



Your Partner in Roadside Safety

W-Beam Guardrail End Terminals Cable Barrier

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Ingal Malaysia

JKR APPROVED V Products*

MASH COMPLIANT MASH TL3 COMPLIANT



Ingal €⁷2Y-GUARD[™]

Roadside Safety Barrier



Ezy-Guard HC Back to Back Median Safety Barrier



Highway Guardrail Thrie-Beam Roadside Safety Barrier



Guardrail Transitions Semi-rigid to Rigid Barrier Transition



ArmorWire Cable Wire Rope Safety Barrier



ArmorBuffa Temporary End Treatment



ZEE-Park[®] Car Park Barrier Range

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Roadside Safety Barrier



€⁷Y-GUARD **BRIDGE BARRIER**



Guardrail End Terminals Public Domain End Terminals



Ingal RBT Semi-rigid to Rigid Concrete Transition



ArmorZone Temporary Barrier



Raptor Pole Protection Crash Cushion



Car Park and Industrial Specialist Barriers for Car Parks and Warehouses

Y-GUARDHC

Roadside Safety Barrier



Highway Guardrail W-Beam Roadside Safety Barrier



ET-SS Guardrail End Terminal



Ingal Motorcyclist Protection For Motorcyclists, Cyclists and Pedestrians



ArmorCade Temporary Barrier



Pedestrian and **Boundary Fencing**



ColumnBUFFA[™] Column Protection for Car Parks

samantha.lau@valmont.com +6010 220 8508

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*Not all products featured have yet been approved by the Malaysia Public Works Department Standard (JKR).

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Ingal Malaysia

A Division of Ingal Civil Products

Australia's leading manufacturer of road safety barriers since 1933

Committed to Your Safety

Road Safety Barriers • Crash Cushions • Motorcyclist Barriers Delineation • Truck Mounted Attenuators • Carpark Barriers Industrial Barriers • Pedestrian Fencing • Boundary Fencing

WHO WE ARE

Ingal Malaysia is a division of Ingal Civil Products (established 1933), Australia's leading manufacturer and distributor of safety barrier systems for roads and carpark applications throughout the Asia-Pacific region. As a division of Industrial Galvanizers Corporation Pty Ltd, we are part of a large network of companies specialising in engineered steel products and galvanizing services whilst employing over 8000 people in more than 20 countries.

At Ingal Malaysia we pride ourselves on having made a significant contribution to the safety of our roads. Our product range includes road safety barriers, carpark & industrial barriers, workzone & traffic control products, delineation and fencing products.

We are the market leader for safety barrier systems and continue to service our customers through our ongoing program of research and development.

Our premier products have achieved the highest standards of crash test certification, being MASH COMPLIANT and approved by the American Association of State Highway & Transportation Official (AASHTO), the Standard Industry Research Insitute of Malaysia (SIRIM), the Malaysia Public Works Department Standard (JKR) as well as Australian and European road safety classification organistaions.

Products





Containment Levels

Roadside Safety Barrier Testing Standards Explained



Note: The MASH TL4 impact severity is 209.3kJ

WHAT IS A CONTAINMENT TEST LEVEL?

The containment level categorises the capacity of a highway safety device in terms of the vehicle type and mass, speed and impact angle. MASH (Manual for Assessing Safety Hardware) is an international standard that has been adopted in Australia as the basis for all crash testing of highway safety devices. MASH replaced the previous testing standard NCHRP-350 in 2009 and was introduced to better reflect the current vehicle fleet.

For each containment level, or test level, the road safety barrier system is tested using a minimum of two vehicle types. The logic behind this requirement is by testing with a light vehicle and a heavy vehicle within each test level, the capacity of the system will be verified with the large vehicle and the occupant risk parameters of the device will be verified with the small vehicle. In MASH, Test Levels 1, 2 and 3 cover different speed environments from 50km/h up to 100km/h, and test levels 4, 5 and 6 are for heavy vehicles ranging from 10,000kg up to 36,000kg.

MASH TL3 COMPLIANT

Demonstrates the ability to contain and redirect the following:

- 1,100kg car at 100km/h and 25°
- 2,270kg pick-up (ute) at 100km/h and 25°

MASH TL4 COMPLIANT

Demonstrates the ability to contain and redirect the following:

- 1,100kg car at 100km/h and 25°
- 2,270kg pick-up (ute) at 100km/h and 25°
- 10,000kg truck at 90km/h and 15°

NCHRP-350 TL3 COMPLIANT

Demonstrates the ability to contain and redirect the following:

- 820kg car at 100km/h and 20°
- 2,000kg pickup (ute) at 100km/h and 25°

NCHRP-350 TL4 COMPLIANT

Demonstrates the ability to contain and redirect the following:

- 820kg car at 100km/h and 20°
- 2,000kg pickup (ute) at 100km/h and 25°
- 8,000kg truck at 80km/h and 15°





Asia Pacific's Leading Solution Provider for Roadside Safety Barriers

ingal.com.my

samantha.lau@valmont.com

+6010 220 8508

Malaysia www.ingal.com.my 866, Jalan Subang 8, Taman Perindustrian Subang, 47600 Subang Jaya, Selangor, Malaysia. +6010 220 8508

A VAIMONT COMPANY

Head Office Sydney, Australia 57-65 Airds Road, Minto NSW 2566 Ph: +61 2 9827 3333 Fax: +61 2 9827 3300 Local call (within Australia): 1300 446 425 Email: sales@ingalcivil.com.au New Zealand Unit 9, 7 Fraser Road, Mt Wellington Auckland 1072 Ph: +64 21 2464 997 Email: sales@ingalcivil.co.nz Philippines Webforge Philippines Inc 3 Hologram Street, Cabuyao, 4025 Laguna. Ph: +63 49 543 0441 sales@webforge.com.ph



FAQs

Visit our website for more information www.ingal.com.my

WHAT IS A CLEAR ZONE?

