

BG800™

Temporary and Permanent Work Zone Safety Barrier

Product Manual

MASH TL3 COMPLIANT



Release 01/19 (Australia/New Zealand)

www.ingalcivil.com.au

1.0 Introduction

BG 800® is a versatile longitudinal steel barrier vehicle restraint system that is anchored to the ground at the ends of barrier runs. Standard sections of BG 800™ are listed below;

- 6m & 12m standard sections
- 6m & 12m terminal end sections

BG 800™ has male and female QuickLink connectors which allow for simple and speedy connection when aligning two pieces of BG 800™, and further shortens the installation times.

The BG 800™ can be utilised in permanent or temporary applications and there are various connections to other barrier systems and crash cushions.

There is a standard system which is BG 800™ and two main system variations. These are MDS (Minimum deflection system) and LDS (Limited deflection system).

1.1 Testing & Acceptance

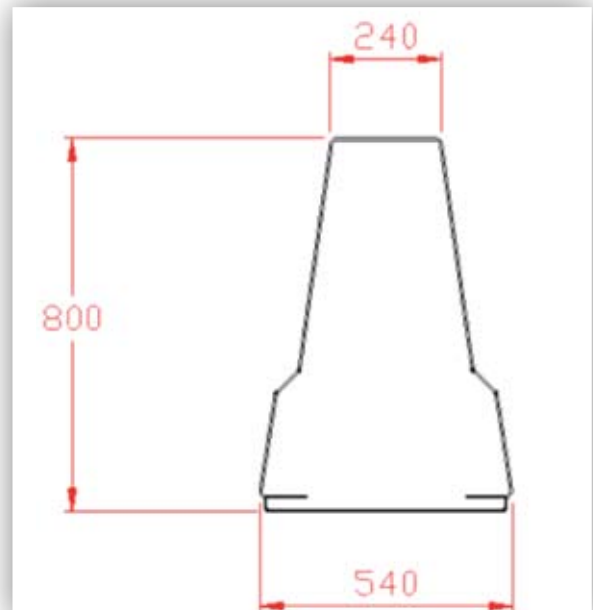
BG 800™ has been developed as a rapidly deployable Steel Safety Barrier for use where a vehicle restraint system conforming to both American & European test standards with a selection of containment levels.

1.2 Characteristics

BG 800™ has been designed for both permanent and temporary applications. Common uses include;

- Work zone protection
- Contraflow opportunities
- Controlled access
- Bridge applications

Note: This manual is designed to complement any project drawing packages that are provided. Where conflicts arise the Ingal Civil Products project drawings take priority over this manual.



2.0 Design Considerations

2.1 Median & Roadside Applications

BG 800™ can be impacted from either side of the barrier with no difference in performance. Therefore, the barrier can be used in both roadside and median/bi-directional traffic applications.

2.2 Length

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 minimum recommended installed length of BG 800™ is 18m between inner anchor shoes; i.e. for an installation with no approved crash cushion connected to the end terminal, the minimum total system length including terminals and anchors is 30m.

Note: Please refer to acceptance conditions which may differ to the above recommendations.

2.3 Curves

Various degrees of movement can be achieved using the following components.

- 0.67° at the QuickLink joint
- 5° at the 6m slotted plates joint
- 5° radius section
- 10° radius section

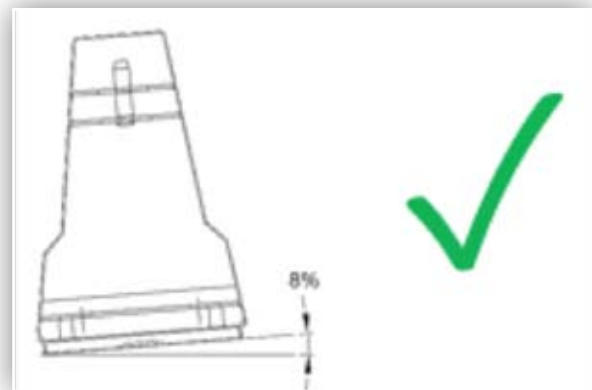
Examples of achievable curves can be found in the Curved Barrier section of this manual.

2.4 Environment

BG 800™ should not be installed where there are fixed objects that may affect performance of the barrier if impacted.

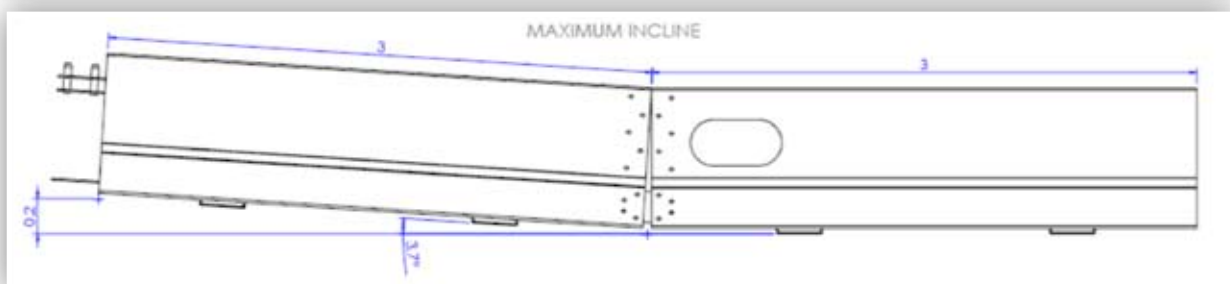
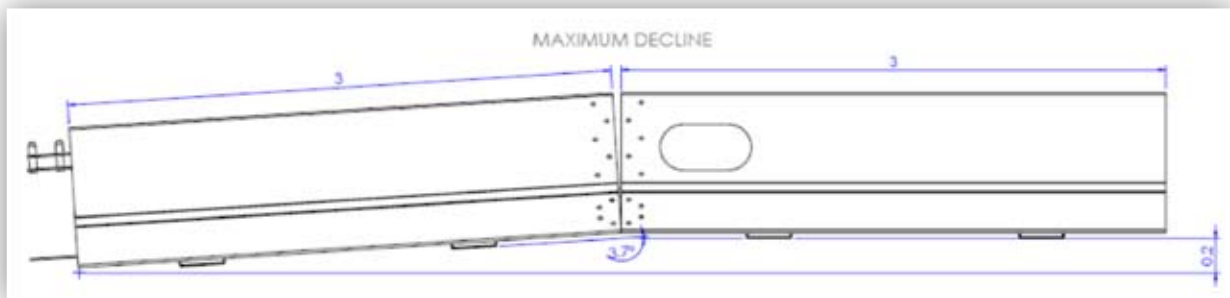
2.5 Slopes

For the system to perform correctly, it should be installed on ground that has a cross slope of no more than 8%. When installing the BG 800™ Gate we recommend this maximum cross slope should be reduced to 5% to allow controlled manual operation of the gate.



NOTE: Extreme care must be taken when opening a gate on a slope as the gate can move under its own weight.

The maximum incline and decline that BG 800™ can typically achieve is demonstrated in the images below which shows a 6m section with bolted slotted plates.



2.6 Length of Need

The length of need for BG 800™ is the total installed length between the two inner anchor shoes.

The beginning of the length of need is measured 6m from the approach (upstream) end of the BG 800™ terminal (at the inner anchor shoe). It must be noted that when an approved, non-gating (redirective) end termination such as a crash cushion is connected to the BG 800™ terminal, then the approach (upstream) end of such system becomes the beginning of the length of need. If an approved, gating (non-redirective) end termination such as a crash cushion is connected to the BG 800™ terminal, then the beginning of the length of need remains 6m from the approach (upstream) end of the BG 800™ terminal (inner anchor point).

When deciding length of need of a system consideration must be given to the proximity of any anchor points to any excavations, if the BG 800™ is to be used to protect errant vehicles from excavations we recommend that the anchoring takes place beyond any excavation and if any extra anchoring is required, it should be single sided away from the excavated face.

2.7 Ground Conditions

The ground conditions that the barrier is to be installed on and anchored to, need to be established to ensure the correct anchoring choice is made and the appropriate anchor shoe is connected to the barrier. Details of common ground conditions and the available types of anchors and anchor shoes can be found in drawing BG-60-23 and in the appendix of this manual.

Note: For use of BG 800™ on any ground conditions or anchors that are not shown in this drawing please contact Ingal Civil Products Ltd for further advice.

2.8 Crash Cushions

When choosing a suitable crash cushion for use with BG 800™, special consideration must be given to opting for a gating (non re-directive) crash cushion or a non-gating (re-directive) crash cushion. A non-gating crash cushion is one that has been tested to withstand a side impact from an errant vehicle and a gating system is one that has not been tested for this impact angle. If opting for a gating crash cushion then consideration must be given to allow for a safe run out area behind the system.

If it is not possible to locate the terminal ends outside the clear zone, then an approved end termination (such as a crash cushion) can be fitted to the BG 800™ full height terminal. Any crash cushion placed in front of a full height terminal will have its own anchoring specifications and assembly instructions. Any

connection between BG 800™ and the approved end termination will be designed and supplied by either the BG 800™ supplier or the approved end termination supplier. They shall work together to ensure a suitable connection is available.

Approved end terminations that are currently available with designed connections are:

- I. **QuadGuard** – Non gating (re-directive)
- II. **TRACC** – Non gating (re-directive)
- III. **Absorb 350** – Gating (non re-directive)
- IV. **Tau II** – Non gating (re-directive)
- V. **SMART** – Non gating (re-directive)

2.9 Anchoring

BG 800™ has successfully been tested with a selection of anchoring methods and in various ground conditions making it a versatile system that can be used on many differing surfaces.

Standard BG 800™ requires anchoring to the ground at each end of a run and at intermediate locations spaced at 60m intervals. There are integral anchor points beneath an easily removed cover at the extreme end of the specially designed anchor sections. There is a second anchor point at the first bolted joint up stream of the end of the section; these anchors can either be external or internal anchor shoes depending upon site restrictions or preference. Both the anchor shoes and the integral anchor points require 4 anchor pins/bolts each (8 in total per end anchor section).

As a means of reducing the deflection of the system, intermediate anchoring can be introduced to create the BG 800™ Minimum Deflection System (MDS) and Limited Deflection System (LDS).



2.10 Delineators

Reflective delineators can be attached to the side wall or top of the BG 800™ as required and at the relevant spacing's. There are two options of delineators available, one a fixed reflector and the second a reflector with a flexible joint which helps makes it resistant to breaking.

In addition to the reflectors, there are available specially manufactured brackets that allow cone lamps to be fixed to the top of the BG 800™.



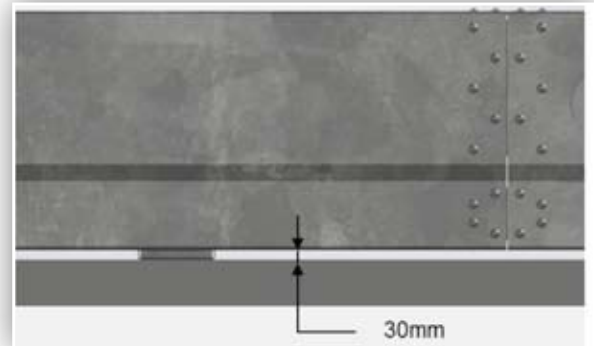
Other locally sourced options may also be acceptable.

2.11 Kerbs

BG 800™ can be installed to a surface which is raised by a kerb of no more than 100mm high.

2.12 Drainage

The design of BG 800™ incorporates 250mm long feet located at regular intervals along the barrier that sit 30mm below the base of the lower side wall and span the full width of the barrier. There are three steel feet per 6m section.



2.13 Weight

BG 800™ weighs approximately 90kgs a metre. Standard 12m sections have a nominal weight of 1080kg and 6m sections nominally 540kg.

2.14 Safety Zone

BG 800™ systems require a safety zone behind them to allow the system to perform correctly.

