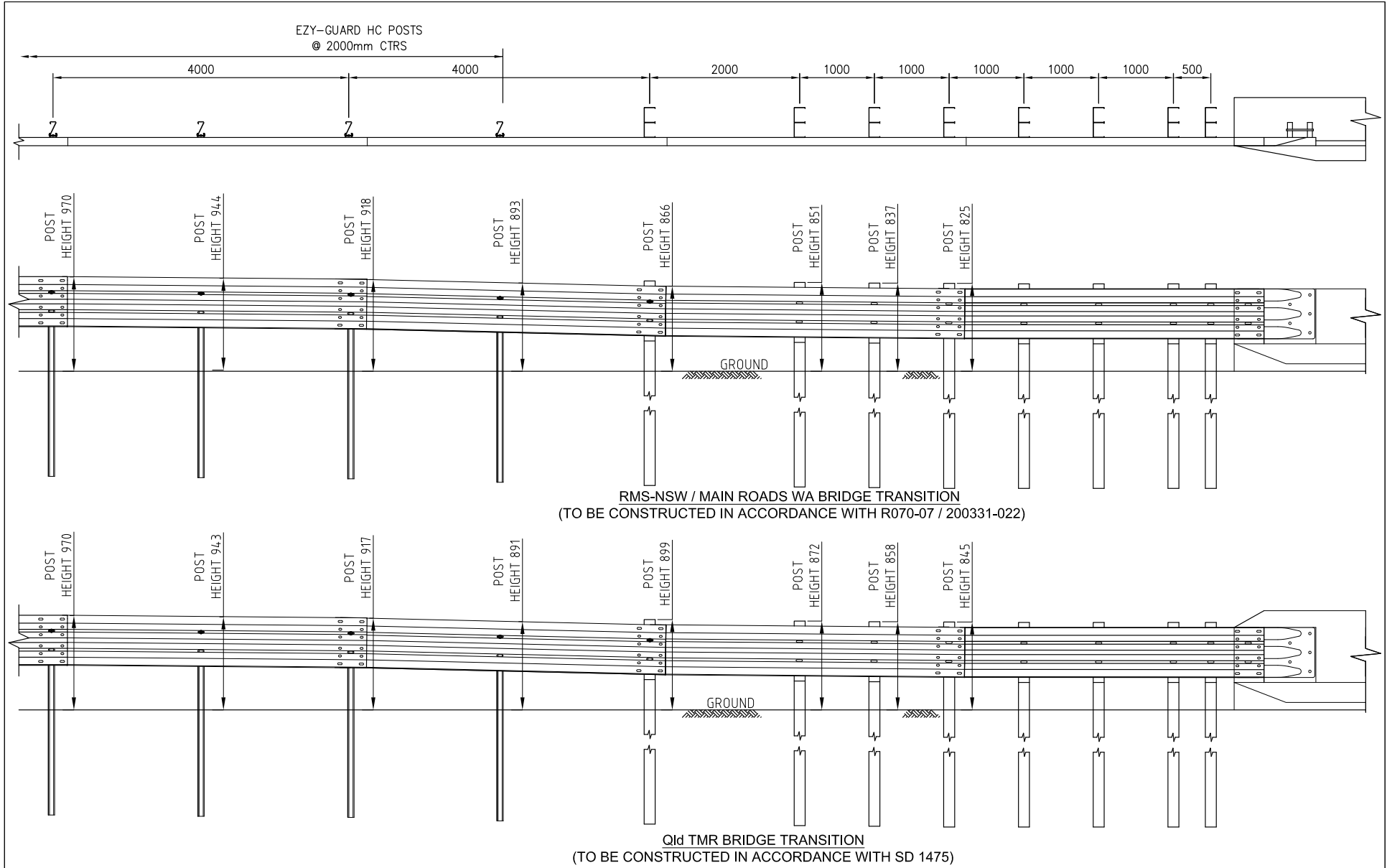
HC "Z" POST & CARRIAGE ASSEMBLY
PLAN VIEW



REVISIONS							REFERENCES								NAME	DATE	 INGAL CIVIL PRODUCTS A Walworth COMPANY	PROJECT		 INGAL CIVIL PRODUCTS PART No.		
														DRAWN	AUSCOL	05-07-2016		DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS 57-65 ARDROS ROAD MINTO, N.S.W 2566 PH: +61 2 9827 3333 www.ingalcivil.com.au	TITLE		EZY-GRADE HIGH CONTAINMENT POST CONFIGURATION DETAIL	DRAWING No. EZY-HC-004
														CHECKED	MC	04-10-2016						
														APPROVED	LG	04-10-2016						
														SCALE	N.T.S. @	A3						
	REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED		DRAWING NUMBER	REFERENCE DRAWINGS					ISSUE FOR						Rev:		