The horizontal width of space available for the safe use of an errant vehicle which consists of the verge area and is measured from the nearside edge of the left hand traffic lane. In the case of a divided road it is also measured from the offside edge of the right-hand traffic lane to the edge of pavement for opposing traffic.

WHAT IS THE WORKING WIDTH?

The maximum width that is required to prevent an impacting vehicle from colliding with an object behind a road safety barrier system. This includes both the dynamic deflection and the extra width due to the roll of the impacting vehicle.

WHAT IS A TERMINAL?

The specially designed end pieces of a road safety barrier system. The leading terminal is on the end of the road safety barrier system that faces oncoming traffic and the trailing terminal is on the other end. Terminals are subdivided into classifications of gating and non-gating terminals.

WHAT IS A GATING TERMINAL?

Terminals that are designed to break away, pivot or hinge, and that allow a vehicle to pass through when impacted at an angle to the end, or at a point upstream of the beginning length of the associated road safety barrier system.

WHAT IS A NON-GATING TERMINAL?

Terminals that are designed to redirect a vehicle and absorb part of the energy of an impacting vehicle at any point along the terminal without allowing it to pass behind the road safety barrier system.

WHAT IS THE POINT OF NEED?

The point that a terminal will redirect an errant vehicle rather than allowing it to pass through. This is measured from the beginning of the terminal.

WHAT DOES MASH MEAN?

MASH (Manual for Assessing Safety Hardware) is an international standard that has been adopted in Australia for crash testing of safety devices. The 2009 MASH replaces the previous testing standard: the NCHRP-350. ASBAP have nominated MASH as the basis for all barrier testing.

MASH TL2 COMPLIANT

The TL2 is a containment level under the MASH Standard. Compliance with this test demonstrates the system's ability to contain and redirect the following:

- 1,100kg car at 70km/h and 25°
- 2,270kg pick-up (ute) at 70km/h and 25°

MASH TL3 COMPLIANT

The TL3 is a containment level under the MASH Standard. Compliance with this test demonstrates the system's ability to contain and redirect the following:

- 1,100kg car at 100km/h and 25°
- 2,270kg pick-up (ute) at 100km/h and 25°

MASH TL4 COMPLIANT

The TL4 is a containment level under the MASH Standard. Compliance with this test demonstrates the system's ability to contain and redirect the following:

- 1,100kg car at 100km/h and 25°
- 2,270kg pick-up (ute) at 100km/h and 25°
- 10,000kg truck at 90km/h and 15°



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Ingal **€∑Y-GUARD**™

Highway Safety Barrier

MASH TL3 Compliant Roadside Safety Barrier

	JKR APPROVED 🗸	MASH TL3 COMPLIANT					
RAPID INSTALLATION	Few components facilitate rapid installa	ation.					
PROVEN SAFETY	Crash tested and fully compliant to MA	rash tested and fully compliant to MASH TL3.					
COST SAVINGS	Savings on freight and faster to install.						
RAPID INSTALLATION	Fewer components facilitate rapid insta	allation.					
FEWER PARTS	No blocking pieces or rail stiffener plates.						
VULNERABLE ROAD USERS	Z-post profile comprises smooth round height of Z-post is lower than w-beam.	led edges and the above ground					

INTRODUCTION

Introducing the Ingal Ezy-Guard[™] W-Beam guardrail system. Ezy-Guard highway safety barrier imposes lower forces to the impacting vehicle than traditional guardrail.

Changing the concept of how traditional w-beam guardrail works, Ingal Ezy-Guard[™] uses a unique 'Z' shaped steel post which connects to the w-beam guardrail panel via a slot in carriage. The Ezy-carriage has the ability to move within the slot on Z-post. An Ezy-Carriage is used to secure the w-beam to Z-posts and eliminate the requirement for blocking pieces and rail stiffening plates. This unique connection provides a soft ride-down for occupants and smooth vehicle containment and redirection.



Designed in Australia, Ezy-Guard[™] guardrail crash barriers impose lower forces to the impacting vehicle than traditional guardrail crash barriers. As the crash barrier deflects, vehicle impact energy is dissipated and as a result, reduces occupant risk. The ductile Z-posts provide a forgiving impact, reducing ride-down deceleration forces and minimising vehicle damage.

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

Ezy-Guard[™] has been crash tested and evaluated according to the specifications of the AASHTO Manual for Assessing Safety Hardware (MASH) TL3. In the crash test, Ingal Ezy-Guard[™] has demonstrated containment and re-direction of a 2,270kg pick-up traveling at 100km/h and impacting at 25° to the barrier. The MASH specification is an update to and supersedes NCHRP Report 350 for evaluating new safety hardware devices since 2009.

Ezy-Guard[™] has been accepted by the Local Road Authority (JKR Malaysia) and Malaysian Highway Authority (Lembaga Lebuhraya Malaysia), Australia, New Zealand, GHWA-USA, Mexico , Canada, Brunei, Philippines, Thailand and many other countries.