The safety zone size should meet or exceed the dynamic deflection size listed in the **System Types** section.



2.15 Testing

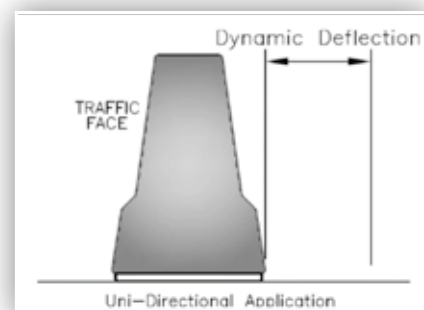
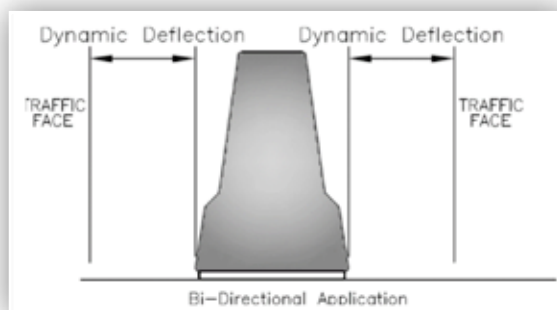
BG 800™ has been tested in accordance with NCHRP 350, MASH and BS EN 1317 parts 1 and 2 and has successfully demonstrated its capability to achieve the following containment and performance levels. NCHRP 350 TL-1, TL-2, TL-3 or TL-4, MASH TL-3 and BS EN 1317 Containment Level T1, T2, T3, N1, N2, H1 or H2.

The design features of the BG 800™ enable it to be deployed as either a single or double sided barrier. However, a factor to be taken into consideration when being utilised as a double-sided barrier, is the working width (or deflection) of the system. The table below describes some of the test criteria met by BG 800™.

Test Standard	Performance Level		Test Reference	Vehicle Type	Impact Speed (km/h)	Impact Angle (°)	Vehicle Mass (kg)
NCHRP 350	TL-2		2-11	Pickup	70	25	2000
	TL-3		3-10	Light Car	100	20	820
			3-11	Pickup	100	25	2000
	TL-4		4-12	Truck	80	15	8000
MASH	TL-3		3-11	Pickup	100	25	2270
EN 1317	N2	L2	TB11	Light Car	100	20	900
			TB32	Car	110	20	1500
	H2		TB51	Bus	70	20	13000

3.0 System Types

BG 800™ is a versatile product with many system variations to suite different project requirements. The following section details various setup options.



System Type	Anchor Interval (m)	Test Standard	Performance Level	Design Speed (km/h)	Dynamic Deflection (m)
Standard	60	MASH	TL-3	100	1.66
		NCHRP 350	TL-4	80	1.74
			TL-3	100	1.60
			TL-2	70	1.36
Anti-Gawk System (AGS)	36	NCHRP 350	TL-2 + 10 km/h	80	0.94
Lower Deflection System (LDS)	12	NCHRP 350	TL-4	80	0.42
			TL-3	100	0.89
Minimum Deflection System (MDS)	6	NCHRP 350	TL-3	100	Top 0.305 Toe 0.076
		MASH	TL-3	100	Top 0.470 Toe 0.130

Notes: MDS systems require the addition of T-Top sections along the top of the barrier. See T-Top section for further details. Please refer to acceptance conditions which may differ to the above published deflections. AGS system anchor spacing may be lower to ensure wind loading requirements are met.

3.1 Calculated Deflections

Reduced safety zone data tables shows calculated deflections in metres at various performance levels for BG 800™ when anchored as per system setup: (These calculations have been based on actual test data).

The normalised deflections have been calculated using the formula contained in the extract from EN1317 part 2 UAP document below.

Note: The actual and normalised values of dynamic deflection and working width shall be measured and recorded in the test report.

Normalised Dynamic Deflection: D_N (m)

$$D_N = \frac{D_M \times M_T (V_T \sin \theta_T)^2}{M_M (V_M \sin \theta_M)^2}$$

Normalised Working Width: W_N (m)

$$W_N = W_M - D_M + D_N$$

Where:

- Measured Maximum Dynamic Deflection: D_M (m)
- Measured Working Width: W_M (m)
- Test Total Mass: M_T (kg)
- Test Velocity: V_T (m/s)
- Test Angle: θ_T
- Measured Test Total Mass: M_M (kg)
- Measured Test Velocity: V_M (m/s)
- Measured Test Angle: θ_M

We can calculate the expected deflections of the systems when impacted at slower speeds and shallower impact angles using an EN1317 formula. These deflections are shown on the systems pages in tables and can be used for justifying reduced safety zones, when restricted by site specific restraints.

Standard – NCHRP 350 TL-3

Below is a table showing the expected deflections of the TL-3 BG 800™ system if impacted at various angles and various speeds with a 2000kg Truck (60.0m Between Anchors).

Impact Speed (mph)	Impact Speed (km/h)	Deflection (m)				
		5°	10°	15°	20°	25°
25	40	0.01	0.04	0.10	0.17	0.27
31	50	0.02	0.07	0.16	0.27	0.42
37	60	0.03	0.10	0.22	0.39	0.60
40	64	0.03	0.12	0.26	0.45	0.69
43	70	0.03	0.14	0.31	0.53	0.82
50	80	0.05	0.18	0.40	0.70	1.07
56	90	0.06	0.23	0.51	0.88	1.35
60	97	0.07	0.26	0.58	1.02	1.55
62	100	0.07	0.28	0.62	1.09	1.66

Standard – NCHRP 350 TL-4

Below is a table showing the expected deflections of the TL-4 BG800 system if impacted at various angles and various speeds with an 8000kg Truck (60.0m Between Anchors).

Impact Speed (mph)	Impact Speed (km/h)	Deflection (m)				
		5°	10°	15°	20°	25°
25	40	0.05	0.21	0.46	-	-
31	50	0.08	0.32	0.71	-	-
37	60	0.12	0.46	1.03	-	-
40	64	0.13	0.53	1.18	-	-
43	70	0.16	0.63	1.40	-	-
50	80	0.21	0.82	1.82	-	-

Standard – MASH TL-3

Below is a table showing the expected deflections of the TL-3 BG 800™ system if impacted at various angles and various speeds with a 2270kg Truck (60.0m Between Anchors).

Impact Speed (mph)	Impact Speed (km/h)	Deflection (m)				
		5°	10°	15°	20°	25°
25	40	0.01	0.04	0.10	0.17	0.26
31	50	0.02	0.07	0.15	0.26	0.40
37	60	0.02	0.10	0.22	0.38	0.58
40	64	0.03	0.11	0.22	0.44	0.67
43	70	0.03	0.13	0.25	0.52	0.79
50	80	0.04	0.17	0.30	0.68	1.03
56	90	0.06	0.22	0.39	0.86	1.31
60	97	0.06	0.25	0.49	0.99	1.51
62	100	0.07	0.27	0.56	1.06	1.61

Minimum Deflection System (MDS) – NCHRP 350 TL-3

Below is a table showing the expected deflections of the MDS TL-3 BG 800™ system if impacted at various angles and various speeds with a 2000kg Truck (6.0m Between Anchors, with T-Top).

Impact Speed (mph)	Impact Speed (km/h)	Deflection (m)				
		5°	10°	15°	20°	25°
25	40	0.00	0.01	0.03	0.05	0.07
31	50	0.00	0.02	0.04	0.08	0.11
37	60	0.01	0.03	0.06	0.11	0.17
40	64	0.01	0.03	0.07	0.12	0.19
43	70	0.01	0.04	0.08	0.15	0.22
50	80	0.01	0.05	0.11	0.19	0.29
56	90	0.02	0.06	0.14	0.24	0.37
60	97	0.02	0.07	0.16	0.28	0.43
62	100	0.02	0.08	0.17	0.30	0.46

Lower Deflection System (LDS) – NCHRP 350 TL-3

Below is a table showing the expected deflections of the LDS TL-3 BG800 system if impacted at various angles and various speeds with a 2000kg Truck (12.0m Between Anchors).

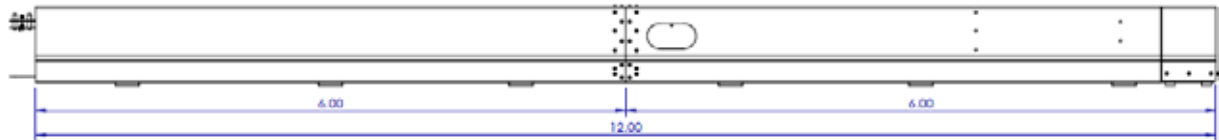
Impact Speed (mph)	Impact Speed (km/h)	Deflection (m)				
		5°	10°	15°	20°	25°
25	40	0.01	0.02	0.06	0.10	0.15
31	50	0.01	0.04	0.09	0.15	0.23
40	64	0.02	0.06	0.14	0.25	0.38
43	70	0.02	0.08	0.17	0.30	0.45
50	80	0.03	0.10	0.22	0.39	0.59
56	90	0.03	0.13	0.28	0.49	0.75
62	100	0.04	0.16	0.35	0.60	0.92

Minimum Deflection System (MDS) – MASH TL-3

Below is a table showing the expected deflections of the MDS TL-3 BG 800™ system if impacted at various angles and various speeds with a 2270kg Truck (6.0m Between Anchors, with T-Top).

Impact Speed (mph)	Impact Speed (km/h)	Deflection (m)				
		5°	10°	15°	20°	25°
25	40	0.00	0.00	0.01	0.01	0.02
31	50	0.00	0.01	0.01	0.02	0.03
37	60	0.00	0.01	0.02	0.03	0.05
40	64	0.00	0.01	0.02	0.03	0.05
43	70	0.00	0.01	0.02	0.04	0.06
50	80	0.00	0.01	0.03	0.05	0.08
56	90	0.01	0.02	0.04	0.07	0.10
60	97	0.01	0.02	0.04	0.08	0.12
62	100	0.01	0.02	0.05	0.08	0.13

4.0 Component Identification



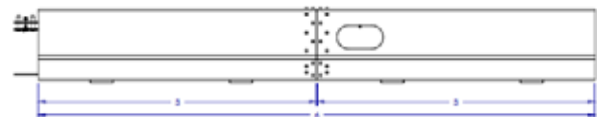
12m full height terminal - male/female QuickLink



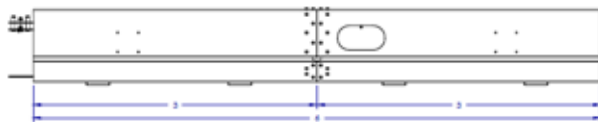
12m standard – male/female QuickLink



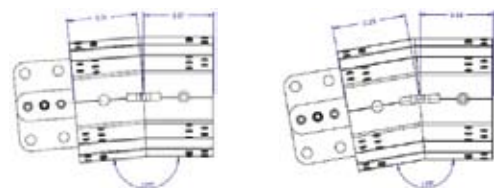
6m single piece – male/female QuickLink



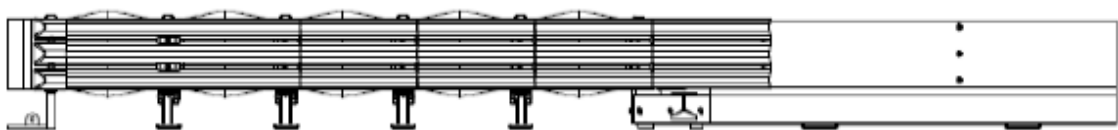
6m standard section with 5° slotted plates at join



6m wheelset – male/female QuickLink



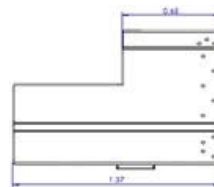
5 degree, 10 degree angle sections – left/right



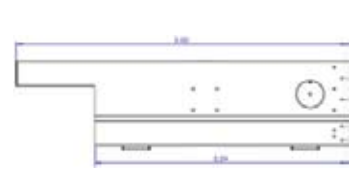
Crash cushion end treatment



6m gate section



1.4m gate post



3m gate hinge

Notes: All M16 bolts used for connecting sections of BG 800™ together to be at least grade 8.8. Numerous extra components are available and bespoke options also. Please contact Ingal Civil Products for further information.

