NZTA M23:2021 Specification and guidelines for road safety hardware

November 2021

VERSION 5.0 DRAFT FOR COMMENT

WAKA KOTAHI NZ TRANSPORT AGENCY

New Zealand Government

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More information

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If you have further queries, call our contact centre on 0800 699 000 or write to us:

Waka Kotahi NZ Transport Agency
Private Bag 6995
Wellington 6141

This document is available on Waka Kotahi's website at www.nzta.govt.nz

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RECORD OF AMENDMENTS			
Amendment Number	**Status**	**Effective Date**	**Updated by**
Version 1.0	Superseded	1999	
Version 2.0	Superseded	2002	
Version 3.0	Superseded	2005	Julian Chisnall
Version 4.0	Superseded	2009	Julian Chisnall
Version 5.0	Draft	November 2021	Joe Southey

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Foreword

This document is prepared by the Safe and Sustainable Standards team, Programme and Standards, Waka Kotahi NZ Transport Agency (Waka Kotahi).

The objective of this document is to set out the requirements for and provide guidance on the selection and deployment of road safety hardware on roads, cycle ways, footpaths, tunnels, underpasses, overpasses and bridges built as part of the state highway network or under Waka Kotahi control. It has been written for wider application, including full or part adoption by local authorities.

From 2006 the Safe System approach became the underlying philosophy for road safety across many nations. Many governments, including the New Zealand Government, recognised that road crashes are a major cause of societal suffering, preventable death and injury and a major burden on health systems and society in general. As a result, the Safe System approach has been adopted in the Road to Zero action plan to reduce deaths and injuries on the transportation network. The Safe System approach is based on human injury tolerance to impact forces. The Safe System approach acknowledges that humans make errors, but that the transportation network should be designed to compensate for that error such that users will survive the consequences of mistakes made.

Road safety barriers are a Primary Safe System intervention and an integral component of providing safer roads, however it should not be expected that a road safety barrier system will provide complete protection for vehicle occupants over the wide range of variables that could apply in a crash. To mitigate this risk, a barrier installation must be designed to minimise risk and the barrier hardware must be designed to operate predictably to allow for optimal design. The joint Australian–New Zealand standard for road safety hardware, AS/NZS 3845, provides a testing framework consistent with Safe System principles based on the American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH) testing protocol. MASH sets out performance parameters for safety hardware so that performance under a range of conditions can be well understood. One of the critical performance parameters within MASH is the management of forces exerted on vehicle occupants during a crash which must be kept within specific survivability limits. Because MASH is aligned with this Safe System principle it supports Road to Zero.

The main changes from the 2009 version of the document that have been incorporated into this 2021 version include:

- Change from NCHRP 350 test regime to MASH.
- Incorporation of M23 Notes within the document.
- Addition and updating of appendices relating to specific types of safety hardware.

Readers of this document are advised to read and be conversant with the contents of AS/NZS 3845 Parts 1 and 2, the Waka Kotahi Traffic Control Devices (TCD) Manual and with other Waka Kotahi documents including, but not limited to, M14 Specification for Edge Marker Posts and P24 Specification for Permanent Traffic Signs.

1. SCOPE

This document provides specifications and guidance for the performance, design, selection and installation of permanent and temporary road safety hardware systems and devices to be used on the New Zealand road network including structures which are under Waka Kotahi NZ Transport Agency (Waka Kotahi) control. It has been written for wider application, including full or part adoption by local authorities.

The guidance provided within this document is not all encompassing but is intended to assist road authorities, designers and installers to find the information required to understand the usefulness of safety hardware on their road network.

For the purposes of this document, a road safety hardware system or device comprises one or a combination of the following components as defined in AS/NZS 3845 Parts 1 and 2:

- Roadside and/or Median Barriers;
- Bridge Barriers;
- End Terminals and/or Crash Cushions;
- Barrier Transitions;
- Truck Mounted Attenuators (TMAs); and
- Other road safety devices (such as underrun protection, longitudinal channelizing devices and bollards)

This document includes the five appendices listed below. Users of this document are advised to read and be conversant with the full contents of the document:

Appendix A: Permanent road safety hardware
Appendix B: Concrete and bridge barrier systems
Appendix C: Temporary road safety hardware systems
Appendix D: Slip formed concrete barrier systems
Appendix E: Road safety hardware design statements

2. ASSOCIATED DOCUMENTS

Reference should be made to the following associated documents:

- AS/NZS3845 Part 1: 2015 Road safety barrier systems
- AS/NZS3845 Part 2: 2017 Road safety devices
- AASHTO Manual for Assessing Safety Hardware (MASH)
- Austroads Guide to Road Design Part 6 Roadside Design, Safety and Barriers
- Waka Kotahi Standard Drawings
- Waka Kotahi Technical Memoranda (Road Safety Hardware Series)
- Waka Kotahi notifications to sector (e.g. Technical Advice Notes)
- Waka Kotahi Traffic Control Devices (TCD) Manual; all parts including reference to barrier and / or road safety hardware
- Waka Kotahi Traffic Control Devices Manual Part 8 – Code of Practice for Temporary Traffic Management (CoPTTM)
- Waka Kotahi Bridge Manual
- Waka Kotahi M14 Specification for Edge Marker Posts
- Waka Kotahi P24 Specification for Permanent Traffic Signs

Refer also: (a) References in Section 12
(b) www.nzta.govt.nz/resources/road-safety-barrier-systems
(c) hip.nzta.govt.nz/tan

3. DEFINITIONS

The definitions in AS/NZS 3845 Parts 1 and 2 and Austroads Guide to Road Design Part 6 shall apply to this document. In case of ambiguity AS/NZS 3845 shall take precedence.