GUARDRAIL SAFETY BARRIERS



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EZY-GUARD POST AND COMPONENTS





- **Z-Post Front View**
- Front Isometric View



Ezy-Carriage Plan View



Post Bolt Side View

Post Bolt Plan View



- Narrow system width of only 200mm, saving valuable space.
- No blocking piece (packer), making Ezy-Guard easier to install and repair.
- Flexible and smooth vehicle containment, providing softer impact to errant vehicle and occupant.
- Z-post profile comprises smooth rounded edges and the above ground height of Z-post is lower than w-beam, unlike the traditional U-post, reducing the risk to vulnerable road users like motorcyclists, pedestrians and cyclists.
- Energy absorbing, ductile Z-post due to the designed yielding/ bending action; thus reducing the risk from the impact of wheel snagging on the Z-post.





Single sided W-Beam



Ingal **EZY-GUARD**[™]

SPECIFICATIONS

Ingal Ezy-Guard Z-post length:	1,600mm
Rail height above ground:	730 mm
Z-post height above ground:	720mm
Z-post spacing:	2,000mm
Ezy-Guard Smart system width:	200mm





MASH TL3 and NCHRP-350 TL4 Compliant Roadside Safety Barrier

MASH TL3 COMPLIANT

RAPID INSTALLATION	Fewer components facilitate rapid installation.
SAFER	Fully compliant to MASH TL3.
COST SAVINGS	Savings on freight costs and faster to install.
FEWER PARTS	No blocking pieces or rail stiffener plates.
NARROW WIDTH	A system width of just 200mm conserves valuable formation width.





GUARDRAIL SAFETY BARRIERS

STD 2m SPACING	1000	1000		6000	<u>PAN</u>		1000	1000	2000	STD 2M SPACING
_2	Z	;	2			2			<u>.</u>	22
.		-	•1					•	81	
EDGE LINE										
	20	000	2000	SINGLE POST	CONFLICT 4000		20	00 _	2000	
	2		2	1000±400		1000±400			2	2
		•			<u></u>			•		

EDGE LINE

INTRODUCTION

Introducing the Ezy-Guard 4. This next generation steel guardrail barrier provides one of the best guardrail solutions available today. It provides MASHTL3 containment. The superior design offers rapid installation, improved motorist safety and more metres of barrier for your dollar. If you need a highway barrier which is built is to last, is cost effective and can be deployed quickly, this guard rail is the ideal choice.

The Z-post profile shields vulnerable road users from post edges and provides sectional strength when driving through difficult ground conditions. For locations with a high volume of motorcycle traffic, the Ingal MPR system can be used with Ezy-Guard 4, offering additional protection to vulnerable road users.

An Ezy-Carriage is used to secure the W-beam rails to the Z-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. Road Safety barriers today are far advanced from their predecessor; this next generation safety guardrail safety barrier will stand the test of time and deliver superb safety standards that are currently unrivalled.

In the event that the Z-post cannot be installed to the required in-ground depth due to a conflict with underground services, there are two solutions to choose from. These are to install a concrete strip footing and use baseplated posts, or alternatively the posts can be omitted up to a maximum 6m clear span.

- Fewer parts.
- Narrow width.
- Rapid installation.
- High performance.
- Local design and manufacture.
- Consideration for motorcyclists.
- 6m Clear Span approved.



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 meter
Rail height above ground:	787mm
Z-post height above ground:	777mm
Post spacing:	2m
Ezy-Guard 4 system width:	200mm
Crash rating:	MASH TL3
MASH TL3 crash test deflection:	1.65m
Surface treatment:	Galvanised to AS/NZS 4680



Reducing the post spacing will lead to a reduction in dynamic deflection. Contact your Ingal representative for more information.



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High Containment Roadside Safety Barrier

	MASH TL3 COMPLIANT MASH TL4 COMPLIANT
HIGH PERFORMANCE	Demonstrated containment and re-direction of a 10,000kg truck travelling at 90km/h.
SAFER	Fully compliant to MASH TL4.
FEWER PARTS	No blocking pieces or rail stiffener plates.
RAPID INSTALLATION	Fewer components facilitate rapid installation.
COST SAVINGS	Savings on freight costs and faster to install.
NARROW WIDTH	A system width of just 245mm conserves valuable formation.





GUARDRAIL SAFETY BARRIERS





INTRODUCTION

Introducing Ezy-Guard High Containment. A member of the Ezy-Guard family, and the next generation steel guardrail barrier. Providing superior motorist safety with a tested containment of MASH Test Level 4.

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

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

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

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.

- Fully compliant to MASH TL4.
- High containment.
- Locally designed and manufactured.
- Narrow footprint saving road width.
- Consideration for motorcyclists with rounded post corners.
- Easy to transport and simple to install.



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:	980 mm
Z-post height above ground:	970mm
Post spacing:	2,000mm
Ezy-Guard HC system width:	245mm
Crash rating:	MASH TL4
MASH TL3 crash test deflection:	1.16m
MASH TL4 crash test deflection:	1.20m
NCHRP TL4 crash test deflection:	1.0m





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Back to Back Install

Maintaining MASH roadside safety with less components

MASH TL3 COMPLIANT

MASH TL4 COMPLIANT

ADVANTAGES

The Ezy-Guard High Containment barrier can be installed "back to back" which provides several advantages over traditional dual guardrail systems:

- Less components provides faster installation
- Less visual clutter
- Uses less roadside space than traditional dual guardrail systems
- Maintains TL3/TL4 MASH compliance
- Compatible with Ezy-Lift Carriage to maintain crash-test rating when road is overlayed





GUARDRAIL SAFETY BARRIERS



AS5100 Deck and Side Mounted Bridge Barrier

TL2 & TL3 OPTIONS	AS 5100.2 COMPLIANT AS/NZS 3845.1 COMPLIANT
SAFER	Integrated components provide superior safety to MASH TL2/TL3.
ENGINEERED	Low load transfer into the structure, minimising concrete damage in a crash.
COST SAVINGS	Off the shelf components with stock readily available.
VERSATILE	Deck or side mounted options available.
ADAPTABLE	Can be easily retrofitted to existing structures.

