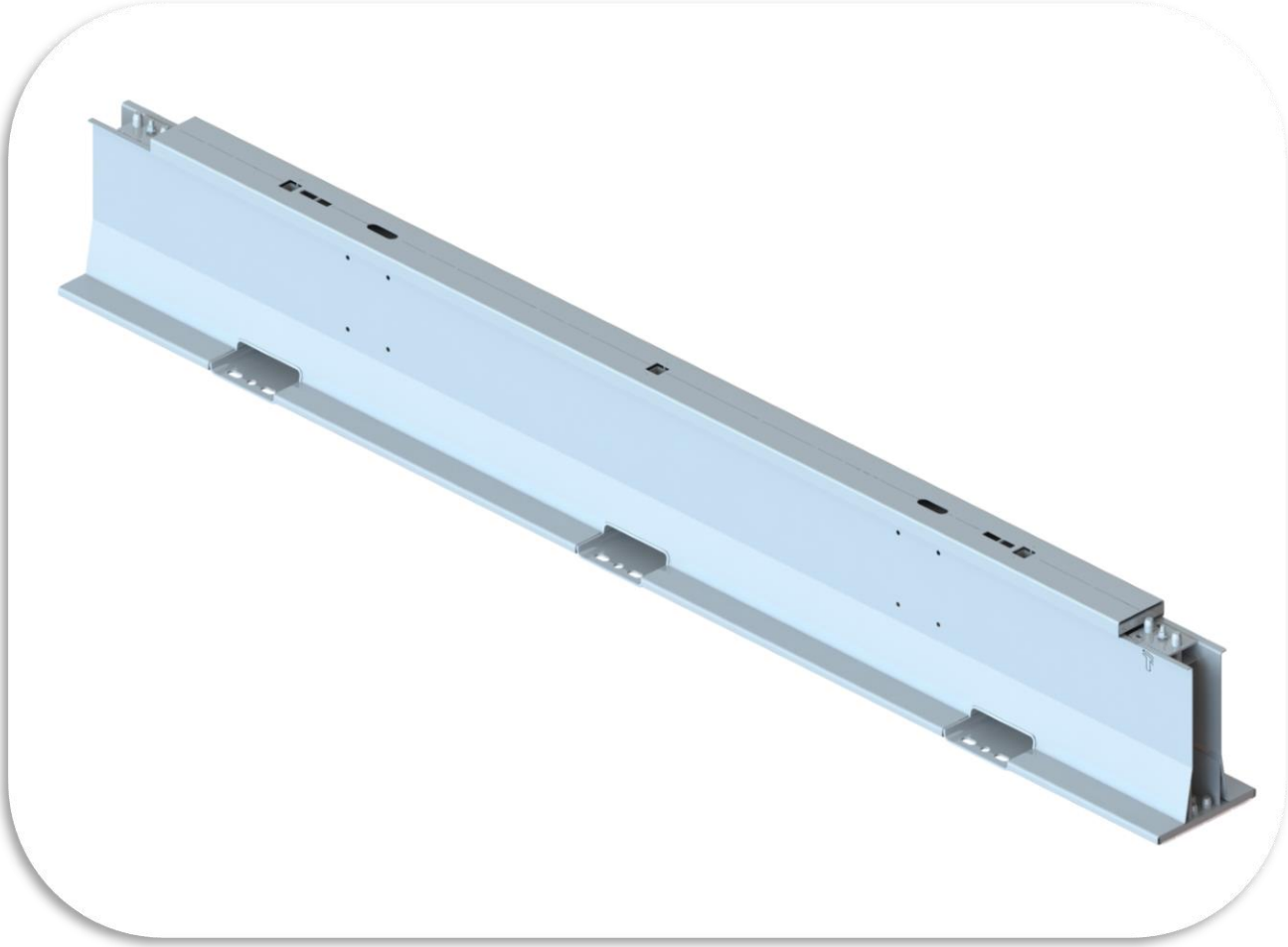
Part No. 627704

HighwayGuard™ LDS

North America

Product Manual



Revision History

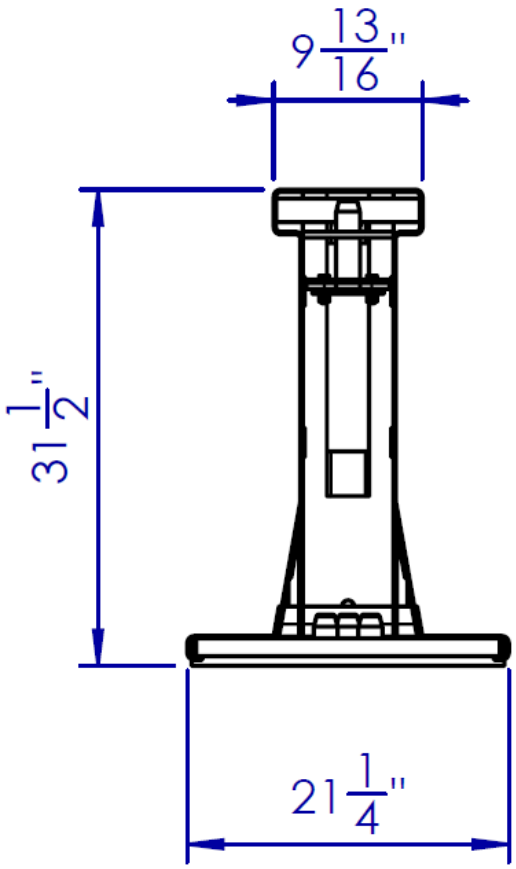
Revision	Date	Prepared by	Approved by	Reason for change
1.0	Dec 2019	A. Marsh	O. Pulling	First issue
1.1	Apr 2020	A. Marsh	O. Pulling	Name correction
1.2	Jan 2021	A. Marsh	O. Pulling	Document title updated, other minor amendments
1.3	Feb 2021	A. Marsh	O. Pulling	VLB reference removed

Contents

Introduction

HighwayGuard™ is a MASH 16 TL-3 & TL-4 compliant steel safety barrier. The 20ft single barrier section, with the unique T-Connector provides quicker installation, removal, and separation of barrier sections. It also offers the ability to remove sections within a run to create access gaps, replace damaged sections or alter barrier runs.