4. ACCEPTED ROAD SAFETY HARDWARE SYSTEMS

Only those road safety hardware systems listed in this document (including its appendices) are accepted for use on the state highway network, unless an Interim Acceptance Notice or a Site Specific Acceptance has been issued by the Waka Kotahi Lead Safety Advisor for roads and structures under Waka Kotahi control, or the appropriate person for local roads.

The latest versions of the Appendices to this document are available on the Waka Kotahi website: www.nzta.govt.nz/resources/road-safety-barrier-systems

A list of the current Interim Acceptances is available on the Waka Kotahi website: www.nzta.govt.nz/resources/road-safety-barrier-systems

Road safety hardware systems used on state highway structures shall also conform to the requirements of the Bridge Manual, available on the Waka Kotahi website: www.nzta.govt.nz/resources/bridge-manual/index.html

5. CONCRETE BARRIER PROFILES AND CONFIGURATION

All permanent concrete barrier systems shall use the public domain F-shape monolithic profiles detailed on Waka Kotahi Standard Details B8, unless specific acceptance has been sought from and granted by the Waka Kotahi Lead Safety Advisor. For temporary concrete barrier systems only those systems listed as accepted in M23 Appendix C may be used.

5.1 Temporary precast barrier installations:

Precast concrete barriers to be used in temporary situations shall conform to either the Waka Kotahi TCB-1 design (public domain; available on the Waka Kotahi website: https://www.nzta.govt.nz/resources/temporary-concrete-barrier-public-domain-pin-and-loop-system-tcb-1/), or one of the accepted proprietary designs listed in M23 Appendix C. These temporary barriers units are designed to be placed freestanding on the road surface, not embedded, however in some cases the barriers may be fixed (pinned) to the ground surface in accordance with the manufacturer's requirements. The common temporary systems, such as TCB 1, are not suitable for permanent installations.

5.2 Permanent precast and cast in situ barrier installations

Precast and cast in situ concrete barrier to be used in permanent installations shall conform to the F-shape profile and reinforcement details given in Appendix B of this document. Transition and other details are provided in Appendix B. The 300 mm deep, minimum 3 m long footing (refer Appendix B of this document, drawing series B8) is required at each end of the barrier run and at any intermediate free joints (spaced no greater than every 48 m for TL-4 and 24 m for TL-5). This 300 mm depth is inclusive of any nominal system embedment. For ease of construction the integral anchor footing may extend the full length of the segment.

Shear key joints are not acceptable. A dowelled joint (or other mechanical system) that is capable of transferring the full operational loads across the joint shall be provided between precast units or any cast in situ barrier less than 48 m in length. Standard details for dowelled joints are shown on the Waka Kotahi Standard Drawings B8 series.

In addition to a suitable dowelled joint and the additional footing depth detailed above, all precast and cast in situ concrete barriers shall be embedded below the road surface as follows:

- A minimum of 100 mm below the top surface of an unbound, compacted pavement layer, excluding any chipseal surfacing, or
- A minimum of 50 mm into a concrete or asphaltic concrete surface, excluding any OGPA layers.

Note that the required embedment depth is in addition to the full F-shape barrier profile detailed in Standard Drawing B8-1 (refer Appendix B of this document) and any requirement for additional anchorage at a system joint. This means the foundation level for a nominal 6 m unit will be a minimum of 300 mm below road surface level. Rigid barriers must be fully supported on both sides of a joint to resist lateral forces, and at ends where connection to a semi-rigid system may impart considerable longitudinal force.

Precast barrier fabricators must ensure that appropriate reinforcing, fixtures and fittings are provided for safe handling of the barrier segments.

5.3 Permanent slip formed barrier installations

Slip formed concrete barrier to be used in permanent installations shall conform to the F-shape profile and reinforcement details given in M23 Appendix B of this document. Transition and other details are provided in Appendix B. A 300 mm deep, 3 m long footing (refer Waka Kotahi drawing B8-1) is required at each end of the barrier run and at any intermediate open joints (spaced no greater than every 48 m for TL-4 and 24 m for TL-5). This 300 mm depth is inclusive of any nominal system embedment.

The base construction specification for slip formed concrete barriers shall be as per Appendix D of this document.

As part of the footing as detailed above, all precast concrete barriers shall be embedded below the road surface as follows:

- A minimum of 100 mm below the top surface of an unbound, compacted pavement layer, excluding any chipseal surfacing, or
- A minimum of 50 mm into concrete or asphaltic concrete surface, excluding any OGPA layers

6. ACCEPTANCE CRITERIA FOR ROAD SAFETY HARDWARE SYSTEMS

Acceptance by the Lead Safety Advisor is required for a road safety barrier system or device to be listed in this document. The process for acceptance is outlined in Section 11 of this document and is in general accordance with the procedures and requirements of AS/NZS3845 Part 1 2015.

All road safety hardware products submitted for acceptance shall have undergone physical crash testing in accordance with a recognised testing protocol as outlined below and in Section 11.

6.1 Materials

The materials used for manufacture of road safety hardware shall be in accordance with the requirements of AS/NZS3845.

6.2 MASH protocol

The primary criterion for the acceptance of a new road safety hardware system or significant variant of an existing accepted system is that it shall have been successfully crash tested and the results evaluated in accordance with the most recent edition of the AASHTO Manual for Assessing Safety Hardware (MASH).