The new addition to the Ezy-Guard family is the Ezy-Guard Bridge Barrier System. Using many components from the MASH Test Level 4 Ezy-Guard High Containment system, the bridge barrier configuration is designed for bridges and structures requiring AS5100 compliant edge protection. The Ezy-Guard Bridge Barrier can be deck or side mounted to the bridge structure, saving valuable lane width. It can also be easily retrofitted to existing structures.

The Ezy-Guard Bridge Barrier system uses all off-the shelf components, with all stock readily available, minimising repair time in the event of a vehicle impact.

The Ezy-Guard Bridge Barrier is designed for minimal load transfer into the structure, reducing potential concrete damage in a crash. This means less road closures or need to repair concrete after impact damage.

The Ezy-Guard Bridge Barrier System is compatible with W-Beam Guardrails, but maximum MASH rating is achieved through the use of Ingal's proprietary Ezy-Guard 4 or Ezy-Guard HC guardrail systems.



- Lower impact risk to vehicle occupants through controlled yielding of barrier posts
- Low load transfer into the structure, minimising concrete damage in a crash
- MASH TL2 and TL3 options available to suit your needs
- Off the shelf components with stock readily available
- Narrow 250mm footprint, saving valuable lane width
- Easily retrofitted to existing structures
- Deck or side mounted options





SPECIFICATIONS

Thrie-Beam Length:	4,000mm
Ezy-Guard BB Z-Post Mass:	13.5kg
Corrosive Protection:	HDG to AS4680
Rail Height Above Ground:	980mm
Z-Post Height Above Ground:	970mm
Post Spacing:	1m or 2m
Ezy-Guard BB System Width:	245mm

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Ezy-Lift[®] Carriage

Future-proofing your guardrail installation

MASH TL3 COMPLIANT



INTRODUCTION

The Ezy-Lift[®] Carriage is an innovative height adjustment carriage to ensure a compliant barrier height after the road has been over-layed. For existing Ezy-Guard installations where the road surface has been over-layed or resurfaced, resulting in the barrier height being outside of the installation tolerance, the Ezy-Lift carriage is available to bring the W-Beam back to the appropriate height.

The carriage gives the option to lift the W-Beam by +50, +100, +150 and +180mm.

There is no need to reinstall new road safety barriers after resurfacing, meaning a cost effective solution with minimal road closure time. The Ezy-Lift Carriage can be easily retrofitted in the field and uses the same reliable and proven technology of the Ezy-Guard Smart road safety barrier, maintaining your MASH TL-3 containment level.

- Fully tested & compliant system.
- Compatible with MASH TL3 Ezy-Guard Smart and TL4 Ezy-Guard 4.
- Easy-to-install.
- Option to lift the W-Beam by +50, +100, +150 and +180mm.
- Retrofit to existing Ezy-Guard after resurfacing.
- No need to reinstall new road safety barriers.
- Consistent high performance.





Ezy-Guard® Deflections

All Ezy-Guard systems are crash tested according to MASH standards.

DEFLECTION DATA OF EZY-GUARD PRODUCTS

All Ezy-Guard systems are crash tested to its designed test levels according to MASH standards.

To enhance the versatility of our product, Ingal do provide crash test data by using FEA (finite element analyse) simulations for the non-standard test conditions and installations. All crash simulation models are build based on calibrate models of the physical crash tests. The calibration process is documented in NCHRP-179 report.

Ingal continues to work on a comprehensive dataset of FEA simulation results to meet all customers' need.

MASH Testing with 2,270kg Pickup								
Due du st	Vehicle Speed	Impact Angle	MASH Test	Deflection at different Post Spacing (m)				
Product	(km/h)	(Deg)	Level	2m (Standard)	1m	0.5m		
Emy Cuard 4	100	25°	TL3	1.65	1.05	0.73		
Ezy-Guard 4	70	25°	TL2	0.9	0.57	0.4		
	100	25°	TL3	1.16	0.8*	0.5*		
	80	25°		0.8*	0.6*	0.33*		
Ezy-Guard HC	70	25°	TL2	0.7	0.5*	0.3*		
	60	25°		0.6	0.35*	-		

MASH Testing with 10,000kg Truck								
Product	Vehicle Speed Impact An (km/h) (Deg)	Impact Angle	MASH Test	Deflection at different Post Spacing (m)				
FIOUUCU		(Deg)	Level	2m (Standard)	1m	0.5m		
Ezy-Guard HC	90	15	TL4	1.2	0.8**	0.5**		

NCHRP-350 Testing with 8,000kg Truck					
Product Vehicle Speed Impact Angle Containment Post Spacing Deflect					
Ezy-Guard 4	80	15	TL4	2m	1.53



* Deflection determined from FEA crash simulation

** Deflection determined from interpolate data of existing crash test and simulation, values are subjected to change once crash test or simulation is completed.