Future Highway Care manufactured and supplied barrier is identifiable with the Highway Care logo on the access hatch plate.

5.0 Safety Statements

5.1 General Safety

- All required traffic safety precautions should be complied with. All workers should wear required safety clothing. (Examples, and not limited to, include: high visibility vests, steel capped footwear, gloves and hard hat).
- Only authorised trained personnel should operate any machinery. Where overhead machinery is used, care must be taken to avoid any overhead hazards.
- Before drilling or excavation always ensure that the area is clear of underground services. (The appropriate service providers may need to be contacted).
- Avoid placing hands or fingers in and around moving machine parts when components are being lifted and manoeuvred into place.

5.2 System Safety Statements

- Take care when unloading the BG 800™ components as there may be limited space to work with. Never go underneath a load that is being lifted.
- All operatives must be careful when installing BG 800™ especially with the risk of a trapping injury occurring.



Gloves



Hard Hat



Steel-Capped Footwear



Hi-Visibility Vest

6.0 Installation

6.1 Tools List

Tool	Information
Lifting Device	Such as lorry mounted crane or wheeled excavator. Must have suitable lifting capacity and reach to lift, manoeuvre and install BG 800™. It is also recommended that these cranes are remote control for ease of use.
Lifting Chains	<p>A two leg assembly with a 2500kg lifting capacity, each chain is 2m long c/w hook and locking clasp, and shortening clutch. This is suitable for lifting 12m sections of barrier and 6m sections made up from 2 x 3m sections only.</p> <p>A two leg set with a 2500kg lifting capacity, each chain needs to be 3m long c/w hook and locking clasp, and shortening clutch. These chains are for lifting 6m lengths of barrier that are half of the 12m sections.</p>
Tag Rope	Rope with spring loaded carabineer clip. The rope length needs to be 1.5 times the lifting height of the barrier.
Drilling Equipment	<p>Either an electric hammer drill c/w 32mm drill bit or an air driven rock drill c/w 33mm rock drill tool. To speed up installation consideration should be given to having 2 drilling machines available.</p> <p>Also, a diamond core drill suitable for cutting a 32mm hole up to 300mm deep in case of reinforcement bar when drilling in concrete.</p>
Generator & Extension Lead	For use with the hammer drills, and/or diamond core drill. Should be capable of a high enough output to drive two hammer drills at the same time as a minimum.
Measuring Wheel & Road Marking Paint/chalk	To mark BG 800™ positioning where required.
2 off 6ft crow bar/wrecking bar	To assist with minor barrier re-alignment.
Magnetic BG 800™ 'T' Bar Socket	For inserting and removing QuickLink security nut.
Wooden Packers	Approx. 520mm x 300mm x 19mm. wooden ply wood packers. These are used to support barrier over uneven surfaces.
Timbers	<p>Two blocks approximately 200mm x 200mm x 300mm.</p> <p>Approximately 75mm x 75mm timber bearers.</p>
Small Impact Gun	Complete with suitable sockets. 24mm impact socket as a minimum.
Compressor & Extension Pipes	For the Rock Drills and Impact Gun. Should be capable of driving two rock drills at once.
Spanners/Wrenches	Combination spanners to include as a minimum 2 of each of the following 13mm, 24mm, 30mm, 32mm & 36mm.
Torque Wrench (S)	Suitable for torques up to 150 Nm. C/W suitable 24mm socket.
Torque Wrench (L)	Suitable of torques up to 300 Nm. C/W suitable 32mm socket.
Sledge Hammer	To hammer in anchor pins.
Cranked Crow Bar	Useful for removing tight pins.
10m Measuring Tape	
8mm & 10mm Allen Keys	
½ & ¾ Drive Socket Sets	
Podger (round pry bar)	

6.2 Preparation

Before any installation is carried out, it is important to prepare and plan correctly. This may involve planning barrier positions using CAD layouts and/or performing site visits. This is necessary to keep time spent on site to a minimum and ensure the installation proceeds without issues. Items to be considered and checked are; lifting restrictions such as low bridges/overhead cables, underground services in the vicinity of drilling operations, layout and alignment of barrier.

6.3 Getting Started

When planning the job, it is essential that the following points are established and agreed with the client:

- The required performance level of the BG 800™.
- The start, finish and alignment of the BG 800™.
- Any additional anchorages required (e.g. to reduce deflection at a specific hazard that cannot be relocated away from the safety zone) and their locations.
- Any curvature of the BG 800™ in both the horizontal and vertical planes.
- The type of pavement construction and the method of anchorage.
- Any expansion joints are identified.
- In the case of concrete pavements, if reinforcement is encountered when drilling that this can be drilled through.
- The method of reinstatement of drilled holes when the BG 800™ is removed.
- There are no underground services, waterproof membranes etc. Which could be damaged by drilling.
- There are no overhead cables that could be contacted by the lifting operation.
- There is adequate working room and safety zone.

6.4 Lifting BG 800™

Each standard 12m section of BG 800™ weighs approximately 1080kg.

If using the normal method of installation with a lorry mounted crane and articulated truck, the safe working load of the crane must be in excess of 1.08 tonnes at a reach of 8m to enable 12m units to be safely offloaded, loaded and installed on site.



BG 800™ is lifted with two leg chains attached to the lifting points on the top of the barrier. Each individual piece of BG 800™ has two lifting points and when these pieces are bolted together to make up a normal section of BG 800™, there are four possible lifting points along its length. BG 800™ has identical lifting points on the underside to facilitate lifting inverted sections.

If the barrier to be lifted has a bolted joint in its length (I.E. A section made from two pieces) then using the standard chains, the barrier must be lifted from the lifting points closest to and either side of this bolted joint. If the length of barrier is a piece without a joint in the middle (I.E. an individual piece) then the longer chains are required as the lifting points are at either end of the piece.



6.5 Lifting Point Certification

Each lifting point has been welded in accordance with DIN 18800 class E. Two lifting points per barrier should be used. Below is the capacity table that each lifting point has been designed and engineered

Item	Max Weight (kg)	Lifting Capacity
6m Section	Male: 562 Female 555	4.1 times the weight of 6m Section.
12m Section	1155	2.0 times the weight of 12m Section

6.6 Using Tag Ropes

Use tag ropes to control the position of the barrier being lifted. They should not be too long, 8 metres is adequate for a load 3 sections high. They should be attached to the lifting eyes towards the ends of the barrier sections.

A light pull for a limited period is all that is needed to control the barrier; any more will give the barrier momentum which has then to be stopped.



Do not wrap the rope around your hand or fingers and avoid treading on or over the rope.

Keep at least 3 metres from the barrier as slight adjustments with the crane can cause a pendulum effect along the barrier.



Never get between the length of barrier and a solid object. A swinging barrier carries energy and can crush.

6.7 Using Chains

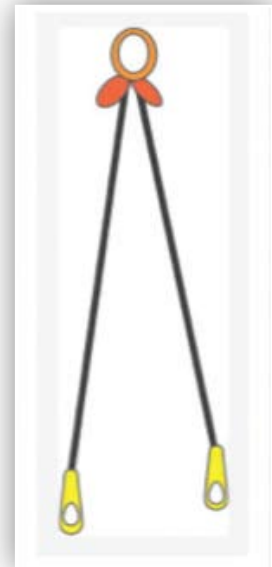
All fabric slings and metal chains must be checked before use to ensure:

- That they are undamaged.
- The load imposed is within their capacity.

The recommended chains to use are two leg sets each leg 2 metres long, each with a shortening clutch to allow tilting the barrier if required. They are rated at 2 tons per pair provided that the angle between the legs does not exceed 90° or 2 tons per leg if one leg is used with the chain vertical.

It is recommended that before using the chains:

- Check the number on the chain against the test certificate and check that the test certificate is current.
- Check the chain for damage - look at the links for distortion and nicks. Look at the hooks - not bent open, not twisted, latches working.
- Check the chain lengths for the lift being carried out and shorten one leg if necessary to adjust the slope of the barrier. Shortening one chain will raise the end with the short chain. Check the chain is properly seated in the shortening clutch. If hook type shortening clutches are used, the chain goes across the hook into the slot formed by the hook. The point of the hook does not go into the chain link!
- Check chains are not twisted before hooking on. When hooking on to the barrier, make sure the hook is around the bar that runs across the slot.



Never hook onto the sheet steel directly.

Make sure the hooks face outward. I.e. the open side of the hook nearest the end of the barrier.

Avoid overloading chains. This is particularly easy to do by snatching the chains, as when turning the barrier over.

A chain which has been overloaded can break at any time. Inspection cannot detect imminent failure. A chain break can kill. Report any chain that has been overloaded - it must be replaced.

When loading barrier on to trailers generally use the chains at equal length. This will give the barrier a slight slope down to the male end.

Terminal end sections are heavier at the terminal end. Shorten one chain by about six links to get a more even centre of gravity.

Barrier where the central joint has been angled to follow a curve will not lift level with a two leg chain. Where the angle is more than 1° - 2° it is advisable to use 2 two leg chains on the crane hook. One two leg chain will need to have 3 metre legs, both with shortening clutches. The other two leg chains will need to have 6 metre legs, both legs with shortening clutches. Both chains need to be rated at least 1.4 tons at 45° - 60° to vertical.

Hook the 3 metre chains to the lifting points nearest the bolted joint and use the 6 metre legs for the outer lifting points. Adjust chain length for even lifting but keep the angle to the vertical of the outer chains less than 60°.

6.8 Ancillary Lifting Devices

There are various alternative lifting devices that can be used with BG 800™. See the Photo Example section at the end of this manual for illustrations.

Note: Ensure the lifting device used is compliant with local laws and regulations.

Please contact Ingal Civil Products for further information.

6.9 Transport

6.9.1 Safety Zones for Offloading & Loading

The swinging load must be controlled with correctly fixed tag ropes. The loads must not be allowed to swing over or into live traffic lanes.

Suitable safety zones will need to be considered as part of the planning process. The decision regarding these zones will need to consider the lengths of the units being delivered. Strong winds will affect the controllability of the suspended load and risks must not be taken.

The load should be lowered so that it is immediately above the ground as soon as it is clear of the truck and then jibbed out to the final position.

6.9.2 Loading & Unloading

Prior to loading, a visual check on the barrier condition must be carried out. If in doubt to the suitability of a damaged barrier, do not use until checked by a competent person.

It is important to ensure the correct loading of the BG 800™. Confirm the barrier is put on the delivery truck the right way around and the terminal sections are in the correct place on the load. Add any radii/slotted joints sections that may be required.



When loading trailers with chains, it will be necessary for somebody to be on the top of the load to position the barrier and detach the lifting chains from the barrier.

This is a potentially dangerous operation and great care must be taken. The following precautions must be observed;

- When climbing onto the load a ladder must be used. This must extend at least 1 metre above the load. It must be held at ground level by a second person.
- All barriers being placed should be controlled by a tag rope, preferably two, and certainly two ropes in windy conditions.
- The barrier should not be lifted over the person on the trailer. Where it is necessary for the person to get to the other side of a barrier being placed the barrier should be put down temporarily on the trailer and the person climb over the barrier. Observe the same precautions when unloading.
- Barrier is usually loaded with the male ends at the front of the truck.
- Some loads may need a terminal end on the top or bottom layer.
- A female terminal end, if required, will usually be on the bottom layer in the centre of the trailer with the terminal towards the front of the trailer.
- A male terminal end, if required, will usually be on the top layer of the trailer with the terminal towards the back of the trailer.
- A minimum of 2 wooden bearers are required to support each layer of barrier.

