



M23 Appendix C

NZTA M23:2023

Appendix C: temporary road safety hardware & devices

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Version 11

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Document references

- AS/NZS 3845 Part 1:2015
- AS/NZS 3845 Part 2:2017
- Waka Kotahi NZTA M23
- Waka Kotahi NZTA M23 Appendix F
- Waka Kotahi NZTA M23 Interim acceptance notices
- AUSTRROADS Part 6: Roadside Design, Safety and Barriers



Waka Kotahi is part of, and contributes to, the Road to Zero safety strategy.

Road to Zero is the government's strategy to guide improvements in road safety over the period 2020–2030. The strategy's vision is to stop people being killed or seriously injured on our roads. This means that no death or serious injury while travelling on our roads is acceptable.

For more information visit www.nzta.govt.nz/road-to-zero.

Revision record

Date	Notes
April 2017	Product updates
October 2017	Product updates
February 2018	Product updates
December 2019	Product updates based on latest ASBAP TCUs.
April 2020	Product updates based on latest ASBAP TCUs.
December 2020	Product updates based on latest ASBAP TCUs.
June 2021	Product updates based on latest ASBAP TCUs.
July 2021	Product updates based on latest ASBAP TCUs.
January 2022	Product updates based on latest ASBAP TCUs. Revised wording for risk assessments, fixed and freestanding barrier combinations and hardware combinations that aren't currently accepted.
December 2022	Product updates and additions based on latest ASBAP TCUs. Addition of risk assessment guide for end treatment selection. Removed references to CoPTTM and updated to refer to NZGTTM New format.
September 2023	Product updates and additions based on latest ASBAP TCUs.

Contents

Introduction.....	6
Glossary	7
Water-filled barriers (including end treatment)	9
Armorzone MASH TL-2 barrier and end treatment	10
LO-RO TL-2 barrier and SLED end treatment	11
Ricochet TL-2 plastic barrier and end treatment.....	12
Sentry II Water-cable barrier (requires end treatment)	13
Traffix water cable MASH TL-2 barrier and SLED Mini end treatment	14
Steel barrier systems.....	15
BG800 steel barrier	16
Defender Barrier 100 steel safety barrier (FS, HC & LDS variants)	17
HighwayGuard safety barrier	18
HV2 steel barrier	19
Safezone steel barrier	20
Zoneguard steel barrier	21
Concrete barrier systems	22
DELTABLOC DB80 K150 concrete barrier	23
DELTABLOC DB80 T150S & DB80A T150S concrete barrier	24
J-J Hooks concrete barrier	25
Rebloc 80SAH_4, 80SAH_12 & 80SAH_12_8B.....	26
Rebloc 120FA_6_SF	27
TCB-1 concrete barrier.....	28
End treatments	29
ABSORB-M crash cushion.....	33
ArmorBuffa end treatment.....	34
SLED-US end treatment (MASH SLED)	35
Hercules	36
QuadGuard M10 CZ.....	37
QuadGuard M10 (including QuadGuard M Wide).....	38
SCI-100 Smart Cushion	39
Universal TAU-M	40
Truck and trailer mounted attenuators	41
Scorpion II (MASH Model A, C & C-90 variants)	42
Scorpion II trailer attenuator (MASH)	43
Scorpion II (MASH TL-2 variant).....	44
Silke (MASH).....	45
SS180M TMA (MASH)	46
Verdegro Blade (MASH)	47
OTHER TMAs	48

Scorpion II METRO Slim48

Stuer-Egghe JUMINI light truck mounted attenuator (Level 1 only)49

Verdegro LTMA Light truck mounted attenuator (Level 1 only)50

[Legacy hardware](#)51

Introduction

This hardware summary appendix has been prepared with the intention of providing basic outline detail on all temporary road safety hardware systems accepted for use by Waka Kotahi NZ Transport Agency.

The appendix has been prepared to assist all organisations and individuals who interact with temporary road safety hardware systems and devices. The listed information provides the technical performance characteristics of the respective hardware or device; however, the Installation Designer must satisfy themselves that the performance is appropriate for the (TTM) activity being undertaken in accordance with their organisation's Practice Note, Safe Work Method Statement (SWMS) or Standard Operating Procedure as appropriate. The technical details within this appendix have been extracted from the respective product, installation and technical manuals of each system or device.

For more detailed information, refer to the individual manuals for each product or contact the System Supplier.

The information, commentary and details provided in this appendix are collected from a variety of reliable sources however the formally issued and endorsed System Owner/System Supplier product installation manuals must still be used as reference material for products. Do not utilise a system or device listed in this appendix without first consulting the System Owner/System Supplier and obtaining the correct and most recent documentation for the product.

Glossary

(Refer also to AS/NZS 3845 Part 1 2015 and Part 2 2017)

Aesthetic Barrier	A road safety barrier with improved aesthetics compared to other barrier types but reduced safety performance and/or lacking a crashworthy end treatment
Anchorage	The component used to restrain the end of the barrier system and to transmit impact forces to the ground
Bi-directional application	Two-way traffic e.g. Barrier hardware that can be hit by both adjacent and opposing traffic
Chevron	Retro-reflective chevron signs attached to the barrier units to guide drivers along a temporary barrier system (M23 Appendix F)
Clear Area	An area, behind or in front of a road safety barrier system, which should be kept free of hazards for the proper operation of the road safety barrier system or combination of systems. Also referred to as run out area or lateral safety zone
Clear Zone	An outdated safety concept which has been replaced by a risk assessment of the Design Envelope in accordance with Safe System principles. Clear zones were defined as the roadside area bordering the travel lanes which should be free of hazards and traversable
CoPTTM	NZTA Code of Practice for Temporary Traffic Management, (CoPTTM: Part 8 of the Traffic Control Devices manual), superseded by NZGTTM
Crashworthy	A feature that has been proven acceptable for use under specified conditions either through crash testing or in-service performance
Crossfall	The transverse sloping of the road surface toward the shoulder or gutter
Deflection	The horizontal displacement of the barrier when impacted
Design Envelope	The roadside area of interest, the scale of which is based on a risk assessment in accordance with Safe System principles, within which hazards should be treated or protected
End Treatment	A crashworthy end treatment must be provided when the end of a barrier is exposed to head-on impacts
End User	The purchaser or hirer/hiree of the safety hardware
Energy Absorbing Unit	The individual units in a crash cushion that absorb impact energy
FHWA	USA Federal Highways Administration
Flare Rate	The curvature applied near the end of a road safety barrier installation. Expressed as the ratio of the longitudinal distance to the transverse offset, by which a road safety barrier flares away from the road
Flexible Barrier	Barrier systems which dissipate crash impact energy largely by deflection of the barrier system. Lower impact forces are imposed on the vehicle and occupants
F-Shape Barrier	Concrete barrier of the current accepted F shape cross-section
Gating	A road safety barrier treatment designed to allow an impacting vehicle to pass through the device, when impacted at an angle, upstream from the point of redirection
Impact angle	For a longitudinal barrier, it is the angle between the face of the barrier and the vehicle's impact direction.
Installation Designer	The entity that designs the length, location and types of components of a system to be installed on a section of the road network. The Installation Designer designs the system to suit the particular conditions of the section of road network
Length of need	The required length of barrier system that is redirective, to shield the hazard
MASH	Manual for Assessing Safety Hardware (MASH) is a Manual for Assessing Highway Safety Features. This is the current test protocol for road safety hardware accepted by Waka Kotahi
Minimum Length	Minimum standalone length of safety barrier system, excluding end treatments
NCHRP 350	National Co-operative Highway Research Program (report) 350 (superseded by MASH)
NZGTTM	New Zealand Guide to Temporary Traffic Management (supersedes CoPTTM)
Pinning	Either connecting adjacent transportable barrier sections or fastening of barrier sections to the pavement or ground
Point of Redirection	That point on a barrier system downstream of which will be redirective. Previously referred to as "point of need"

Proprietary	A road safety barrier system that is the subject of patent or other intellectual property rights
Public Domain	A road safety barrier system that is not the subject of patent or other intellectual property rights within Australia and New Zealand. Note: These systems are also referred to as non-proprietary road safety barrier systems
RCA	Road Controlling Authority that has control of the road, sometimes referred to as Road Authority
Redirective	The ability of a barrier system to redirect an impacting vehicle away from the barrier without barrier pocketing or rupture
Ribbon Strength	The longitudinal strength of a barrier system to provide crash energy containment and redirection
Rigid Barrier	Barrier system that has no deflection under impact. Higher impact energy transmitted to vehicle and occupants
RUPD	Rear underrun protection device. An energy-absorbing device permanently fixed to the rear chassis of any truck or trailer of an articulated truck that is used to reduce the occupant impact severity in an impacting vehicle. Note: These devices are also referred to as truck underrun barriers (tubs)
Semi-Rigid Barrier	Barrier systems which deflect during re-direction. Impact energy to vehicle and occupants is less than for a rigid system but greater than a flexible system
Shadow Vehicle	A Shadow Vehicle is used to provide additional guidance for road users approaching from the rear and close protection for personnel on foot and/or work vehicles in the working space
Shy Line	The distance from the edge of the travelled way outside of which the start of a roadside object (e.g. Barrier) will not cause a driver to change their vehicles lateral placement or speed
Sight/ Anti-Gawk Screens	Screens to shield visual distractions from passing drivers
Site Specific Risk Assessment	An assessment which is specific to the site that considers risk based on parameters such as road user exposure, crash likelihood and crash severity
Slope	The relative steepness of the terrain expressed as a ratio or percentage
Support Vehicle	A Support Vehicle is a vehicle to which a TMA is attached
System Installer	The entity that installs the system
System Owner	The entity that has the property rights to the road safety hardware system through their ownership of the patent
System Supplier	The entity that supplies the system or device
Test Level (TL)	A set of prescribed test conditions, defined in terms of vehicular mass, impact speed and angle that defines the crash energy. The test level of deployed hardware must meet or exceed the test level for the posted speed limit as listed below: TL-3: greater than 70 km/h TL-2: 50 km/h to 70 km/h TL-1: 50 km/h or less
TMA	Truck/trailer mounted attenuator
TMD	Traffic management diagram
TMP	Traffic management plan
Uni-directional application	One-way traffic. Eg barrier hardware that cannot be hit by opposing traffic
Vaulting	Abrupt upward movement of an impacting vehicle
Wear and tear	Damage that naturally and inevitably occurs as a result of normal use or aging
Working Width	The distance between the traffic face of the road safety barrier system before the impact and the maximum lateral position of any major part of the system or vehicle during and after the impact. Note: In design, the working width is the required clearance between the face of a road safety barrier and a hazard
Work Vehicle	A Work Vehicle is a vehicle carrying out activity adjacent to the road, or on the carriageway, or supporting personnel on foot. Work Vehicles must be task specific and complete only one task at a time
WRSB	Wire Rope Safety Barrier, a flexible barrier system

Water-filled barriers (including end treatment)

The following general notes apply to all water-filled barriers:

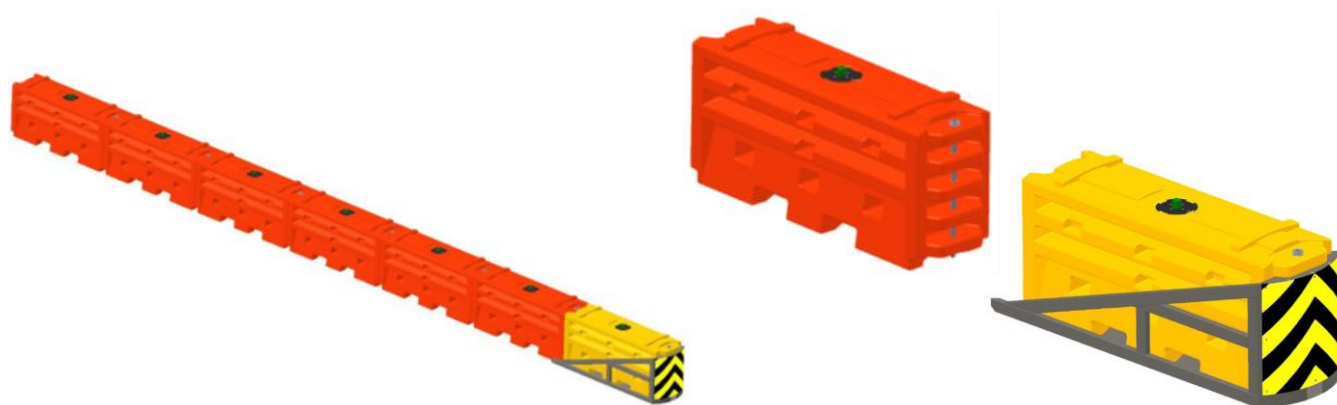
- a) All temporary water-filled barriers are freestanding (not fixed to the ground).
- b) The risk assessment undertaken in planning and preparation of the deployment must take into regard the working spaces and safety zones irrespective of the barrier in use.
- c) The barrier test level must meet or exceed the test level corresponding to the posted speed limit.
- d) In-service impact deflection in excess of the test values indicated for each product must be allowed for in any temporary traffic management plan.
- e) All units must be connected with the appropriate connecting hardware and filled with water when in use.
- f) Apply antifreeze additives in the water when using in sub-zero conditions. Use mixture ratios as per the System Supplier's specifications.
- g) Disposal of water shall be in accordance with relevant statutory approvals, regional plans, environmental management plans, and in accordance with the following principles:
 - (i) Where water is discharged to ground or stormwater, it shall be released in a measured way to manage erosion and sediment transport.
 - (ii) Ecotoxic additives (as classified under the Hazardous Substances and New Organisms Act 1996) shall be avoided unless there are no practicable alternatives to their use.
 - (iii) Water with ecotoxic additives shall be disposed of at a facility consented to receive, dispose and/or treat such waste.
- h) The barrier system will be considered non-compliant if the end treatment component is not fitted.
- i) Gating and partially gating end treatments shall have a clear area of at least 6 m laterally by 18.5 m longitudinally from the point of redirection of the terminal/terminal and system combination. Note that a longitudinal safety zone is to be factored into the risk assessment(s) and planning and in some cases this may exceed the clear area requirement.
- j) Site specific grading may be necessary to ensure that there are no "humps" or "hollows" that may significantly alter the impacting vehicle's stability, reduce surface friction between the barrier and the ground or substantially alter the barrier height in relation to the ground.
- k) Barriers should not be installed immediately in front of or behind kerbs:
 - (i) On roads with a permanent speed limit of 70km/h or more, do not place temporary road safety barrier systems in front of or on top of a kerb, irrespective of profile. Special consideration may be given to placement of the temporary barrier system on top of a mountable or semi-mountable kerb where a site risk assessment has determined the site constraints preclude other options. Do not place the barrier where it could contact the kerb within its normal deflection range for the speed environment (TL2 or TL3 as appropriate to permanent speed).
 - (ii) On roads with a permanent speed limit of 60km/h or less, temporary road safety barrier systems may be placed on top of the kerb. A site risk assessment should be completed to consider the impacts the kerb will have on the impact height and angle of an errant vehicle. Do not place the barrier where it could contact the kerb within its normal deflection range for the speed environment (TL1 or TL2 as appropriate to permanent speed).
 - (iii) Site specific risk assessments must be reviewed and approved by a suitably trained independent agent of the RCA, prior to implementation as part of the TMP development and approval process.
- l) Barriers must be checked frequently for damage and correct water content with any faults corrected in a timely manner.
- m) Provide delineation as determined by thorough risk assessment, planning works and TCD Rule requirements.
- n) Refer to the System Supplier's product guidelines for instructions on the viability of minor repairs. Repairing a crack or hole may not return the plastic to its original strength, although minor repairs may be enough to ensure water tightness.