Highway Guardrail

Malaysia's widest range of W-Beam Highway Safety Barriers

Engineered For Safety

JKR APPROVED 🗸

ADAPTABLE	To provide railing protection to motor vehicles at dangerous road areas such as • Steep Slope • Obscure Curve/Bend • Sharp Corners	
PROVEN SAFETY	To act as a directional railing for vehicle moving traffic in the right direction.	
RELIABILITY	To act as a median barrier for avoiding head on collision.	
SECURITY	To act as a protective barrier for pedestrian along the highway.	
APPROVED	Complies with standards requirements of the Malaysian Public Works Department (JKR).	

SPECIFICATIONS

AASHTO M180-(2018)		
AASHTO DESIGNATION: M 111M/ M 111-09 BS EN ISO 1461 : 2009		
AASHTO M180-(2018)		
345 N/mm ²		
483 N/mm ²		
12%		

INGAL MALAYSIA GUARDRAIL RANGE

ТҮРЕ	EFFECTIVE LENGTH (mm)	OVERALL LENGTH (mm)	NOMINAL THICKNESS (mm)
INGAL 1	3810	4128	2.67
INGAL 2	4000	4318	2.67
INGAL 3	3810	4128	3.00
INGAL 4	4000	4318	3.00





GUARDRAIL SAFETY BARRIERS



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samantha.lau@valmont.com



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Guardrail End Terminals

Public Domain Guardrail End Terminals

DEPENDABLE	End Terminals are used to end and complete guardrail safety barriers.
PROVEN SAFETY	Designed to shield the ends of guardrail to provide redirection of vehicles and their occupant.
ADAPTABLE	Can be used with proprietary Ingal guardrail or public domain systems.
APPROVED	Complies with standards requirements of the Malaysian Public Works Department (JKR).

TYPE 2 – TERMINAL ANCHORAGE UNIT /BUFFER RETURN

JKR APPROVED 🗸





GUARDRAIL END TERMINALS

TYPE 3 – 90° TWISTED TERMINAL ANCHORAGE UNIT

JKR APPROVED



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ELEVATION

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GUARDRAIL SAFETY BARRIERS

HIGHWAY GUARDRAIL - THRIE-BEAM



TYPICAL RAIL SECTION



THRIE BEAM

(All dimension are subject to manufacture tolerance) All dimension are in mm



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BRIDGE ENDPOST CONNECTION BRACKET

GUARDRAIL SAFETY BARRIERS

HIGHWAY GUARDRAIL - THRIE-BEAM POST



TVDE	H x h x tl x t2(mm)		SECTION ADEA (cm ²)	MOMENT OF INERTIA		SECTION MODULUS	
			SECTION ANEA (CIII)	lx (cm⁴)	ly (cm⁴)	Sx (cm ³)	Sy (cm ³)
А	C178 x 76 x 6 x 6	14.3	19.08	903.5	102.5	101.5	52.0
В	C150 x 76 x 6 x 6	13.2	17.50	610.0	98.0	80	45.3
С	C125 x 65 x 6 x8	13.4	17.11	425	65.5	68.0	14.4



Double Mounted Thrie Beam



Guardrail can be curved to suit site



Buffer Return



Guardrail supported by Channel Post



Guardrail supported by Channel Post

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ET-SS

Front Anchored Technology

	MASH TL2 COMPLIANT MASH TL3 COMPLIANT		
EASY ASSEMBLY	Splices at mid-span of the posts allow for easy assembly.		
SAFER	Protective cover available for vulnerable road users, ideal for shared use paths.		
VERSATILE	Compatible with various proprietary and public domain guardrail systems.		
ADAPTABLE INSTALLATION	Baseplated and concrete anchor post options for challenging installation sites.		
COST SAVINGS	Vertically compressed rail is flattened and maintains connection to unit for quicker repair and clean up.		





GUARDRAIL END TERMINALS





INTRODUCTION

The ET-SS is an all-steel tangent end terminal for use with W-beam guardrail systems. Using a proprietary head that flattens and extrudes W-beam guardrail upon end-on impacts within the MASH testing criteria, the ET-SS dissipates energy while guiding flattened rail through the mouth at the bottom of the unit. The system is MASH Test Level 3 compliant as a redirective, gating end terminal. It is also available in Test Level 2 configuration.

- Splices at mid-span of the posts allow for easy assembly.
- Extruded rail is flattened and maintains connection to unit for quicker repair and clean up.
- Compatible with various W-beam guardrail systems.

BASEPLATED & CONCRETE ANCHOR POST OPTIONS

For locations where the posts cannot be driven to the appropriate depth due to an underground services conflict or similar, a surface mounted option is now available. This variant uses baseplated posts which are chemically anchored to a 250mm thick concrete pad. A concrete anchor post option is also available for locations where the 1.8m anchor post cannot be installed.

- Tall narrow extruder head provides less obstruction for ongoing maintenance operations such as mowing and snow removal.
- 100% galvanized steel head and post design reduces weather or UV related issues.
- The ET-SS head has the potential to be reused after impact. The ultimate decision of reusability rests with the specifying transportation authority.
- Unique anchorage design allows guardrail run to remain anchored after end-on impacts, when impacted according to MASH guidelines.





Guardrail Transitions

ASBAP Semi-rigid to rigid barrier transition



INTRODUCTION

The most common types of bridge barriers are reinforced concrete walls or metal rails on concrete parapets. If improperly treated, the exposed ends of these barriers can pose a significant hazard to errant vehicles. In most instances an approach guardrail is used to shield the exposed end and to prevent vehicles from impacting these rigid ends.