6.3 Other considered criteria

In addition to the stated crash test performance, consideration will also be given to the following:

In-service performance:	In the case of a product with no demonstrable in-service history, an in-service trial may be required at the cost of the system manufacturer and / or supplier, unless otherwise agreed with Waka Kotahi.
Availability of spares for maintenance:	The system manufacturer/supplier will need to demonstrate that spare parts are available within the timeframes defined in the relevant maintenance/repair contract and will remain available on the New Zealand market for a period not less than 10 years after installation.

6.4 Consideration of alternative protocols

Road safety hardware that has been tested under an alternative crash test regime (e.g. NCHRP 350 or CEN1317) may be accepted for use on state highways on application to the Lead Safety Advisor. Acceptance will be based on the equivalence of performance of the system under the alternative crash test regime, as determined by physical crash testing, compared with MASH criteria.

6.5 Labelling

All system components shall be identified in accordance with the requirements of Section 3, Clause 3.2.8 of AS/NZS3845 Part 1:2015.

6.6 Legacy systems

Road safety hardware systems accepted for installation on the state highway network prior to 1 November 2012 were required to be tested and evaluated in accordance with the now superseded National Cooperative Highway Research Program Report 350: Recommended Procedures for the Safety Performance of Highway Features (NCHRP 350). Such legacy systems may remain on the state highway network and continue to be maintained, unless damage is such that upgrade to an accepted MASH system makes economic sense. Legacy systems shall not be used for new installations on state highways.

Waka Kotahi reserves the right to modify or revoke acceptances of legacy products.

6.7 Colour of wire rope safety barrier posts

All wire rope safety barrier posts to be installed on the state highway network shall be supplied with a white powder coat finish. The applied powder coat finish shall comply with the requirements of AS 4506:2005, 'Metal Finishing – Thermoset powder coatings', for use in Atmospheric Classification D which includes a minimum coating thickness of 60 microns over the pre-treated galvanized post. Colour to be white (00-E-55 to NZS/BS 5252) in a low-gloss (preferred) or semi-gloss finish.

7. ROAD SAFETY HARDWARE SYSTEM PERFORMANCE

7.1 Permanent protection on roads

The minimum performance level for permanent road safety hardware systems installed on state highways for side or median protection is MASH Test Level 3 (TL-3) unless otherwise determined by the Lead Safety Advisor. The minimum performance level for permanent road safety hardware systems installed on local roads for side or median protection is at the discretion of the RCA. The performance level of the various road safety hardware systems accepted for use on state highways is given in Appendix A of this document.

The vehicle mix/type commonly operating on the route to be protected by the permanent road safety hardware system must be carefully considered when assessing the required performance level of the road safety hardware to ensure an appropriate and cost-effective solution is specified.

7.2 Temporary protection on roads

The performance level for temporary road safety hardware systems installed on state highways for side or median protection shall be based on a risk assessment process consistent with the principles contained within Traffic Control Devices Manual Part 8. A key criterion is the operating speed of the road. The minimum performance level for temporary road safety hardware systems installed on local roads for side or median protection is at the discretion of the RCA.

The risk assessment process shall consider any relevant information to ensure an appropriate and cost-effective solution is specified, including but not limited to: the posted and operating speed of the road, the nature of the hazards at the site including risk to construction personnel, the road geometry and the vehicle mix/type commonly operating on the route.

The performance level of the various temporary road safety hardware systems accepted for use on state highways is given in Appendix C of this document.

7.3 Protection on structures

The minimum performance level required for road safety hardware systems on structures shall be determined using the method given in Appendix B, Section B3 of the Bridge Manual: https://www.nzta.govt.nz/assets/resources/bridge-manual/docs/Bridge-manual-pdf-appendix-B-v3.2.pdf

Accepted road safety barriers for installation on state highway bridges are listed in Appendix B of this document, along with related rigid barrier details including anchor blocks and transitions. The nominal minimum barrier system for new state highway bridges is an "HT" type TL-5 standard barrier (refer drawings B9-1A, B9-1B, B9-1C and B9-1D)

Where the state highway structure is in a location where provision must be made for the needs of cyclists and pedestrians, TL-5 "HT" type rigid concrete barriers with a TL-4 capacity deck connection or metal parapet system may provide an acceptable solution, subject to appropriate design. Attachment of untested handrail systems is not permitted.

7.4 Aesthetic barriers

Aesthetic barrier systems comprise timber facings over steel rails and steel posts. The timber facings result in more visually appealing systems than those using steel components.

Aesthetic barrier systems are considered suitable for use on local road networks with vehicle operating speeds up to 70 km/h (equivalent to MASH TL-2 crash test conditions) at the discretion of the road controlling authority.

Currently no MASH or NCHRP 350 crash tested end terminal is available for aesthetic barrier systems.

Aesthetic barrier systems are not for use on the state highway network without site specific acceptance from the Waka Kotahi Lead Safety Advisor.

Aesthetic barrier systems are generally terminated using a proprietary sloping end which should be flared away from traffic, wherever possible, to mitigate risk of end-on impact. The terminal end must be flared away from the road at least 500 mm (flare rate to comply with Austroads GTRD Part 6). Whenever practical consider extending the rail and terminal end to achieve a greater offset.

8. DESIGN, INSTALLATION AND MAINTENANCE REQUIREMENTS

8.1 Design and installation competency

The design and installation of all permanent road safety hardware system installations shall be compliant with the crash tested and accepted design, except where varied in accordance with a road safety hardware system configuration granted Interim or Site Specific Acceptance in accordance with section 4 above.