Armorzone MASH TL-2 barrier and end treatment



Summary	
Test level / conditions:	TL-1 and TL-2
Status	Accepted
Technical information	
Dimensions	2 m effective length, 450 mm width, 870 mm height
Weight	50 kg (empty), 570 kg (filled)
Water fill capacity	520 litres
Minimum length	50 m (2 end treatments and 23 units)
Length to point of redirection	<ul style="list-style-type: none"> Leading: 24 m (12 units, including end treatments) Trailing: 26 m (13 units, including end treatments)
Clear area	18.5 m x 6 m clear run-out area required, measured from the from the point of redirection
Working width	<ul style="list-style-type: none"> TL-2: 4.60 m (deflection 4.10 m from rear edge of barrier (70 km/h, 2270 kg vehicle, 25° angle)) TL-1: 2.61 m (deflection 2.16 m from rear edge of barrier (50 km/h, 2270 kg vehicle, 25° angle))
Grade or placement restrictions	<ul style="list-style-type: none"> A maximum approach and cross slope of 1V:10H is preferable. On slopes greater than this approval is required from the road controlling authority
Other restrictions / considerations	<ul style="list-style-type: none"> NO NCHRP 350 units to be used – these are no longer permitted/compliant The adjacent road operating speed must be limited to 70 km/h and the installation should endeavour to minimise the impact angles to 25° (1 lateral: 2.14 forward) The Armorzone MASH TL-2 End Treatment forms an integral part of this system and must be installed and maintained in accordance with the product installation/maintenance manual and relevant Waka Kotahi specifications/requirements Armorzone systems should be installed on a compacted surface Refer also to general notes for water-filled barriers

LO-RO TL-2 barrier and SLED end treatment



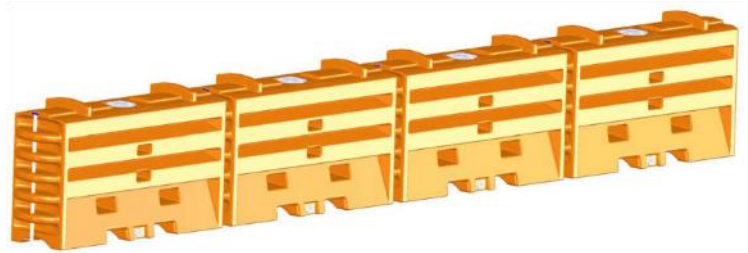
Summary	
Test level / conditions:	TL-2 and TL-1
Status	Accepted
Technical information	
Dimensions	1924 mm effective length, 570 mm width, 914 mm height
Weight	73 kg (empty), 688 kg (filled)
Water fill capacity	615 litres
Minimum length	41 metres between end treatments
Length to point of redirection	<ul style="list-style-type: none"> Leading: 24 m Trailing: 24 m
Clear area	18.5 m x 6 m clear run-out area required, measured from the from the point of redirection
Minimum radius	Not provided – contact supplier
Working width	<ul style="list-style-type: none"> TL-2: 4.1 m (deflection 3.6 m from rear edge of barrier (70 km/h, 2270 kg vehicle, 25° angle)) TL-1: 2.3 m (deflection 1.8 m from rear edge of barrier (50 km/h, 2270 kg vehicle, 25° angle))
Grade or placement restrictions	<ul style="list-style-type: none"> A maximum approach and cross slope of 1V:10H is preferable. On slopes greater than this approval is required from the road controlling authority
Other restrictions / considerations	<ul style="list-style-type: none"> The adjacent road operating speed must be limited to 70 km/h and the installation should endeavour to minimise the impact angles to 25° (1 lateral: 2.14 forward) Barriers must be lifted by mechanical methods and use the lifting provision slots as provided Refer also to general notes for water-filled barriers

Ricochet TL-2 plastic barrier and end treatment



Summary	
Test level / conditions:	TL-2
Status	Accepted
Technical information	
Dimensions	1700 mm effective length, 580 mm width, 1020 mm height
Weight	Barrier: 62 kg (empty), 662 kg (full) end treatment: 42 kg
Water fill capacity	600 litres
Minimum length	61m (2 x end treatments (each 2 yellow sections + end cap) and 32 x orange barrier sections)
Length to point of redirection	15.8 m (7 units plus end treatment)
Clear area	18.5 m x 6 m clear run-out area required, measured from the from the point of redirection
Working width	<ul style="list-style-type: none"> TL-2: 3.50 m (deflection 3.50 m from rear edge of barrier (70 km/h, 2270 kg vehicle, 25° angle)) TL-1: 2.28 m (deflection 2.28 m from rear edge of barrier (50 km/h, 2270 kg vehicle, 25° angle))
Grade or placement restrictions	Ground conditions must be of satisfactory compactness and levelness does not exceed 10% (1V:10H) for both longitudinal and cross slope
Other restrictions / considerations	<ul style="list-style-type: none"> End treatment units and end caps (yellow) must not contain water When assembling the barrier system always have a clear working zone of at least 2 metres on either side of the barrier Barriers must be lifted by mechanical methods and use the lifting provision slots as provided Refer also to general notes for water-filled barriers

Sentry II Water-cable barrier (requires end treatment)



Summary	
Test level / conditions:	TL-3
For use with	The SLED-US water-filled, non-redirective, gating crash cushion is the only currently accepted end treatment
Status	Accepted
Technical information	
Dimensions	1924 mm effective length, 572 mm width, 1163 mm height
Weight	72.6 kg (empty), 907 kg (full)
Water fill capacity	832 litres
Minimum length	58 m (30 units)
Length to point of redirection	29 m (15 units)
Clear area	18.5 m x 6 m clear run-out area required, measured from the from the point of redirection
Minimum radius	5.5 m
Working width	3.5 m (deflection 2.9 m from rear edge of barrier (100 km/h, 25°, 2270 kg vehicle))
Grade or placement Restrictions	<ul style="list-style-type: none"> The foundation is required to support the weight of the fully loaded sections eg Concrete, asphalt, soil and gravel Designed to be used in applications where the cross-fall and longitudinal slope will be 10 degrees or less (1V:6.7H)
Other restrictions / considerations	The moulded-in steel cables are not to be used for lifting the Sentry II sections

Traffic water cable MASH TL-2 barrier and SLED Mini end treatment



Summary	
Test level / conditions:	TL-1 and TL-2
For use with	The SLED Mini end treatment is the only currently accepted end treatment
Status	Accepted
Technical information	
Dimensions	1854 mm effective length, 457 mm width, 812 mm height
Weight	45.6 kg (empty), 500 kg (full)
Water fill capacity	466 litres
Minimum length	46.4 m (23 modules plus two end treatments)
Length to point of redirection	12 units plus end treatment
Clear area	18.5 m x 6 m clear run-out area required, measured from the from the point of redirection
Working width	<ul style="list-style-type: none"> TL-2: 5.47 m (deflection 4.46 m from rear edge of barrier (70 km/h, 25°, 2270 kg vehicle) TL-1: 5.7 m (deflection 5.2 m from rear edge of barrier (50 km/h, 25°, 2270 kg vehicle)
Grade or placement restrictions	A maximum approach and cross slope of 1:10 is preferable. On slopes greater than this approval is required from the RCA
Other restrictions/ considerations	<ul style="list-style-type: none"> NO NCHRP 350 units to be used – these are no longer permitted/compliant The adjacent road operating speed must be limited to 70 km/h and the installation should endeavour to minimise the impact angles to 25° (1 lateral: 2.14 forward)

Steel barrier systems

The following general notes apply to all steel barriers:

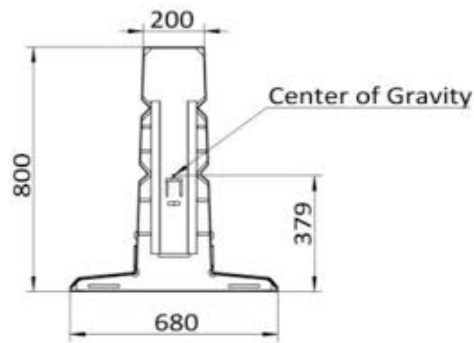
- a) The barrier system will be considered non-compliant if an appropriate end treatment or transition component is not fitted.
- b) The risk assessment and planning will determine appropriate working spaces and safety zones irrespective of the barrier in use.
- c) The barrier test level must meet or exceed the test level corresponding to the posted speed limit (refer Barrier supplier specifications as to relevant MASH test level).
- d) In-service impact deflection in excess of the test values indicated for each product should be allowed for in any temporary traffic management plan.
- e) Temporary steel barriers may need to be fixed (eg pinned) to the ground or freestanding, according to the requirements of the barrier.
- f) Fixed barriers must be installed on pavements that meet or exceed the System Owner/Supplier's requirements. Indicative suitable pavements are minimum 250 mm thick concrete or asphaltic concrete, minimum 150 mm asphaltic concrete over minimum 150 mm granular pavement, or 400 mm granular pavement. Note that some barriers will require thicker pavements.
- g) Fixed barriers may deflect less than freestanding barriers during a crash and therefore may transfer more energy to vehicle occupants. This is particularly true of minimum deflection system (MDS) variants. The transition of deflection between end terminal and barrier, or different barrier types, must be managed to provide acceptable risk in accordance with the site-specific risk assessment. Low deflection variants should only be used where the need justifies the risk and the additional installation and remediation effort.
- h) It is preferable to only connect fixed end treatments to fixed barriers to mitigate the risk due to differential stiffness.
- i) A **site-specific risk assessment** must be undertaken to determine the appropriate barrier and end treatment combination and included with the traffic management plan submission. For more information refer to Section 2 of the notes for end treatments.
- j) All units must be connected with the appropriate connecting hardware.
- k) Low-radius variants may only be used where posted and operating speed is less than accepted for the variant and radius.
- l) Site specific grading may be necessary to ensure that there are no "humps" or "hollows" that may significantly alter the impacting vehicle's stability or substantially alter the barrier height in relation to the ground.
- m) Barriers should not be installed immediately in front of or behind kerbs.
 - (i) On roads with a permanent speed limit of 70km/h or more, do not place temporary road safety barrier systems in front of or on top of a kerb, irrespective of profile. Special consideration may be given to placement of the temporary barrier system on top of a mountable or semi-mountable kerb where a site risk assessment has determined the site constraints preclude other options. Do not place the barrier where it could contact the kerb within its normal deflection range for the speed environment (TL2 or TL3 as appropriate to permanent speed).
 - (ii) On roads with a permanent speed limit of 60km/h or less, temporary road safety barrier systems may be placed on top of the kerb. A site risk assessment should be completed to consider the impacts the kerb will have on the impact height and angle of an errant vehicle. Do not place the barrier where it could contact the kerb within its normal deflection range for the speed environment (TL1 or TL2 as appropriate to permanent speed).
 - (iii) Site specific risk assessments must be reviewed and approved by a suitably trained independent agent of the RCA, prior to implementation as part of the TMP development and approval process.
- n) Barriers must be checked frequently for damage and pin condition with any faults corrected in a timely manner.
- o) Provide delineation as determined by thorough risk assessment, planning works and TCD Rule requirements.
- p) The minimum distance from a barrier to an excavation must not be less than the dynamic deflection.

BG800 steel barrier



Summary					
Test level / conditions:	<ul style="list-style-type: none"> BG800: TL-3 and TL-4 (T-top lite must be attached for TL-4 containment and pavement must be concrete or deep lift AC) BG800 MDS: TL-3 				
For use with	<p>A site-specific risk assessment must be undertaken to determine appropriate end treatment:</p> <ul style="list-style-type: none"> SMART crash cushion QuadGuard M10 CZ Crash Cushion Universal TAU-M crash cushion BG800 may be connected to HighwayGuard LDS Safety Barrier with the correct transition <p>For freestanding terminals a more detailed assessment of risk and mitigation options is required:</p> <ul style="list-style-type: none"> ABSORB M end treatment (up to 80 km/h permanent posted speed limit on asphalt foundations, up to 70 km/h permanent posted speed limit on concrete foundations) 				
Status	<p>BG800: Accepted</p> <p>BG800 MDS: Requires site specific sign off by the Waka Kotahi Lead Safety Advisor via M23.Queries@nzta.govt.nz</p>				
Technical information					
Dimensions	6 m or 12 m length, 540 mm width, 800 mm height				
Weight	1080 kg (12 m unit)				
Minimum length	<ul style="list-style-type: none"> BG800: 72 m excluding end treatments BG800 MDS: 42 m 				
Length to point of redirection	<ul style="list-style-type: none"> BG800: <ul style="list-style-type: none"> TL-3: Interface between the last fixed barrier unit and the end treatment TL-4: 36 m from leading and trailing end BG800 MDS: Interface between the last fixed barrier unit and the end treatment 				
Anchor spacing	<table border="0"> <tr> <td>BG800:</td> <td>BG800 MDS: 6 m</td> </tr> <tr> <td> <ul style="list-style-type: none"> 48 m (chipseal or unsealed pavement) 60 m (AC or concrete pavement) </td> <td></td> </tr> </table>	BG800:	BG800 MDS: 6 m	<ul style="list-style-type: none"> 48 m (chipseal or unsealed pavement) 60 m (AC or concrete pavement) 	
BG800:	BG800 MDS: 6 m				
<ul style="list-style-type: none"> 48 m (chipseal or unsealed pavement) 60 m (AC or concrete pavement) 					
Working width	<table border="0"> <tr> <td>BG 800:</td> <td>BG800 MDS: 0.98 m (deflection 0.44 m)</td> </tr> <tr> <td> <ul style="list-style-type: none"> TL-3: 2.2 m (deflection 1.66 m) TL-4: 3.66 m (deflection 2.31 m) </td> <td></td> </tr> </table>	BG 800:	BG800 MDS: 0.98 m (deflection 0.44 m)	<ul style="list-style-type: none"> TL-3: 2.2 m (deflection 1.66 m) TL-4: 3.66 m (deflection 2.31 m) 	
BG 800:	BG800 MDS: 0.98 m (deflection 0.44 m)				
<ul style="list-style-type: none"> TL-3: 2.2 m (deflection 1.66 m) TL-4: 3.66 m (deflection 2.31 m) 					
Grade or placement restrictions	Not to be installed on ground of cross slope greater than 8% (1 V:12.5 H)				
Other restrictions / considerations	<ul style="list-style-type: none"> Requires an anchoring system approved by the System Owner The final section at both ends of any BG800 steel barrier installation must be fixed to the pavement in accordance with the System Supplier's instructions BG800 MDS requires the addition of steel 'T-Top' sections on top of the barrier 				

Defender Barrier 100 steel safety barrier (FS, HC & LDS variants)