Guardrail is typically more flexible than the bridge barriers to which they are attached. A transition section is therefore required wherever there is an increase in stiffness when going from a semi-rigid W-Beam/Thriebeam barrier into a more rigid bridge barrier.

Ezy-Guard 4 and Ezy-Guard HC are both approved for connection to the recently approved ASBAP rigid transition. This is a longer transition compared to the older NCHRP-350 rigid transitions and uses the asymmetric transition panel and SHS blocks in place of the C-section blocks.







Ingal RBT

Semi-rigid barrier to rigid concrete structure transition



INTRODUCTION

The Ingal RBT is a MASH Test Level 3 compliant transition for connecting a range of semi-rigid barriers to a rigid concrete structure. The transition is 6m long and comprises a series of I-Beam posts at 1m and 0.5m spacing on the approach to the rigid structure. The transition posts are a common section used in guardrail end-terminals.

The posts support a 3.5mm BMT thrie-beam panel and a symmetric W-beam to thrie-beam transition panel. Upon impact, the stiffness of the I-Beam resists lateral deflection of the rail, leading to the containment and redirection of the vehicle without excessive pocketing.

The upstream end of the transition can connect directly into the Ezy-Guard 4 system via the symmetric transition panel. Alternatively, the transition can connect to the Ezy-Guard HC and LDS systems, with the height discrepancy transitioned over two thrie-beam panels.

The Ingal RBT has been crash tested when attached to the same rigid concrete barrier as detailed in Austroads SBTA 21-005 Transition.



MASH TL3 COMPLIANT

- Compliant to MASH TL3.
- Simple to install.
- Adaptable connects to existing Ezy-Guard Smart, Ezy-Guard 4 and Ezy-Guard HC guardrail systems.
- Narrow profile, saving valuable formation width.
- Fast to repair in the event of a collision.
- Uses off-the-shelf components.
- Custom designed delineators.
- Maximum cross fall for installation of the Ingal RBT is 10H:1V (10%).
- Posts and rails are hot dip galvanized in accordance with AS/ NZS 4680.

SPECIFICATIONS (TL3)

Ingal RBT Post Length	1,830mm
Ingal RBT Post Mass	25kg
Ingal RBT System Mass	251kg
Rail Height Above Ground	880mm
Post Spacing	1,000mm & 500mm
Ingal RBT System Width	235mm
Containment Level	MASH Test Level 3



W-Beam to ThrieBeam Transition Panels

SPECIFICATIONS

 Effective length
 2m

 Surface Treatment
 AS/NZS 4680 Galvanised



Symmetric Transition W-Beam to ThrieBeam

Asymmetric Transition Panels

SPECIFICATIONS



Asymmetric Transition from W-Beam to ThrieBeam - LHS Asymmetric Transition from ThrieBeam to W-Beam - RHS

ThrieBeam and W-Beam Terminal Connector



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Ingal MPR

Offering the highest level of protection to our motorcyclists

	MASH TL3 COMPLIANT	EN1317 COMPLIANT
SMART DESIGN More space between the system and the ground (60mm), allowing with drainage, snow clearance, cleaning of hard shoulders, etc.		
SAFER	Compliant to AS/NZS 3845:2015 and crasl	n tested to EN1317 and MASH TL3.
COST SAVINGS	No modification required to traditional guardrail barriers to accommodate Ingal MPR.	
EASY TO INSTALL	Quick installation on new or retrofit project	cts.





MOTORCYCLIST PROTECTION





INTRODUCTION

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

Class A impact severity recorded from dummy testing, this offers the motorcyclist the highest level of protection from head injury.

Traditional highway safety barriers installed on the road carriageways to restrain vehicles from impacting roadside hazards, these typically take the form of the W-Beam rail supported by a series of posts. These posts introduce a significant hazard to an errant motorcyclist in a run-off road accident. The Ingal MPR consists of an under-riding rail which is mounted on a spring bracket. Upon impacting this rail, the spring bracket deflects back absorbing some of the impact energy from the motorcyclist, whilst the rail contains and re-directs the motorcyclist away from the rigid posts and hazards.



- The specially designed anchoring system fully facilitates the positioning of the guard rail at the correct height, ensuring a uniform distance from the ground and compensating for uneven terrain and height differences in the existing barriers.
- The mounting bracket also allows the motorcyclist rail to be raised to match alterations in the level of the road surface.
- The motorcyclist rail can be assembled and raised without the need to modify the traditional vehicle barrier system.
- More space between the system and the ground (60mm), allowing water drainage, cleaning of hard shoulders, etc.
- Small number of components and ease of installation make the system very cost-effective.

Post Cap

Mitigates injury to motorcyclists



Ingal has developed a capping system that can be attached to new or existing guardrail installations with C Posts. Manufactured from durable polymers, the Ingal Post Cap shields the sharp edges of the post and blocking piece. The Ingal Post Cap provides an aesthetic, rapid and safe solution for all roadside users.

Stack Cushion

Protects from impacting posts



The Ingal Stack Cushion has been designed to fit onto Wire Rope Safety Barriers to provide protection for motorcyclists in the event of a collision.

Ingal Stack Cushion has no aggressive edges or corners and can be attached to existing wire rope posts providing a softer impact for motorcycle users.

Ingal Malaysia

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ArmorWire Cable Safety Barrier

3 or 4 Cable Wire Rope Safety Barrier

NCHRP-350 COMPLIANT

Most user-friendly cable barrier in the market, easiest installation & after-impact repair.