All persons undertaking the design (Installation Designer), review and audit and inspection (Peer Reviewer) or installation and maintenance (System Installer) of permanent and temporary road safety hardware system installations on the state highway network shall have attended and passed the appropriate Waka Kotahi endorsed course, or an accepted alternative, within the 5 years prior to commencing the activity.

8.2 Changes to road safety hardware systems

Any change(s) to the crash-tested and accepted design/configuration of the road safety hardware system will deem the hardware non-compliant with this document unless prior acceptance of the change(s)/departure(s) from the tested configuration has been granted by the Lead Safety Advisor. The changes and acceptance must be notified to the RCA's project representative prior to installation and be traceable, including being recorded in the project as built information and loaded into the RCA's asset management database.

Such changes may include, but not be limited to, modification of the system components, changes to the foundation design, or installation of the system outside tested conditions. The need for such changes may be due to a variety of factors such as ground conditions or the presence of other roadside features.

Application for departure acceptance shall be accompanied by a signed declaration from the System Owner/Manufacturer/Supplier warranting that the alternative design system will achieve the required

level of protection. The signed declaration should preferably be justified based on independent crash test or modelling reports supporting the proposed configuration.

8.3 Ground conditions

The design of all road safety hardware system installations shall take account of the ground conditions (including pavement construction and service trenches as per Section 8.5.1 at the proposed installation site into which the ground mounted portions of the system are to be installed. All crash testing of accepted systems has been undertaken using standardised soil for repeatability and consistency across test facilities. The AASHTO MASH test standard uses a soil which has similar bearing strength to NZTA M/4 basecourse compacted to NZTA B/2.

As part of the design process the Installation Designer shall satisfy themselves that the ground conditions at the installation site are or will be equivalent to or better than those used for the crash testing of the accepted system. Ground conditions should be tested and evaluated for compliance with design conditions as follows:

- An initial assessment of the site should be made to evaluate the existing subsurface conditions which may be present. This should include review of the potential geotechnical hazards in the vicinity which could impact on the performance of the road safety hardware system. If compliant ground conditions are not present, the following should be carried out;
- Appropriate geotechnical testing should be undertaken to a greater depth than the nominal system installation depth
- Testing of the ground conditions must be made at every anchor point and should be undertaken at regular intervals along the length of the proposed installation such that the Installation Designer considers the ground condition risk is mitigated.

Where the ground conditions vary from the standardised soil used in the crash testing of the accepted system under consideration, the Installation Designer shall either amend the foundation design in accordance with the design/installation guidance provided by the System Supplier, or consider an alternative protection system.

Information relating to the design of alternative foundations is contained in Waka Kotahi Technical Advice Note #16-18 Wire Rope Safety Barrier systems – post footing issues (updated Dec 2016).

The foundation design, together with all site investigation results, shall be retained as formal project records in accordance with the Waka Kotahi project documentation requirements.

In constrained locations where post that would normally be driven cannot be installed, the barrier may be installed on system specific base plated posts on a ground beam or structure, as detailed in the System Supplier's installation guidance and/or as per Waka Kotahi TM-2012.

When upgrading an existing semi-rigid barrier from timber posts to steel posts the ground conditions must be checked as detailed above. The timber post must be removed, and the cavity backfilled with suitable material and compacted. Where the cavity is behind a new post location material finer than AP40 mixed with a small percentage of cement (e.g. 0.5%) may be an acceptable solution.

Where installation of the barrier foundation, including driven components, damages the ground surface, creating potential for water ingress, this must be rectified eg by sealing with a granular and bitumen mixture.

Galvanised components that are contact with timber, concrete or cementitious mortar that are exposed to the weather shall be treated as per Waka Kotahi Specification S9 Section 4.7.3.

Where the ground conditions are outside those accepted by the System Supplier(s), the Installation Designer shall apply to the Waka Kotahi Lead Safety Advisor for departure acceptance as detailed in 8.2 above.

8.4 Anchorage

Ground conditions are to be checked and confirmed at least as good as test conditions. Where the ground conditions vary from the standardised soil used in the crash testing of the accepted system under consideration, the Installation Designer shall either amend the foundation design in accordance with the design/installation guidance provided by the System Supplier, or consider an alternative protection system.

WRSB systems must be anchored at both end with the anchor recommended by the System Supplier. Maximum anchor spacing is to be as per Section 8.7.

Accepted M23-compliant W-beam end terminals must be used to terminate and anchor W-beam barriers, except where the W-beam is transitioned to a rigid barrier using an accepted transition.

MASH surface mounted end terminals are not currently available. NCHRP350 surface mounted terminals may be an option where there is no better alternative, however site-specific acceptance is required from the Waka Kotahi Lead Safety Advisor prior to specification or installation.

Rigid barrier shall have anchors as per APPENDIX B.

8.5 Minimum clearances

8.5.1 Services

The minimum clearance between ground mounted features of the road safety hardware (including, but not limited to posts and anchor blocks) and any buried services, including subsoil drainage, shall be that required by the service asset owner. Due care must be taken to ensure foundations are not installed into weak trench backfill. Where the location of a backfilled trench (including subsoil drains) is known the clearance between hardware foundations and the backfilled trench shall be at least 1.0 m.

8.5.2 Batter hinge point

The minimum support width or offset to the batter hinge point shall be 1.0 m for both flexible (measured from centreline of the system) and semi-rigid barrier systems (measured from side of the system closest to trafficable lanes). Refer Figure 1.