Summary			
Test level / conditions:	<ul style="list-style-type: none"> 100 FS (Free Standing): TL-2 and TL-3 100 HC (High Containment): TL-3 and TL-4 100 LDS (Low Deflection): TL-3 		
For use with	<p>A site-specific risk assessment must be undertaken to determine appropriate end treatment:</p> <p>100 FS variant:</p> <ul style="list-style-type: none"> QuadGuard M10 CZ Crash Cushion <p>For freestanding terminals a more detailed assessment of risk and mitigation options is required:</p> <ul style="list-style-type: none"> MASH SLED (up to 80 km/h permanent posted speed limit) ABSORB M end treatment (up to 80 km/h permanent posted speed limit) <p>100 HC and LDS variants:</p> <ul style="list-style-type: none"> Hercules crash cushion (permitted for use in unidirectional applications only. Not permitted as a departure terminal) QuadGuard M10 CZ Crash Cushion Universal TAU-M crash cushion <p>For freestanding terminals a more detailed assessment of risk and mitigation options is required:</p> <ul style="list-style-type: none"> ABSORB M end treatment (up to 80 km/h permanent posted speed limit) 		
Status	Accepted		
Technical information			
Dimensions	3.9 m effective length, 680 mm width, 820mm height		
Weight	320 kg (1040 kg including ballast boxes: 100 FS only)		
Minimum length	100 FS: 156 m	100 HC: 97.5 m	100 LDS: 78 m
Length to point of redirection	100 FS: 66.3 m	100 HC: 0 m (TL-3), 7.8 m (TL-4)	100 LDS: 0 m
Anchor spacing	<ul style="list-style-type: none"> 100 FS: (Not applicable, freestanding system) 100 HC: 48.15 m maximum spacing (every twelfth barrier) 100 LDS System: 9.15 m maximum spacing (every second barrier) 		
Working width	100 FS: 2.58 m (deflection 1.9 m)	100 HC: <ul style="list-style-type: none"> TL-3: 2.98 m (deflection 2.30 m) TL-4: 3.31 m (deflection 2.47 m) 	100 LDS: 1.56 m (deflection 0.88 m)
Grade or placement restrictions	<ul style="list-style-type: none"> Not to be installed on ground of cross slope greater than 10% (1V:10H) Minimum horizontal and vertical curve radii of the system are 230 m. Each 3.9 m unit allows up to 1° of movement per joint 		
Other restrictions / considerations	<ul style="list-style-type: none"> Anchored variants require an anchoring system approved by the System Owner Each 100 FS unit must be fitted with three concrete-filled ballast boxes For 100 HC and 100 LDS pins must be placed in the first available holes after the approach end treatment, and the last available holes before the departure end treatment 		

HighwayGuard safety barrier



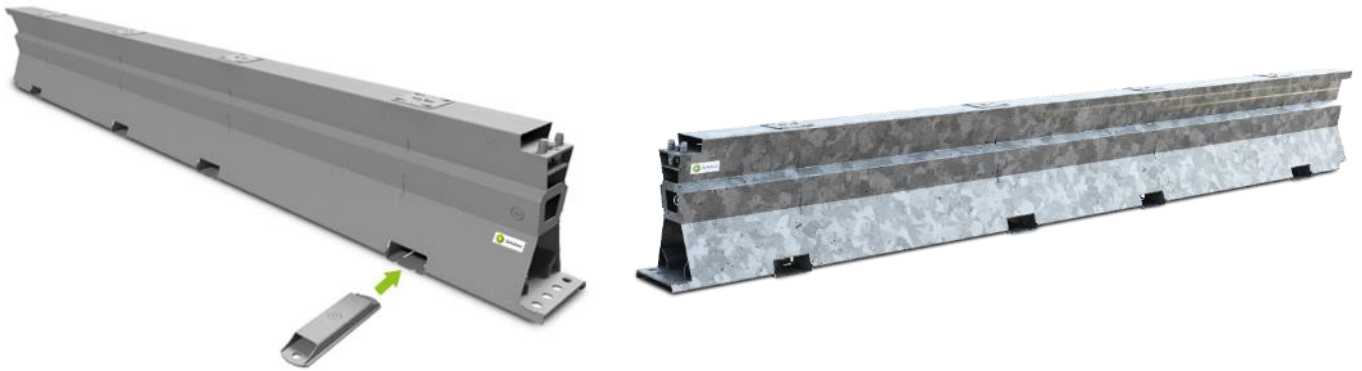
Summary	
Test level / conditions:	HighwayGuard: TL-3 and TL-4 HighwayGuard LDS and MDS: TL-3
For use with	A site-specific risk assessment must be undertaken to determine appropriate end treatment: <ul style="list-style-type: none"> • QuadGuard M10 CZ Crash Cushion • Universal TAU-M crash cushion (Permitted for use in unidirectional applications only. Not permitted as a departure terminal) For freestanding terminals a more detailed assessment of risk and mitigation options is required: <ul style="list-style-type: none"> • ABSORB M end treatment (up to 80 km/h permanent posted speed limit) • ArmorBuffa end treatment (up to 80 km/h permanent posted speed limit)
Status	HighwayGuard & HighwayGuard LDS: Accepted HighwayGuard MDS: Requires site specific sign off by the Waka Kotahi Lead Safety Advisor via M23.Queries@nzta.govt.nz
Technical information	
Dimensions	6 m or 12 m length, 540 mm width, 800 mm height
Weight	614 kg per unit
Minimum length	<ul style="list-style-type: none"> • HighwayGuard pinned @ 58 m spacing on structural AC or concrete pavement: 120 m • HighwayGuard pinned @ 42 m spacing on compacted granular pavement: 108 m • HighwayGuard LDS: 60 m • HighwayGuard MDS: 36 m
Length to point of redirection	<ul style="list-style-type: none"> • TL-3: Interface between the last fixed barrier unit and the end treatment • TL-4: <ul style="list-style-type: none"> ○ HighwayGuard: 30 m from each end of the barrier ○ HighwayGuard LDS: 34.5 m from leading end, 49.5 m from trailing end
Anchor spacing	<ul style="list-style-type: none"> • HighwayGuard: <ul style="list-style-type: none"> ○ 58 m (structural AC or concrete pavement) ○ 42 m (compacted granular pavement) • HighwayGuard LDS: 12 m or 24 m • HighwayGuard MDS: 2 m
Working width	<ul style="list-style-type: none"> • TL-3: <ul style="list-style-type: none"> ○ HighwayGuard pinned at 58 m spacing: 2.47 m (deflection 1.93 m) ○ HighwayGuard pinned at 42 m spacing: 2.25 m (deflection 1.71 m) ○ HighwayGuard LDS pinned at 12 m spacing :1.22 m (deflection 0.68 m) ○ HighwayGuard LDS pinned at 24 m spacing: 1.70 m (deflection 1.16 m) ○ HighwayGuard MDS: 0.67 m (deflection 0.03 m) • TL-4: HighwayGuard: 3.51 m (deflection 2.16 m)
Grade or placement restrictions	Maximum grade 8% (1V:12H)
Other restrictions / considerations	<ul style="list-style-type: none"> • Requires an anchoring system approved by the System Owner • All offsets are to be measured from the relevant outer edge of the foot (the foot is not trafficable)

HV2 steel barrier



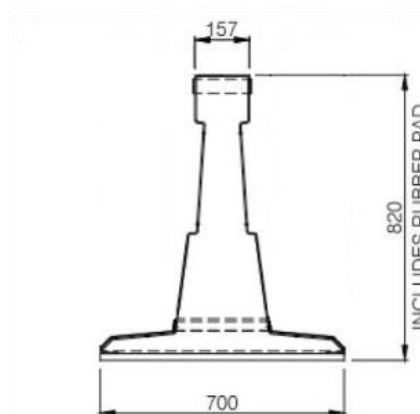
Summary	
Test level / conditions:	TL-3 and TL-4
For use with	A site-specific risk assessment must be undertaken to determine appropriate end treatment: <ul style="list-style-type: none"> • QuadGuard M10 CZ Crash Cushion • MASH SLED (up to 80 km/h permanent posted speed limit)
Status	Accepted
Technical information	
Dimensions	5.8 m effective length, 450 mm width, 900 mm height
Weight	2088 kg per unit
Minimum length	<ul style="list-style-type: none"> • TL-3: 98.6 m (17 units, excluding end treatment) • TL-4: 278 m (48 units, excluding end treatment)
Length to point of redirection	<ul style="list-style-type: none"> • TL-3: 22.5 m (MASH SLED) or 0 m (QuadGuard M10 CZ) • TL-4: 138 m
Anchor spacing	Not applicable (freestanding system)
Working width	<ul style="list-style-type: none"> • TL-3: 1.84 m (deflection 1.47 m) • TL-4: 3.74 m (deflection 2.37 m)
Grade or placement restrictions	May be used on firm surfaces such as asphaltic concrete, chipseal, smooth/uniform unsealed pavement, smooth natural ground
Other restrictions / considerations	Occupant Impact Values of small vehicle impacts into the HV2 Transition Section may exceed acceptable limits and must be considered

Safezone steel barrier



Summary	
Test level / conditions:	<ul style="list-style-type: none"> Safezone & Safezone LDS: TL-3 and TL-4 Safezone MDS: TL-3
For use with	<p>A site-specific risk assessment must be undertaken to determine appropriate end treatment:</p> <ul style="list-style-type: none"> Universal TAU-M crash cushion <p>For freestanding terminals a more detailed assessment of risk and mitigation options is required:</p> <ul style="list-style-type: none"> ABSORB M end treatment (up to 80 km/h permanent posted speed limit)
Status	<p>Safezone & Safezone LDS: Accepted</p> <p>Safezone MDS: Requires site specific sign off by the Waka Kotahi Lead Safety Advisor via M23.Queries@nzta.govt.nz</p>
Technical information	
Dimensions	5.8 m length, 454 mm width, 810 mm height
Weight	505 kg
Minimum length	<ul style="list-style-type: none"> Safezone: 69.6 m (between crash cushions) Safezone LDS & MDS: 40.6 m (between crash cushions)
Length to point of redirection	<ul style="list-style-type: none"> Safezone TL-3, LDS TL-3 & MDS: Interface between the last fixed barrier unit and the end treatment Safezone TL-4: 27.4 m Safezone LDS TL-4: 15.8 m
Anchor spacing	<ul style="list-style-type: none"> Safezone: 69.6 m Safezone LDS: 11.6 m Safezone MDS: 5.8 m
Working width	<ul style="list-style-type: none"> Safezone TL-3: 2.06 m (deflection 1.7 m) Safezone TL-4: 2.96 m (deflection 2.07m) Safezone LDS TL-3: 1.13 m (deflection 0.61m) Safezone LDS TL-4: 2.17 m (deflection 0.85 m) Safezone MDS TL-3: 08.1 m (deflection 0.17 m)
Grade or placement restrictions	Not to be installed on ground of cross slope greater than 8% (1V:12H)
Other restrictions / considerations	Requires an anchoring system approved by the System Owner

Zoneguard steel barrier



Summary	
Test level / conditions:	<ul style="list-style-type: none"> Zoneguard: TL-3 and TL-4 Zoneguard MDS: TL-3
For use with	<p>A site-specific risk assessment must be undertaken to determine appropriate end treatment:</p> <ul style="list-style-type: none"> Universal TAU-M crash cushion QuadGuard M10 CZ <p>For freestanding terminals a more detailed assessment of risk and mitigation options is required:</p> <ul style="list-style-type: none"> ABSORB M (up to 80 km/h permanent posted speed limit)
Status	<p>Zoneguard: Accepted</p> <p>Zoneguard MDS: Requires site specific sign off by the Waka Kotahi Lead Safety Advisor via M23.Queries@nzta.govt.nz</p>
Technical information	
Dimensions	15.24 m length, 700 mm width, 820 mm height (includes rubber pad)
Weight	1405 kg
Minimum length	<ul style="list-style-type: none"> 75 m with anchors at 65 m spacing 95 m with anchors at 10.2 m spacing
Length to point of redirection	<p>TL-3: Interface between the last fixed barrier unit and the end treatment</p> <p>TL-4: 25 m from leading end, 51 m from trailing end</p>
Anchor spacing	65 m maximum spacing
Working width	<ul style="list-style-type: none"> Zoneguard TL-3: 2.6 m (deflection 1.9 m) Zoneguard TL-4: 3.5 m (deflection 2.8 m) Zoneguard MDS: 0.8 m (deflection 0.1 m)
Grade or placement restrictions	<ul style="list-style-type: none"> Not to be installed on ground of cross slope greater than 7% (1V:15H)
Other restrictions / considerations	<ul style="list-style-type: none"> Requires an anchoring system approved by the System Owner The final section at both ends of any Zoneguard Steel Barrier System installation must be fixed to the pavement in accordance with the System Supplier's instructions The maximum anchor point spacing limit may be waived in special circumstances subject to acceptance of an evidence-based application in writing to the Lead Safety Advisor All offsets are to be measured from the relevant outer edge of the foot. The foot is not trafficable

Concrete barrier systems

The following general notes apply to all concrete barriers:

- a) All temporary concrete barriers are freestanding (not fixed to the ground), except as required for transitions to fixed crash cushions
- b) The Risk Assessment and planning will determine appropriate in working spaces and safety zones irrespective of the barrier in use
- c) The barrier test level must meet or exceed the test level corresponding to the posted speed limit (refer System Supplier specifications as to relevant MASH test level)
- d) It is preferable to only connect fixed end treatments to fixed barriers to mitigate the risk due to differential stiffness. A site-specific risk assessment must be undertaken to determine the appropriate barrier and end treatment combination and included with the traffic management plan submission. This assessment must demonstrate that risks associated with vehicle impact with the hardware have been considered and deemed appropriate for the for the site conditions including:
 - (i) Works duration
 - (ii) Vehicle speeds and volumes, approach angles, % HCV and travel direction
 - (iii) Relative stiffness of the end treatment and barrier
- e) In-service impact deflection in excess of the test values indicated for each product should be allowed for in any temporary traffic management plan
- f) Ensure safe and correct lifting and manoeuvring of barriers is undertaken. Barrier size and weight means heavy machinery/plant is required. Ensure product manual and expert advice is sought for installation/removal. Appropriate handling equipment and procedures must be used
- g) All units must be connected with the appropriate connecting hardware
- h) Connecting hardware must be kept in good condition and the hardware replaced if it is damaged, including the barrier unit(s) where these are integral. Modification of any kind, including cutting or welding is not acceptable
- i) The barrier system will be considered non-compliant if an appropriate end treatment or transition component is not fitted
- j) Site specific grading may be necessary to ensure that there are no “humps” or “hollows” that may significantly alter the impacting vehicle’s stability, reduce surf ace friction between the barrier and the ground or substantially alter the barrier height in relation to the ground
- k) Barriers should not be installed immediately in front of or behind kerbs
 - (i) On roads with a permanent speed limit of 70 km/h or more, do not place temporary road safety barrier systems in front of or on top of a kerb, irrespective of profile. Special consideration may be given to placement of the temporary barrier system on top of a mountable or semi-mountable kerb where a site risk assessment has determined the site constraints preclude other options. Do not place the barrier where it could contact the kerb within its normal deflection range for the speed environment (TL-2 or TL-3 as appropriate to permanent speed)
 - (ii) On roads with a permanent speed limit of 60 km/h or less, temporary road safety barrier systems may be placed on top of the kerb. A site risk assessment should be completed to consider the impacts the kerb will have on the impact height and angle of an errant vehicle. Do not place the barrier where it could contact the kerb within its normal deflection range for the speed environment (TL-1 or TL-2 as appropriate to permanent speed)
 - (iii) Site specific risk assessments must be reviewed and approved by a suitably trained independent agent of the RCA, prior to implementation as part of the TMP development and approval process
- l) Barriers must be checked frequently for damage and connection condition with any faults corrected in a timely manner as per Waka Kotahi letter dated 11 February 2014
- m) Provide delineation as determined by thorough risk assessment, planning works and TCD Rule requirements