Exceptional vehicle control and behaviour.

System with the lowest part count in the market.

Low cost system installation and maintenance.

Same system can be used in roadside as well as median application.

Consideration for vulnerable road users - no sharp edges or exposed hooks on posts.









INTRODUCTION

Armorwire s a high tension cable barrier consisting of unique 'oval' shaped steel posts. Slots within the posts house the barrier cables at the required height and each post has a concrete footing. It is recommended that the Armorwire cables are anchored using the Universal Armorwire Terminal End (A.T.E) which has been accepted to NCHRP 350 TL-3.

Armorwire TL-3 cable barrier is designed as a 3-cable system and constructed to provide acceptable structural adequacy, minimal occupant risk and safe trajectory as set forth in NCHRP 350 for longitudinal barriers. When impacted with an 820kg and 2000kg vehicle at speeds of 100kph and side on entry angles up to 25 degrees, the impacting vehicle is re-directed in a safe manner.

Armorwire TL-4 is a high tension 4 barrier cable system and each post has a concrete footing. In addition to the TL-3 system crash rating, the TL-4 is crash tested with an 8000kg vehicle at speeds of up to 100kph and side on entry angles up to 25 degrees, the impacting vehicle is re-directed in a safe manner.





TL-3 DEFLECTION RESULTS

NCHRP 350 TL-3 (Test 3-11): 2000kg pickup truck, 100kph at 25°					
Post Spacing	Dynamic Deflection	Working Width			
3.0m	1.54m	1.54m			
Post Spacing	Dynamic Deflection	Working Width			
9.0m	3.27m	3.27m			
TL-4 DEFLECTION RESULTS					
NCHRP 350 TL-4 (Test 4-12): 8000kg truck, 80kph at 15° angle					

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Post Spacing	Dynamic Deflection	Working Width
3.0m	1 10m	215m

Plastic Cap Plastic Car 19mm 19 mm Wire Rope Wire Rop Line Post Line Post Rubber Ring Rubber Ring Plastic Socket Plastic Socket Rebar Ring Rebar Ring 25Mpa Concrete Concrete supplied by others supplied by others 3 Cables Line Post Setup 4 Cables Line Post Setup

- Lowest vehicle deflection system in its category (NCHRP 350).
- Tested and accepted to NCHRP 350 TL-4 (four wire system) & TL-3 (three wire system).
- Manufactured in Malaysia.
- Narrow footprint saving road width.
- Various foundation pile sizes available.
- Easy to transport and simple to install.
- Matching NCHRP 350 TL-3 terminal end available Universal (ATE)
- Minimal build-up in snow or sand environments.
- No sharp edges or exposed hooks on posts.

Ingal Malaysia



ArmorWire Terminal End

Universal A.T.E. Cable Barrier Terminal End (anchoring for 3 or 4 cable barriers)

NCHRP-350 COMPLIANT

Tested and accepted to NCHRP 350 TL-3.

High performance at low cost.

Easy and fast to repair after impact.

Rapid installation with zero maintenance required.

Foundations can be drilled using the same machine used for line post.

Typically less concrete is required for the anchor piles (compared to other systems).









INTRODUCTION

The Universal Armorwire Terminal End (A.T.E.) is used to anchor high tensioned 3 or 4 cable barriers. All cables connect to the unique 'trigger' post which is attached to the ground strut, while concrete foundations and rebar cages complete the anchor set-up. The ArmorWire Universal A.T.E.™ is tested and accepted to NCHRP 350 TL-3 criteria and as a barrier system terminal end for either 3 or 4 cable barriers.

The Universal A.T.E. is designed and constructed to provide acceptable structural adequacy, minimal occupant risk and safe trajectory as set forth in NCHRP 350 for cable barrier terminal ends.

When impacted with an 820kg and 2000kg vehicle at speeds of 100kph, due to the immediate loss of cable tension, the errant vehicle remains on its wheels at all times without vaulting or rolling which is common on terminal ends where cables remain tensioned during impact.

When an errant vehicle impacts directly with the Universal A.T.E. barrier system terminal end, the cables disconnect from the trigger post de-tensioning the cable barrier immediately. This allows the vehicle to remain on its wheels at all times without snagging or vaulting which is common behaviour on traditional cable barrier anchors.

The ArmorWire Universal A.T.E. barrier system terminal end offers the simplest installation and repair process, promptly re-establishing safety on our roads, saving more lives.



- Compliant to NCHRP 350 TL-3.
- High performance with low cost.
- Fast to install providing cost savings.
- · Zero maintenance required.
- Foundations can be drilled at same time as line post.
- Uses less concrete than other systems.







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ArmorZone™



High performance temporary work-zone barrier



- Provides excellent work-zone protection to temporary construction sites and other roadside activities.
- Exceptionally good vehicle control and low deflection.
- Easy install and transportation.
- Environmentally friendly 100% recyclable.
- 120m/h deployment rate by only 2 personnel.

The water-filled nature of the ArmorZone™ barrier simplifies its deployment and transportation while increasing safety during the installation process as the empty barriers only weigh 50 kg and are easily handled by two operators.

ArmorZone[™] deployment involves interlocking the 2.16 m long units with a unique connecting pin and filling each barrier with 520L of water. ArmorZone[™] can be deployed straight or with low curvature, on either roadside or median applications, in speed zones up to 70 km/h. The ArmorZone[™]

barrier has many advantages in the market place including high durability, high performance, fast (and safe installation) at a very competitive cost and is the ideal temporary barrier for the civil construction market.