HighwayGuard™ is an anchored steel safety barrier that can be used in temporary and permanent applications.

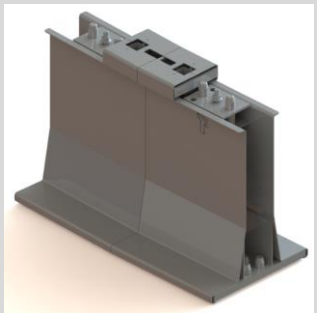
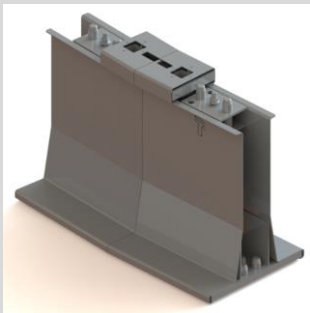
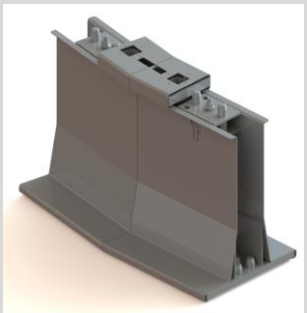


Containment Level	Weight	Standard Barrier Length
MASH TL-3 & TL-4	62lb per foot	20ft

System Components

20ft Barrier	End Cap
 1217lb	 60lb

Standard T-Connector	2.5 Degrees T-Connector	5 Degrees T-Connector	10 Degrees T-Connector
 95lb	 133lb	 133lb	 133lb

Wheelsets	2.5 Degrees Barrier	5 Degrees Barrier	10 Degrees Barrier
 47lb	 294lb	 296lb	 300lb

Note: Weights are approximate only.

20ft HighwayGuard™ to BG800™ Transition

1354lb

Design Considerations

It is important that HighwayGuard™ is planned/designed and installed in accordance with this manual and any approval/regulatory conditions placed upon its acceptance use in that territory.

Delineation

Reflective delineators may be required for both permanent and temporary applications. The specification (size, shape, colour, position) can vary in accordance to meet local regulations/requirements.

Drainage

HighwayGuard™ has a 3/8" drainage gap underneath the barrier. Additional drainage provision is provided at anchor points.

Pavement Types

HighwayGuard™ has been tested installed on asphalt pavement that is approximately 6" asphalt concrete over a granular subbase.

Alternative ground conditions may be acceptable but could require different anchor solutions.

Install Lengths

The permissible length of the system is unlimited, but the barrier must be anchored at the end of each run and intermediately as required by the system type.

The recommended minimum length of barrier is 200ft to replicate test set up. Installing with tested anchor spacing is recommended to replicate test deflections and working widths.

T-Connection

Where removal of the T-Connector is not possible by plant equipment it can be removed manually.

Curves

The T-Connector can allow an approximate angle of up to 0.23° for vertical connections and 0.77° between barrier sections for horizontal connections. Example horizontal curves;

Method	Description	Approximate Radius (ft)
1	20ft Barrier Section with Standard T-Connections at maximum angle	581
2	20ft Barrier Section with 2.5° T-Connection	460
3	20ft Barrier Section with 5° T-Connection	230
4	20ft Barrier Section with 10° T-Connection	115
5	20ft Barrier Section with 10° Barrier Section and Standard T-Connection	135
6	10° Barrier Section with Standard T-Connection	22
7	10° Barrier Section with 10° T-Connection	12

Deflection/Clear Zone

HighwayGuard™ is designed to absorb energy when impacted. When impacted between anchors deflection occurs. No hazards or obstacles should be in the deflection area such as kerbs, work materials/equipment.

Vehicle roll should be considered with taller vehicles as these may protrude beyond the barrier deflection during impact.

Crash Cushions/Other Connections

Crash cushions should be used when impact to either the approach or departure end of a run of HighwayGuard™ may occur.

Current crash cushions/ connections available;

- QuadGuard (MASH Compliant)
- Highway Care BG800™ Transition (MASH Compliant)

An engineered connection is one that has been designed and jointly agreed by Highway Care and the crash cushion developer as acceptable for use. These may also require approval from relevant road authorities – check road authority approval for guidance on acceptable options available in your market.

For additional crash cushion options, please contact Trinity Highway and Highway Care.

Modifications

No modifications are permitted to HighwayGuard™ components without prior approval from Trinity Highway and Highway Care.

Crash Testing & Performance Levels

HighwayGuard™ has been tested to the MASH (2016), a brief guide showing performance levels and individual tests required is shown below for reference.

Test Standard	Performance Level	Test Reference	Vehicle Type	Impact Speed		Impact Angle (˚)	Vehicle Mass	
				mph	kp/h		lb	kg
MASH	TL-3	3-10	Light Car	62	100	25	2425	1100
		3-11	Pickup	62	100	25	5005	2270
		3-21	Pickup	62	100	25	5005	2270
	TL-4	4-10	Light Car	62	100	25	2425	1100
		4-11	Pickup	62	100	25	5005	2270
		4-12	Truck	56	90	15	22046	10000

System Type	Anchor Interval		Test Standard	Performance Level	Dynamic Deflection	
	ft	m			ft	m
HighwayGuard™ Lowest Deflection System (LDS)	40[1]	12	MASH 16	TL-3	2 3″	0.68
				TL-4	2 7″	0.79

[1] Approximate 40ft, LDS System has staggered anchors – refer to installation section or drawing HG-70-02 for further detail.