DELTABLOC DB80 K150 concrete barrier



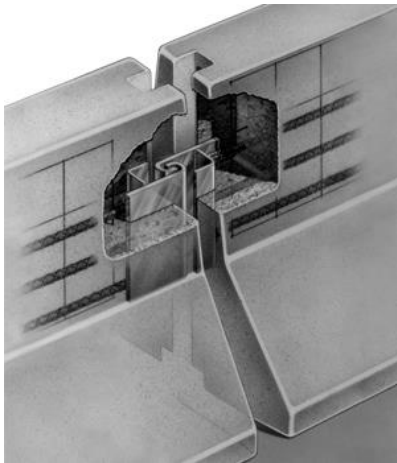
Summary	
Test level / conditions:	TL-3
For use with	A site-specific risk assessment must be undertaken to determine appropriate end treatment: <ul style="list-style-type: none"> • SCI-100 Smart Cushion • Universal TAU-M crash cushion • MASH SLED (up to 80 km/h permanent posted speed limit) • ABSORB M (up to 80 km/h permanent posted speed limit)
Status	Accepted
Technical information	
Dimensions	4 m or 6 m length, 570 mm width, 800 mm height
Weight	2400 kg (4 m unit), 3150 kg (6 m unit)
Minimum length	60 m between end treatments
Length to point of redirection	29.2 m
Anchor spacing	Freestanding
Working width	1.94 m (deflection 1.44 m)
Minimum radius	Using 6 m units: 135 m horizontal radius, 30 m sag curve, 53 m crest curve
Grade or placement restrictions	<ul style="list-style-type: none"> • Not to be placed on crossfall of 6% or greater (approximately 1V:17H) • Foundation pavement conditions must be smooth and free of snag points, kerbs or obstructions that may interfere with the operation of the product • Not to be placed on unstable (mud, un-compacted sand) ground or a surface where the full underside surface of the barrier is not in contact with the road surface) • Barrier rotation – 7° lateral per section, 4° vertical per section
Other restrictions / considerations	<ul style="list-style-type: none"> • The three barrier units connected to a fixed end treatment must be anchored to a suitable foundation using the connection system specified in the installation manual • Use of 2 m DB80 K150S units is restricted to tight radius curves and emergency accesses only

DELTABLOC DB80 T150S & DB80A T150S concrete barrier



Summary	
Test level / conditions:	<ul style="list-style-type: none"> DB80 T150S: TL-3 and TL-4 DB80A T150S: TL-3
For use with	A site-specific risk assessment must be undertaken to determine appropriate end treatment: <ul style="list-style-type: none"> QuadGuard M10 CZ crash cushion Universal TAU-M crash cushion
Status	Accepted
Technical information	
Dimensions	6 m length, 570 mm width, 800 mm height
Weight	3300 kg
Minimum length	DB80 T150S: 92 m between end treatments DB80A T150S: 68 m between end treatments
Length to point of redirection	<ul style="list-style-type: none"> TL-3: Interface between the last fixed barrier unit and the end treatment TL-4: 32.3 m (leading), 59.7 m (trailing)
Anchor spacing	<ul style="list-style-type: none"> DB80 T150S: Freestanding (anchored at the ends only) DB80A T150S: 3 m
Working width	DB80 T150S <ul style="list-style-type: none"> TL-3: 1.36 m (deflection 0.81 m) TL-4: 2.50 m (deflection 0.81 m) DB80A T150S <ul style="list-style-type: none"> Concrete foundation: 0.91 m (deflection 0.34 m) Asphalt foundation: 0.91 m (deflection 0.55 m)
Minimum radius	135 m horizontal radius, 310 m radius sag curve, 583 m radius crest curve
Grade or placement restrictions	<ul style="list-style-type: none"> Not to be placed on crossfall of 10% or greater (approximately 1V:10H) Foundation pavement conditions must be smooth and free of snag points, kerbs or obstructions that may interfere with the operation of the product Not to be placed on unstable (mud, un-compacted sand) ground or a surface where the full underside surface of the barrier is not in contact with the road surface)
Other restrictions / considerations	<ul style="list-style-type: none"> Barrier units fixed to the ground must be anchored using the connection system and foundation specified in the installation manual

J-J Hooks concrete barrier



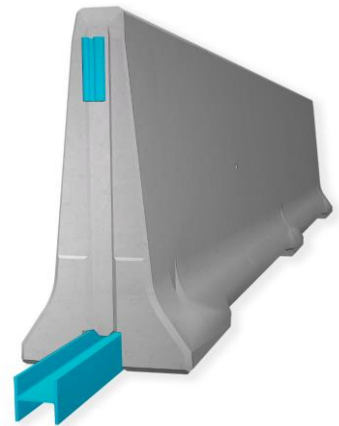
Summary	
Test level / conditions:	TL-3
For use with	<p>A site-specific risk assessment must be undertaken to determine appropriate end treatment:</p> <ul style="list-style-type: none"> • SCI-100 Smart Cushion • QuadGuard M10 CZ Crash Cushion (6 m units only) (forward direction application only) • Universal TAU-M crash cushion (6 m units only) • MASH SLED (up to 80 km/h permanent posted speed limit) • ABSORB M (up to 80 km/h permanent posted speed limit) • ArmorBuffa (up to 80 km/h permanent posted speed limit)
Status	Accepted
Technical information	
Dimensions	6 m and 3.6 m length, 606 mm width, 810 mm height
Weight	4300 kg (6 m unit), 2600 kg (3.6 m unit)
Minimum length	<ul style="list-style-type: none"> • 6 m units: 66 m between end treatments (11 units) • 3.6 m units: 59 m between end treatments (16 units)
Length to point of redirection	<ul style="list-style-type: none"> • 6 m unit: 33 m • 3.6 m unit: 29.5 m
Anchor spacing	Freestanding
Working width	<ul style="list-style-type: none"> • 6 m unit: 2.2 m (deflection 1.6 m) • 3.6 m unit: 2.23 m (deflection 1.63 m)
Minimum radius	<ul style="list-style-type: none"> • 6 m units – 51 m horizontal radius, 40 m ag curve, 53 m crest curve • 3.6 m units - 32 m horizontal radius, 30 m sag curve, 45 m crest curve
Grade or placement restrictions	Not to be placed on crossfall of 6% or greater (approximately 1V:17H)
Other restrictions / considerations	Not to be placed on, directly in front, or directly behind a kerb. If in front - deflection zone must be present behind. Behind kerb – minimum 3 m rearward offset

Rebloc 80SAH_4, 80SAH_12 & 80SAH_12_8B



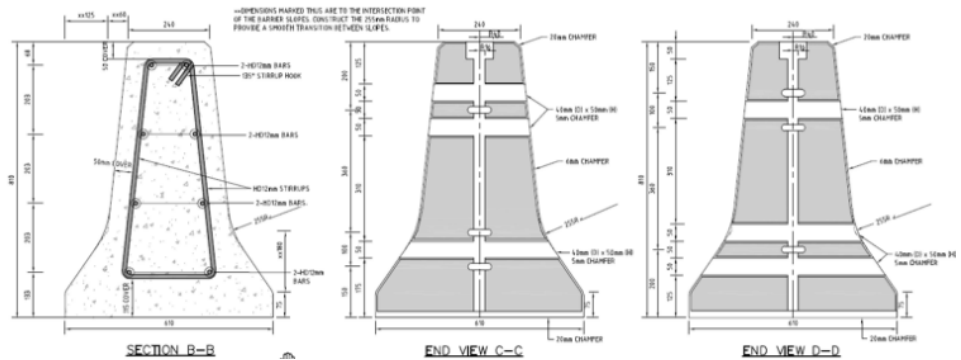
Summary			
Test level / conditions:	<ul style="list-style-type: none"> 80SAH_12: TL-3 and TL-4 80SAH_4 & 80SAH_12_8B: TL-3 		
For use with	A site-specific risk assessment must be undertaken to determine appropriate end treatment: <ul style="list-style-type: none"> SCI-100 Smart Cushion 		
Status	Accepted		
Technical information			
Dimensions	12 or 4 m length, 300 mm width, 800 mm height		
Weight	3400 kg		
Minimum length	80SAH_4: 109 m between end treatments (27 units)	80SAH_12: 108 m between end treatments (9 units)	80SAH_12_8B: 60 m between end treatments (5 units)
Length to point of redirection	<ul style="list-style-type: none"> 80SAH_12: <ul style="list-style-type: none"> TL-3: Interface between barrier and end treatment (fixed end treatment) TL-4: 70.5 m (leading), 85.5 m (trailing) 80SAH_4 & 80SAH_12_8B: Interface between barrier and end treatment 		
Anchor spacing	<ul style="list-style-type: none"> 80SAH_4 & 80SAH_12: freestanding (anchored at the ends only) 80SAH_12_8B: 4 m 		
Working width	80SAH_4: 1.51 m (deflection 1.21 m)	80SAH_12: <ul style="list-style-type: none"> TL-3: 1.56 m (deflection 1.31 m) TL-4: 3.23 m (deflection 1.70 m) 	80SAH_12_8B: 0.6 m (deflection 0.3 m)
Minimum radius	<ul style="list-style-type: none"> 80SAH_4: 86 m horizontal radius, 60 m sag curve, 380 m crest curve 80SAH_12 & 80SAH_12_8B: 260 m horizontal radius, 173 m sag curve, 687 m crest curve 		
Grade or placement restrictions	<ul style="list-style-type: none"> Maximum crossfall of 10% Must be installed on a concrete or asphaltic concrete surface Foundation pavement conditions must be smooth and free of snag points, kerbs or obstructions that may interfere with the operation of the product 		
Other restrictions / considerations	<ul style="list-style-type: none"> The appropriate Rebloc to crash cushion transition must be used and be anchored to the pavement as required by the installation manual 80SAH_4 & 80SAH_12 must be freestanding except for end anchors as per the installation manual 80SAH_12_8B must be anchored as per the installation manual The variants listed here should not be mixed with each other within a barrier string 		

Rebloc 120FA_6_SF



Summary	
Test level / conditions:	TL-3 and TL-5
For use with	A site-specific risk assessment must be undertaken to determine appropriate end treatment: <ul style="list-style-type: none"> • SCI-100 Smart Cushion
Status	Accepted
Technical information	
Dimensions	6 m length, 620 mm width, 1200 mm height
Weight	5000 kg
Minimum length	102 m between end treatments (17 units)
Length to point of redirection	<ul style="list-style-type: none"> • TL-3: Interface between barrier and end treatment • TL-5: <ul style="list-style-type: none"> ○ Leading: 48.3 m ○ Trailing: 53.7 m
Anchor spacing	Freestanding (anchored at the ends only)
Working width	<ul style="list-style-type: none"> • TL-3: 1.0 m (deflection 0.4 m) • TL-5: 2.29 m (deflection 1.58 m)
Minimum radius	150 m horizontal radius, 185 m sag curve, 650 m crest curve
Grade or placement restrictions	<ul style="list-style-type: none"> • Maximum crossfall of 10% • Must be installed on a concrete or asphaltic concrete surface • Foundation pavement conditions must be smooth and free of snag points, kerbs or obstructions that may interfere with the operation of the product
Other restrictions / considerations	The appropriate Rebloc to crash cushion transition must be used and be anchored to the pavement as required by the installation manual

TCB-1 concrete barrier



Summary	
Test level / conditions:	TL-3
For use with	A site-specific risk assessment must be undertaken to determine appropriate end treatment: <ul style="list-style-type: none"> MASH SLED (up to 80 km/h permanent posted speed limit) ABSORB M (up to 80 km/h permanent posted speed limit)
Status	Accepted
Technical information	
Dimensions	6 m length, 610 mm width, 810 mm height
Weight	4500 kg
Minimum length	60 m between end treatments (10 units)
Length to point of redirection	<ul style="list-style-type: none"> Leading: 21.77 m Trailing: 39.47 m
Anchor spacing	Freestanding
Working width	2.22 m (deflection 1.61 m)
Minimum radius	235 m horizontal radius
Grade or placement restrictions	<ul style="list-style-type: none"> Not to be placed on crossfall of 6% or greater Not to be placed on unstable (mud, uncompacted sand) ground or a surface where the full underside surface of the barrier is not in contact with the road surface) Barrier rotation – 7° lateral per section, 4° vertical per section
Other restrictions / considerations	Barriers must be natural concrete in colour with the manufacturing information (refer drawing) clearly visible

End treatments

The following guidance notes are split into two sections. The first section of general notes applies to all end treatments. The second section gives guidance on site-specific risk assessment to determine what type of end treatment is safe and appropriate.

1. General notes

- a) The Risk Assessment and planning will determine appropriate working spaces and safety zones irrespective of the end treatment in use.
- b) The end treatment test level must meet or exceed the test level corresponding to the posted speed limit (refer Barrier supplier specifications as to relevant MASH test level)
- c) In-service impact deflection in excess of the test values indicated for each product should be allowed for in any temporary traffic management plan.
- d) A **site-specific risk assessment** must be undertaken to determine the appropriate barrier and end treatment combination and included with the traffic management plan submission. For guidance on the risk assessment process refer to Section 2 of these notes for end treatments.
- e) End treatment and barrier combinations not accepted in M23 should not be used. Where there is a compelling reason to consider other combinations the risk assessment must include additional detail including evidence that the resultant outcome is likely to be acceptable. Such evidence could include use of information from similar products and field performance information to give an indication of likely performance as well as specific information for details such as the connecting pieces between components. Additional information regarding level of risk may include duration of works, operating speed environment etc. A departure request must be forwarded to the Waka Kotahi Lead Safety Advisor prior to acceptance of the barrier design.
- f) Bi-directional applications must utilize an accepted bi-directional transition configuration. The barrier system will be considered non-compliant if an appropriate end treatment or transition component is not fitted.
- g) Gating and partially gating end treatments shall have a clear area of at least 6 m laterally by 18.5 m longitudinally from the point of redirection of the terminal/terminal and system combination. Note that a longitudinal safety zone is to be factored into the risk assessment(s) and planning and in some cases this may exceed the clear area requirement.
- h) Site specific grading may be necessary to ensure that there are no “humps” or “hollows” that may significantly alter the impacting vehicle’s stability, reduce surf ace friction between the barrier and the ground or substantially alter the barrier height in relation to the ground.
- i) Barriers, including end treatments, should not be installed immediately in front of or behind kerbs:
 - (i) On roads with a permanent speed limit of 70km/h or more, do not place temporary road safety barrier systems in front of or on top of a kerb, irrespective of profile. Special consideration may be given to placement of the temporary barrier system on top of a mountable or semi-mountable kerb where a site risk assessment has determined the site constraints preclude other options. Do not place the barrier where it could contact the kerb within its normal deflection range for the speed environment (TL2 or TL3 as appropriate to permanent speed).
 - (ii) On roads with a permanent speed limit of 60km/h or less, temporary road safety barrier systems may be placed on top of the kerb. A site risk assessment should be completed to consider the impacts the kerb will have on the impact height and angle of an errant vehicle. Do not place the barrier where it could contact the kerb within its normal deflection range for the speed environment (TL1 or TL2 as appropriate to permanent speed).
 - (iii) Site specific risk assessments must be reviewed and approved by a suitably trained independent agent of the RCA, prior to implementation as part of the TMP development and approval process.
- j) End treatments must be checked frequently for damage and connection condition with any faults corrected in a timely manner.
- k) Provide delineation as determined by thorough risk assessment, planning works and TCD Rule requirements.
- l) The end treatment must be inspected after each impact and where appropriate pulled out to its original length. Depending on the impact and type of end treatment, components or the entire end treatment may get damaged and need replacement.

- m) For end treatments utilising water, apply antifreeze additives in the water when using in sub-zero conditions. Use mixture ratios as per the System Supplier's specifications.
- n) Disposal of water shall be in accordance with relevant statutory approvals, regional plans, environmental management plans, and in accordance with the following principles:
 - (i) Where water is discharged to ground or stormwater, it shall be released in a measured way to manage erosion and sediment transport.
 - (ii) Ecotoxic additives (as classified under the Hazardous Substances and New Organisms Act 1996) shall be avoided unless there are no practicable alternatives to their use.
 - (iii) Water with ecotoxic additives shall be disposed of at a facility consented to receive, dispose and/or treat such waste.

2. End treatment selection

This guidance note clarifies the Waka Kotahi NZ Transport Agency requirements regarding the selection of terminations to temporary road safety barrier installations. The guidance is indicative and not exhaustive, and in many cases other risks should be considered or the effects of risks may be different to those described in this document. In such cases readers should use their own judgement or seek further advice as appropriate.

A site-specific risk assessment must be undertaken to determine the appropriate barrier and end treatment combination and this assessment must be included with the traffic management plan submission. The risk assessment must be conducted regardless of the hardware used and must demonstrate that risks associated with vehicle impact with the hardware have been considered and deemed appropriate for the site conditions including but not limited to the risks covered in **Table 1**.

