Detail Sheet

Australian Made Energy Absorbing Bollard (EAB) - Permanent

Product summary

Status	May be used following a site-specific risk assessment
Category	Permanent Bollard
Test Level	Test Level 0; 1600kg at **60km/h** (AS3845:1999 - superseded)
Supplier	Australian Bollards
Description	The Energy Absorbing Bollard (EAB; previously named OmniStop bollard) is a non-gating energy absorbing bollard designed for low speed environments.

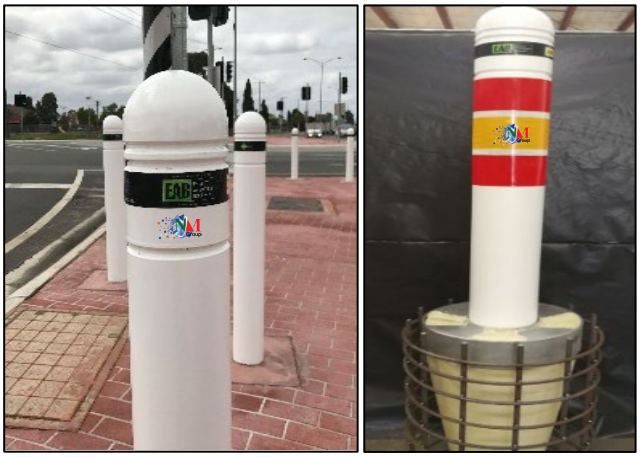

Figure 1. Energy Absorbing Bollard

Introduction and purpose

This detail sheet is intended to supplement *VicRoads Road Design Note 06-04 - Accepted Safety Barrier Products*. Please refer to RDN 06-04 for the current VicRoads acceptance status, information on the product assessment process and general acceptance conditions.

The technical details within this document have been extracted from information submitted to VicRoads by the Supplier.

VicRoads requirements take precedence over the product manual. Where a departure from these requirements is required, users should understand the risks and document their engineering decisions.

For more detailed product information, refer to the individual product manual or contact the System Supplier.

Technical information

The Energy Absorbing Bollard should be designed, installed and maintained in accordance with the following VicRoads conditions for use.

Summary Conditions for Use

Accepted configuration	Energy Absorbing Bollard, with high grade carbon hollow bar (thick walled tube) which is inserted into a foam cartridge.
Variants	
Deflection	N/A
Product manual reviewed	Australian Bollards Energy Absorbing Bollard
ASBAP issue	Not accepted by ASBAP

Refer VicRoads conditions for use (below).

VicRoads Conditions for Use

Tested design requirements

Containment level	Speed (km/h)	Vehicle mass (kg)	Point of Redirection (m)*		Minimum length of barrier (m)	Post/Pin Spacing (m)*	Dynamic deflection (m)	Working width (m)	Notes
			Leading	Trailing					
TL-0[1]	50	1600[2]	N/A	N/A	N/A	N/A	N/A	N/A	

Note 1. The EAB is recognised for meeting a previous standard: AS3845:1999- Test Level 0: 1600kg car at 50km/h
Note 2. Tested vehicle mass is not MASH or NCHRP 350 compliant.

Approved Terminals and Connections

Crash Cushions or Terminals must be fitted to both ends of a barrier	
Public Domain Products	
W-Beam Guardrail	Not Permitted
Thrie-Beam Guardrail	Not Permitted
Type F Concrete Safety Barrier	Not Permitted
Proprietary Products	
All	Not Permitted

Design Guidance

System width (m)	0.6 (below ground foundation) 0.15 (bollard)
Installation	This product must be installed and maintained in accordance with the Product Manual and Road Agency specifications. Road Agency specifications and standards shall have precedence.
Systems conditions	1. Must be used in accordance with the VicRoads Technical Alert – Roadside Bollards (attached) 2. Accepted for use on roads with a posted speed limit of 50km/h or less.
Gore area use	Not Permitted
Pedestrian area use	Permitted – consider potential for snagging and deflection.
Cycleway use	Permitted – consider potential for snagging and deflection.
Frequent impact likely	Not Permitted
Remote location	Not Permitted
Median use	Not Permitted

Foundation pavement conditions

Submitted Foundation Pavement Conditions					
Pavement	**Use**	**Accepted Speed (max)**	**Post/Pin spacing (m)**	**Pavement construction**	**Post/pin type**
Concrete	N/A	N/A	N/A	N/A	N/A
Deep lift asphaltic concrete	Permitted	50	N/A	Foundation pavement conditions must be smooth and free of snag points, kerbs or obstructions that may interfere with the operation of the product	N/A
Asphaltic concrete over granular pavement					
Flush seal over granular pavement					
Unsealed compacted formation					
Natural surface					

Other considerations and comments

Application

The EAB is recognised for meeting a previous standard: AS3845:1999- Test Level 0: 1600kg car at 60km/h.