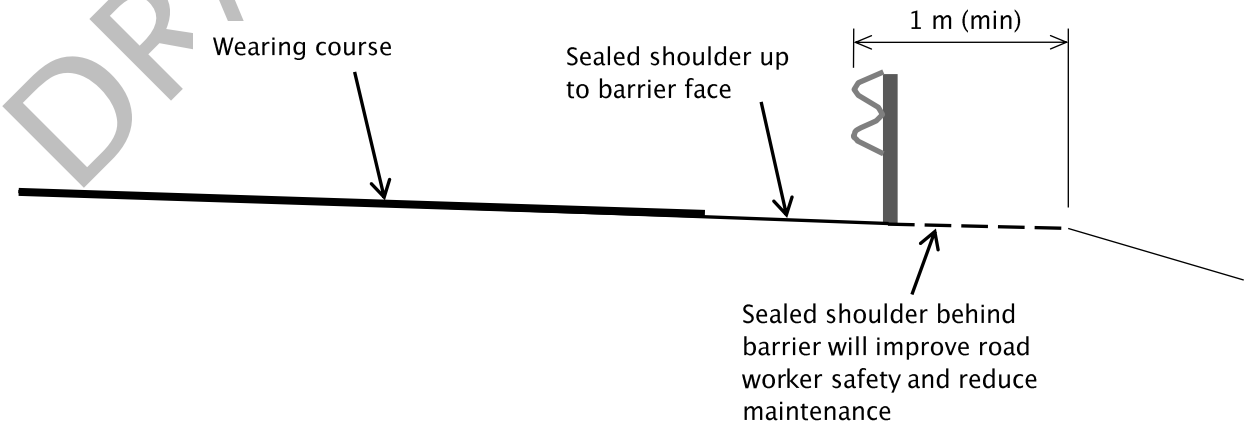

Figure 1: Typical cross section

Where the shoulder material behind the barrier is not sealed consideration should be given to sealing this to improve road worker safety and reduce maintenance.

This distance may only be reduced if:

(a) The System Supplier provides a warranted alternative footing or offset configuration that is accepted by the Lead Safety Advisor, and
(b) The evidence-based reasoning for the need to reduce the offset proposed by the Installation Designer is accepted by the Lead Safety Advisor.

8.5.3 Vertical hazards

WRSB should not be used where non-frangible fixed hazards (eg utility poles, trees, sign gantries) are within the tested deflection width. Where non-fixed hazards may be within the deflection width the Installation Designer must use a risk assessment to determine the appropriateness of the selected barrier type. Note that horizontal curvature can complicate deflection concerns especially on convex curves and consideration should be given to increasing space for deflection to compensate as shown in the table below (from VicRoads RDN 06-16).

Table 1: WRSB Deflection Correction for Curves

Barrier radius (m)	Deflection correction factor Fc
200 – 400	1.5
401 – 500	1.4
501 – 800	1.3
801 – 1500	1.1
>1500	1.0

For new flexible and semi-rigid road safety barrier installations, lighting columns shall be installed so that there is at least 1.5 m clearance between the closest parts of the barrier system and the traffic face of the lighting column. In retrofit situations only, this may be reduced to 1.0 m with application to, and acceptance by, the Waka Kotahi Lead Safety Advisor. Lighting columns behind flexible barriers should not be on a frangible 'slip base'; for retrofit installations, lighting columns should be modified to reduce the risk being activated by a deflecting barrier.

8.5.4 Footpaths

Wherever possible provide clearance of at least 0.5 m between footpaths or cycle paths and the rear of non-rigid safety hardware. Where this is not possible the Installation Designer shall consider appropriate mitigation for effects of deflection and parts of hardware that could injure a pedestrian or cyclist, e.g. the top of posts and protruding bolts. Protective covers over potentially dangerous parts of hardware may be installed where the System Supplier warrants that these will have no detrimental effect on the performance of the hardware.

8.6 Standard details for design

Waka Kotahi has prepared a number of standard design details for certain road safety hardware installations which shall be used unless alternative details have been accepted by the Lead Safety Advisor.

These standard design details are available from the Waka Kotahi website.

8.7 Minimum/maximum installation lengths

The minimum length for any road safety barrier system installation is specified on the associated data sheets in Appendix A of this document. For any installation shorter than the specified minimum the Installation Designer shall apply to the Waka Kotahi Lead Safety Advisor for departure acceptance.

The maximum length for any wire rope safety barrier (WRSB) installation is 2500 m where this in accordance with the System Owner's and System Supplier's guidance, including the anchors. Where longer lengths are required, multiple runs of WRSB are required with appropriate overlaps between runs.

A minimum installation length of semi-rigid barrier in accordance with Austroads technical advice SBTA 21-002 may be acceptable where physical constraints preclude an optimal length of installation and these have been clearly demonstrated and documented by the Installation Designer.

8.8 Curved barriers

For horizontal radii above 600 m, a narrow median and up to 3.0 m post spacing may be acceptable.

For horizontal radii below 600 m, the Installation Designer should consider a wider median and/or closer post spacing to mitigate risk of vehicle intrusion into the opposing lane. Other design factors such as sight distance, available seal width, AADT and maintenance must also be considered.

For horizontal radii below 250 m, the Installation Designer should consider mitigation for issues caused by differences in tension, or another barrier type (semi-rigid or rigid).

All shop-curved W-beam and Thrie-beam lengths must be weld marked (or similar) with the nominal radius prior to galvanising to assist with maintenance activities.

8.9 Safety barriers for motorcyclists

WRSB systems should be avoided on popular motorcyclist routes due to the current motorcyclist community perception that WRSB is especially hazardous for riders. While no direct evidence of increased injury from the ropes has been found, safety barrier posts present the greatest risk for motorcyclist injury and in these situations, semi-rigid barrier with crash tested CMPS (under-run) is advised over WRSB with post cushions.