Table 1: Risk analysis items and effects

Risk item	Effect on risk
Works duration	Increased duration increases risk because traffic is <u>exposed</u> to the hazard for a longer time.
Vehicle speeds	Increased speed increases vehicle kinetic energy, which has a direct effect on the <u>severity</u> of a crash. The speed value used to determine the required barrier performance level must be the highest likely impact speed, therefore a temporary speed limit is not sufficient to manage speed down to a level allowing the use of lower speed rated hardware. This is because motorists frequently fail to recognise the need for speed reduction when a temporary speed limit is in place, particularly at unattended sites outside normal operating times. This has led to unacceptable crash outcomes. For this reason, all road safety hardware performance levels must be appropriate for the permanent posted speed limit, not the temporary speed limit. Any variation must be approved by the road controlling authority.
Vehicle volumes (AADT)	Increased traffic volume increases risk because more traffic is <u>exposed</u> to the hazard.
Vehicle approach angles	Increased approach angles increase the risk of high impact angles which in turn increases the kinetic energy. Increased kinetic energy has a direct effect on the <u>severity</u> of a crash. Additional lanes and horizontal curvature both increase the risk of high approach angles.
Percentage heavy commercial vehicles (% HCV)	Heavy Commercial Vehicles have much greater kinetic energy than light vehicles and require higher test level barriers and/or more working width. Increased kinetic energy has a direct effect on the <u>severity</u> of a crash.
Vehicle travel direction	The travel direction of vehicles on undivided carriageways determines whether the relative stiffness of the end treatment and barrier is critical to system performance, such as when a trailing end treatment for the nearside traffic may also have to operate

	as a leading end treatment for the far side traffic. Transitioning from a relatively flexible system to a more rigid system can increase the <u>severity</u> of a crash.
Relative stiffness of the end treatment and barrier	<p>Differences in hardware stiffness can lead to unsafe conditions such as pocketing or vehicle instability.</p> <p>End treatment fixity should comply with the following guidance, subject to outcome of risk assessment and all reasonable steps having been undertaken to mitigate any identified risks:</p> <ul style="list-style-type: none"> (i) Freestanding end treatments should generally only be used with freestanding barriers to mitigate risks associated with differential deflection or stiffness between the end treatment and the barrier. (ii) Fixed end treatments should generally be used on fixed barriers to mitigate risks associated with differential deflection or stiffness between the end treatment and the barrier. (iii) For sites with mono-directional flow, where reverse angle impact risk has been eliminated, fixed end treatments may be used with fixed or freestanding barriers. <p>Freestanding end treatments may be used with fixed barriers where a site-specific risk assessment of the transition between end treatment and barrier and vice versa shows that the combination is acceptably safe. Connecting hardware must be kept in good condition and the hardware replaced if it is damaged, including the barrier unit(s) where these are integral. Modification of any kind, including cutting or welding is not acceptable.</p>

Table 2: Indicative division of temporary end treatments into three types

Type	Description	Accepted usage
1	Water-filled freestanding road safety barrier systems with integral end treatment sections.	<ul style="list-style-type: none"> (i) May only be used on state highways where there are 2 or fewer lanes in any one direction (divided or un-divided) or the offset from live traffic is less than 8m and where the permanent posted speed limit (PPSL) is 70km/h or less. (ii) May not be used in higher speed environments (i.e. permanent posted speed limit greater than 70km/h) unless the site-specific risk assessment has been completed and accepted by the Waka Kotahi Lead Safety Advisor via M23.Queries@nzta.govt.nz. May only be used where high-speed side impacts are unlikely, penetration behind the barrier is acceptable and use of a redirecting impact attenuator is not feasible for reasons other than cost or convenience.
2	Water-filled freestanding end treatments with supplementary transition support designed for low-risk temporary traffic management sites.	<ul style="list-style-type: none"> (iii) May be used where the permanent posted speed limit is up to 80km/h. (iv) May only be used where the permanent posted speed limit is above 80km/h if site-specific acceptance has been granted by the Lead Safety Advisor.
3	Heavier re-usable/repairable systems designed for high-risk temporary sites and permanent installations. These systems often have TL-3 (100km/h) and TL-2 (70 km/h)	May be used in combination with an appropriate barrier on all sites, irrespective of lane configurations and speed environments.

	variants. For temporary installations, some of these systems can be mounted on either steel plates (pinned) or concrete pads.	
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For temporary end treatment selection, the following definitions of duration of works apply:

- Short term – the crash cushion will be installed for a period of 3 months or less.
- Medium term - the crash cushion will be installed for a period of 3 to 6 months.
- Long term – the crash cushion will be installed for a period of more than 6 months.

Table 3: Indicative temporary end treatment selection matrix

Duration of temporary works and/or Traffic volume (AADT)	↑	↑	3 or 2	3	3
			2	3 or 2	3
			1	2	3 or 2
			Permanent posted speed limit and/or No. of live lanes (adjacent to works) →		

Table 4: Indicative temporary end treatment selection key

	Severity criteria	Exposure criteria
1	Permanent posted speed limit < 60kmh No. of live lanes <2	Duration < 3months "Low" AADT
2	Permanent posted speed limit < 80kmh No. of live lanes <2	Duration 3 to 6 months "Medium" AADT
3 or 2	Permanent posted speed limit ≥ 80kmh No. of live lanes >2	Duration > 6 months "Medium AADT"
<i>NB: Type 2 end treatment may require site-specific acceptance from the RCA</i>		
3	Permanent posted speed limit > 80kmh No. of live lanes >2	Duration > 6 months "High" AADT

ABSORB-M crash cushion



Summary	
Test level / conditions:	TL-2 and TL-32
End treatment type	<ul style="list-style-type: none"> • Non-redirective, gating • Freestanding
For use with	Temporary concrete barriers, temporary steel barriers (where accepted transitions are available)
Status	<ul style="list-style-type: none"> • 3 element unit: accepted up to 80 km/h (permanent speed limit) unless site specific risk assessment demonstrates safe deployment can be achieved • 2 element unit: accepted up to 60 km/h (permanent speed limit)
Technical information	
Dimensions	<ul style="list-style-type: none"> • TL-3: 7.22 m length, 670 mm width, 1100 mm height • TL-2: 5.29 m length, 670 mm width, 1100 mm height
Weight	Not provided – contact supplier
Water fill capacity	Not provided – contact supplier (a minimum of 200 L water supply capacity is required)
Clear area	18.5 m x 6 m clear run-out area required, measured from the connection to the longitudinal barrier
Grade or placement restrictions	<ul style="list-style-type: none"> • The maximum approach and cross slope is 8% (1V:12H) • Foundation pavement conditions must be smooth and free of snag points, kerbs or obstructions that may interfere with the operation of the product
Other restrictions / considerations	<ul style="list-style-type: none"> • The front element must not be filled with water as that would cause the system to perform improperly • All plastic end treatments used to shield rigid or semi-rigid barriers can pose a significant hazard when struck at a steep angle near the transition. Under some impact conditions vehicles may penetrate and strike the barrier end or intrude a significant distance (over 30m) into the shielded area. For this reason, plastic crash cushions/end treatments must not be installed on curves, or wide roads where steep angles of impact are more likely. The installation Designer is to take this into account in their design • The end treatment must not be installed on curves or wide roads where steep angles of impact are more likely • The end treatment must only be attached to the barrier by using the accepted proprietary transition attachment

ArmorBuffa end treatment



Summary	
Test level / conditions:	TL-2 and TL-3
End treatment type	<ul style="list-style-type: none"> • Non-redirective, gating • Freestanding
For use with	Freestanding temporary concrete barriers, temporary steel barriers (where accepted transitions are available)
Status	Accepted up to 80 km/h (permanent speed limit) unless site specific risk assessment demonstrates safe deployment can be achieved
Technical information	
Dimensions	TL-2: 5.30 m length, 525 mm width, 1100 mm height TL-3: 9.31 m length, 525 mm width, 1100 mm height
Weight	Not provided – contact supplier
Water fill capacity	700 L per element (4 elements)
Clear area	18.5 m x 6 m clear run-out area required, measured from the connection to the longitudinal barrier
Grade or placement restrictions	<ul style="list-style-type: none"> • The maximum approach and cross slope is 8% (5° or 1V:12H) • Foundation pavement conditions must be smooth and free of snag points, kerbs or obstructions that may interfere with the operation of the product
Other restrictions / considerations	<ul style="list-style-type: none"> • All plastic end treatments used to shield rigid or semi-rigid barriers can pose a significant hazard when struck at a steep angle near the transition. Under some impact conditions vehicles may penetrate and strike the barrier end or intrude a significant distance (over 30m) into the shielded area. For this reason, plastic crash cushions/end treatments must not be installed on curves, or wide roads where steep angles of impact are more likely. The installation Designer is to take this into account in their design

SLED-US end treatment (MASH SLED)



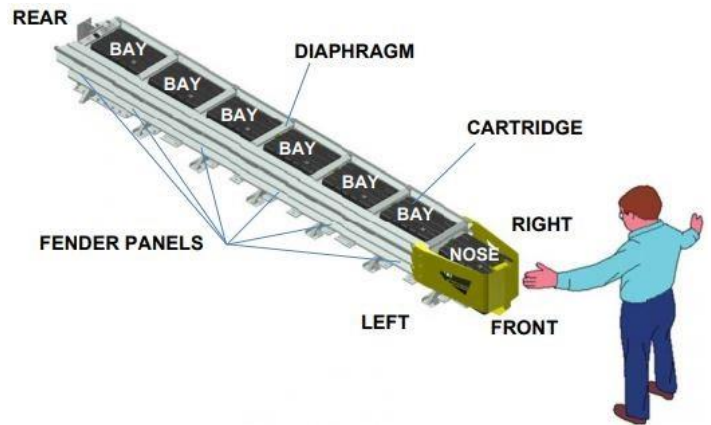
Summary	
Test level / conditions:	TL-1, TL-2 & TL-3
End treatment type	<ul style="list-style-type: none"> Non-redirective, gating Freestanding
For use with	Sentry Water Cable Barrier System, Temporary Concrete Barrier (TCB1), temporary steel barriers (where accepted transitions are available)
Status	Accepted up to 80 km/h (permanent speed limit) unless site specific risk assessment demonstrates safe deployment can be achieved
Technical information	
Dimensions	<ul style="list-style-type: none"> TL-1: 3.85 m length, 571 mm width, 1084 mm height TL-2: 5.77 m length, 571 mm width, 1084 mm height TL-3: 7.90 m length, 571 mm width, 1084 mm height
Weight	Module: 72.6 kg (empty), 907 kg (full), CIS: 89.36 kg
Water fill capacity	832 litres per module (front module must be empty)
Clear area	18.5 m x 6 m clear run-out area required, measured from the connection to the longitudinal barrier
Grade or placement restrictions	<ul style="list-style-type: none"> The maximum cross slope or approach slope the End Treatment may be used on is 1 in 10. On slopes greater than this approval is required from the RCA Foundation pavement conditions must be smooth and free of snag points, kerbs or obstructions that may interfere with the operation of the product
Other restrictions / considerations	<ul style="list-style-type: none"> The end treatment is only to be installed where it is likely to be struck head on The end module attached to the CIS must not be filled with water The SLED-US end treatment must not be attached or fixed to the ground The minimum acceptable configuration for use on >70 km/h state highway sites is the 4 module TL-3 configuration All plastic crash cushions used to shield rigid or semi-rigid barriers can pose a significant hazard when struck at a steep angle near the transition. Under some impact conditions vehicles may penetrate and strike the barrier end or intrude a significant distance (over 30m) into the shielded area. For this reason, plastic crash cushions/end treatments must not be installed on curves, or wide roads where steep angles of impact are more likely. The installation Designer is to take this into account in their design The end treatment must only be attached to barriers using the accepted transition attachment The SLED-US end treatment differs from the SLED-EURO in that it does not employ steel lateral panels on the rear two cartridges

Hercules



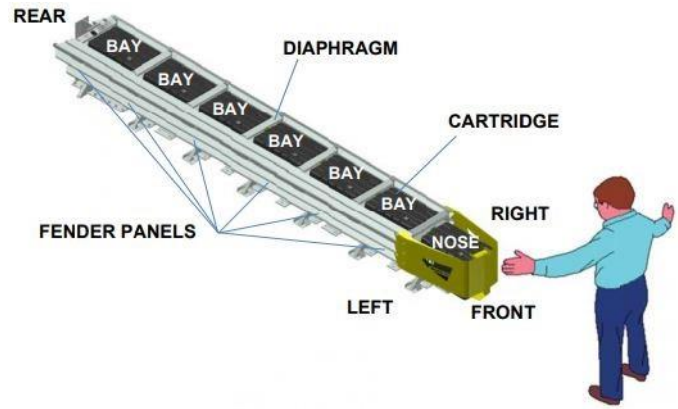
Summary	
Test level / conditions:	TL-3
End treatment type	<ul style="list-style-type: none"> • Redirective, non-gating • Fixed
For use with	Fixed or freestanding barriers in accordance with barrier system conditions listed in this appendix (where reverse impacts are possible, e.g. bidirectional traffic, a risk assessment must be completed and steps to mitigate the likelihood of reverse impact should be implemented)
Status	Accepted
Technical information	
Dimensions	<ul style="list-style-type: none"> • Width: 590 mm • Length: 5.9 m • Height: 890 mm
Weight	1051 kg
Grade or placement restrictions	<ul style="list-style-type: none"> • 6.0 m x 800 mm x 190 mm depth reinforced concrete • Hazard free area 3 metres downstream of the crash cushion and 12 metres laterally must be provided • Side slope shall not exceed 8%
Other restrictions / considerations	<ul style="list-style-type: none"> • Requires an anchoring system approved by the System Owner • Transitions to adjacent barriers are available from the System Supplier • Inspection frequency to be based on volume of traffic and impact history. Visual drive-by inspections are recommended at least once a month. Walk-up inspections are recommended at least once a year

QuadGuard M10 CZ



Summary	
Test level / conditions:	TL-2 and TL-3
End treatment type	<ul style="list-style-type: none"> • Redirective, non-gating • Fixed
For use with	Fixed or freestanding barriers in accordance with barrier system conditions listed in this appendix (where reverse impacts are possible, e.g. bidirectional traffic, a risk assessment must be completed and steps to mitigate the likelihood of reverse impact should be implemented)
Status	Accepted
Technical information	
Dimensions	<ul style="list-style-type: none"> • TL-2: 4 m length, 610 mm width, 817 mm height • TL-3: 6.71 m length, 610 mm width, 817 mm height
Weight	Not supplied
Grade or placement restrictions	<ul style="list-style-type: none"> • Should be assembled on: <ul style="list-style-type: none"> ○ An existing or freshly placed and cured concrete base (Min 28 MPa and 150 mm min depth), or ○ Steel plate on 150 mm asphalt concrete over 150 mm compacted subbase • Hazard free area 3.1 m downstream and 11 m laterally to be provided • Cross-slope shall not exceed 8% and should not twist more than 2% over the length of the system
Other restrictions / considerations	<ul style="list-style-type: none"> • Requires an anchoring system approved by the System Owner • Transitions to adjacent barriers are available from the System Supplier • Inspection frequency to be based on volume of traffic and impact history. Visual drive-by inspections are recommended at least once a month. Walk-up inspections are recommended at least once a year

QuadGuard M10 (including QuadGuard M Wide)