Installation

HighwayGuard™ must be installed in accordance with this manual and with the latest state road authority conditions. Where conflict arises road authority conditions take priority over this manual.

Planning

Prior to starting an installation, it is recommended that the customer informs the installer of;

- Start/end positions and alignment requirements of each barrier run (including crash cushions)
- Curvature (horizontal and vertical) required to ensure appropriate components available
- Installation site risks identified (e.g. overhead cables, bridges, tunnels, drilling limitations)
- Traffic management measures in place to ensure appropriate and safe working space

Tools List

(T)ool / (C)onsumable	Information
(T) Magnetic T-Bar Socket	For inserting and removing the T-Connector security nut.
(T) Drilling Equipment	Electric or air driven rock drill. Suggested drill bits are 1 1/8" (1" dia resin anchors) 1ft 6" long.
(T) Measuring Wheel & (C) Road Marking Paint	To mark barrier position where required.
(T) 2 off 6.5ft crow bar/wrecking bar	To assist with minor barrier re-alignment.
(T) Timber Blocks	To aid installation/removal on uneven ground.
(T) Wrench	With 1 ½" socket.
(C) Resin	Resin for 1" threaded anchor

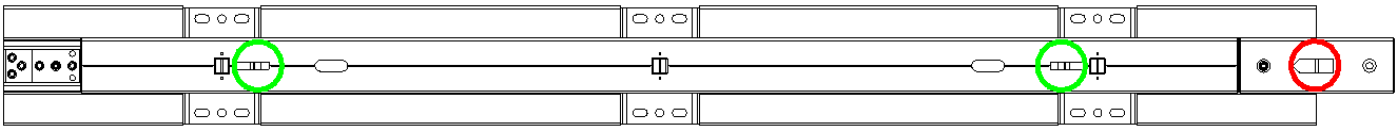
Lifting points

Caution

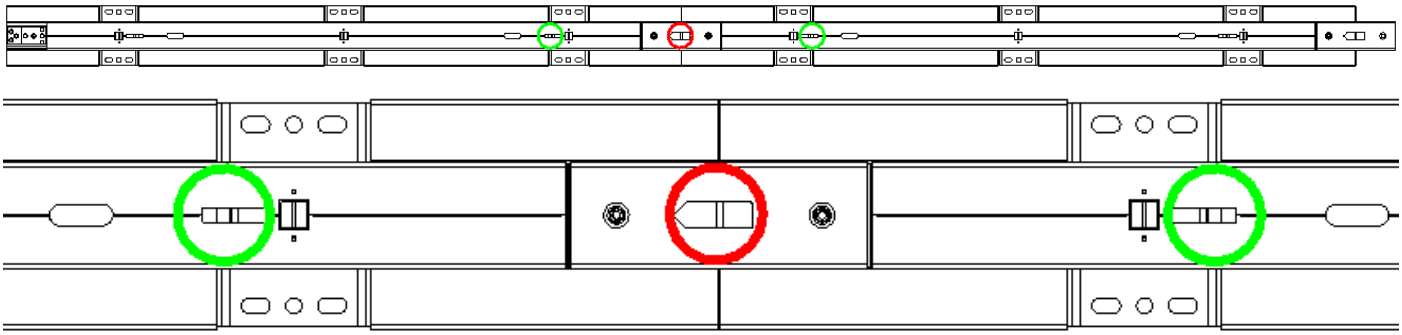
Do not use the T-Connection lifting points to lift barrier sections (highlighted by red circles). These are for lifting the T-Connection only.

Ensure lifting equipment is certified and in a safe/useable condition.

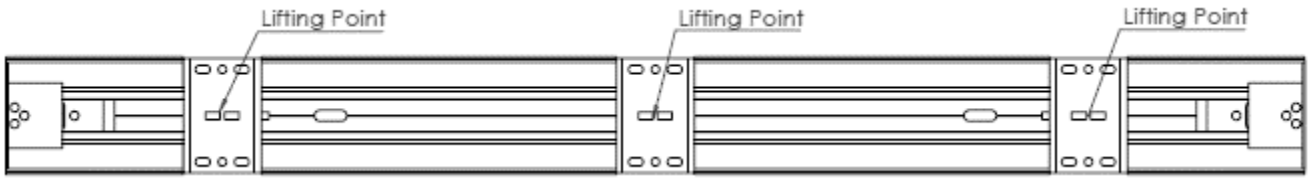
Each 20ft barrier section has two designated lifting points allowing hooks to attach marked in green below.



When two 20ft sections are bolted together they can be lifted as a single 40ft piece using the lifting points either side of the central T-Connection.



It is also possible to lift inverted sections using the designated lifting points on the underside of the barrier. When lifting a 40 foot section use the two lifting points either side of the T-Connection.



Lifting Equipment	Information
Mechanical/Pneumatic Lifting Device	Such as a truck mounted crane or wheeled excavator. It must have suitable lifting capacity and reach to install HighwayGuard™.
Lifting Chains	Two leg assembly with a 5512lb lifting capacity, each chain is 26.5ft long c/w hook, locking clasp and shortening clutch.
Tag Rope	Suggested 1.5 times the lifting height of the barrier.