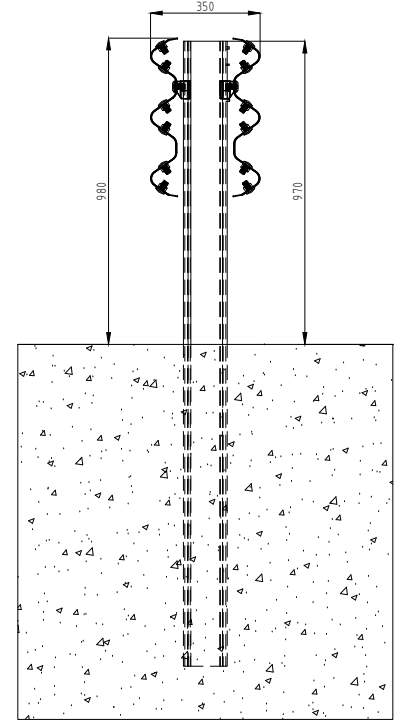
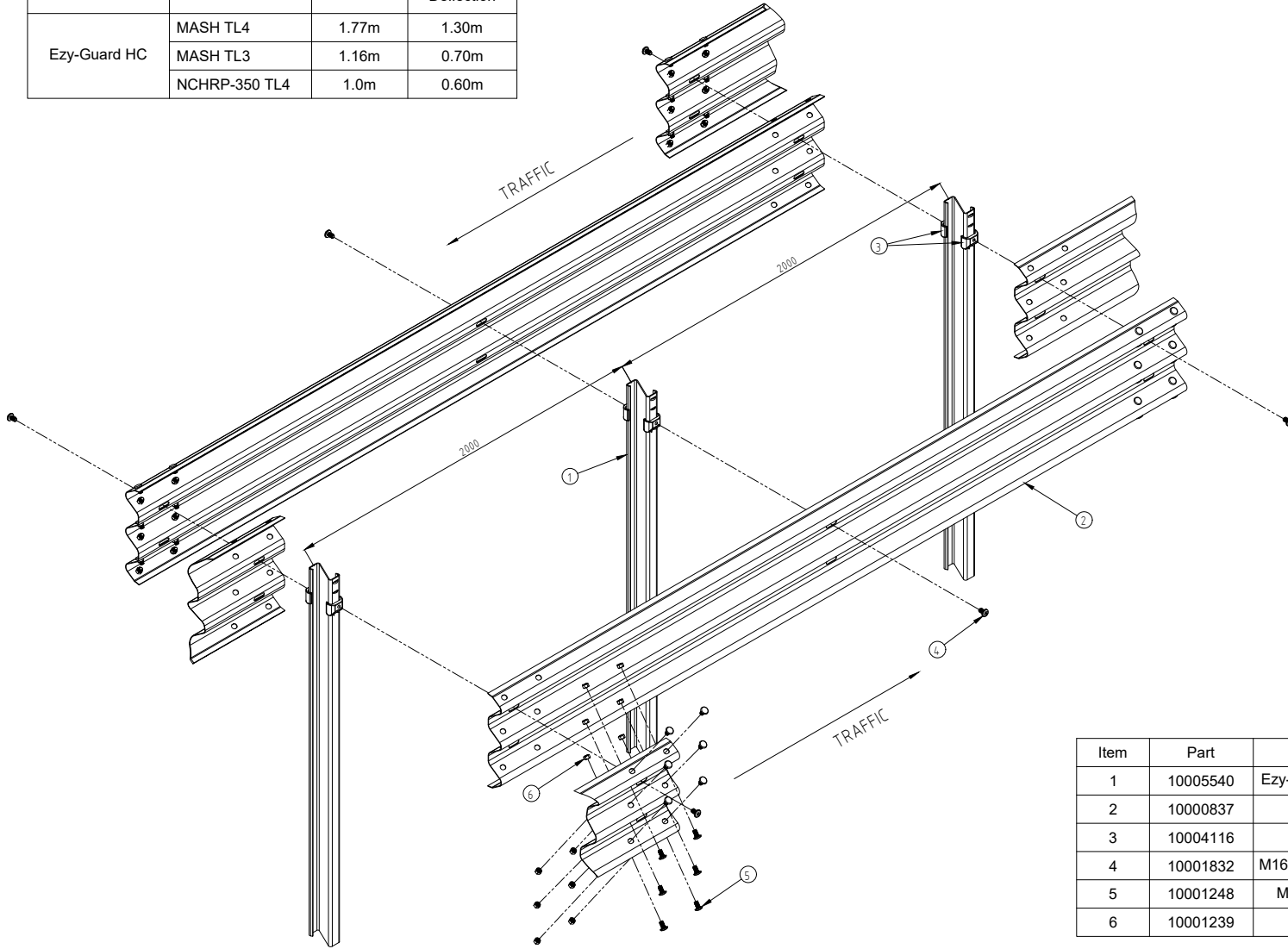
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE	DRAWINGS	NAME	DATE	 INGAL CIVIL PRODUCTS a valmont company	PROJECT	INGAL CIVIL PRODUCTS PART No.					
												DRAWN		AUSCOL	05-07-2016	DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS 57-65 AIRDS ROAD PH. +61 2 9827 3333 WINTO, N.S.W. 2566 www.ingalcivil.com.au	TITLE EZY-GUARD HIGH CONTAINMENT TRANSITION DETAIL EZY-GUARD HC TO 790MM W-BEAM	DRAWING No. EZY-HC-002
												CHECKED		LG	12-07-2016			
												APPROVED		LG	12-07-2016			
												SCALE		N.T.S. @	A3			
												ISSUE FOR						