Summary	
Test level / conditions:	TL-2 and TL-3
End treatment type	<ul style="list-style-type: none"> • Redirective, non-gating • Fixed
For use with	Compatible concrete or steel temporary barriers (where reverse impacts are possible, e.g. bidirectional traffic, a risk assessment must be completed and steps to mitigate the likelihood of reverse impact should be implemented)
Status	Accepted
Technical information	
Dimensions	<ul style="list-style-type: none"> • TL-2: 4 m length, 610 mm width (QuadGuard M10) or 1.755 m (QuadGuard M Wide), 817 mm height • TL-3: 6.71 m length, 610 mm width (QuadGuard M10) or 1.755 m (QuadGuard M Wide), 817 mm height
Weight	Not supplied
Grade or placement restrictions	<ul style="list-style-type: none"> • Should be assembled on an existing or freshly placed and cured reinforced concrete base (Min 28 MPa and 150 mm min depth) • Hazard free area 3.1 m downstream and 11 m laterally to be provided • Cross-slope shall not exceed 8% and should not twist more than 2% over the length of the system
Other restrictions / considerations	<ul style="list-style-type: none"> • Requires an anchoring system approved by the System Owner • Transitions to adjacent barriers are available from the System Supplier • Inspection frequency to be based on volume of traffic and impact history. Visual drive-by inspections are recommended at least once a month. Walk-up inspections are recommended at least once a year

SCI-100 Smart Cushion



Summary	
Test level / conditions:	TL-2 and TL-3
End treatment type	<ul style="list-style-type: none"> • Redirective, non-gating • Fixed
For use with	Fixed or freestanding barriers in accordance with barrier system conditions listed in this appendix (where reverse impacts are possible, e.g. bidirectional traffic, a risk assessment must be completed and steps to mitigate the likelihood of reverse impact should be implemented)
Status	Accepted
Technical information	
Dimensions	<ul style="list-style-type: none"> • TL-2: 4 m long, 610 mm wide, 840 mm high • TL-3: 6.55 m long, 610 mm wide, 840 mm high
Weight	<ul style="list-style-type: none"> • TL-2: 1120 kg • TL-3: 1570 kg
Grade or placement restrictions	<ul style="list-style-type: none"> • Foundations must be a flat surface with longitudinal and cross slopes of 10:1 or less • Smart Cushion impact units should not be located over drainage basins or expansion joints
Other restrictions / considerations	<ul style="list-style-type: none"> • Requires an anchoring system approved by the System Owner • The SCI can be bolted onto a concrete pad and inserted into a rebated seal area and work independent of a barrier string. The SCI is also accepted fixed to asphaltic concrete as per the System Supplier's instructions • Barriers that are wider than 610 mm (excepting F-Shape barriers with base widths up to 700 mm) and/or have reverse direction traffic require a transition as per the supplier's instructions

Universal TAU-M



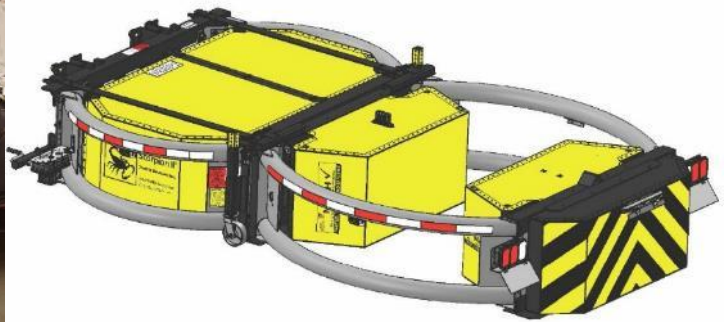
Summary	
Test level / conditions:	TL-2 and TL-3
End treatment type	<ul style="list-style-type: none"> • Redirective, non-gating • Fixed
For use with	Fixed or freestanding barriers in accordance with barrier system conditions listed in this appendix (where reverse impacts are possible, e.g. bidirectional traffic, a risk assessment must be completed and steps to mitigate the likelihood of reverse impact should be implemented)
Status	Accepted
Technical information	
Dimensions	<ul style="list-style-type: none"> • TL-2: length: 4 bays, 4.33 m • TL-3: length: 7 bays, 6.93 m • 762 mm width • 830 mm height
Weight	Varies with configuration
Grade or placement restrictions	<ul style="list-style-type: none"> • Side slope limit: Vertical (7%) • Should be assembled on: <ul style="list-style-type: none"> ○ An existing or freshly placed and cured concrete base (Min 28 MPa and 150 mm min depth). The foundation surface shall have a light broom finish, or ○ 150 mm asphaltic concrete over 150 mm compacted sub-base using when used with a tension-strut backup. Additional maintenance requirements apply
Other restrictions / considerations	<ul style="list-style-type: none"> • Requires an anchoring system approved by the System Owner • All kerbs, raised islands and elevated objects greater than 100 mm high that would be beneath, beside or less than 15 m in front of a TAU-M crash cushion should be removed prior to installation • For median use single sided installation only where rear impact is not possible

Truck and trailer mounted attenuators

The following general notes apply to all truck and trailer mounted attenuators (TMAs):

- a) All activities utilising truck or trailer mounted attenuators must be undertaken in accordance with the Health and Safety at Work Act 2015 and the New Zealand Guide to Temporary Traffic Management (NZGTTM) and supported by a risk assessment that is specific to the tasks being undertaken
- b) TMAs may be considered for use on roads with a higher posted speed than that listed in the technical information below where a risk assessment has determined their deployment to be safe and appropriate for the road environment
- c) When deployed as part of a work activity a Shadow Vehicle or Work Vehicle may have an attenuator fitted and deployed when the risk assessment for the task shows a safety benefit
- d) The System Supplier must be able to provide written confirmation to the End User that:
 - (i) The proposed configuration of TMA and Support Vehicle (where this differs from the Support Vehicle as used in testing) are warranted for safe performance by the System Owner
 - (ii) The attenuator mount has been structurally certified by an appropriately qualified Heavy Vehicle Specialist Certifier
- e) At all times the Support Vehicle must be compliant with the Land Transport Rule including Vehicle Standards Compliance
- f) Ensure weight of Support Vehicle used for mounting is finalised before fitting of attenuator (to avoid ride height fluctuations by adding weight following attachment)
- g) Attenuator must be inspected prior to each deployment to ensure no damage to outer casing or support
- h) All repairs to the attenuator and mounts must be undertaken by a repairer certified by the System Owner
- i) If optional jockey wheels are fitted, these must be safely stowed for transport
- j) Support Vehicle must be deployed in second gear (manual transmission) or park (automatic transmission) with the handbrake engaged during static TTM operations
- k) Support Vehicle must not use secondary braking restraint (chocked)

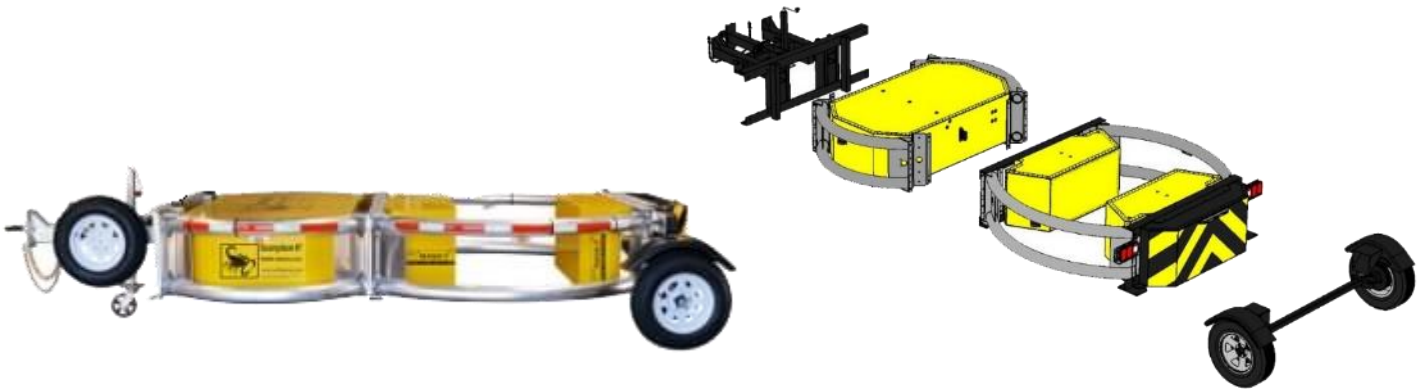
Scorpion II (MASH Model A, C & C-90 variants)



SUMMARY

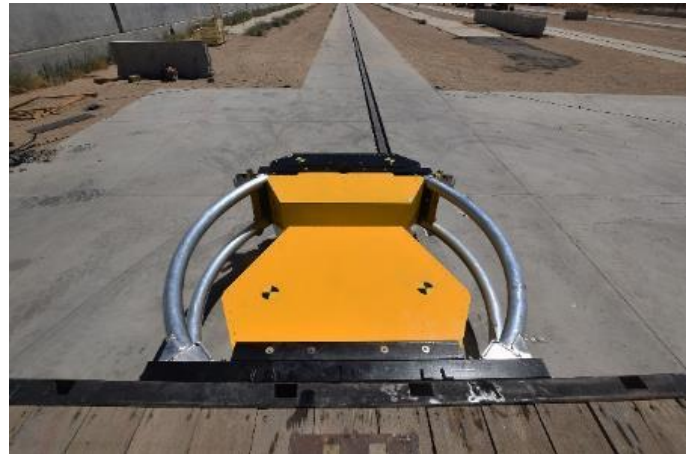
Test level / conditions:	TL-3
Status	Accepted
Technical information	
Maximum permanent posted speed	100 km/h
Dimensions	<ul style="list-style-type: none"> • Length: 3930 mm • Width: 2450 mm • Height: 600 mm • Height (up position): 3830 mm
Weight	900 kg
Road clearance	280 mm – 330 mm
Support vehicle gross mass excluding TMA and mounting hardware	Minimum 6804 kg – dependent on local vehicle requirements
Roll ahead distance	5.12 m
Recommended maximum travel speed	With TMA in down position: 50 km/h
Other restrictions / considerations	<ul style="list-style-type: none"> • The Scorpion TMA uses hydraulic lifting and lowering mechanisms not reliant on gravity (to ensure full lowering position). Care must be taken to ensure full deployment is achieved before operation • Ensure all four jacking wheels are secured in up positions before operating the mounted vehicle

Scorpion II trailer attenuator (MASH)



Summary	
Test level / conditions:	TL-3
Status	Accepted
Technical information	
Maximum permanent posted speed	100 km/h
Dimensions	<ul style="list-style-type: none"> Length: 5400 mm Width: 2400 mm Height: 910mm (above surface level when deployed)
Weight	873 kg
Road clearance	280 mm – 330 mm
Support vehicle gross mass excluding TMA and mounting hardware	Minimum 6151 kg – dependent on local vehicle requirements
Roll ahead distance	6.2 m
Recommended maximum travel speed	90 km/h
Other restrictions / considerations	Pintle hook and backing plate must be structurally certified by an appropriately qualified Heavy Vehicle Specialist Certifier

Scorpion II (MASH TL-2 variant)



Summary	
Test level / conditions:	TL-2
Status	Accepted as Light TMA (refer M23 Appendix F for deployment guidance)
Technical information	
Maximum permanent posted speed	80 km/h
Dimensions	<ul style="list-style-type: none"> Length: 2300 mm Width: 2400 mm Height: 600 mm
Weight	690 kg
Road clearance	305 mm
Support vehicle gross mass excluding TMA and mounting hardware	Minimum 3300 kg – dependent on local vehicle requirements
Roll ahead distance	12.4 m
Recommended maximum travel speed	With TMA in down position: 50 km/h
Other restrictions / considerations	<ul style="list-style-type: none"> The Scorpion II MASH TL-2 may only be deployed on up to Level 2 roads where a risk assessment has determined their deployment to be safe and appropriate for the road environment and the end user's HSW policies and procedures The support vehicle must have a tare weight of at least 3300 kg and when stationary be deployed in "Park" or second gear with brakes applied A confirmation of available roll-ahead distance of 12.4 m, as a risk assessed minimum, must be provided for in all TMPs/TMDs and on-site records when deployed In the event of an impact into a deployed Scorpion II LTMA a full TTM incident report must be provided to Waka Kotahi within 48 hours The Scorpion TMA uses hydraulic lifting and lowering mechanisms not reliant on gravity (to ensure full lowering position). Care must be taken to ensure full deployment is achieved before operation Ensure all four jacking wheels are secured in up positions before operating the mounted vehicle

Silke (MASH)



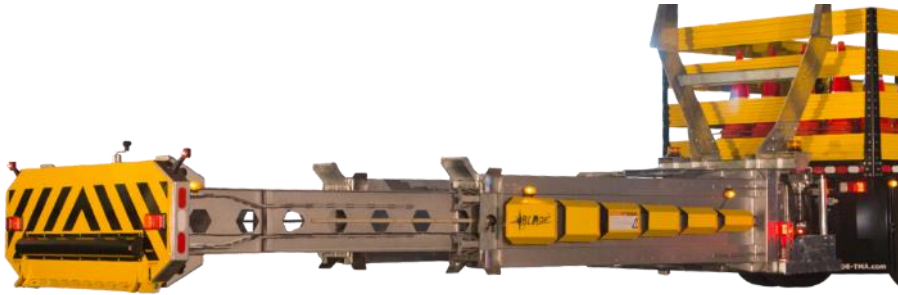
Summary	
Test level / conditions:	TL-3
Status	Accepted
Technical information	
Maximum permanent posted speed	100 km/h
Dimensions	<ul style="list-style-type: none"> • Length: 6328 mm • Width: 2295 mm • Height: 605 mm
Weight	1450 kg
Road clearance	300 mm
Support vehicle gross mass excluding TMA and mounting hardware	Minimum 5500 kg – dependent on local vehicle requirements
Roll ahead distance	5.9 m (tested), 15 m (recommended)
Recommended maximum travel speed	With TMA in down position – minimum/creep speed

SS180M TMA (MASH)



Summary	
Test level / conditions:	TL-3
Status	Accepted
Technical information	
Maximum permanent posted speed	100 km/h
Dimensions	<ul style="list-style-type: none"> Length: 4460 mm Width: 2090 mm Height: 959 mm (above surface level when deployed)
Weight	922 kg
Road clearance	305 mm
Support vehicle gross mass excluding TMA and mounting hardware	6150 to 11000 kg – dependent on local vehicle requirements
Roll ahead distance	6.4 m
Recommended maximum travel speed	With TMA in unfolded position – 40 km/h

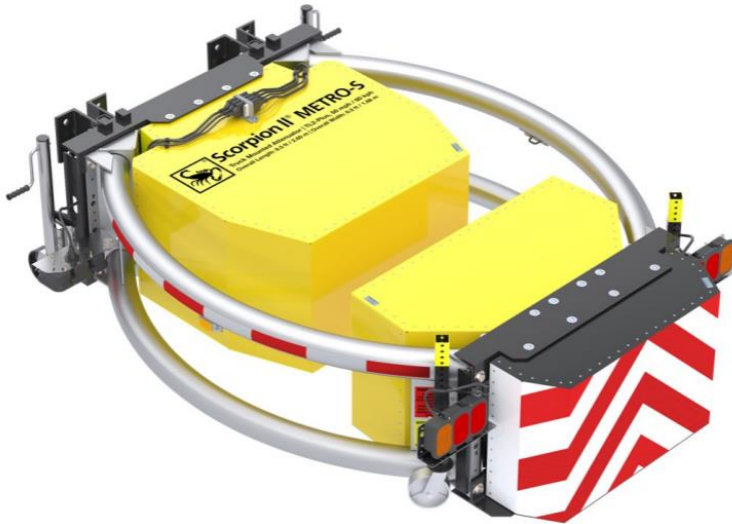
Verdegro Blade (MASH)