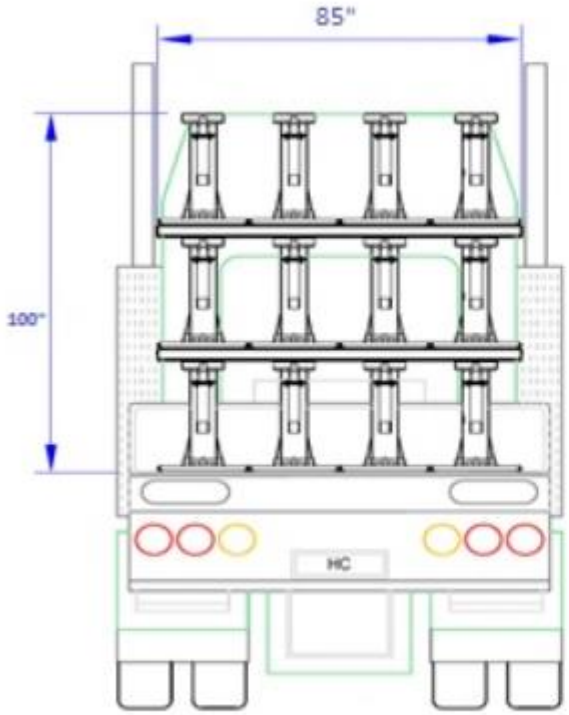
Loading/Unloading

Caution

Ensure all barrier sections are secured to the truck bed with adequate ratchet straps prior to transport movements.

HighwayGuard™ can be inverted to maximise the length of barrier per load.

Check local regulations for potential weight/transport restrictions.



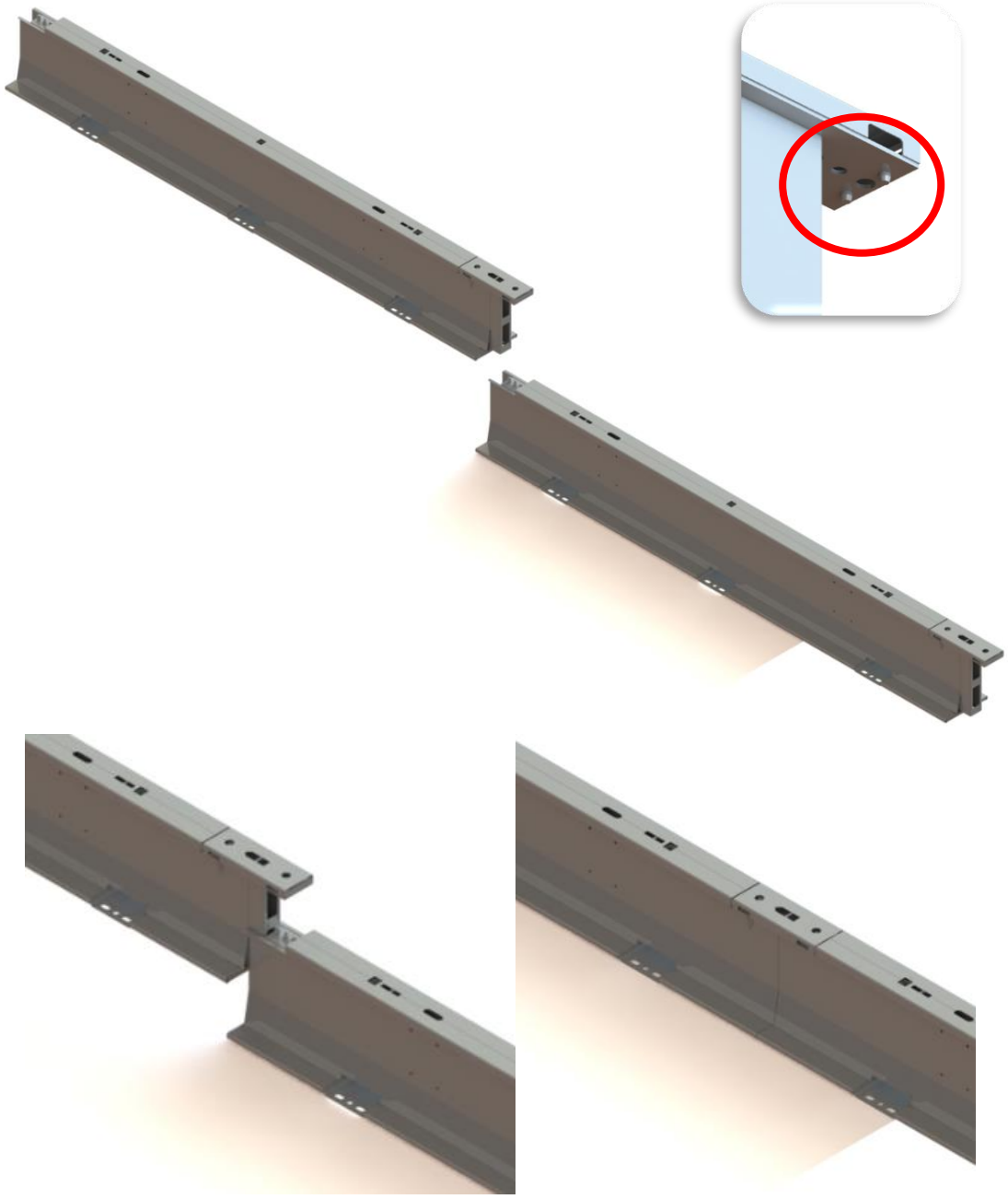
460ft Upright

820ft Inverted

When loading with the T-Connection attached to barrier sections; position these so that they will match the orientation of the install to avoid turning barrier round on site. Typically, they will be at the rear of the trailer.

Connection

Barrier sections are lowered into position with the T-Connection already attached to the end of the barrier that is being joined to the run of barrier. Ensure orientation of T-Connector allows alignment pins to be lowered onto next section.

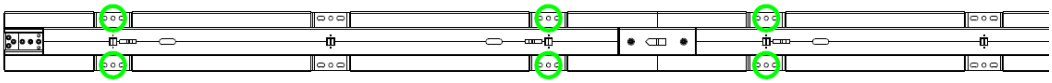


Caution

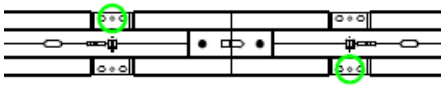
Ensure all barrier sections being lifted have a tag line attached. Joining barrier sections presents a crush risk, ensure operator has clear view and communication ability when barriers are being aligned and connected.