6.9.3 Trailers with No Side Posts

These are typically loaded with a maximum of 3 layers of barrier, 4 barriers per layer (12 in total).

On each layer the outer two barriers and the centre barrier are the right way up and the barriers between them inverted. Place the first layer directly on the trailer and secure it with two 2000kg ratchet straps.

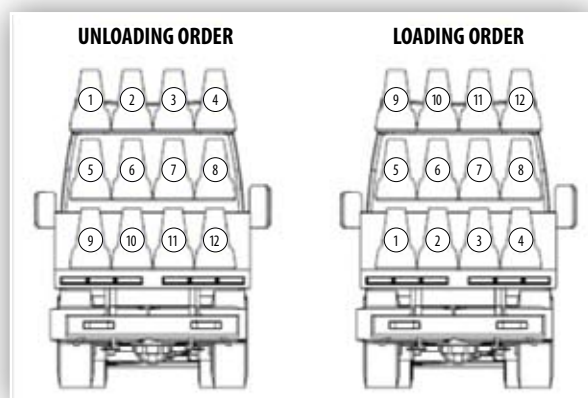
Place two 75mm square hardwood bearers on top of the barriers before the second layer. Ideally, they should be 2.5 metres long, but 2.9 metre timbers can be used at an angle across the trailer. The timbers should be placed about 2 metres from the ends of the barrier and clear of the feet of the inverted first layer units and the feet of the second layer units.

Secure the second layer with two 2000kg ratchet straps.

Place the third layer on similar timbers and secure with ratchet straps. When placing ratchet straps over the layers, ensure that the two on the bottom layer are nearer the centre and space the straps for the subsequent layers further out towards the ends.

On each layer not secured by a head board, prevent the load from sliding forward by passing a strap or chain through the male connections on the front of the barrier and diagonally back to the trailer. If straps are used, use sleeves to prevent the barrier chaffing the straps.

Note: When loading barrier which has been angled at the bolted joint to follow a curve, these should be straightened prior to transport.



Typical 144m per trailer

6.9.4 MDS Loading/Unloading Trailers with No Side Posts

It is recommended BG 800™ T-Top is installed on site after the initial barrier has been positioned.

When BG 800™ is transported with T-Top attached they are loaded with a maximum of 3 layers of barrier, 4 barriers per layer (12 in total).

Place the first layer directly on the trailer with appropriate short bearers and secure it with two 2000kg ratchet straps.

Place two 75mm square hardwood bearers on top of the short bearers before the second layer. Ideally, they should be 2.5 metres long, but 2.9 metre timbers can be used at an angle across the trailer. The timbers should be placed about 2 metres from the ends of the barrier and clear of the first layer units and the feet of the second layer units.

Secure the second layer with two 2000kg ratchet straps.

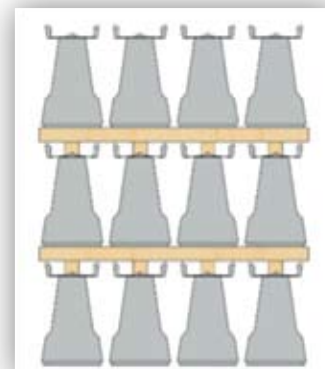
Place the third layer on similar timbers and secure with ratchet straps. When placing ratchet straps over the layers, ensure that the two on the bottom layer are nearer the centre and space the straps for the subsequent layers further out towards the ends.

On each layer not secured by a head board, prevent the load from sliding forward by passing a strap or chain through the male connections on the front of the barrier and diagonally back to the trailer. If straps are used, use sleeves to prevent the barrier chaffing the straps.

Note: It is not necessary to transport BG 800™ with the T-Top already attached. T-Top can be added as required to standard units when they have been installed.

See the T-Top section of this manual for details on installing T-Top.

T-Top can be left attached to BG 800™ units but timbers must be used and positioned securely to ensure no weight sits on the T-Top edges.



6.10 Truck Mounted Cranes/Wheeled Excavator

It is essential that the operators of such equipment are fully trained and are aware of the regulations related to lifting and lifting equipment. For example, those set out in NOHSC 7019 (1992).

These brief notes are not intended to replace or supplement any training course that the crane operator should attend. However, they give an erector an indication of the factors that must be considered by the authorised crane operator.

Before using the lifting equipment, we recommend the operators should check as a minimum:

- The safe working load of the equipment.
- That there are no defects with the equipment.
- That there are no overhead cables.
- That the vehicle is stabilised.
- That the vehicle is on reasonably level ground.

Before lifting the load, it is recommended the operator should:

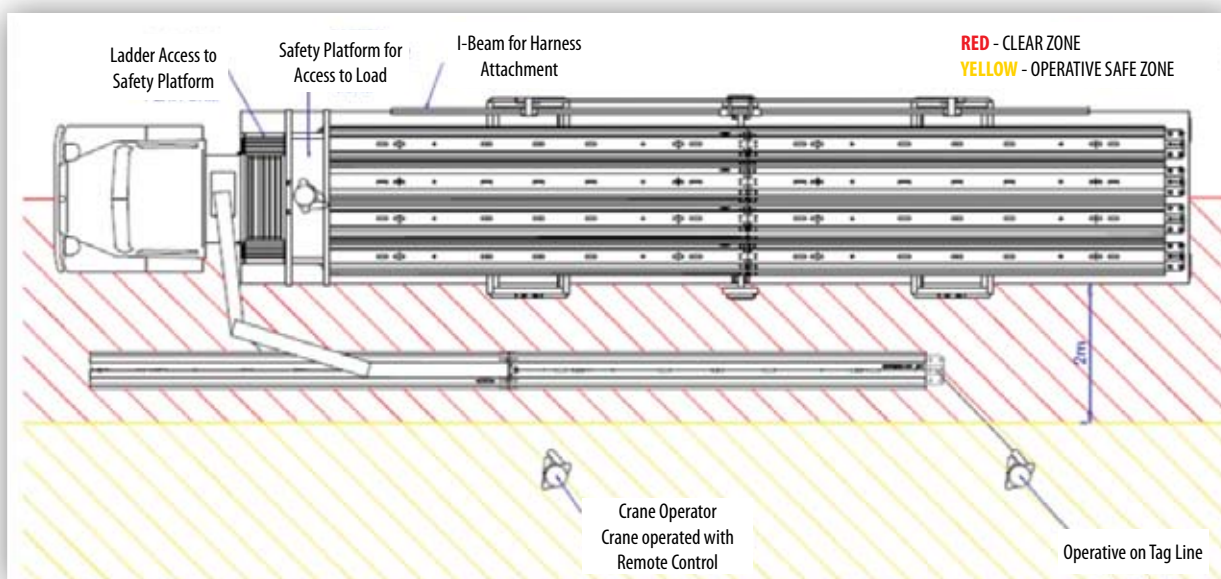
- Check the safe working load of any slings or chains.
- Establish the weight of the load.
- Check that the area to receive the load is clear.
- Ensure that the load will not swing out of control.
- Ensure that the load is balanced.

When lifting the load, it is recommended the operator should:

- **NOT** swing the load over any other workers.
- **NOT** allow others to walk under a suspended load.
- **NOT** allow the load to swing out of control.
- **NOT** swing the jib or load over a live traffic lane.
- **NOT** exceed the safe working load.

After lifting the load the operator should:

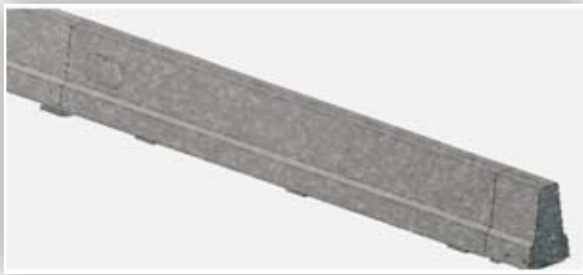
- Stow the crane in such a way that it cannot move during the transit.



7.0 Terminal Installation

BG 800™ is always secured at its start and end by a full height terminal. When a full height terminal is used facing oncoming traffic, it must be transitioned to an approved end termination (such as a crash cushion). Details of crash cushion transitions and connections are available from the crash cushion supplier.

Installation is normally started from the end of the BG 800™ and laid in the direction of traffic flow. Sometimes when a long length of BG 800™ is to be installed and site conditions allow, the installation can commence at any point along the length of the run, using a section of BG 800™ with two male ends as the first unit to be placed and subsequent standard sections laid outwards in both directions from this section simultaneously, this double male quick link section can easily be identified by applying a paint mark to the top external face of the barrier.



Full height terminal with hood cover



Double male section



Full height terminal with hood cover removed for anchoring and/or crash cushion installation



Full height terminals (male and female) anchoring positions are indicated below.

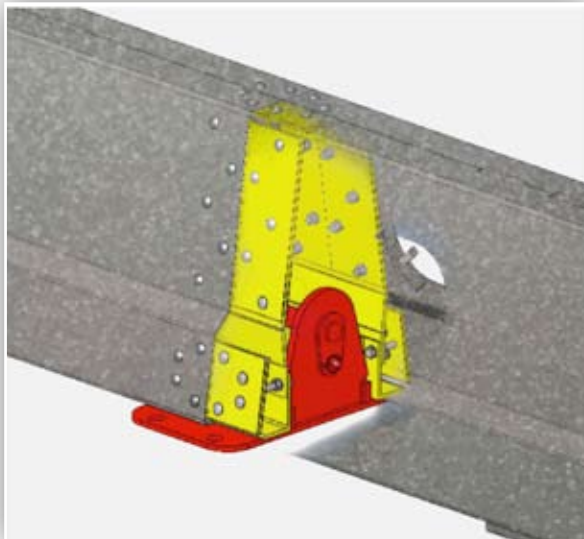
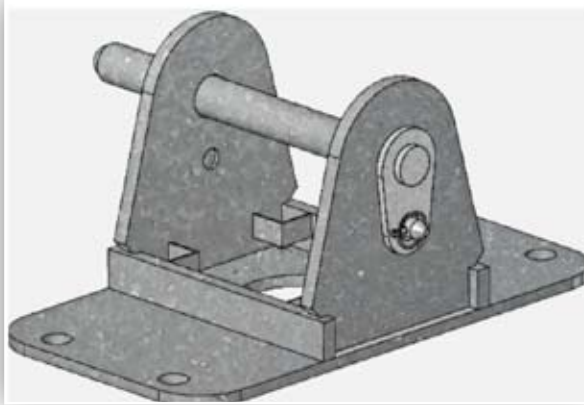


Crash cushion installed in front of full height terminal

At the bolted joint there will either be an external anchor shoe or internal anchor shoe.

Note: It is recommended that no drilling takes place until at least the next two barrier sections have been installed.

7.1 External Anchor Shoe



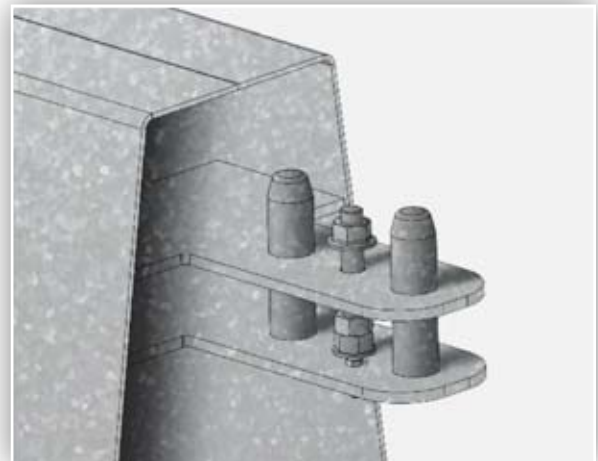
1. Lower the terminal into the correct position as agreed with the client.
2. Completely connect the first standard section to the terminal section (see **Standard Sections Installation** section).
3. Drill through the external anchor shoe anchor to the ground after use the appropriate method of anchoring as agreed with the client prior to installation (see **Drilling for Anchors** section).
4. Remove the 8 bolts (3 along each side and 2 on the end) from the end cap hood section of the barrier and lift off the terminal cover (approx 30kgs).
5. Drill through the anchor plate and fasten using the appropriate method as agreed with the client prior to installation (see **Drilling for Anchors** section). Replace and secure hood/cover plate.