Given that this standard has been superseded, the EAB is no longer considered a compliant road safety device and should only be used following a site-specific risk assessment. The EAB should only be used as road safety device after all compliant systems have been considered and if the hazard cannot be removed, relocated or redesigned - cost should not be a key factor.

The EAB may also be considered as a Protection Device, in accordance with VicRoads Technical Alert – Roadside Bollards (attached).

Spacing requirements

Spacing requirements may vary depending on job specific requirements. The supplier's recommended spacing is:

- 600mm from the centre of the bollard post to any kerb (for cyclist safety).
- 1400mm between bollard post centres.

Footing requirements

- Cartridges are to be mounted in a permanent concrete footing of 600mm diameter and 1000mm minimum depth.
- It is recommended the lowest 300mm of the concrete footing have strength of 25MPa.
- The remainder of the concrete footing must have strength of 20MPa or more.

Footing detail and associate technical requirements are outlined within the supplier's Product Installation Manual

Prior to installing the product, contact dial before you dig or visit the website https://www.1100.com.au/.

Local & Utility Authorities must be notified of any proposed installation prior to the commencement of works, as separate approval may be required.

Damaged Components

Damaged components must be replaced.

Product Use

The product must be used for its intended purpose. VicRoads does not endorse the suitability of the product for other purposes. Should the proponent be inclined to use the product outside the scope of purpose, then please contact: SafeSystemEngineering@roads.vic.gov.au.

Pavement reinstatement

Where this product is being considered in a temporary application within the road pavement, the VicRoads pavement team must endorse the proposed pavement reinstatement plan prior to use.

References

- Product Installation Manual and Product Operational Manual refer licensed product supplier website.
- VicRoads Road Design Note 06-04 Accepted Safety Barrier Products.
- VicRoads Supplement to Austroads Guide to Road Design – Part 6.

Detail Sheet – Update Summary

Issue	Approved	Amendment
Dec 2016	M-SSD	First edition
Sept 2017	M-SSD	Footing requirements
June 2019	M-SSE	New format. Acceptance status changed, following an update to AS/NZS 3845:2017. Reference added to VicRoads Technical Alert – Roadside Bollards

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June 2019

Technical Alert

Roadside Bollards

Introduction

Bollards are being installed on the roadside for a variety of reasons. Given that roadside bollards do not have the same energy management or redirection capabilities as a road safety barrier, they should only be used in situations where a safety barrier is not feasible and where the hazard cannot be removed, relocated or redesigned. This technical alert clarifies the types of bollards that have emerged and their preferred application. Before using a bollard, it is important to clearly define the key objective and show that the most suitable product has been selected. This technical alert provides guidance to assist in the selection process.

In general, there are four main categories of bollard.

Category	Testing	Objective
Road Safety Device	Compliant crash testing to AS/NZS 3845.2:2017.	Used to shield hazards and/or other roadside features from an errant vehicle
Protection Device	Compliant or Modified crash testing based on AS/NZS 3845.2:2017. (may not comply with occupant injury criteria)	Used to protect pedestrians or high-severity hazards from errant vehicles in low-speed environments.
Roadside Furniture	Non-compliant testing, engineering analysis or not tested.	Used for delineation, physical obstruction or minor asset protection in product suitable locations.
Vehicle Security Barrier	Compliant crash testing for 'Hostile Vehicle' purposes - IWA14–1: Vehicle security barriers. Impact severity for errant vehicles to be minimised through design.	Used to stop a hostile vehicle attack in accordance with IWA 14-2 and relevant guidelines. Impact likelihood and severity for errant vehicles to be minimised via speed and location or roadside protection.

Preface

All bollards have an element of risk. As such, bollards should only be used when the objective of the bollard is achieved, and the associated risk can be managed. While VicRoads prefers bollards with greater energy absorption capabilities, we recognise the benefit of product customisation to suit certain objectives. Product developers often choose a balance between containment capacity, energy absorption and practicality, realising that higher containment will cost more, and greater energy absorption will require a more complex and less practical system. Bollard selection requires an understanding of the bollard benefits/limitations and the site conditions.