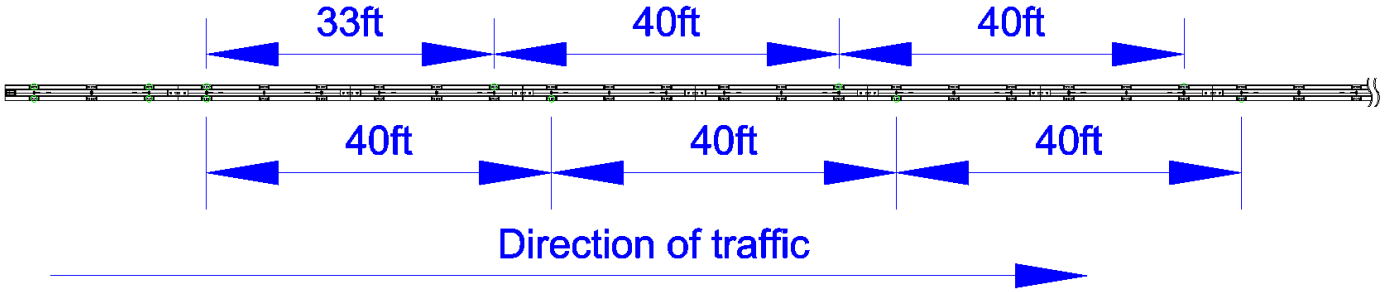
Anchoring

HighwayGuard™ is anchored with a minimum 6 anchor points at the first and last sections in a run of barrier. This will be in the first and last two 20ft barrier sections as shown;



For the Lowest Deflection System, the 2 anchors are spaced every 40ft but staggered over the T-Connection.





The LDS TL-4 system was tested with 1" diameter grade 8.8 resin threaded bar (1 1/8" drill bit) with typical 1ft 4" embedment. The LDS TL-3 system was tested with typical 1ft embedment.

Crash cushions or connections/transitions should be used when impact to either the approach or departure end of a run of HighwayGuard™ may occur.

When using crash cushions (both NCHRP 350 or MASH) the HighwayGuard™ barrier must be anchored at the start and end of runs in accordance with the latest drawings.

Barrier Removal

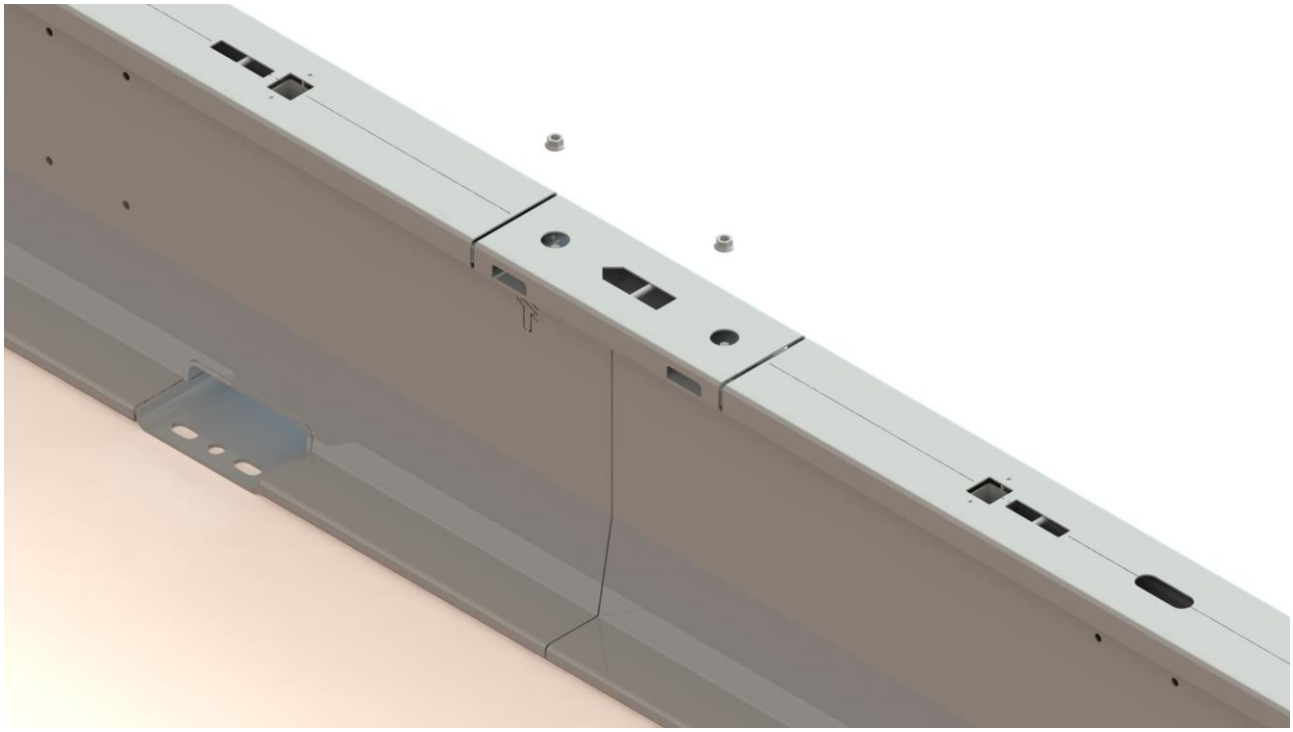
To remove the barrier sections it is the reverse of the installation process. Namely;