6. The anchorage at the departure end of the run uses a similar method to the approach end but with a female full height terminal.

Note: The external anchor shoe is typically left installed to the terminal end sections.

7.2 Standard Section Installation

All sections must be physically bolted together through the top QuickLink plates using the double lock assembly shown in the image below. These assemblies are pre-installed on the BG 800™ and the connected sections are simply bolted together by attaching the nut into the magnetic socket of the "T" bar, lowering it through the hole located in the roof of the BG 800™ and placing it over the bolt thread. The "T" bar can then be used to tighten the connection to a torque ranging between **70 and 100 Nm**, i.e. normal spanner tight.



Once the BG 800™ is joined to the terminal end and both sections correctly positioned; the drilling of the terminal anchors can be carried out (see **Terminal Installation** section and **Drilling for Anchors** section).

For the departure end, the procedure is similar to that of the approach end. Once the securing of the QuickLink has been completed then either fix the external anchor to the ground or lock the terminal to the inner anchor shoe and then fix the end of the terminal as detailed in the **Terminal Installation** section.

7.3 Laying BG 800™

The barrier should be unloaded from the truck as detailed in the section **Lifting BG 800™**. If a truck mounted crane with remote operation is used, a minimum of a three man team is required. These operatives should carry out the following operations:

- One person oversees all movements and all directions should be given by that person only. This operative will usually operate the crane, guide the BG 800™ QuickLinks into place, and unhook the chains from the barrier.
- The second member of the team guides the barrier with a tag rope while it is being lifted down from the load.
- The third member of the team hooks the chains onto the barrier on the load. Before any lifting takes place this person must be in a safe and secure position.

7.4 Joining BG 800™ Sections



WARNING: Keep Hands and Feet clear when connecting barrier units together

The BG 800™ should be suspended from the crane with the female end approximately 100mm lower than the male end. The female end is then lowered over the male end of the BG 800™ already in place and the QuickLinks connected leaving all faces of the BG 800™ flush with each other.

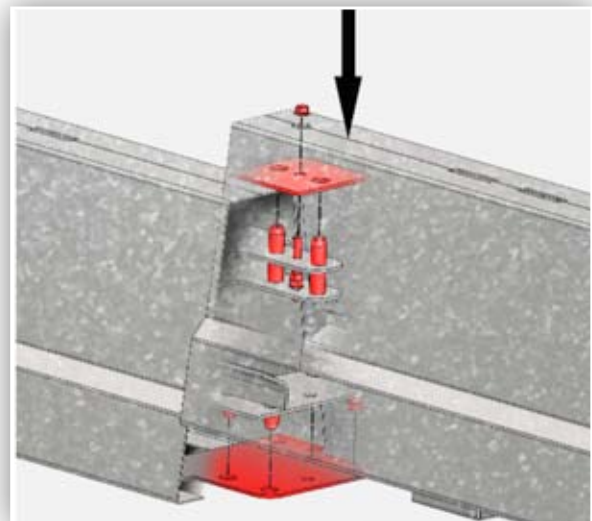


The maximum allowable tolerance at the joints is the female section should be no more than 10mm above the male end.

If this cannot be achieved, first check along the length of BG 800™ for alignment and adjust for horizontal alignment if necessary. If the ground is uneven and the male end is low, lift the male end of the installed BG 800™ and place plywood packers under the foot at the male end.

If the BG 800™ still won't sit flush, unhook the leg of the chain nearest the joint being made, bring the other chain leg vertical and lift and lower on this leg. The last option is to lift the last installed section of BG 800™, place a timber bearer under the male end and lower the BG 800™ onto this timber bearer. Then lower the next section of BG 800™ into place and connect. Once the connection is made and the joint flush, (within 10mm) raise the penultimate section and remove the timber bearer. If these methods do not work the barrier may be damaged and should not be used.

Where the barrier needs to curve in the horizontal or vertical planes, a limited amount of adjustment can be achieved at the bolted joint. To achieve this, remove the cover by the bolted joint and slacken all the bolts. This can be best done using an impact wrench. If this is not available; use a ring spanner. The loosening process can be helped by hitting the domed head of the bolts with a large, copper mallet while pulling on the spanner. Tighten the bolts after adjustment has been achieved. See other operations **Curved Barrier** section for more details on curves.

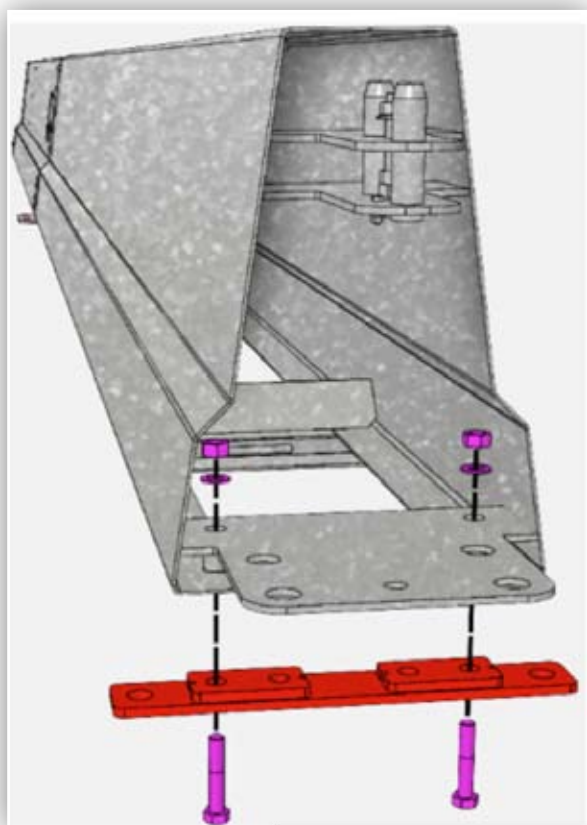


7.5 Intermediate Anchoring

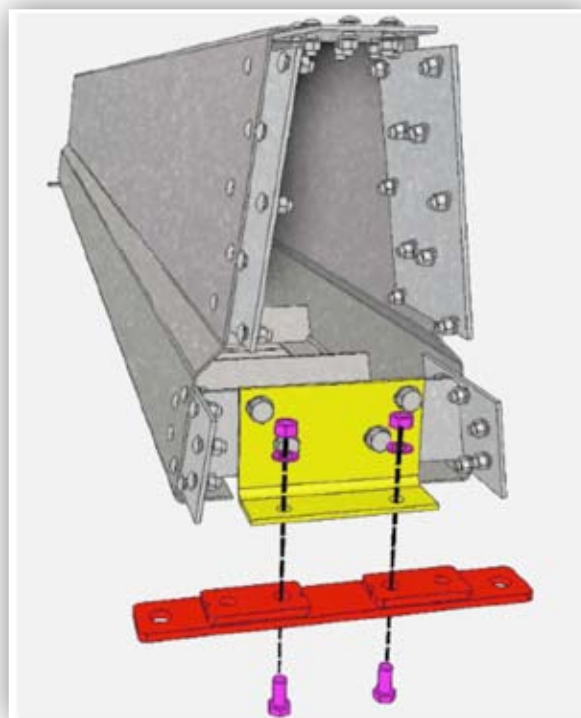
Additional anchorage along the length of the installed BG 800™ may be specified.

There are 2 standard locations for the use of intermediate anchors with BG 800™, one that is connected at the QuickLink Joint and the second which is attached to the barrier at the bolted joint.

To fit the intermediate anchor at the QuickLink joint, lower the barrier to the ground with the male end supported on a block at least 300mm high. Bolt the anchor plate to the barrier using the two tubes located inside the barrier on the lower QuickLink plate on the male end. Use M24 x 120 grade 8.8 bolts with nuts and a washer; the nuts and washers must be located **inside** the barrier. The bolts should be tightened to a torque ranging between 100 and 200 Nm, i.e. normal spanner tight.

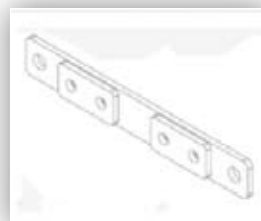


To fit an intermediate anchor at the bolted joint the BG 800™ must be inverted (see **Lifting** section and **Inverting** section). Once inverted safely the 2 small barrier joint plates need to be removed and swapped with the intermediate anchor small lower joint plates using the existing M16 fasteners. Then the L plate needs to be bolted to the two protruding plates using 4 M24 x 50mm bolts, nuts and washers. On to this L plate the intermediate anchor can be fixed.

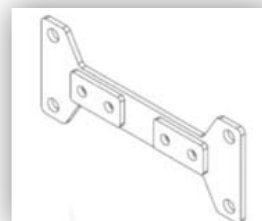


Once the intermediate anchors have been fixed to the BG 800™, position the barrier in the usual way. After installation, drill through the intermediate anchor using the holes as templates and secure by the specified method (asphalt pins, mechanical anchor bolts or resin anchors according to pavement surface).

Typical Intermediate Anchor Options



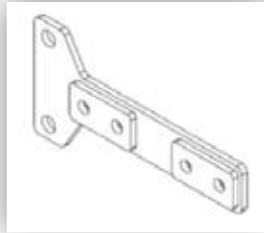
Standard



Bow Tie

7.6 Single Sided Intermediate Anchors

Ingall Civil Products crash tested single sided anchors are typically used where there is an excavation very close to the BG 800™ that undermines the strength of the normal anchoring position. These attach to the barrier in the same way as the standard intermediate anchors.



BG800 Single Sided Anchor

7.7 Ingall Civil Products BG 800™ Single Sided Anchor

These must be anchored on the traffic face using both anchoring locations and are not to be used when BG 800™ can be impacted from both sides or when screen is attached on top of the BG 800™.

Note: A bow tie anchor anchored on one side can also be used for single sided anchoring. Please contact Ingall Civil Products for advice about further intermediate anchoring options.

7.8 Drilling for Anchors

7.8.1 Hole Sizes

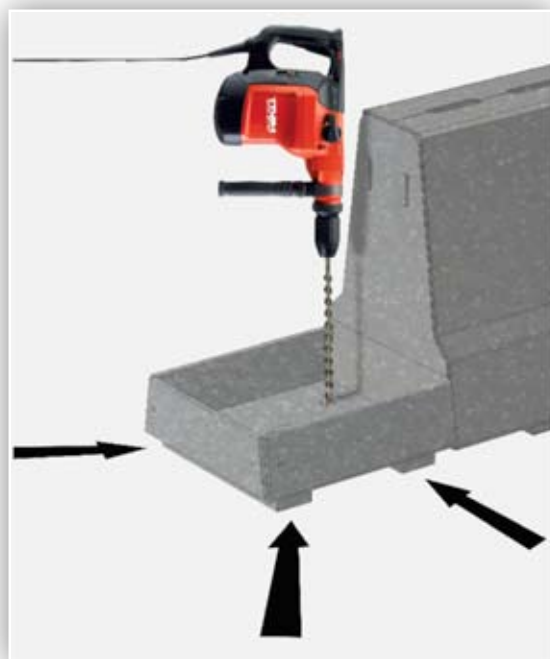
Holes for securing BG 800™ are drilled 32mm diameter for the asphalt pins, 30mm for mechanical anchor bolts and 28mm diameter for resin anchors.