Summary	
Test level / conditions:	TL-2 and TL-2
Status	Accepted
Technical information	
Maximum permanent posted speed	<ul style="list-style-type: none"> • 100 km/h (TL-3) • 60 km/h (TL-2)
Dimensions	<ul style="list-style-type: none"> • Length: 5913 mm (extended), 4100 mm (retracted) • Width: 2338 mm • Height: 768 mm (above surface level when deployed) or 3937 mm (up position)
Weight	1100 kg
Road clearance	280 mm – 330 mm
Support vehicle gross mass excluding TMA and mounting hardware	Minimum 5711 kg – dependent on local vehicle requirements
Roll ahead distance	4.4 m
Recommended maximum travel speed	With TMA in down position – 50 km/h
Other restrictions / considerations	<ul style="list-style-type: none"> • When raised the Blade TMA must be retracted for transport to ensure maximum vehicle height restrictions are not exceeded • The support vehicle for a compliant Blade MASH TL-3 TMA must have a minimum gross mass (excluding TMA) of 7262 kg. The physical size of this support vehicle may therefore affect the operation of the unit in its retracted MASH TL-2 configuration on Level 2 and 3 roads with permanent speed limits of 60 km/h or lower. This aspect must be considered by the TTM Operator when undertaking their risk assessment and safe work method statement (SWMS) for any deployment of the TL-2 configuration

OTHER TMAs

Scorpion II METRO Slim



Summary	
Test level / conditions:	MASH TL-2
Status	May only be deployed where a risk assessment has determined the deployment to be safe and appropriate for the road environment as detailed in the end user's health and safety at work policies and procedures
Technical information	
Maximum permanent posted speed	<ul style="list-style-type: none"> 80 km/h (urban state highways and local roads) Not suitable for use on motorways, expressways and rural state highways
Dimensions	<ul style="list-style-type: none"> 2634 mm length 1872 mm width 1050 mm height (above surface level when deployed) or 3367 mm (up position)
Weight	300 kg
Road clearance	305 mm \pm 25 mm
Support vehicle gross mass excluding TMA and mounting hardware	3300 kg
Roll ahead distance	27.8 m
Recommended maximum travel speed	With TMA in down position – creeping speed
Other restrictions / considerations	<ul style="list-style-type: none"> The support vehicle must have a curb weight of 3300 kg and when stationary be deployed in "Park" or second gear with brakes applied A confirmation of available roll-ahead distance of 30 m, as a risk assessed minimum, must be provided for in all TMPs/TMDs and on-site records when deployed Not suitable for use on motorways, expressways and rural state highways

Stuer-Egghe JUMINI light truck mounted attenuator (Level 1 only)



Summary

Test level / conditions:	CEN/TS16786 (approximately equivalent to MASH TL-1)
Status	May only be deployed on Level 1 roads where a risk assessment has determined the deployment to be safe and appropriate for the road environment as detailed in the end user's health and safety at work policies and procedures

Technical information

Maximum permanent posted speed	50 km/h
Dimensions	2460 mm length, 1900 mm width, 920 mm height (above surface level when deployed) or 1810 mm (up position)
Weight	300 kg
Road clearance	280 mm – 320 mm
Support vehicle gross mass excluding TMA and mounting hardware	1845 to 5100 kg
Roll ahead distance	9.4 m
Recommended maximum travel speed	With TMA in down position – creeping speed
Other restrictions / considerations	<ul style="list-style-type: none"> The support vehicle must have a tare weight of between 1845 kg and 5100 kg and when stationary be deployed in "Park" or second gear with brakes applied A confirmation of available roll-ahead distance of 10 m, as a risk assessed minimum, must be provided for in all TMPs/TMDs and on-site records when deployed In the event of an impact into a deployed JUMINI LTMA a full incident report must be provided to the road controlling authority within 48 hours

Verdegro LTMA Light truck mounted attenuator (Level 1 only)



Summary	
Test level / conditions:	NCHRP 350 TL-2 (not MASH compliant)
Status	May only be deployed on Level 1 roads where a risk assessment has determined the deployment to be safe and appropriate for the road environment as detailed in the end user's health and safety at work policies and procedures
Technical information	
Maximum permanent posted speed	70 km/h
Dimensions	1975 mm length, 2030 mm width, 830 mm height (above surface level when deployed) or 2700 mm (up position)
Weight	200 kg
Road clearance	280 mm – 330 mm
Support vehicle gross mass excluding TMA and mounting hardware	2500 to 5500 kg
Roll ahead distance	>6 m
Recommended maximum travel speed	With TMA in down position – 50 km/h
Other restrictions / considerations	<ul style="list-style-type: none"> The support vehicle must have a tare weight of between 2500 kg and 5500 kg and when stationary be deployed in "Park" or second gear with brakes applied A confirmation of available roll-ahead distance of 10 m, as a risk assessed minimum, must be provided for in all TMPs/TMDs and on-site records when deployed In the event of an impact into a deployed Verdegro LTMA 70K a full incident report must be provided to the road controlling authority within 48 hours

Legacy hardware

In this section
Legacy water filled barriers
ARMORZONE TL-2 plastic barrier and end treatment
WATER-WALL TL-1 plastic barrier and MINI-SLED end treatment
Legacy end treatments
ABSORB 350 crash cushion
ACZ-350 temporary crash cushion
SLED (EURO) end treatment
QUADGUARD II crash cushion system (including QUADGUARD II CZ)
TAU-II crash cushion
TRACC crash attenuation cushion
Legacy TMAs
ALPHA 70K
SCORPION I (Model A, C & C-90 models)
SS90HD
STUER-EGGHE JL-D-850 'JULIETTA' 100K
U-MAD (70K & 100K models)

Legacy water filled barriers

ARMORZONE TL-2 plastic barrier and end treatment



Summary	
Test level / conditions:	NCHRP 350 TL-2
Status	Legacy system (not for new state highway installations) from 1 January 2021)
Technical information	
Dimensions	2 m effective length, 450 mm width
Weight	50 kg (empty), 570 kg (full)
Water fill capacity	520 litres
Minimum length	50 m (2 end treatments and 23 units)
Length to point of redirection	16 m (8 units)
Minimum radius	28 m
Grade or placement restrictions	A maximum approach and cross slope of 1V:10H is preferable
Deflection	2.1 m from rear edge of barrier (70 km/h, 2000 kg vehicle, 25° angle)
Working width	Not reported
Water fill hole diameter	125 mm
Other restrictions / considerations	<ul style="list-style-type: none"> • Any identified single instance of MASH units used in conjunction with NCHRP 350 units will be considered non-compliant practice, rated as “dangerous” and a notice of non-conformance will be issued • The adjacent road operating speed must be limited to 70 km/h and the installation should endeavour to minimise the impact angles to 25° (1 lateral: 2.14 forward) • The Armorzone TL-2 End Treatment forms an integral part of this system and must be installed and maintained in accordance with the product installation/maintenance manual and relevant Waka Kotahi specifications/requirements • Armorzone systems should be installed on a compacted surface

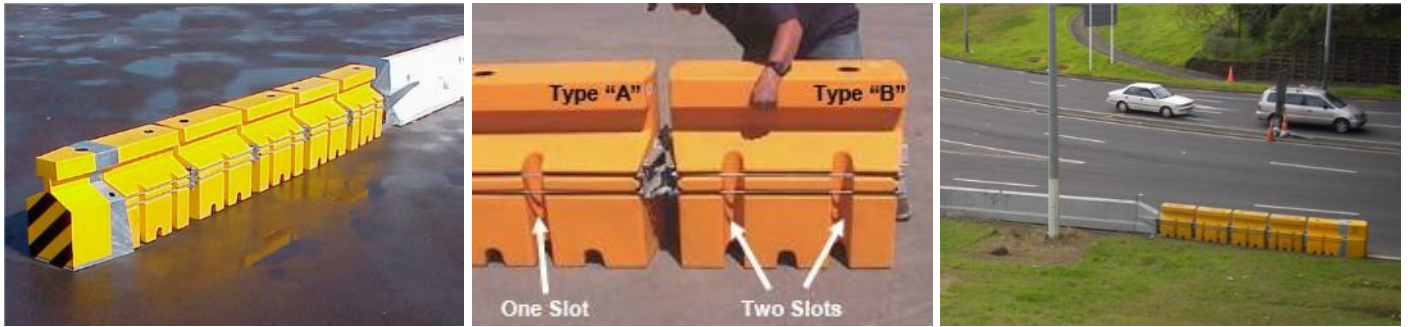
WATER-WALL TL-1 plastic barrier and MINI-SLED end treatment



Summary	
Test level / conditions:	NCHRP 350 TL-1
For use with	The MASH TL-1 SLED Mini End Treatment is the only currently accepted end treatment
Status	Legacy system (not for new state highway installations) from 1 January 2021
Technical information	
Dimensions	1854 mm effective length, 460 mm width, 822 mm height
Weight	35 kg (empty), 500 kg (full)
Water fill capacity	465 litres per section
Minimum length	52.4 m minimum total length (26 units plus two end treatments)
Length to point of redirection	Mini-SLED plus 7 Water-Wall barrier units
Minimum deflection	2.44 m from rear edge of barrier (50 km/h, 2000 kg vehicle, 25° angle)
Working width	2.9 m
Grade or placement restrictions	End Treatment not to be placed on cross or approach slopes greater than 10°
Other restrictions/ considerations	<ul style="list-style-type: none"> • Any identified single instance of MASH units used in conjunction with NCHRP 350 units will be considered non-compliant practice, rated as “dangerous” and a notice of non-conformance will be issued • The Water-Wall + Mini-SLED TL1 temporary barrier system may only be used on temporary traffic management sites where the permanent posted speed limit is 50 km/h or less and the site is under temporary traffic management control • All Water-Wall TL1 temporary barrier system units must be connected with the appropriate steel connecting pin and filled with water when in use • If the Mini-SLED TL1 End Treatment component of this system is NOT fitted, the entire barrier system will be considered non-conforming • The Yellow SLED module is NOT filled with water • The Mini-SLED End Treatment must not be attached or fixed to the ground, or any other object

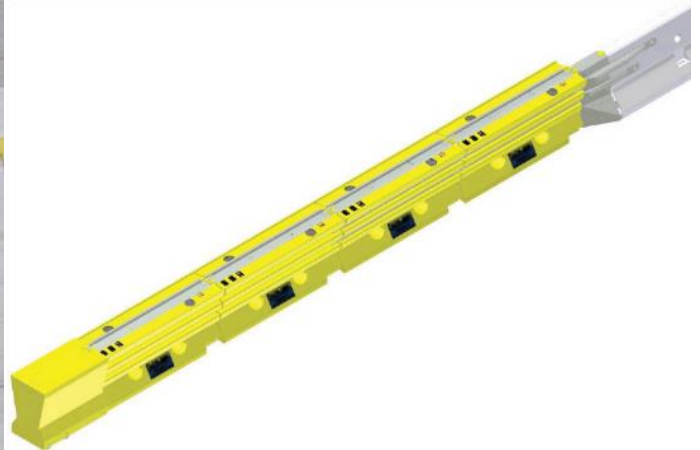
Legacy end treatments

ABSORB 350 crash cushion



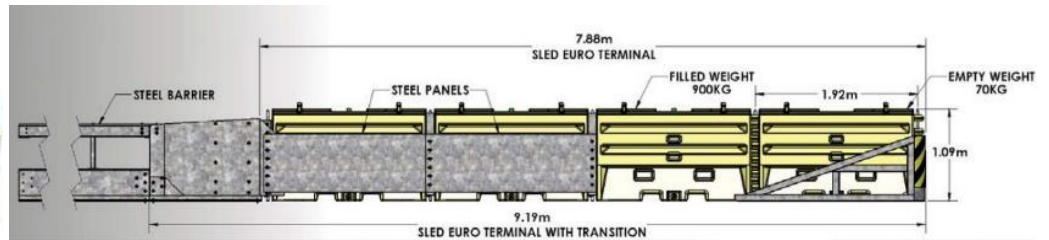
Summary	
Test level / conditions:	NCHRP 350 TL-2 and TL-3
End treatment type	<ul style="list-style-type: none"> • Non-redirective, gating • Freestanding
For use with	Temporary steel and concrete barriers
Status	Legacy system (not for new state highway installations) from 1 January 2021 Accepted up to 70 km/h (permanent speed limit) unless site specific risk assessment demonstrates safe deployment can be achieved
Technical information	
Dimensions	1 m length (per module), 610 mm width, 820 mm height
Minimum length	Nine energy absorbing elements: 9.7 m (unless site specific risk assessment demonstrates safe deployment can be achieved with five energy absorbing units)
Weight	39 kg per module (empty), 317 kg (filled)
Water fill capacity	265 litres per module (front module must be empty)
Clear area	6 m x 22.5 m clear area to enable the system to gate
Grade or placement restrictions	<ul style="list-style-type: none"> • A maximum approach and cross slope of 1V:10H is preferable. On slopes greater than this, approval is required from the RCA • The system should always be installed on a firm surface that prevents it from becoming embedded in the surface over long periods of time
Other restrictions / considerations	<ul style="list-style-type: none"> • The installation should be completed prior to filling the energy absorbing elements with water. Moving the elements while they are full may damage them • The element that attaches to the nosepiece must not be filled with water as that would cause the system to perform improperly • The two types of elements must be assembled in an alternating fashion (A and B) • All plastic crash cushions used to shield rigid or semi-rigid barriers can pose a significant hazard when struck at a steep angle near the transition. Under some impact conditions vehicles may penetrate and strike the barrier end or intrude a significant distance (over 30m) into the shielded area. For this reason, plastic crash cushions/end treatments must not be installed on curves, or wide roads where steep angles of impact are more likely. The installation Designer is to take this into account in their design • The temporary crash cushion must not be installed on curves or wide roads where steep angles of impact are more likely • When installed on concrete barrier, the temporary crash cushion must only be attached using the accepted proprietary transition attachment • When installed on steel barrier, the temporary crash cushion must only be attached using the accepted proprietary transition attachment for the steel barrier system and the final lengths of steel barrier must be fixed or fixed to the road surface in accordance with the System Supplier's specifications • Drive-by system inspections are recommended at least monthly, and hands-on inspections are recommended at least yearly

ACZ-350 temporary crash cushion



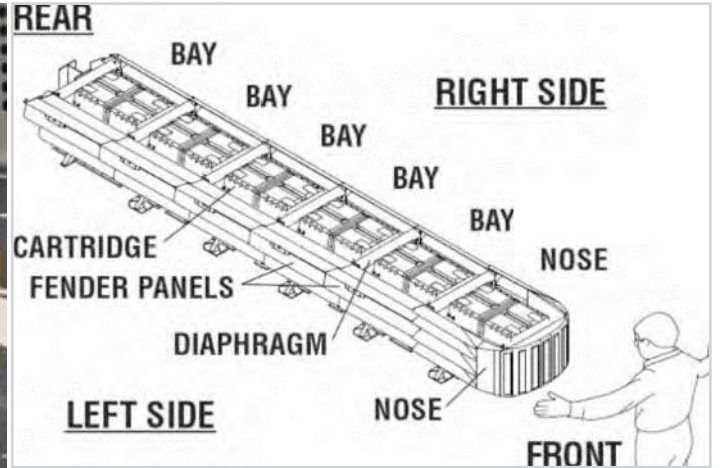
Summary	
Test level / conditions:	NCHRP 350 TL-2 and TL-3
End treatment type	<ul style="list-style-type: none"> • Non-redirective, gating • Freestanding
For use with	Temporary concrete barrier installations. This system is not accepted for use with temporary steel barrier systems
Status	Legacy system (not for new state highway installations) from 1 January 2021 Accepted up to 80 km/h (permanent speed limit) unless site specific risk assessment demonstrates safe deployment can be achieved
Technical information	
Dimensions	9.6 m length, 600 mm width, 800 mm height
Weight	613 kg (empty), 2797 kg (full)
Water fill capacity	2184 litres
Clear area	6 m x 22.5 m clear area to enable the system to gate
Grade or placement restrictions	Not to be placed on grades greater than 5%
Other restrictions / considerations	<ul style="list-style-type: none"> • There must be sufficient free space for recovery behind the end treatment should the vehicle strike the end treatment laterally and pass through • The end treatment must contain the correct number of segments required for the test level appropriate for the situation • The end treatment is only to be installed where it is likely to be struck head on • The end treatment must not be installed on curves or wide roads where steep angles of impact are more likely • The end treatment must only be attached using the accepted proprietary transition attachment • All plastic crash cushions used to shield rigid or semi-rigid barriers can pose a significant hazard when struck at a steep angle near the transition. Under some impact conditions vehicles may penetrate and strike the barrier end or intrude a significant distance (over 30m) into the shielded area. For this reason, plastic crash cushions/end treatment must not be installed on curves, or wide roads where steep angles of impact are more likely. The installation Designer is to take this into account in their design • Visual drive-by inspections are often all that is required. Special inspection considerations include the amount of water in the sections, how properly aligned the segments are and checks for any water leakage in the surrounding area