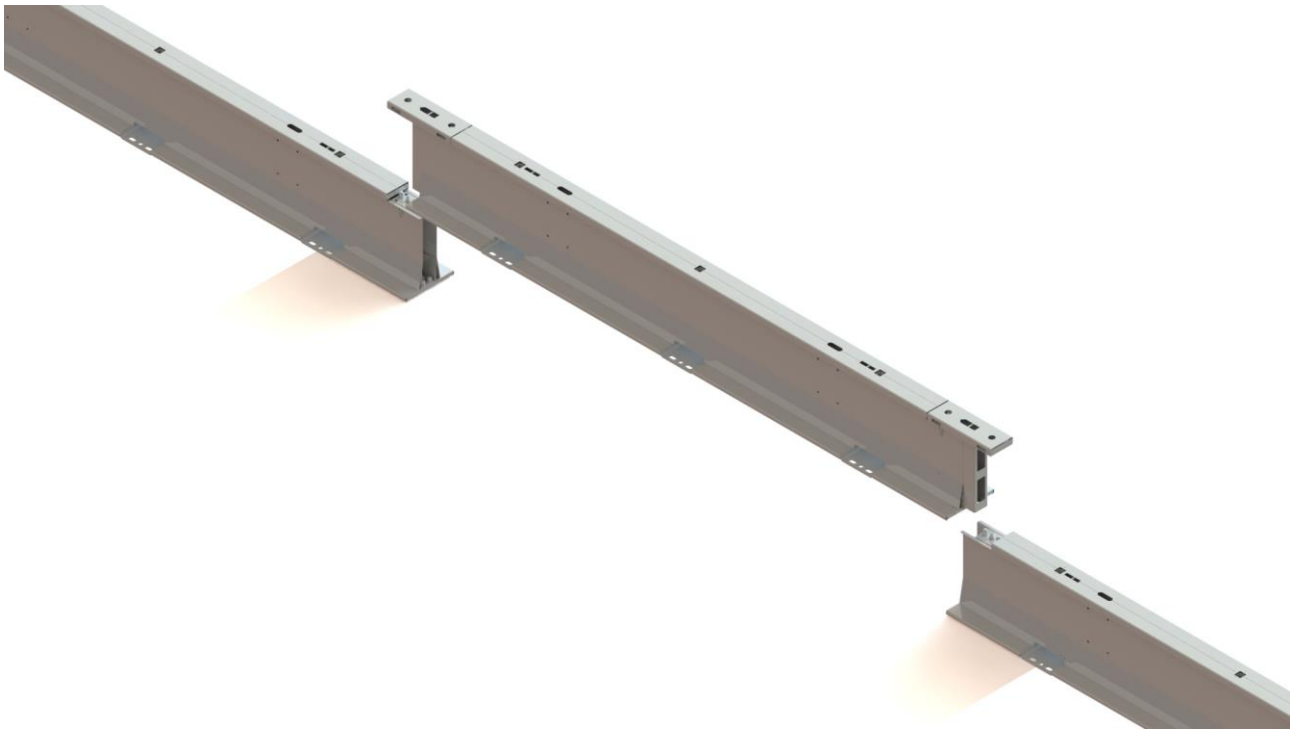
- **Unbolt from the ground**
- **Remove security nut from the side of the T connector you wish to separate**
- **Lift barrier section and T connector from adjoining**
- **If the section of barrier being removed lifts the next section, place a 2" high block under the foot of the section being removed next to the joint to be separated and lower the barrier. It will then separate.**

Special Operations

Creating Access Gap

Lift out individual sections by disconnecting the T-Connection and removing the security nut. The section can now be lifted out.





Bridges

Where possible anchoring should take place off bridge decks. Any anchoring on bridge decks needs to be agreed in advance with the technical expert responsible for the bridge to ensure it is not damaged. If anchoring either side of a bridge deck expansion joint then this movement must be mirrored in the barrier.

Wheelsets

These allow barrier sections to be manoeuvred without lifting machinery/equipment such as installing in tunnels or areas with overhead restrictions.

The wheelsets can be raised and lowered from the top of the barrier using a manual wrench and 1" socket.

Caution

Impact guns should not be used to operate the wheels.

Pavement

HighwayGuard™ has been tested on asphalt pavement that is approximately 6" asphalt concrete over a granular subbase. The LDS TL-4 system was tested with 1" diameter grade 8.8 resin threaded bar (1 1/8" drill bit) with typical 1ft 4" embedment. The LDS TL-3 system was tested with typical 1ft embedment.

Always ensure the resin manufacturer's installation/application instructions are adhered to.

Alternative ground conditions may be acceptable but might require different anchor solutions.

Maintenance and Repair

HighwayGuard™ is generally a maintenance free barrier. It is recommended that some basic maintenance is carried out of the system every 10 years, this involves a visual check for signs of corrosion/damage both outside and inside the barrier.

For wheeled sections ensure that they are raised/lowered and maneuvered around, greasing the jacking mechanism if required on an annual basis.

Any damage to the galvanised coating should be repaired with zinc rich paint to prolong the life of the barrier.

Damage after vehicle impact will need to be assessed on a case by case basis by a competent person, typically low angle impacts will not warrant barrier replacement. Significant impacts will mean damaged sections will need to be lifted out and replaced.

Permanent Applications

For permanent applications the following conditions apply;

- **1" threaded bar with resin is recommended for anchoring.**
- **After initial installation it is recommended that the site is revisited after 1 month for inspection. After this it is recommended a thorough inspection is carried out every 5 years.**

Appendix

Frequently Asked Questions

1) What type of equipment is required to install HighwayGuard™?
Suitable lifting equipment such as a crane with hook lifting chains, marking and drilling equipment (e.g. Hilti or compressed air rock drill), magnetic socket. Please refer to the tools and lifting equipment section.

2) What ground conditions are required to install HighwayGuard™?
HighwayGuard™ has been tested installed on asphalt pavement that is approximately 6" asphalt concrete over a granular subbase.