Note: Always follow the installation instructions supplied by the fixing manufacturer.

7.8.2 Using Hammer Drill

A commonly used drill is a Hilti TE 76 ATC. The ATC in its name refers to the system which stops the drill spinning round if the drill bit jams while drilling. If other drills are used these may not have this protection. The Hilti TE 70 series takes drills with the SDS MAX connection. There are several connection systems, check when preparing equipment that the drill bit fits the drill. Normally take two of each size of drill bit required. Before inserting the drill bit into the drill chuck, wipe clean the mating part and, if a SDS drill, grease with a small quantity of grease.

Drill bits wear. When blunt it is not worth re-sharpening them as they will also have worn on the diameter and will produce an undersized hole.



7.8.3 Drilling Asphalt

Drilling through asphalt in flexible road construction may be slower than drilling concrete. There is an increased risk of the drill dust jamming the drill bit so regularly lift the drill out of the hole when drilling.

On deep holes, start with a short drill bit for maximum drilling speed and change to a longer drill bit when

necessary. Drill through the steel of the plate. This depth is correct for both steel pins and resin anchors. Do not drill deeper (bridge decks or special surfacing may require different depths of hole).

7.8.4 Drilling Concrete

Drill with the Hammer Drill on high speed. It is not necessary to push down on the drill; the weight of the drill is sufficient. If the drill has ATC it needs to be only lightly held. Remove the drill from the hole frequently to clear the dust. For Hilti HSLTZ M24/60 bolts, drill to a depth of 240mm below the surface of the plate being drilled through. Use tape on the drill bit or a depth stop. Do not drill deeper than necessary. If reinforcing bar is found in the concrete, stop using the hammer drill and drill through the bar with a diamond core drill.

7.8.5 Using a Wet Diamond Core Drill

The diamond core drill is generally used just to cut through reinforcing bar found when hammer drilling concrete.

The system used consists of a drill incorporating a slip clutch, a connection between the drill and the core bit incorporating a swivelling water connector, the diamond core bit and a pump up water bottle and hose. Always carry a spare core bit.

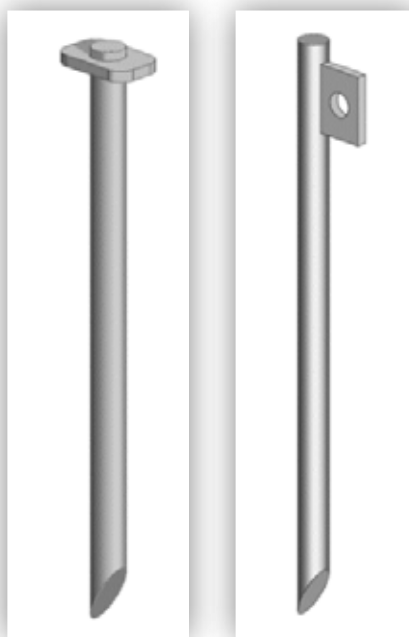
To use, pump up the water bottle and adjust the feed tap until there is a steady trickle from the drill. Start the drill on high speed and carefully feed the drill bit down the hole. Drill with light pressure but hold the drill tightly as the bit may jam. Progress will be slow through the reinforcing bar. As soon as the drill starts to cut faster, you are back in concrete. Withdraw the core drill, check to see if the rebar has come out inside the core drill. If not, drill down the hole for a few seconds with the hammer drill and then fish out the cut rebar with a magnet on the end of a rod. Carry on drilling with the hammer drill.

7.9 Different Anchor Types Installation

The list below are the most commonly used foundation anchors. Please contact Ingal Civil Products for alternative anchoring solutions.

Note: Always follow the installation instructions supplied by the fixing manufacturer. These may differ to the guidelines below.

7.9.1 Flat Top Pin & Flag Top Pins



Flat Top Pin (BG-21-20) Flag Top Pin (BG-21-24)

1. Drill a hole with a diameter of 32mm and a depth of 450mm.
2. Clean the hole using an air line and blow pipe or similar.
3. Position the anchor plate.
4. Fit either a flag top or flat top pin in the hole.
5. Drive the pin into the ground using a large hammer/sledge hammer as required.

Note: Flag top pins should not be used on any external anchor. Pins are normally used on temporary installations only.

7.9.2 Mechanical Anchor Bolt



FMA-24-185-YZ

1. Drill a hole with a diameter of 30mm and a depth of 250mm.
2. Clean out the hole using an air line and blow pipe or similar.
3. Insert the complete mechanical anchor into the hole.
4. Tighten the anchor to the manufacturer's specification.

7.9.3 Resin Anchor Studding



FATB-24-460-GLV

Note: This part No. does not include the resin

1. Drill a hole with a diameter of 28mm and a depth of 450mm.
2. Clean the hole using an air line blow pipe or similar.
3. Mix the resin as specified by the manufactures specification.
4. Pour the required volume of resin into the hole; leave approximately 100mm without resin at the top of the hole as this may need to be increased or decreased to suit each application.

5. Position the anchor plate.

6. Fit the nut and washer to the anchor studding; leave approximately 2 full threads showing at the top of the studding.

7. Push the anchor stud into the hole to the required depth, the resin should reach the top of the hole, if not increase the quantity of resin.

8. Wait for the resin to cure as per manufacturers specifications.

9. Tighten the anchor nuts to the manufacturer's specification.

7.10 Anchor Removal

Hilti bolts can be unscrewed but will be tight for the full length of the thread due to the cone nut being squeezed onto the bolt. Do not tap the bolt down as it will release the cone from the sleeve and the cone will turn with the bolt and not unscrew. If the cone comes loose from the sleeve, crowbar the bolt upwards and retighten the bolt before attempting to unscrew the bolt. After removing the barrier/anchor, remove the anchor bolt sleeves which protrude from the concrete.

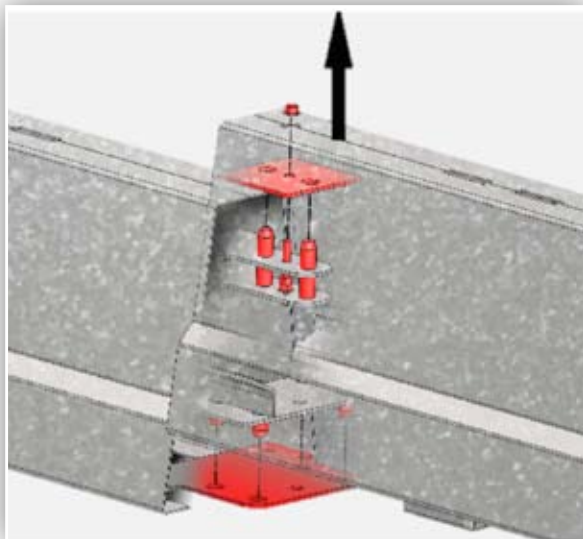
Resin anchors unscrew easily. Cut off the remaining studding.

Asphalt pins can normally be loosened by tapping sideways with a hammer and pulled out of the hole. A large crow bar could be used to aid removal.

If pins are tight in the terminal end and/or inner anchor shoe they could be attached to the crane using a ring and shackle. Apply a small amount of lift and rotate the pin by using a large adjustable spanner on the "flag" part of the pin. Driven pins used for securing intermediate anchors are best withdrawn by lifting the barrier with a 3 ton strap passed under the barrier next to the anchorage.

8.0 Barrier Removal

To separate the barrier sections, lift with the chain legs at equal length. This will tend to lift the connected end first. If the section of barrier being removed lifts the next section, place a 50mm 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.



9.0 Noise Pollution

The BG 800™ installation process requires the use of trucks, cranes and drilling equipment for fixing the anchors. Whilst this type of plant and equipment does not create excessive noise, care and consideration must be taken when working in residential areas at night.

10.0 Other Operations

10.1 Curved Barrier

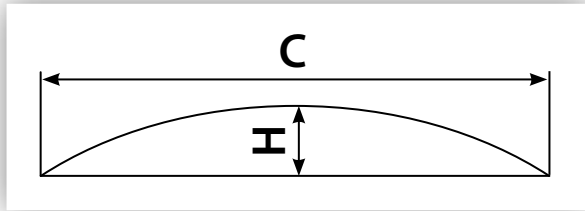


In many cases, the barrier may have to follow a curve. There are a number of options depending on the curve. These are described below followed by a table of curvatures that can be achieved and methods of estimating the curvature.

1. Movement at the QuickLink - this allows slight curvature usually sufficient for horizontal curves on motorways and dual carriageways.
2. Slackening the bolts in the standard joint in the middle of a 12m section and retightening after "bending".
3. Using a BG 800™ 0.6m long Angle Section these can be specified with a 2.5°, 5° or 10° angle and are quickly installed using the standard QuickLink connections.
4. Replacing the standard joining plates at the bolted joint in the barrier with slotted plates designed to allow up to a 5° bend in the barrier. Where these plates are fitted the bolts need to be slackened slightly to set required angle and then all bolts at the joint where the plates are installed must be re-tightened.
5. Using shorter barrier lengths. If methods 3 and 4 are used with 12m barrier sections, a 10° bend can be achieved in 12m. If, however, the 6m (2x3m) barriers are used then effectively the radius is halved.

To find the radius of the curve, measure the straight line distance between two points on the curve (C) and measure the maximum distance from this straight line to the curve (H) and use formula.

To find radius of curve:



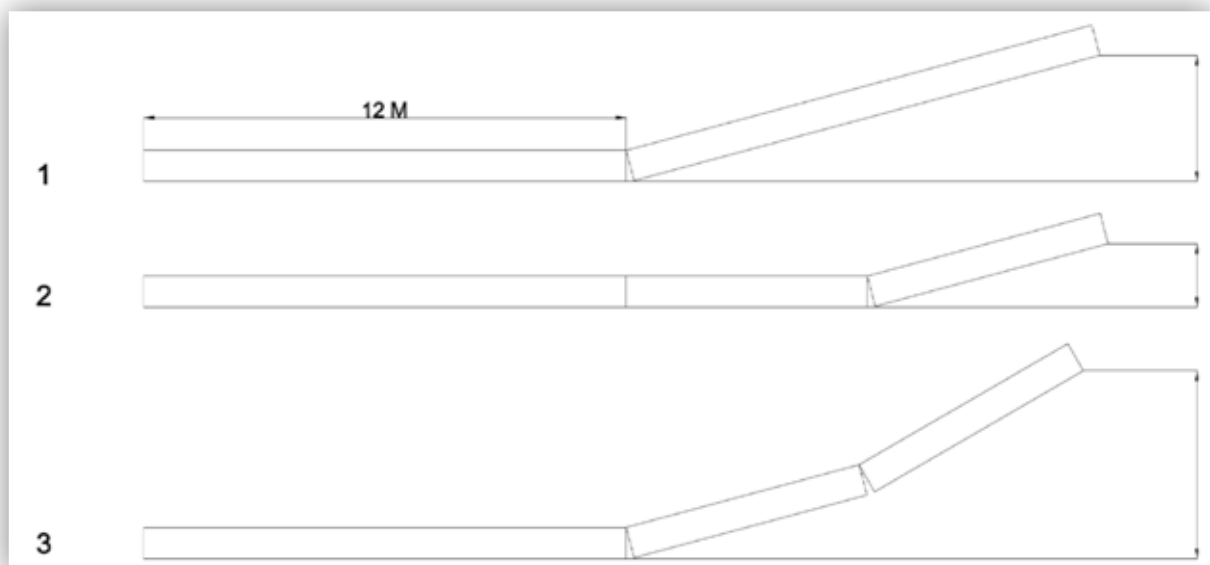
$$\text{Radius} = R = \frac{C^2 + 4H^2}{8H}$$