8.10 Testing of wire rope safety barrier installations

All wire rope safety barrier installations shall be tested. The System Supplier shall have a static pull test procedure available to define testing required for WRSB foundations to ensure the system will perform as intended. The test must load the foundation away from the carriageway, i.e. in the same direction as expected lateral force loading from errant vehicles.

A sample of not less than 3% (or one post in every 100 m, whichever percentage is greater) of each installed length of wire rope safety barrier shall be tested in accordance with the System Owner's instructions (generally static pull tests) and the results of all testing retained as formal project records in accordance with the Waka Kotahi project documentation requirements as detailed in the

project contract documents. For installations within engineered fill, the Installation Designer may propose a reduced sampling rate of testing, with relevant supporting information, to the Waka Kotahi Lead Safety Advisor for consideration of departure acceptance.

8.11 Drawing/specification descriptions

Without written permission from the Lead Safety Advisor, proprietary products shall not be specified on drawings or in documentation associated with road safety hardware installations for which Waka Kotahi investment has been sought. To do so is considered a breach of the Commerce Act and Waka Kotahi procurement policy.

Road safety hardware shall be referred to in generic terms only. No specific performance test criteria need be specified unless critical to the outcome performance, only that the system shall be compliant with this document. A description such as "W-Beam barrier with continuous motorcyclist protection system complying with NZTA M23" is sufficient. Generic terms, such as "flexible", "semi-rigid" or "rigid", for defining system types, may also be used.

8.12 Layout

The layout of all permanent and temporary road safety hardware shall comply with the following guidelines:

8.12.1 Roadside and median safety barriers

The layout of all roadside and median safety barriers shall be in accordance with Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers, with particular reference to Section 5 Road Safety Barriers, and any applicable guidance issued by the Lead Safety Advisor.

8.12.2 Transitions

All transitions between road safety barrier systems shall be in accordance with the relevant Waka Kotahi standard details or proprietary system details as accepted by Waka Kotahi, unless otherwise approved by the Lead Safety Advisor.

8.12.3 Bridge barriers

The layout of all bridge barriers, ie the barriers providing containment along the bridge deck, shall be in accordance with the requirements of the Waka Kotahi Bridge Manual.

A site-specific risk assessment must be undertaken for every design to ensure residual risks have been considered.

Barriers on the approaches to bridges shall be in accordance with Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers, with particular reference to Section 6 Road Safety Barriers and any applicable guidance issued by the Lead Safety Advisor.

8.12.4 Temporary safety barriers

The layout of all temporary road safety barriers shall be in accordance with the requirements of TCD Manual Part 8, the accepted traffic management plan for the work site and the system specific requirements (such as ballasting or anchorage) detailed by the System Owner/Supplier.

Permanent barriers may be used for long term or temporary work area protection.

8.13 Installation

All permanent and temporary road safety hardware systems shall be installed in accordance with the instructions of the System Owner/Supplier.

The Installation Designer shall take account of any prevailing environmental conditions at the site that may affect the in-service performance of the road safety hardware system and ensure the most appropriate maintenance regime is documented.

Installation tolerances shall be as defined in AS/NZS 3845 except as below:

a) System specific tolerances for proprietary systems specified by the System Owner shall take precedence over those in AS/NZS 3845 or this document, and
b) System height shall be -0 mm to +20 mm from the specified system height
c) Finished pavement level, including all surface layers such as OGPA and overlays, must be accounted for
d) The surface level reference point shall reflect the most likely location of the closest vehicle tyre at first point of impact (projected crossfall).

8.14 Documentation

A Design Statement (RSHDS1) and/or Construction Review and Audit form (RSHDS4), as detailed in Appendix E or project specific equivalent document(s) shall be completed and stored with the project QA documentation for all road safety hardware system installations undertaken as part of Waka Kotahi funded works.

8.15 Maintenance

All permanent and temporary road safety hardware systems shall be maintained in accordance with the instructions of the System Owner/Supplier and to the standard necessary to preserve the crashworthiness of the system. The exception to this is situations where modifications have been made to the installation in accordance with Section 8.2; in those cases, the modified maintenance requirements shall take precedence. As a guide, drive-by system inspections are recommended at least monthly, and hands-on inspections are recommended at least yearly.

Height of barriers shall be maintained at the height specified by the System Owner, with tolerances as per Section 0.

Maintainers should access asset management records to obtain original System Owner, design and product information.

WRSB cables that are under tension must be de-tensioned prior to cutting.

All WRSB systems must be checked after impacts to ensure that the tension is maintained.

W-beam guardrail elements may be considered serviceable after localised damage to a single rib, but non-serviceable if there is damage to two ribs within 2 m.

Thrie-beam guardrail elements may be considered serviceable after localised damage to a single rib, but non-serviceable if there is damage to two or more ribs within 2 m.

9. TEMPORARY ROAD SAFETY BARRIERS

Road safety hardware installed on temporary traffic management sites shall be selected from the systems detailed in Appendices C or A of this document.

Barriers shall have at least the offset from the active traffic lanes shown in the table below (from Austroads Guide to Temporary Traffic Management Part 3: Static Worksites, Table 5.1), unless approved in the Traffic Management Plan.:

Table 2: Temporary Barrier Offset from Lane

Speed (km/h)	Distance (m)*
≤ 40	0.3
41 – 60	0.5
61 – 80	1
> 80	2

**Clearance is measured in front of the barrier system and not behind the barrier system in the deflection zone.*

No attachments, such as visibility screen ('gawk screens') may be attached to any barrier without prior acceptance from the Waka Kotahi Lead Safety Advisor, except for delineator devices permitted within the TCD Manual Part 8.