Alternative ground conditions may be acceptable but could require different anchor solutions.

3) What can HighwayGuard™ attach to?
There is a tested transition to Highway Care BG800™.

4) Does HighwayGuard™ require anchoring?
HighwayGuard™ is an anchored system and must always be anchored as a minimum with 6 anchors at the start and end of the barrier run.

Intermediate anchoring may also be required and the frequency for the LDS system is approximately every 40ft.

5) On average, how long does it take to install HighwayGuard™?
Depending on the application and circumstances at the site, experience of the workforce, equipment available, pre-assemble taken place, once the ground conditions are suitable installation of a trailer with twelve 40ft assemblies can be completed in under 20 minutes.

6) What testing has HighwayGuard™ been approved to?
HighwayGuard™ has been tested to the American standard MASH at TL-3 & TL-4. Please see the testing section for further details.

7) Can HighwayGuard™ be installed in any temperature/humidity environment?
HighwayGuard™ can be installed in the majority of environments. Large temperature swings may make it desirable to use the slotted anchor points to allow barrier movement.

8) What maintenance does HighwayGuard™ require?
HighwayGuard™ is a low maintenance barrier system that requires minimal maintenance. See the maintenance and permanent applications section of this manual for further details.

9) What is the expected lifespan of HighwayGuard™?
HighwayGuard™ has an expected lifespan of over 20 years. This is dependent on maintenance regime and site specific environment.

10) What is the smallest run of barrier and the largest available?
The permissible length of the system is unlimited but the barrier must be anchored at the end of each run and intermediately as required by the system type.

The recommended minimum length of barrier is 10 sections (approximately 200ft) to replicate test set up. Installing with tested anchor spacing is recommended to replicate test deflections and working widths. There is no maximum limit but consideration for works access must be given.

11) I need to achieve a really low deflection as I am working with limited space, what are my options?
HighwayGuard™ Lowest Deflection System (LDS) might be the best option for this application. With the increased anchor intervals at 40ft spacing deflection is reduced. Refer to crash test deflection results and it may be appropriate to risk assess the deflection figure using the calculated deflection tables in this manual.

12) I want to install HighwayGuard™ on a bridge deck, is this possible?
HighwayGuard™ can be installed on bridge decks in both permanent and temporary situations.

Depending on the project it may be possible to anchor either side of the bridge deck expansion joints.

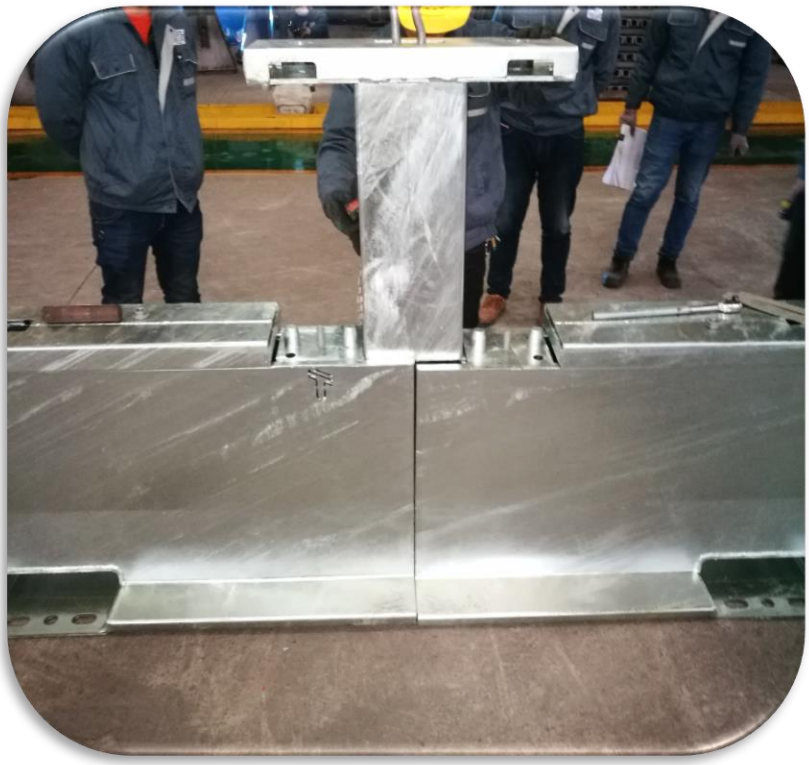
Where anchoring on the bridge deck is required it may require project specific anchor details.