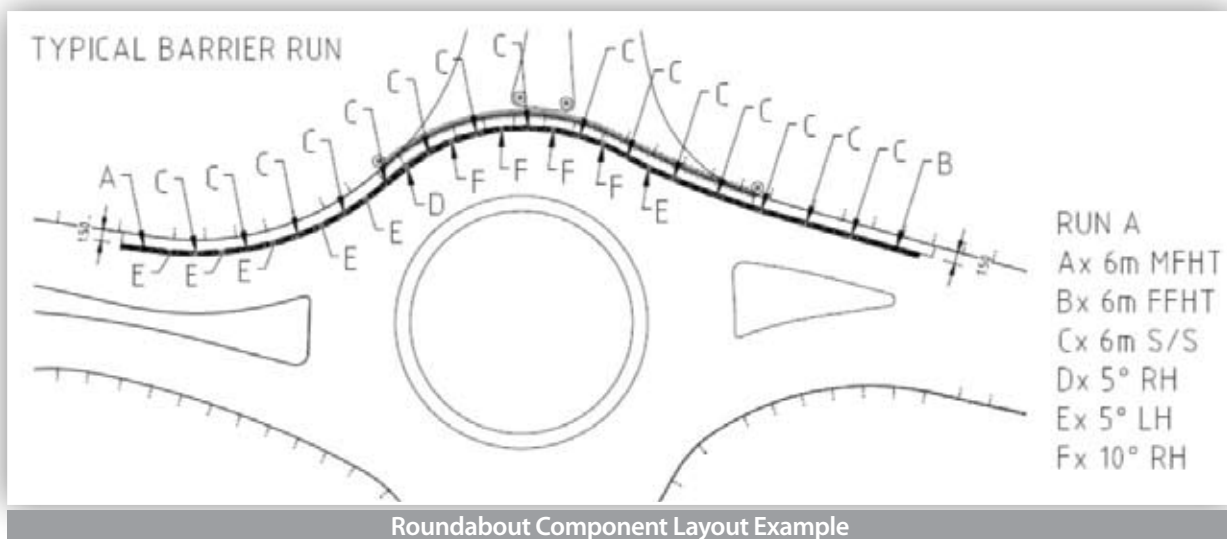
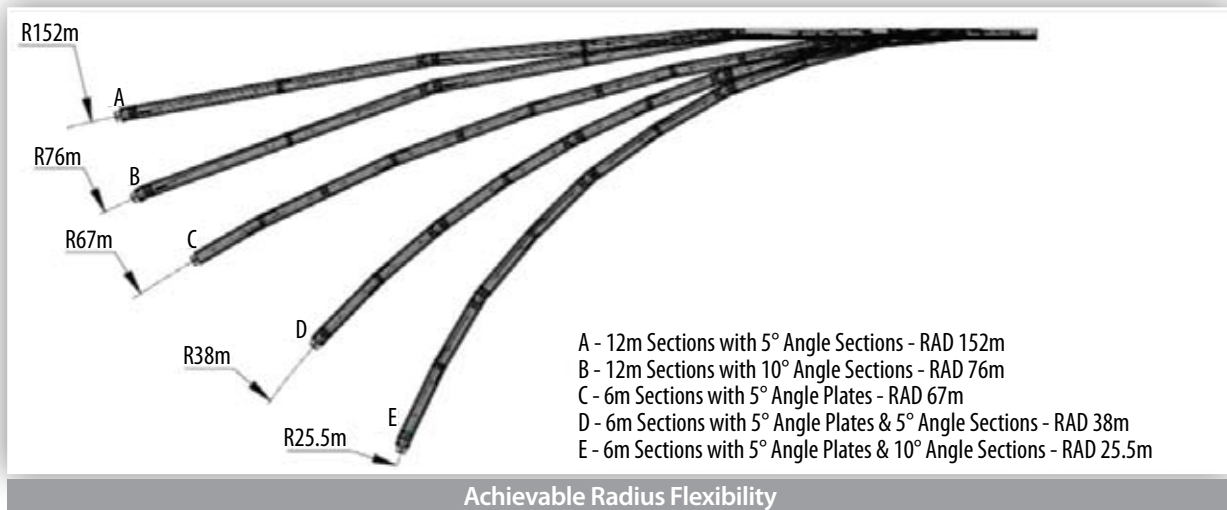
TO FIND THE ANGLE PER 12 METRE LENGTH

$$\text{Angle} = \frac{688}{\text{Radius}}$$

Table of Curvatures

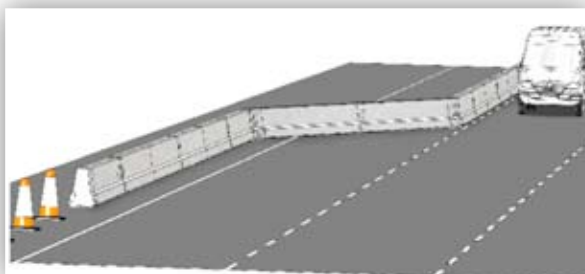
Method	Description	Max Angle°	Radius Metres	Offset Metres at end of 12m	Type
1	Movement on QuickLink	0.67	1030	0.14	1
2	Slackening standard bolted joint	1.5	460	.015	2
3	2 ½ degree radius piece	2.5	275	0.52	1
3	5 degree radius piece	5	137	1.00	1
4	5 degree bend using slotted plates	5	137	0.50	2
3 & 4	5° radius piece & 5° slotted plates	10	69	1.56	3
3 & 4	As above but 3m + 3m = 6m overall	10	35	1.56	3



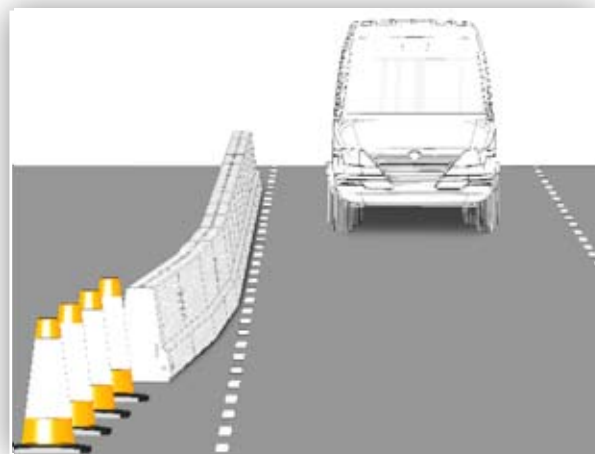


10.2 Offset Ends to Barrier

It is sometimes required that the ends of the barrier are angled away from the traffic flow. This can be achieved either by utilising the movement in the QuickLinks to curve the BG 800™ layout to create a flare away from the traffic lane or a BG 800™ 5° radius piece can be placed in the barrier run at the correct joint to create a flare.



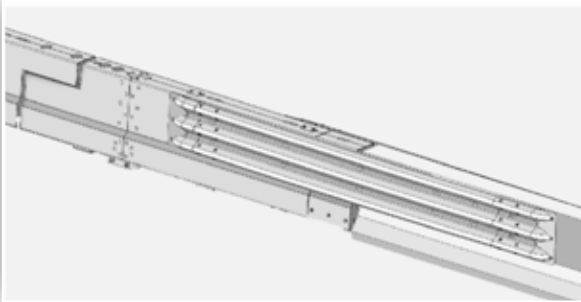
Use of 5° radius section offset end of barrier run



QuickLink offset (taper) end of barrier run

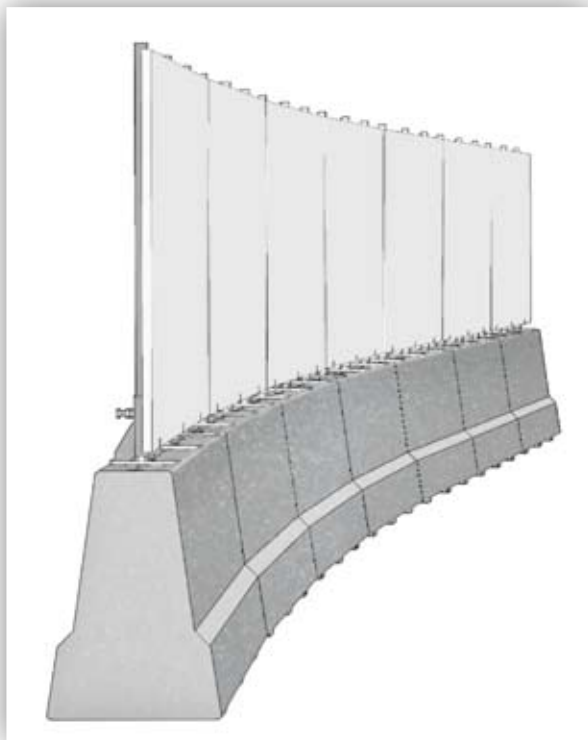
10.3 Connections

There are the following connections available for BG 800™ to other barrier systems.



Connection to precast or slip form concrete

10.4 Anti-Gawk Screen

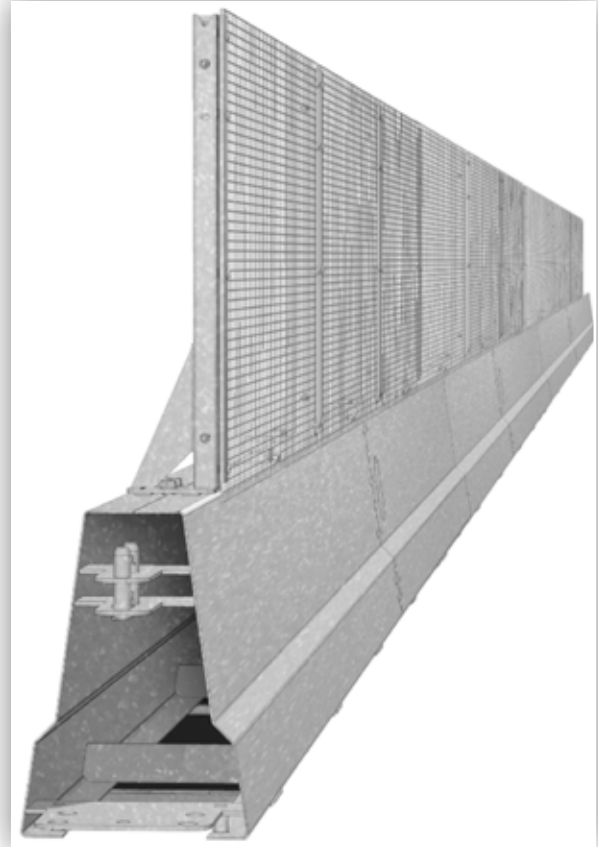


An anti-gawk screen is available subject to country/state approval.

IMPORTANT: When screens are attached to BG 800™ contractors must ensure the anchor spacing and type of anchors are adequate to allow for the wind loading requirements. Refer to drawing BG-70-38 for further detail.

Note: Please Contact Ingal Civil Products for further information.

10.5 Mesh Fence



A security fence is available for non-highway/roads applications. This can be used to give added security to private sites to deter unauthorised access.

Note: Please Contact Ingal Civil Products for further information.

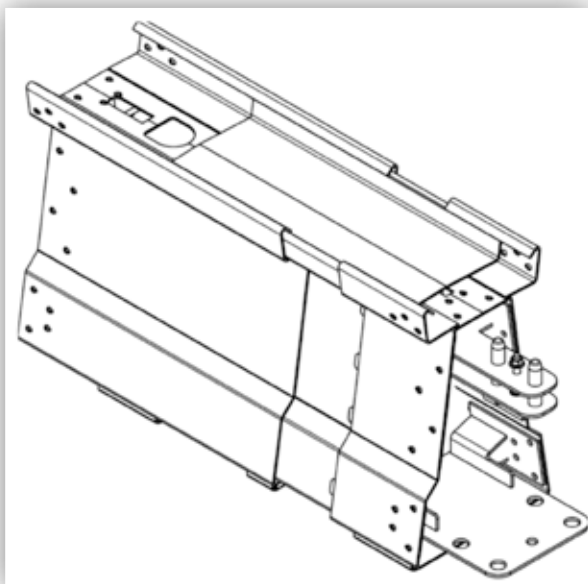
10.6 Expansion Joints

Expansion joints are not required on long runs of barrier on normal carriageways.