AS/NZS 3845 notes that modern vehicles are designed with multiple crashworthy systems, such as airbags, seat belt pretensioners and crumple zones, that can tolerate impact speeds up to 60km/h. As such, a generic bollard (set in an appropriate foundation) with no energy dissipation characteristics could pass some crash test requirements.

Acknowledging that the majority of vehicles can manage energy transfer during a head-on low speed impact (<50km/h), it is critical that ALL bollards (& other devices) can prove a maximum level of containment and ensure that when they are impacted, they do not penetrate or show potential to penetrate the occupant compartment or present an undue hazard to other traffic, pedestrians or personnel in a work zone. Likewise, the collision with a bollard should not cause the vehicle to excessively roll or pitch in order to provide the driver every opportunity to regain control of their vehicle. Tested products, with a known performance level and behaviour, must be used, especially where vulnerable road users are being protected.

Bollard Categories

Road Safety Device

Performance

- Bollards must be crash tested in accordance with AS/NZS 3845.2:2017 to be classified as a compliant 'road safety device'. This standard requires products to demonstrate an acceptable level of crashworthiness for a specified containment level and are evaluated for structural adequacy, occupant risk and vehicular trajectory.

Application

- Road safety devices may be used in locations up to the tested speed (e.g. TL-1 at 50km/h) and can be considered in situationswhere safety barriers are inappropriate due to space limitations, pedestrian accessibility and/or aesthetics.

All road safety devices must be submitted to the Austroads Safety Barrier Assessment Panel (ASBAP) for national assessment. Road Safety Devices accepted by VicRoads are published in RDN 06-04. These devices must be installed as tested to ensure an equivalent performance.

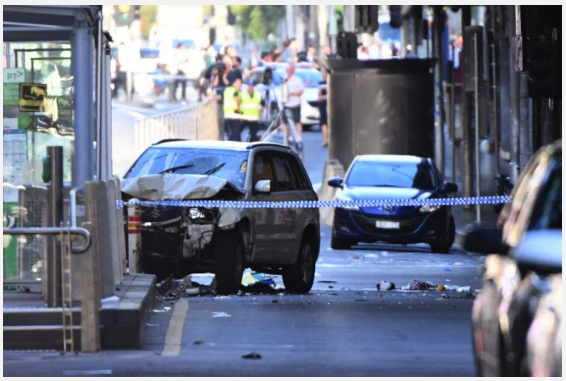
At present, VicRoads is unaware of any bollard that satisfies current crash test protocols. As such, the Energy Absorbing Bollard (EAB) has been recognised for meeting a previous standard (AS3845:1999) to Test Level 0: 1600kg car at 60km/h. Given that this standard has been superseded, the EAB is no longer considered a compliant road safety device and should only be used after a site-specific risk assessment. Refer Product Detail Sheet. The EAB should only be used as road safety device after all compliant systems have been considered and if the hazard cannot be removed, relocated or redesigned - cost should not be a key factor. The EAB may also be considered as a Protection Device, in accordance with below.

Protection Device

Bollards used to protect vulnerable road users, or high-severity hazards are classified as a 'Protection Device'. Protection devices should only be considered when a road safety device is not feasible.

Given the necessity to have pedestrians near the road, there is a need for products to protect high volume pedestrian areas from errant vehicles, with negligible deflection. While these devices are not considered a 'road safety device', without passing all the occupant evaluation criteria, they do offer a proven containment level and may be suitable to protect pedestrians from errant vehicles in low-speed environments (refer application).

While energy absorption characteristics are desirable, via a cartridge or steel deformation, protection bollards are unlikely to pass the minimum occupant injury criteria per AS/NZS 3845, given the need to test unrestrained occupants. As such, protection bollards may be used in certain applications and must be able to contain an errant vehicle and not present an undue risk during impact.



Protection Bollard: Vehicle contained, crumple zone and airbags deployed, bollard did not spear or cause undue risk to others.

Protection devices often balance containment level, energy absorption characteristics and cost. As such, specific performance is dependent on the product design. These devices must be considered on product merit in accordance with this alert. For this reason, protection devices should not be substituted during construction without seeking comment from the original designer. Consultation with the product supplier is essential, to understand the products capabilities, benefits and limitations.