REVISIONS						REFERENCES						PROJECT						INGAL CIVIL PRODUCTS PART No.	
2	04-12-2017	MRWA REFERENCE ADDED	WD	LG	LG														
1	13-07-2017	Qld TMR TRANSITION DETAIL ADDED & POST CHANGE	LG																
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS												

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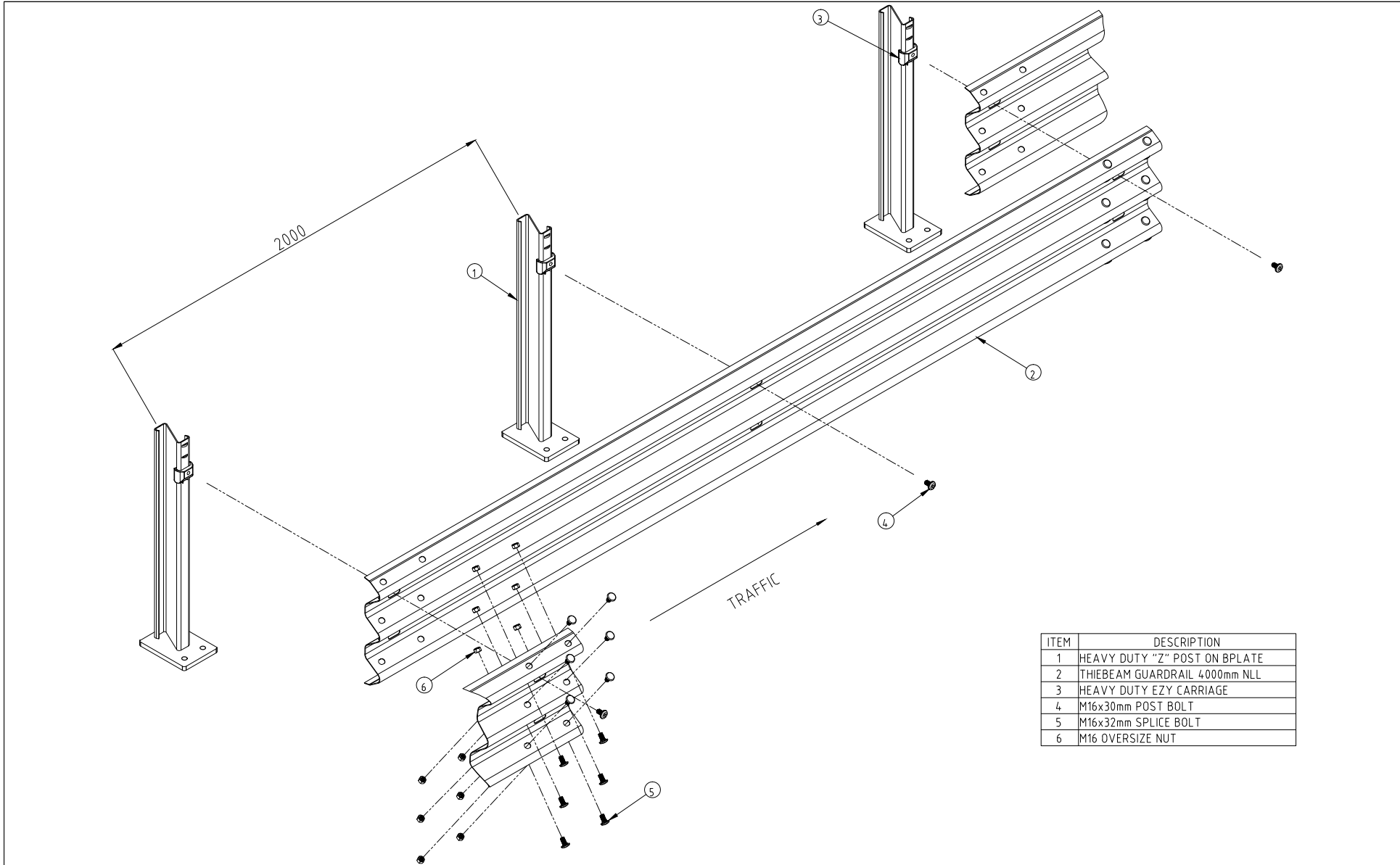
Guardrail System	Containment Level	Deflection	Permanent Deflection
Ezy-Guard HC	MASH TL4	1.77m	1.30m
	MASH TL3	1.16m	0.70m
	NCHRP-350 TL4	1.0m	0.60m