10. BARRIERS ON STRUCTURES

10.1 General

Road safety hardware installed on state highway structures shall be selected from the systems detailed in Appendix B of this document.

Appendix B contains details of the non-proprietary (public domain) bridge barrier systems listed in Table 3.

Table 3: Bridge Barrier Drawings

Drawing series	Ref./Number	Title(s)
Non-Proprietary Bridge Barrier Systems	B3	Thrie-beam Assembly and Fixing Details (No Top Rail)
	B4	Thrie-beam Assembly and Fixing Details (With Top Rail)
	B5	Guardrail Holding Down Bolt Details
	B7	Intermediate Anchor Details (Thrie-beam)
F-Shape Monolithic Barrier System (drawings in preparation)	B8-1	Thrie-beam to Concrete
	B8-2	Thrie-beam to Concrete Details
	B8-3	Typical Dowelled Barrier Joint
	B8-4	Thrie-beam to Concrete Alternative Details
Non-Proprietary Bridge Barrier System (drawings in preparation)	B9-1A to 1D	PA HT and Texas DoT T80HT Bridge Barriers (adapted for use in NZ)
	B9-2	Bridge Barrier – Semi Rigid Transition Details
	B9-3	Bridge Barrier – Transition Details
Legacy Bridge Barrier Systems	B1	W-beam Assembly and Fixing Details (No Top Rail)
	B2	W-beam Assembly and Fixing Details (With Top Rail)
	B6	Intermediate Anchor Details (W-beam)

Electronic copies of the drawings listed above (in PDF format) are available from the Waka Kotahi website at www.nzta.govt.nz/network/technical/hardware/drawings.html and / or are included as Appendix B of this document.

10.2 System performance

Irrespective of any testing regime (such as MASH or NCHRP 350), when used for protection of super- and sub-structure elements:

a) W-beam systems are considered to provide Test Level 3 protection; and
b) Thrie-beam systems are considered to provide Test Level 4 protection;
c) Multi-element steel rail systems are considered to provide Test Level 4 to Test Level 5 protection, depending on configuration;
d) Monolithic concrete systems are considered to provide either Test Level 4 protection (915 mm height) or Test Level 5 protection (1070 mm height); and
e) "HT" type barriers (PA HT, T80HT) are considered to provide Test Level 5 protection (1270 mm height).

Non-proprietary W-beam systems (see B1, B2 and B6) are a legacy system and not accepted for use on state highway bridges including the length of need on approaches to bridges.

Non-proprietary Thrie-beam systems (B3, B4 and B7) are a legacy system and only accepted for use on the state highway network in the following situations:

(i) As part of a transition between barriers of differing stiffness
(ii) On structures carrying low traffic volumes (less than 1000 vehicles per day); and
(iii) In retrofit situations to replace existing bridge systems (eg post & rail or "tombstone" parapet) where it can be demonstrated that the existing deck cannot take the imposed dead and impact loads from a compliant rigid barrier system.

10.3 Compliant site-specific use of bridge barrier systems

On occasion, site specific approval may be granted for use of variations to standard barrier systems. Such approval is to be formally sought from the Lead Safety Advisor before finalising any design drawings or contract documentation.

10.4 Design considerations for barriers on structures

With respect to the standard design drawings for rigid barriers on structures, the following points shall be considered by the Installation Designer:

a) Drawings B9-1A & B9-1B and Drawings B9-1C & B9-1D provide details of PA HT and T80 HT on-structure barriers respectively, as justified by test loading.
b) Drawings B9-2A, B9-2B and B9-3 provide details of transition barriers between a rigid on-structure barrier and semi-rigid off-structure barrier.
c) The combination of reinforcement quantum and barrier dimensions shown on drawings B9-1A and B9-1B together define barrier structural capacities, which shall be matched or bettered by the Installation Designer, who shall assume that all reinforcement shown on these drawings is fully developed.
d) The Installation Designer is responsible for ensuring that all details of barrier reinforcement and anchorage etc. are based on structural design requirements and describe an analytically defensible solution. This requirement may require improvement of the details shown on the standard drawings, despite these being based on recognised as-tested systems.
e) The Installation Designer is responsible for ensuring that the slab or other structure supporting all on-structure barriers is capable of resisting the combination of slab tension and slab flexure resulting from barrier overstrength.
f) The Installation Designer is responsible for ensuring that no off-structure barrier, including transitions beyond abutments, offers less robust performance than an off-structure barrier detailed in accordance with this document.
g) The traffic face profiles shown on the drawings may not be altered from the profiles as dimensioned.
h) The non-traffic face profile defined on the drawings may be varied, but the Installation Designer is responsible for ensuring that the structural capacity as described above is matched or bettered.

11. ACCEPTANCE PROCESS FOR ROAD SAFETY HARDWARE SYSTEMS

11.1 Acceptance process

Waka Kotahi is a member of the Austroads Safety Barrier Assessment Panel (ASBAP). Acceptance of permanent or temporary road safety hardware through the ASBAP process does not necessarily guarantee acceptance for installation on the New Zealand road network as Waka Kotahi retains autonomy over its network in accordance with the ASBAP terms of reference.

The information pack submitted by a safety hardware supplier/manufacturer to ASBAP for consideration for approval may also be used in a commensurate submission to Waka Kotahi.