Performance

- Protection Bollards must be crash tested using AS/NZS 3845.2:2017 as a reference point (e.g. vehicle mass, speed and installation requirements). Any departures or differences must be documented and must be readily available on request.
- Protection Bollards must demonstrate, through crash testing, that they do not penetrate or show potential to penetrate the occupant compartment or present an undue hazard to other traffic, pedestrians or personnel in a work zone (e.g. debris). This test should be at the maximum containment level. Consultation with the supplier is essential.
- Protection Bollards must establish a maximum containment level via crash testing or engineering analysis (LS-DYNA). Containment level is defined by the maximum vehicle weight and speed to be contained (e.g. 2,270kg at 50km/h). The MASH 2,270kg pick-up truck is recommended for testing as this covers the 90th percentile of passenger vehicles.
- Protection Bollards must record and document occupant risk values in accordance with crash testing protocols. Although results will not be evaluated as pass or fail, they must be documented and readily available on request. Lower occupant risk values are preferred.

Application

- Protection Bollards must be installed on roadsides with an operating speed of 60km/h or less. This allows the impact energy to be managed by the vehicle, assuming the bollard does not fail, penetrate the vehicle or present an undue risk to others. Vehicle occupants are most vulnerable during side impacts (some research suggests 30km/h); therefore, the risk of side impact should be minimised, e.g. not near an intersection or tight curve.
- Protection Bollards must only be used to shield vehicles from pedestrian frequented areas (e.g. dining areas and tram stops).
- Protection Bollards must not be used to shield roadside hazards, unless the impact severity of the hazard has been demonstrated to be substantially more than the impact severity of the bollard, e.g. large drop-off or spearing hazard. Hazards such as trees, poles, piers and other rigid point hazards do not have a substantially higher impact severity.
- Protection Bollards must be installed in accordance with the manufacturers' guidelines and specification. Adequate foundation strength is critical for performance, and any differences to the crash tested conditions must be factored into containment level or design.

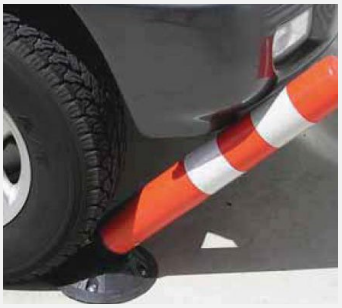
VicRoads does not publish a list of accepted Protection Devices. Designers and/or asset owners should seek documentation from the supplier (e.g. crash test reports, occupant risk values, product details, etc), consider the objective and document their design process in accordance with the requirements above.

Road Furniture

Bollards that have NOT been crash tested are classified as 'road furniture'. They may only be used in situations where there is no requirement for protection from/for errant vehicles. These bollards are made from various materials and are often used for delineation, minor asset protection or to create a physical obstruction.

Delineation

Bollards used for delineation, often made from plastic, must be designed such that they do not create an undue hazard for the vehicle occupants or nearby traffic when impacted. While crash testing would provide a better understanding of impact behaviour, lightweight and flexible materials (e.g. plastic) are generally considered satisfactory.



Plastic Bollard: Flexible design, often used for delineation.

Steel Bollard: Access restriction, containment unknown, impact behaviour unknown.

Access Restriction

Bollards used for access restriction, often made from steel or timber, are considered hazardous to all road users and must be treated as such. Without crash testing, these bollards do not have an established level of containment (cannot guarantee protection from an errant vehicle), nor a certain impact behaviour or mechanism of failure (potentially hazardous). While there may be situations where these devices are appropriate, they should be labelled 'not a road safety device' and are only recommended in very low-speed environments or where they cannot be impacted (e.g. behind barrier). These bollards are also hazardous to cyclists and other vulnerable road users and their location should be carefully considered.

Frangible bollards

Some bollards are considered 'frangible' (e.g. 100m x 180m timber post with a 75mm dia. hole) given their size and/or weakness in one direction. These bollards cannot guarantee protection from an errant vehicle and the impact behaviour is unknown. To be deemed frangible, these devices must be manufactured and installed in accordance with Australian Standards and VicRoads guidance. VicRoads recommends their use is limited to very low-speed environments or where they cannot be impacted (e.g. behind barrier).

Timber Bollard: Access restriction, unknown containment, impact behaviour unknown- deemed frangible in one direction.

Vehicle Security Barriers (VSB)

Unfortunately, vehicles can be used with hostile intent to breach a perimeter, ram and damage infrastructure or as a weapon to injure and kill people.