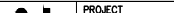
Item	Part	Description	Qty
1	10005540	Ezy-Guard Heavy Duty Z-Post 2000mm	2
2	10000837	Thribeam (2.7) 4000mm NLL	2
3	10004116	Heavy Duty Carriage	4
4	10001832	M16 x 30mm Ezy-Guard Smart post bolt	4
5	10001248	M16 x 32mm Splice Bolt Grade 8.8	24
6	10001239	M16 Oversized Nut	24

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	 DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS 57-65 AIRDS ROAD MINTO, N.S.W 2566 PH. +61 2 9827 3333 www.ingalcivil.com.au	PROJECT	INGAL CIVIL PRODUCTS PART No.			
													DRAWN	A.R.	04/04/18
													CHECKED	W.D.	04/04/18
													APPROVED	L.G.	04/04/18
													SCALE	N.T.S. @	A3
													ISSUE FOR	INFORMATION ONLY	
2	04/02/2020	TABLE OF COMPONENTS UPDATED	VB	LG	LG						TITLE	EZY-GUARD-HC BACK TO BACK CONFIGURATION ASSEMBLY DETAIL	DRAWING No. EZY-HC-017		
1	11/02/2020	DEFLECTIONS TABLE ADDED	VB	LG	LG										
					</										

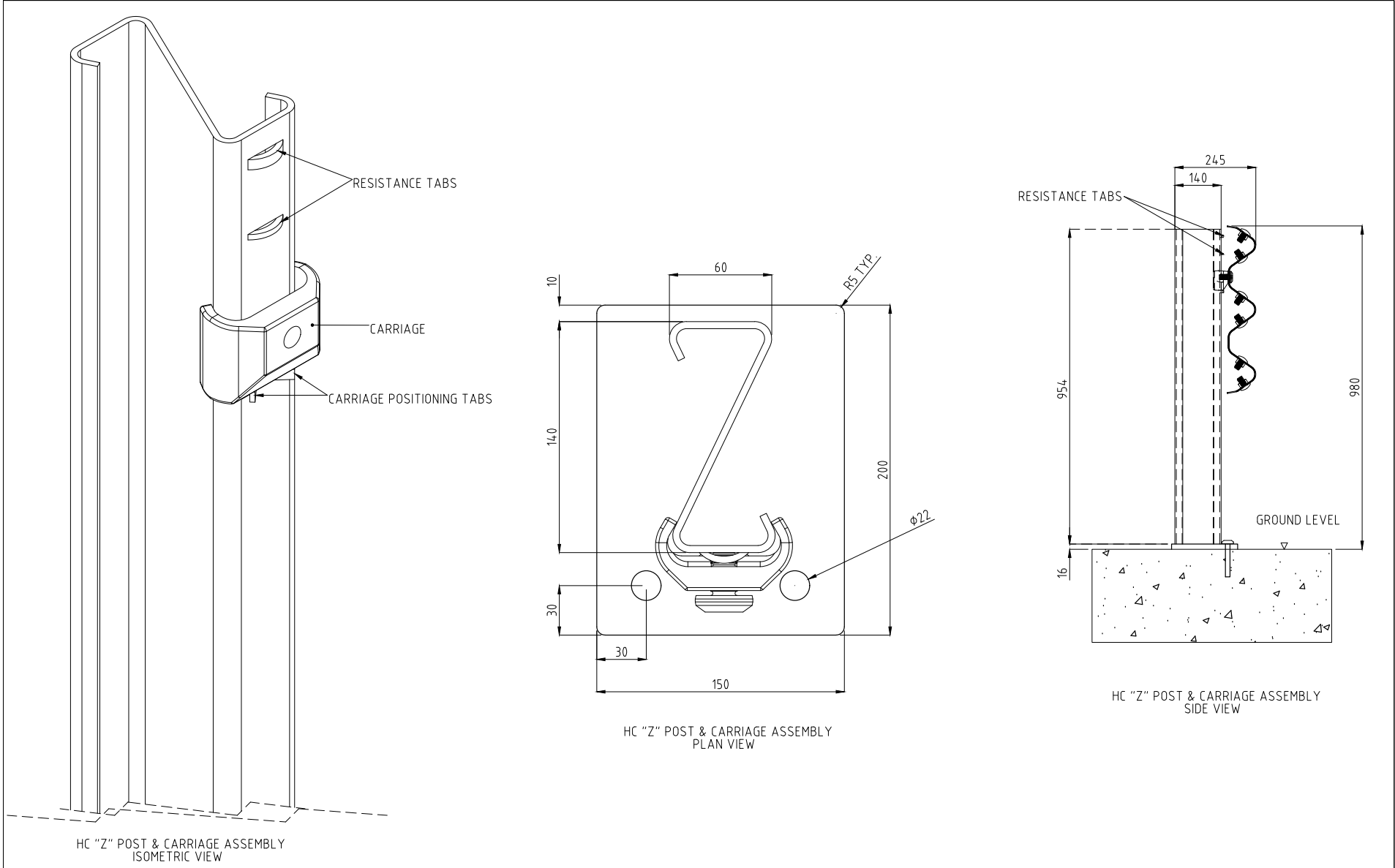
F:\ENGINEERING\SALES & MARKETING\DRAWINGS\EZY-GUARD-HC\EZY-HC-017 - EZY-G HC BB CONFIGURATION ASSEMBLY DETAIL.DWG



ITEM	DESCRIPTION
1	HEAVY DUTY "Z" POST ON BPLATE
2	THIEBEAM GUARDRAIL 4000mm NLL