Where road safety hardware is under assessment by ASBAP, whether from a New Zealand proponent or another, Waka Kotahi may defer its decision on acceptance pending the ASBAP findings.

11.2 Alternative acceptance process

Any permanent or temporary road safety hardware system not accepted by ASBAP but which the supplier/manufacturer is seeking to have approved for use in New Zealand, may be submitted to the Lead Safety Advisor for consideration for approval. The minimum submission requirements include the provision of the following information:

- Full system details including proposed configurations and any known limitations.
  - Permanent barrier systems shall be submitted with details of the associated end terminal.
  - For temporary barrier systems, the system shall comprise barrier units plus end treatments. The end treatment shall be clearly distinguishable from the barrier units.
- Crash test reports from a certified MASH testing facility.
- Draft/final version of the product manual detailing the full installation and maintenance requirements for the system.

Submissions will be reviewed and notification made of any further information required.

Those systems which meet the requirements of this document and are accepted for installation on the state highway network will initially be given Interim Acceptance status. The Interim Acceptance will list any restrictions or special considerations related to use of the system. Road safety hardware with site specific application or other limitations may remain under Interim Acceptance indefinitely in order to manage their use.

An Interim Acceptance may be used as evidence of acceptance for installation of the road safety hardware on the state highway network until the product in question has been listed in the appropriate appendix of this document.

11.3 Interim acceptance

Installation of any road safety hardware subject to an Interim Acceptance requires the following conditions be met, notwithstanding the requirements of this document:

a) Compliance with all System Owner/Manufacturer/Supplier design and/or installation requirements.

b) Compliance with any system specific constraints imposed by Waka Kotahi as part of the Interim Acceptance.
c) Notification of any new installations of the road safety hardware system to the appropriate office of Waka Kotahi.
d) In-service performance shall be recorded and a summary report provided, if requested, to the Lead Safety Advisor 12 months (or other period as agreed) after completion of the installation. Dependant on the number and timeframe of the installations, this period may be extended.
e) New installations of the road safety hardware system shall not be deployed on the state highway network after the expiry date of the Interim Acceptance, unless a further period of acceptance is granted or the product has been formally included in Appendices A, B, or C of this document (at which time the Interim Acceptance will lapse).

11.4 Revocation of acceptance

In regard to any permanent or temporary road safety hardware, should Waka Kotahi discover at any later date that the submitted testing information was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed differs significantly from that which was crash tested or accepted, it reserves the right to modify or revoke any acceptance and remove the product from any formal Waka Kotahi communications.

12. REFERENCES

12.1 Interim acceptances for road safety hardware

Table 4: Interim Acceptances

Product	Supplier	Type	Expiry Date
Necklen 80, 100 & 170 series Superhighway Sign Support Systems	Necklen Engineering	Traffic Sign Supports (Specification P24)	n/a
Kiwisafer™ Culvert End Treatment	Saferoads International	Drainage	n/a
Spigoted Streetlight Column Outreach	Steelgal	Road Lighting (Specification M26)	n/a

12.2 Notifications

Supply of MASH road safety hardware – July 2021 [PDF, 41 KB]

MASH – Full adoption notification of implementation [PDF, 92 KB]

Temporary concrete barrier system acceptance (2) [PDF, 61 KB]

Temporary concrete barrier system acceptance [PDF, 60 KB]

Temporary barrier connections – Notice of inappropriate practices [PDF, 661 KB]

Colour of wire rope safety barrier posts [PDF, 63 KB]

MASH-1 – Discontinuation of 3-cable wire rope barrier systems [PDF, 63 KB]

MASH-1 – Implementation [PDF, 61 KB]

MASH-1 – Notification of adoption [PDF, 65 KB]

M23 terminal grading plan [PDF, 58 KB]

12.3 Technical memoranda

This document takes precedence over the following technical memoranda. In case of any confusion over precedence clarification should be sought from the Waka Kotahi Lead Safety Advisor.

Buried in backslope end treatment – legacy hardware, refer to M23 Appendix A

Lapping of semi-rigid guardrail

Installation and maintenance of M19 3-bolt shear base lighting columns

Nesting of semi-rigid guardrail – legacy hardware, refer to M23 Appendix A

Using low strength concrete around guardrail posts

Frequently asked questions: Barriers and terminals

Road safety hardware system testing

Selection of barrier containment (test) level and length of need calculation

Guidelines for edge protection and medians on dual carriageway roads, incorporating a Safe System philosophy

Bridge W-beam guardrail status

Pipe handrails and fences

Curved terminal

Curved W-beam guardrail terminal

Road safety barrier: ground beam

TL-4 transition detail

Wire rope safety barrier (WRSB) transitions

Temporary Concrete Barrier Public Domain Pin and Loop System (TCB-1)

Delineation associated with barrier systems

M23 terminal grading plan

12.4 Technical advice notes

#15-09 Temporary concrete barrier TCB-1 revision 3

#15-14 Concrete barriers used to temporarily detain rockfall and slope debris

#16-17 Road safety barrier accreditation scheme

#16-18 Wire Rope Safety Barrier systems – post footing issues (updated Dec 2016)

APPENDIX A

PERMANENT ROAD SAFETY BARRIER SYSTEMS

APPENDIX B

CONCRETE AND BRIDGE BARRIER SYSTEMS

APPENDIX C

TEMPORARY ROAD SAFETY HARDWARE SYSTEMS

APPENDIX D

SLIP FORMED CONCRETE BARRIERS

APPENDIX E

ROAD SAFETY HARDWARE DESIGN STATEMENTS