Hostile Vehicle Management (HVM) uses a blend of traffic calming measures to slow down hostile vehicles and vehicle security Barriers (VSB) to stop those hostile vehicles progressing further. VSBs provide the hard stop for penetrative vehicle attack, they are

structural in nature and can be either Active (powered or manual) or Passive (static). Active measures include hinged and sliding gates, boom barriers, retractable blockers and retractable bollards. Passive measures include structural wall, passive bollards and planters.

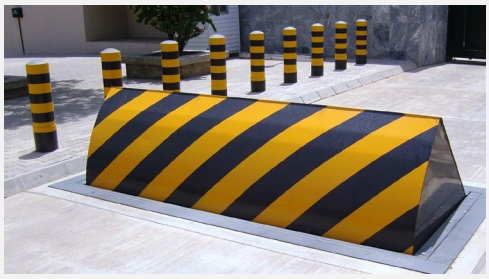
Performance

The impact performance standards for VSBs are IWA14–1: Vehicle security barriers, and PAS68, both of which include a range of test vehicles and evaluation criteria.

- IWA 14 Part 1 specifies the essential impact performance requirements for a vehicle security barrier (VSB) and a test method for rating its performance when subjected to a single impact by a test vehicle not driven by a human.
- IWA 14 Part 2 provides guidance for the selection, installation and use of vehicle security barriers (VSBs) and describes the process of producing operational requirements. Each site will require a specific assessment to understand maximum speeds and angles of attack achievable by a hostile vehicle. This process is called a vehicle dynamics assessment and profiles all the approach routes. This allows the counter-measures to be designed to an appropriate level, preferably not over or under-engineered

Although VSBs are designed and tested with the intent of stopping hostile vehicles, they are often used in locations where they may be impacted by an errant vehicle and therefore should be designed to diminish impact severity. Unlike hostile vehicle attack, errant vehicle impacts can be predicted from the road characteristics (e.g. posted speed) and can be managed through other factors such as speed calming and control.

Like protection bollards, it is acknowledged that many vehicles can manage energy transfer during a low-speed impact, assuming the device does not present an undue risk during impact such as the potential to penetrate the vehicle or cause harm to others. As such, it is critical that VSBs are designed (shaped), positioned and orientated with an errant vehicle impact in mind. This includes smooth surfaces, rounded edges and a large contact surface that will distribute energy. Components that are likely to leave the system during impact or may spear a vehicle must be avoided. Physical crash testing is the preferred method of testing.



VSB Bollard: Similar severity to other roadside hazards, does not present undue risk to occupants or others, must be located within a low speed environment.

VSB Wedge: Smooth surface will distribute impact energy, can be deactivated as needed. Edges are shielded and cannot be impacted head on.

VSB Gate: Narrow impact point will focus energy into the occupant compartment causing undue risk to errant vehicles. This device should be located such that it cannot be impacted by errant vehicles.

Application

- VSBs must be used in accordance with IWA 14 and other relevant hostile vehicle guidelines. i.e. There must be an evidence based threat of attack.
- VSBs must be installed on roadsides with an operating speed of 60km/h or less. This allows the impact energy to be managed by the vehicle, assuming the device does not penetrate the vehicle or present an undue risk to others.

  Higher operating speeds must be crash tested or require roadside protection such as an accepted safety barrier.
- VSBs must be installed in accordance with the manufacturers guidelines and specification. Adequate foundation strength is critical for performance and any differences to the crash tested conditions must be factored into containment level or design.

VicRoads does not publish a list of accepted VSBs. Asset owners should engage a qualified security consultant, consider the conditions above and document their design and decision process.

Summary

1. All bollards have an element of risk and should only be used in situations where there is a need and a safety barrier is not feasible.
2. Before selecting and installing a bollard, designers and/or asset owners must clearly define the objective of the bollard (what it is trying to achieve) and demonstrate that a suitable product has been used. Objectives may include shielding a vulnerable road user or hazard, providing delineation or preventing hostile vehicle attack.
3. Other than ‘road safety devices’, tested in accordance with AS/NZS 3845, VicRoads does not evaluate or maintain a list of approved bollards. As such, practitioners must understand and document the benefits, risks and performance of the bollard by working closely with the product supplier.
4. Bollards must meet the performance requirements as specified in this technical alert.
5. Bollards must be used in an application specified in the technical alert.
6. Given the differences in product performance, bollards must not be substituted without seeking comment from the original designer, as this may affect the original intent.

If you have questions, please feel free to contact SafeSystemEngineering@roads.vic.gov.au or contact (03) 8391 7191.