3	HEAVY DUTY EZY CARRIAGE
4	M16x30mm POST BOLT
5	M16x32mm SPLICE BOLT
6	M16 OVERSIZE NUT

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	 DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS 57-65 AIRDS ROAD MINTO, N.S.W 2566 PH. +61 2 9827 3333 www.ingalcivil.com.au	PROJECT	TITLE	DRAWING No.	Rev	
EZYGUARD HIGH CONTAINMENT POST ON BASE PLATE ASSEMBLY DETAIL EXPLODED VIEW															EZY-HC-005

J:\SALES & MARKETING\DRAWINGS\SE7-GUARD\HCZY-HC-005 - EXPLODED ASSEMBLY BPLATE.DWG



REVISIONS						REFERENCES						PROJECT					
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	 INGAL CIVIL PRODUCTS A valmont COMPANY		TITLE	INGAL CIVIL PRODUCTS PART No.				
								DRAWN	MC			04-10-2016	DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS 57-65 AARDS ROAD PH. +61 2 9827 3333 MINTO, N.S.W 2566 www.ingalcivil.com.au	EZY-GUARD HIGH CONTAINMENT POST ON BASE PLATE CONFIGURATION DETAIL	DRAWING No. EZY-HC-006		
								CHECKED	LG			04-10-2016					
								APPROVED	LG			04-10-2016					
								SCALE	N.T.S. @			A3					
								ISSUE FOR									
1	05/01/2016	BASEPLATE HOLES DIAMETER UPDATED	VB	LG	LG												

Rev: 1

Notes:



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