SLED (EURO) end treatment



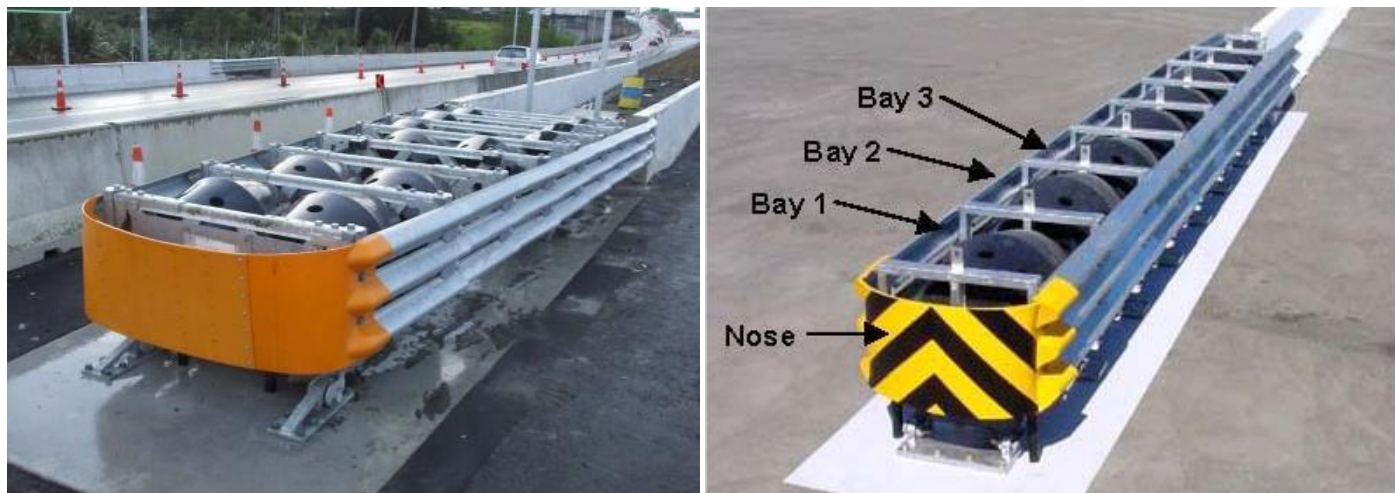
Summary	
Test level / conditions:	NCHRP 350 TL-3 (European standard EN 1317-4)
End treatment type	<ul style="list-style-type: none"> • Non-redirective, gating • Freestanding
For use with	Concrete or steel temporary barriers
Status	Legacy system (not for new state highway installations) from 1 January 2021 Accepted up to 80 km/h (permanent speed limit) unless site specific risk assessment demonstrates safe deployment can be achieved
Technical information	
Dimensions	7.9 m length, 571 mm width, 1084 mm height
Weight	<ul style="list-style-type: none"> • Module: 72.6 kg (empty), 907 kg (full) • Containment Impact Sled (CIS): 89.36 kg
Water fill capacity	832 litres per module (front module must be empty)
Clear area	6 m x 22.5 m clear area to enable the system to gate
Grade or placement restrictions	The maximum cross slope or approach slope the End Treatment may be used on is 1 in 10. On slopes greater than this approval is required from the RCA
Other restrictions / considerations	<ul style="list-style-type: none"> • The end treatment is only to be installed where it is likely to be struck head on • The end module attached to the CIS must not be filled with water • The SLED-EURO end treatment must not be attached or fixed to the ground • The minimum acceptable configuration for use on >70 km/h state highway sites is the 4 module TL-3 configuration • All plastic crash cushions used to shield rigid or semi-rigid barriers can pose a significant hazard when struck at a steep angle near the transition. Under some impact conditions vehicles may penetrate and strike the barrier end or intrude a significant distance (over 30m) into the shielded area. For this reason, plastic crash cushions/end treatments must not be installed on curves, or wide roads where steep angles of impact are more likely. The installation Designer is to take this into account in their design • The end treatment must only be attached to barriers using the accepted transition attachment • The SLED-EURO end treatment differs from the SLED-US in that it employs steel lateral panels on the rear two cartridges

QUADGUARD II crash cushion system (including QUADGUARD II CZ)



Summary	
Test level / conditions:	NCHRP 350 TL-1, TL-2 and TL-3
End treatment type	<ul style="list-style-type: none"> • Redirective, non-gating • Fixed
For use with	Concrete or steel barriers
Status	Legacy system (not for new state highway installations) from 1 January 2021
Technical information	
Dimensions	Available in seven widths from 610 mm to 3200 mm, 6.3 m length (TL-3), 816 mm height
Weight	Varies with configuration
Grade or placement restrictions	<ul style="list-style-type: none"> • Cross-slope shall not exceed 8% nor twist more than 2% over the length of the system • A concrete or asphalt concrete foundation and backup meeting the System Supplier's instructions are required
Other restrictions / considerations	<ul style="list-style-type: none"> • The end treatment must be fixed as per the supplier's instructions • System length is specified by the number of bays the system includes. The number of bays required is a function of the design speed of the roadway, as per the System Supplier's instructions • Visual drive-by inspections are recommended at least once a month. Walk-up inspections are recommended at least once a year for QuadGuard II systems on asphalt

TAU-II crash cushion



Summary	
Test level / conditions:	NCHRP 350 TL-2 and TL-3
End treatment type	<ul style="list-style-type: none"> • Redirective, non-gating • Fixed
For use with	Concrete barriers
Status	Legacy system (not for new state highway installations) from 1 January 2021
Technical information	
Dimensions	<ul style="list-style-type: none"> • TL-3: length: 8 bays. 7.25m (P.C.B Backstop) or 7.75 m (Compact Backstop) • TL-2: length: 4 bays. 3.78 m (P.C.B Backstop) or 4.28 m (Compact Backstop) • 762 mm width, 829 mm height
Weight	Varies with configuration
Grade or placement restrictions	Cross slopes of up to 8% (5 degrees) can be accommodated with the standard hardware and with the instructions provided with the system. If there are cross slopes in excess of 8%, contact the System Supplier to obtain engineering advice and assistance
Other restrictions / considerations	<ul style="list-style-type: none"> • The concrete foundation must be a minimum of 150mm thick, reinforced 28 MPa Portland Cement Concrete (PCC) or 200mm non-reinforced 28mpa PCC • All kerbs, islands and elevated objects greater than 100mm high that would be beneath, beside or less than 15m in front of a TAU-II crash cushion should be removed prior to installation • May be installed with either a freestanding Compact Backstop or a "P.C.B. Backstop" that can be attached to properly reinforced concrete barrier as per the supplier's instructions • The frequency of drive-by inspections is dependent on the traffic volume and the impact history of the system. Drive-by inspections are recommended at least monthly • Hands-on inspections are recommended at least yearly

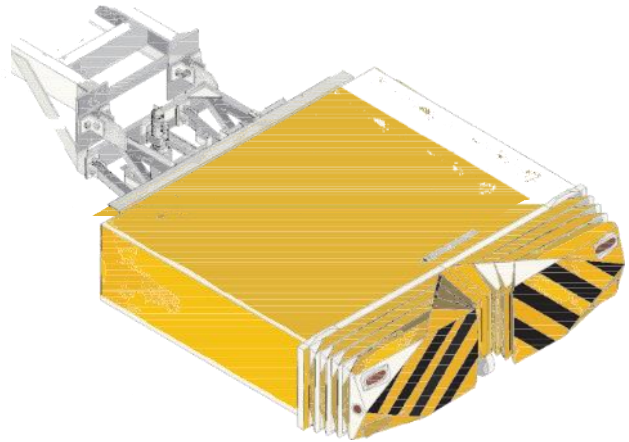
TRACC crash attenuation cushion



Summary				
Test level / conditions:	NCHRP 350 TL-2 and TL-3			
End treatment type	<ul style="list-style-type: none"> • Redirective, non-gating • Fixed 			
For use with	Concrete barriers			
Status	Legacy system (not for new state highway installations) from 1 January 2021			
Technical information				
Dimensions	System	Test Level	Width	Length
	TRACC	3	610mm	6.5m
	Shortracc	2	610mm	4.3m
	Widetracc- B	<u>3</u>	1470mm**	6.5m**
	Widetracc - L	<u>3</u>	1040mm***	6.5m***
	Widetracc - R	<u>3</u>	1040mm***	6.5m***
	<p>** The width of the Widetracc – B can be further increased by adding wing extensions on both sides. The extensions will add 710mm of length and 175mm of system width per extension added</p> <p>*** The width of the Widetracc – L and – R can be further increased by adding wing extensions on one side. The extensions will add 710mm of length and 87mm of system width per extension added</p>			
Weight	Varies with configuration			
Grade or placement restrictions	It is recommended that the TRACC system should not be placed directly behind a raised kerb. The approach area in front of the system should slope at a rate no greater than 10V:1H in the direction of traffic flow. The cross slope should be no more than 12V:1H			
Other restrictions / considerations	<ul style="list-style-type: none"> • The TRACC can be fixed to a combination of asphalt, concrete and compacted sub-base • A plastic nose cone that is supplied with the system should be attached to the front of the TRACC • Installation of the TRACC system and its transitions depends on the traffic pattern and the backup structure at the particular location. Unidirectional traffic (one side or both) requires no transition provided opposing traffic cannot impact the unit • Field repair is to be limited to minor end-on impacts that stroke the system less than 1350mm 			

Legacy TMAs

ALPHA 70K (NCHRP 350)



Summary	
Test level / conditions:	NCHRP 350 TL-2
Status	Legacy system (not for new state highway installations) from 1 January 2021
Technical information	
Maximum permanent posted speed	70 km/h
Dimensions	2540 mm Length, 2360 mm Width, 570 mm Height
Weight	550 kg
Road clearance	280 mm – 330 mm
Support vehicle gross mass excluding TMA	Minimum 6400 kg – dependent on local vehicle requirements
Roll ahead distance	3.3 m
Recommended maximum travel speed	With TMA in down position – 30 km/h
Other restrictions / considerations	<ul style="list-style-type: none"> • The rear steel (central) skid wheel must be fitted • The two rear bottom corners of the fitted TMA must have supplied plastic skid protectors fitted

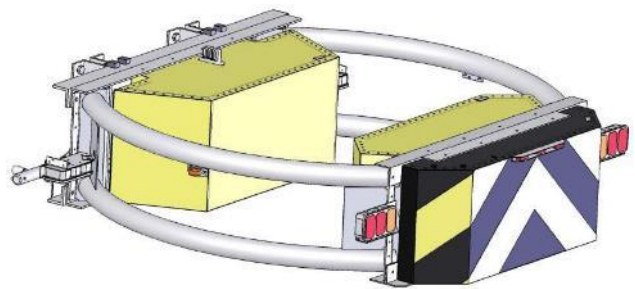
SCORPION I (NCHRP 350 Model A, C & C-90 models)



Model C



Model A



Model A

Summary		
Test level / conditions:	Model A: NCHRP 350 TL-2, Model C and C-90 – NCHRP 350 TL-3	
Status	Legacy system (not for new state highway installations) from 1 January 2021	
Technical information		
Maximum permanent posted speed	Model A (NCHRP350 TL-2)	Model C & C-90 (NCHRP350 T-3)
	70 km/h	100 km/h
Dimensions	2650 mm length, 2450 mm width, 600 mm height	2540 mm length, 2450 mm width, 600 mm height
	Up position height: 3350 mm	Up position height: <ul style="list-style-type: none"> Model C: 3050 mm Model C-90: 4320 mm
Weight	346 kg	900 kg
Road clearance	300 mm	
Support vehicle gross mass excluding TMA	Minimum 6400 kg – dependent on local vehicle requirements	
Roll ahead distance	Not reported	
Recommended maximum travel speed	With TMA in down position – 30 km/h	
Other restrictions / considerations	<ul style="list-style-type: none"> The Scorpion TMA uses hydraulic lifting and lowering mechanisms not reliant on gravity (to ensure full lowering position). Care must be taken to ensure full deployment is achieved before operation Ensure all four jacking wheels are secured in up positions before operating the mounted vehicle 	

SS90HD (NCHRP 350)



Summary	
Test level / conditions:	NCHRP 350 TL-3
Status	Legacy system (not for new state highway installations) from 1 January 2021
Technical information	
Maximum permanent posted speed	100 km/h
Dimensions	5913 mm length, Width – 2338mm, 768mm height (deployed) or 3937 mm (up position)
Weight	1100 kg
Road clearance	280 mm – 330 mm
Support vehicle gross mass excluding TMA	Minimum 7262 kg – dependent on local vehicle requirements
Roll ahead distance	Not reported
Recommended maximum travel speed	With TMA in down position – 50 km/h

STUER-EGGHE JL-D-850 'JULIETTA' 100K (NCHRP 350)



Summary	
Test level / conditions:	NCHRP 350 TL-3
Status	Legacy system (not for new state highway installations) from 1 January 2021
Technical information	
Maximum permanent posted speed	100 km/h
Dimensions	3570 mm length, 2302 mm width, 880 mm to 920 mm height (deployed) or 3570 mm (up position)
Weight	750 kg
Road clearance	280 mm to 320 mm
Support vehicle gross mass excluding TMA	Minimum 9240 kg – dependent on local vehicle requirements
Roll ahead distance	15 m
Recommended maximum travel speed	With TMA in down position – 30 km/h
Other restrictions / considerations	The Stuer-Egghe JL-D-850 'Julietta' 100K TMA uses hydraulic lifting and lowering mechanisms not reliant on gravity (to ensure full lowering position). Care must be taken to ensure full deployment is achieved before operation

U-MAD (NCHRP 350 70K & 100K models)



Summary		
Test level / conditions:	<ul style="list-style-type: none"> 70K: NCHRP 350 TL-2 100K: NCHRP 350 TL-3 	
Status	Legacy system (not for new state highway installations) from 1 January 2021	
Technical information		
Maximum permanent posted speed	70K TL2 Variant	100K TL3 Variant
	70 km/h	100 km/h
Dimensions	1980 mm length, 2290 mm width, 710 mm height (deployed) or 2530 mm (up position)	4190 mm length, 2290 mm width, 710 mm height (deployed) or 3810 mm (up position)
Weight	Cartridge: 284 kg, lifting gear: 176 kg	Cartridge: 414 kg, lifting gear – 176 kg
Road clearance	279 mm – 330 mm	
Support vehicle gross mass excluding TMA	Minimum 6400 kg – dependent on local vehicle requirements	Minimum 8550 kg - dependent on local vehicle requirements
Roll ahead distance	3.3 m	6.17 m
Recommended maximum travel speed	With TMA in down position – 40 km/h	
Other restrictions / considerations	Lock pins must be in place when the TMA is in the travel (up) position or when travelling more than 8km	