ArmorCade®

Temporary delineator



- Low cost of procurement.
- Innovative design for adaptable use
- ^o Low transportation costs: 60 units fit a 6m truck deck.
- ^o Easy installation with no steel pins required.
- [•] Long lifespan due to quality MDPE construction.
- 100% recyclable no internal or external steel.
- Economical use of water (optional).

The latest solution for temporary pedestrian, cyclist and vehicular management.

ArmorCade is made up of 2.0m long plastic units (MDPE) that join together using integral interlocking lugs to form a continuous delineator.

Through innovative design, ArmorCade can be installed straight or with acute radius curves, up to 90 degrees if required.



ArmorBuffa™

MASH TL2 COMPLIANT ASH TL3 COMPLIANT

Temporary end treatment for use on F-Type concrete barrier and HighwayGuard steel barrier





- Designed to perform on a variety of foundations including concrete, asphalt, and any other surfaces capable of bearing the weight of the system.
- Simple to install.
- Narrow profile, saving space on confined or constricted worksites.
- Easy to transport, fast to install and dismantle.

The ArmorBuffa[™] is designed to protect the end of a temporary F-Type concrete barrier and HighwayGuard steel barrier. It is approved for MASH TL2 use (for speed zones up to 70km/h) and MASH TL3 use (for speed zones up to 80km/h).

The innovative ArmorBuffa[™] system utilises a Nose Piece, water-filled Elements, Pins, a Transition and mechanical anchors to absorb kinetic energy of impacting vehicles. All Elements are always filled with water.

Like the ArmorZone™ barrier, the ArmorBuffa™ is easy to transport and provides rapid installation with minimal labour. Once in place the ArmorBuffa[™] is filled with water, making it simple to deploy on-site with minimal disruption. The system can be repaired in event of minor or nuisance impacts and any components damaged beyond repair can be recycled.

Raptor[™] Pole Protection

Exceptional energy-absorbing capability

MASH TL1 COMPLIANT NCHRP-350 COMPLIANT



- Highly reduces the severity of vehicle impacts against poles and trees.
- Usable in places typically impossible to protect.
- Compact size and easy installation (under 30 minutes).
- Two sizes available to fit multiple width hazards.
- Zero maintenance, UV stabilised, approx lifespan 25 years. No foundations are required.

The Raptor[™] is an energy absorbing device designed to reduce the severity of vehicle impacts with utility poles or trees. Its unique technology offers a compact low-cost solution in places where typical crash cushions would not physically fit.

Approximately 30% of the run-off-road fatalities involve severe impacts with hard objects such as poles and trees. With RAPTOR™ the impact energy is absorbed by internal plastic cartridges. RAPTOR™ is also capable of deflecting a vehicle in side-on angled impacts. The RAPTOR™ system has been tested and satisfied the required evaluation criteria for acceptance to both MASH TL1 and NCHRP-350 guidelines for a gating, non re-directive crash cushion.



FENCING

Boundary Fencing

Improving site security around sporting fields, parkland and bushland



BOUNDARY FENCING

Prevents unauthorised vehicle access to protect areas such as sporting fields, parkland & bushland.

The Rigid C posts are driven into the ground and are fitted with Post Caps to protect pedestrians from post edges. Twin 19mm diameter cables pass through pre-punched holes in each post.

All posts are hot dipped galvanized for improved durability. Rapid and low-cost installation is a feature of Ingal Boundary Fencing as no concrete is required for installation.

- Rigid C-Posts are driven into the ground.
- Hot dipped galvanised.
- Twin 19mm cables.
- Protects bushland, sporting fields and parkland from unauthorised vehicle access.
- No concrete required.





FENCING

Pedestrian Fencing

Crucial to maintaining Road Authority Safety Standards



PEDESTRIAN FENCING

Applications:

- Shopping Centres
- School Zones
- Intersections
- Sports Arenas and Events
- Entertainment Venues
 - Tourist Attractions

Pedestrian fencing is used to channel pedestrians in a predictable and safe way in traffic areas. The Pedestrian Fence design has been created using solid steel members and joined with nut and bolt connections which allows the panels to collapse as an entire panel and reduce the potential for detachment of the individual pedestrian fencing elements. Not only does this provide additional pedestrian safety, but it can also prevent the impacting vehicle from becoming impaled.

- Manufactured to State Road Authority specifications.
- Hot dipped galvanised.
- Available in median or verge configuration.
- Separates pedestrian and vehicle activity.
- Designed NOT to spear impacting vehicles.
- Anti-climb design.



Car Park and Industrial

Guardrail barrier protection for car parks, warehouses and industrial

ENHANCED SAFETY AND PROTECTION

Car Park and Industrial barriers are a type of guardrail system specifically designed to be used in low-speed areas such as car parks, private roads, warehouses and other non-road environments. Ingal design and manufacture a range of options to meet the varied needs of each application which includes semi-flexible posts, restricted space designs, fall protection and balustrade designs. Contact Ingal Malaysia for more information or advice on how to design your car park or warehouse project.



ZEE-Park[®]



ZEE-Park[®] DeckGuard



ZEE-Park® Sentinel



ZEE-Park[®] TruckShield



Spring Steel BUFFA™



Cable BUFFA[™]



Column BUFFA™



Rigid Post / Corners / Accessories





The market leader in the design, engineering and manufacture of safety barriers and associated roadside infrastructure.





RELIABLE • DEPENDABLE • ENGINEERED

ingal.com.my samantha.lau@valmont.com +6010 220 8508