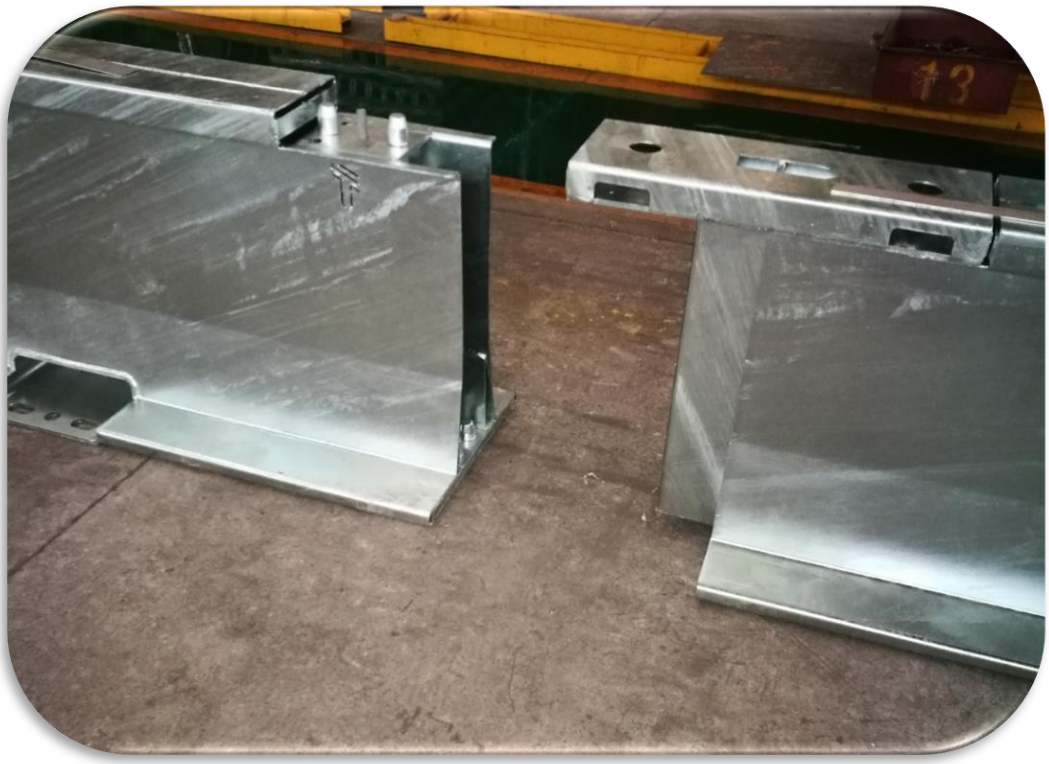
13) What drainage capability does HighwayGuard™ have?
HighwayGuard™ has a 3/8" drainage gap underneath the barrier.

14) How close to excavations can it be placed?
Anchors need to be a minimum of 1ft 9 ½" away from excavation edge.

15) Can access gaps be created in the middle of a long run of barrier?
The T-Connection allows section to be removed easily from a run by crane. All that needs to be done is remove the security nut from two T-Connectors and lift the whole section vertically upwards.

Photo Examples





Example Risk Assessments

Hazard	Scenario	Precautions to minimise the risk	Method
Injury to head	Loading and unloading barrier Manoeuvring barrier Installing barrier	Use of PPE (hard hats) Competent crane operator/spotter Operative to be vigilant	Instruction Training Training
Injury to hands	Loading and unloading barrier Manoeuvring barrier Installing barrier	Use of PPE (gloves) & correct tools Competent crane operator/spotter Operative to be vigilant	Instruction Training Training Training
Injury to feet	Loading and unloading barrier Manoeuvring barrier Installing barrier	Use of PPE (safety boots) Competent crane operator/spotter Operative to be vigilant	Instruction Training Training
Load slipping from crane	Loading and unloading barrier Manoeuvring barrier	Use certified approved slings/lift equipment Competent operative	Inspection Training
Uncontrolled Load	Loading and unloading barrier Manoeuvring Barrier	Use correct tag rope Competent operators Establish correct safety zones	Training Training Training
Slinger falling from vehicle/load	Loading and unloading barrier Manoeuvring barrier Installing barrier	Safe access and egress to vehicle and load Operative to be vigilant	Training Training
Injury from site traffic	Loading and unloading barrier Manoeuvring barrier Installing barrier	Correct site management procedures Operatives to be vigilant	Training Training
Injury from traffic	Loading and unloading barrier Manoeuvring barrier Installing barrier	Correct traffic management procedures Operatives to be vigilant	Training Training

Working on a Live Carriageway

When working on a live carriageway, a safety zone is required between the working area and the live traffic lane. It is not possible to install HighwayGuard™ unless such a safety zone is provided. It is suggested that a minimum area of not less than 1ft 5/8" will be required between the HighwayGuard™ and the safety zone

Coring/Drilling for installation of anchor system

Hazard	Precautions to minimise the risk	Actions
Electrocution Damage to underground services	Before installation procedure: Inspect service plans; Use cable locating equipment and mark the position of underground apparatus. Inspect drill & drill bit	Training
Injury to eyes	Use of PPE (goggles)	Training
Injury to ears	Use of PPE (earmuffs)	Training
Dust inhalation	Use of PPE (face mask)	Training
Injury to skin from chemical anchor resin	Use of PPE (gloves)	Training
Injury from traffic	Correct traffic management procedures followed and operatives to be vigilant	Training

Righting Inverted Units/Inverting Units

Hazard	Precautions to minimise the risk	Actions
Load slipping	Use certified slings Use competent slinger	Inspection Training
Injury to heads	Use of PPE (hard hat)	Instruction
Injury to feet	Use of PPE (steel toe capped safety boots)	Instruction
Injury to legs	Undertake operation in safe restricted area under control of competent spotter and crane operator	Training & Instruction
Death or injury because of manoeuvring truck	All truck movements under control of competent spotter	Training
Injury from collision with passing traffic	Correctly installed traffic management	Training

The risk assessment examples given above are not exhaustive and there may be other risks that need to be considered by the end user or for site specific requirements.

Installation Checklist Example

Installation Checklist				Barrier Run Information		
	Print Name	Sign Name	Date	Location:		
Installed by;				Number of runs:		
Inspected by;				Overall Length:		
				Project Number:		
HighwayGuard™				**Applicable Section; Yes or No**		
Is the site suitable for HighwayGuard™?				Yes	N/A	No
Are the pavement conditions suitable?				Yes	N/A	No
Are the anchors selected suitable for the pavement condition?				Yes	N/A	No
Are all the components available?				Yes	N/A	No
Are any crash cushions installed correctly?				Yes	N/A	No
Are the start and end of the barrier run installed correctly with all 6 anchors installed?				Yes	N/A	No
Are all the QuickLink security nuts installed?				Yes	N/A	No
Has any intermediate anchoring been used? If so, note the spacing here_____				Yes	N/A	No
If BG800™ transition has been used does the anchoring arrangement match how it was tested?				Yes	N/A	No
Check there are no snagging points (more than 9/16”)				Yes	N/A	No
Delineators installed?				Yes	N/A	No

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