Where expansion joints exist in the road surface, such as at the edges of a bridge deck, these should be mirrored in the BG 800™. If the barrier is anchored either side of a bridge i.e. not on the bridge structure but into the ground either side of the structure, then there is no need for expansion joints in the BG 800™.

Expansion within the system is catered for by replacing the standard coupling plates found in the connection between two 6m elements with special plates which have elongated slots enabling movement of the system under temperature fluctuations. These units should be pre-installed and correctly located and identified on the load for speed of installation. If this is not possible however, this process can be performed on site.

For sites where the expansion of the ground that the BG 800™ is to be anchored to is a concern there is a special section of BG 800™ called a Variable Length Section which could be utilised. This requires T-Top sections on the adjacent barrier and T-Top ramp transition.



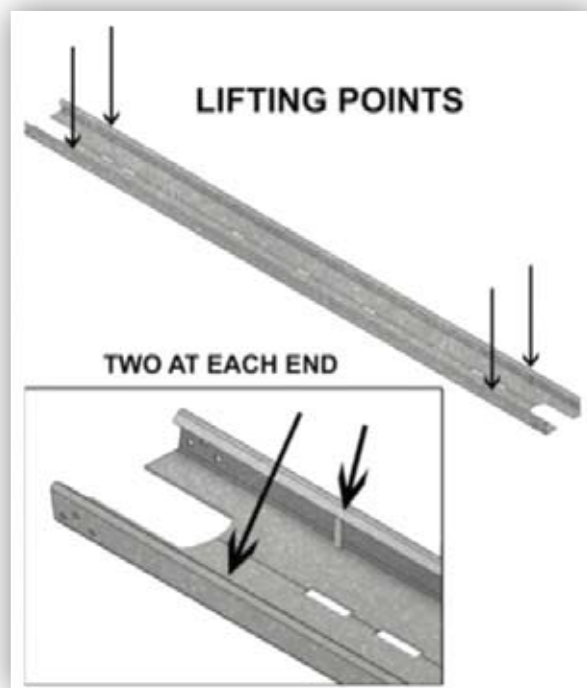
The barrier expansion joint has a movement of **100mm**. Where the road surface expansion joint movement is expected to exceed this amount additional expansion joints can be used on adjacent sections.

Expansion joints could allow extra deflection of the barrier when hit. This can be prevented by securing the barrier either side of the expansion joint with intermediate anchors.

Adjust the gap between the barrier sections at the expansion joint before installation to reflect the situation - cold day large gap - hot, sunny day small gap. Torque the nuts to **90-100 Nm**.

10.7 T-Top

For the BG 800™ Gate and the Minimum Deflection BG 800™ installations, a T-top section is attached to the top face of the BG 800™. The T-top comes in 6m long sections as standard and the lifting points for the T-top only are shown below.

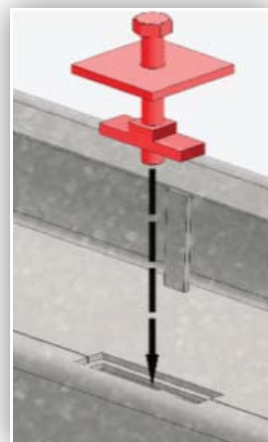


A minimum of two lifting points must be used for lifting. The angle between the two chains should never be more than 120 degrees.

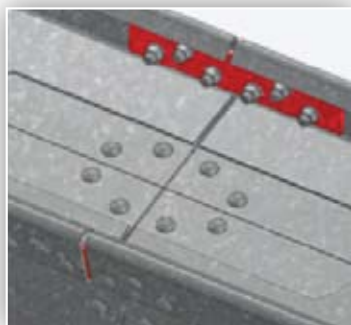
Note: Do not use the T-Top lifting points to lift the BG 800™ sections.

The T-top is simply lowered on to the top of the barrier and aligned with one 6m half section of barrier and then locked down using two bolts per 6m length secured into special nut attached to them.

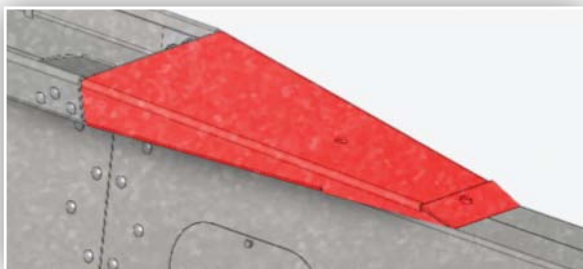
The special nut is passed through the relevant slot in the top of the barrier and then turned 90° to lock it into the slot to allow the bolt to be tightened down to secure the T-top.



One section of T-top is then attached to the next by use of two splice plates either side, fastened with six standard M16 BG 800™ bolts per splice plate.



At the beginning and end of a T-top installation a ramped transition section must be installed, this is simply placed on top of the BG 800™ adjacent to the first or last section of required length of T-top and connected using the splice connection, to bolt it to the T-top.



Note: There are T-top sections available for the 0.61m radius units also.

10.8 Gate

A BG 800™ Gate can be installed in a length of BG 800™ at any pre-determined and pre-planned point along its length within 24m of the start point and end point.

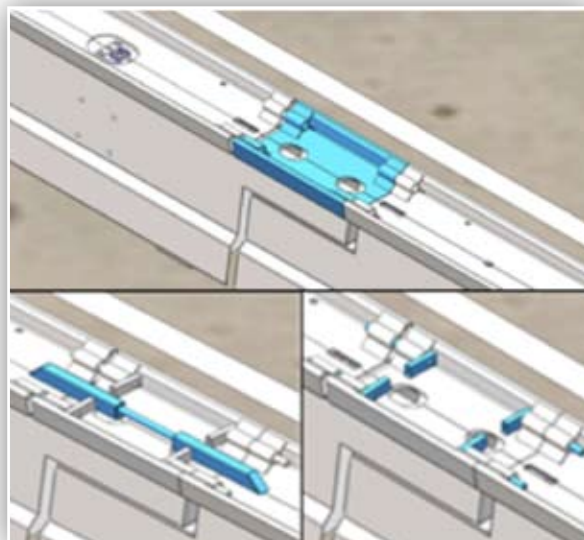
To install a BG 800™ Gate, a female QuickLink fixed gate post is introduced into the run by connecting it to the previous section using the standard QuickLink connector. To this section a 3m mobile gate section is connected using the two gate hinge pins. The pre-determined number of 6m wheeled gate sections are then attached before the 2nd 3m mobile gate hinge is connected; standard bolted joints are used to make the gate. The second gate post section is connected to a second male QuickLink fixed gate post using two further hinge pins. The normal barrier installation using the QuickLinks can then resume from this departure end fixed gate post.

At each end of the BG 800™ Gate, an external anchor shoe will be attached to the fixed gate post and will require anchoring (see **External Anchor Shoe** section).

In addition, at the QuickLink joints immediately before and after the gate, an intermediate anchor will be required (see **Intermediate Anchoring** section).

Note: It is not recommended to use QuickLink joints with the gate, as the movement at this joint makes the gate difficult to manoeuvre when opening and closing.

BG 800™ T-top is also required to be added to the top of the barrier for the BG 800™ Gate installation. This T-top is a standard 6m T-top section attached in the conventional way (see **T-top** section). Installed along the length of the gate and for a gate installation only, at least 12m before and after the anchor point of the fixed gate post. There is a special short removable section that is used at the hinge joint (highlighted in blue below).

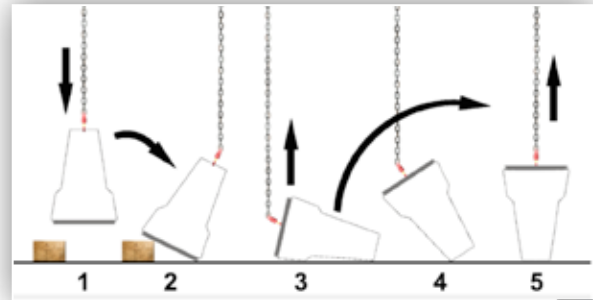


10.9 Turning the Barrier Over

To stack the barrier or work on the fastenings inside the barrier, it is occasionally necessary to invert the barrier.

Do not turn the barrier over by pulling it sideways with the crane. This can cause damage to the crane and chains which could cause an accident due to failure during subsequent lifting operations.

The following method can be used but note that the chain hooks are subject to side load when using this method. Always, therefore, use hooks that are well overrated (typically 2 tons per hook) and use of the conventional type, not the type where the chain attaches to the extended latching bar.



10.9.1 Inverting BG 800™

The steps listed below correspond to the images at the bottom of this page.

1. Lower the barrier onto a wooden block.
2. The centre of the barrier settles on the block clear of cross members and with only one side of the barrier supported by the block.
3. Continue lowering the barrier until it lies on its side. Transfer the chains from the lifting eyes on the top of the barrier to the lifting eyes on the bottom of the barrier.
4. Start to lift the inverted barrier.
5. With the barrier fully inverted it can be lifted and placed into the desired position



CAUTION - When the barrier is set down inverted it is unstable and may fall over causing injury.

Righting Inverted BG 800™

Lower the barrier onto a timber wedge with approximately a one in three slope. The barrier will settle on its side. Transfer the lifting chains from the bottom of the barrier to the top of the barrier and lift in the normal way.



CAUTION - When inverting and righting barriers the barriers may kick sideways, always keep away from the barrier – as required control the barrier by use of tag ropes.

11.0 Maintenance & Repair

BG 800™ is generally a maintenance free barrier system.

It is recommended that some basic maintenance is carried out on the system, we suggest after 10 years of being installed a thorough inspection of the system is carried out, this involves a visual check for signs of corrosion both outside and inside (using the hatches for access), and a check that the fasteners are tight, this could be done by tapping the fastener with a hammer. We suggest that this inspection is carried out at 5-year intervals after the first inspection.

11.1 Galvanising Durability

The steel components supplied as part of the Ingal Civil Products BG 800™ steel barrier system are hot dip galvanized using a process which conforms to EN ISO 1461:1999.

According to EN ISO 1461:1999 the minimum thickness of zinc coating that should be applied to the component is dependent upon the component thickness. According to this standard we can expect the zinc coating of the steel components of the BG 800™ system to be between 55µm and 85µm.

The durability of all steel components of Vehicle Restraint Systems (VRS) that are hot dip galvanized depends on many factors, including the environment where they are put into service.

Considering the areas where VRS are normally located and using the table from EN ISO 14713:1999 (which shows the indicative corrosion rates for various environments). We can estimate the expected lifespan of BG 800™ components.

This estimated lifespan is from 20-100 years and based on the assumption that the zinc coating on any of the components remains undamaged. If damage to the zinc coating is carefully controlled, it is reasonable to accept that the lifespan will be extended.

11.2 Repair

Usually after a design impact there is little damage to BG 800™ and it could continue to be used without concern. If however the barrier has had to withstand a severe impact then it may be necessary to remove and replace a section, this would need to be done in the unlikely event of a tear in the barrier wall or if the barrier has deformed a great deal (i.e. if the barrier run has been left with a large and unacceptable kink in its length).

If damaged sections requiring attention are within 180 metres of the end of the barrier it may be easier to remove sections from the end. If the damage is further from the end, the barrier will have to be split at the downstream end of the section to be removed by unbolting the jointing plates from two joints 12 metres apart. The bolts can be accessed through the hatch by the joint.

It may also be found that sections either side of the impacted length have had the bolt holes elongated at the joint. If during a visual inspection it is noticed that the gap between the two sections of barrier bolted together have come apart more than 15mm then it is necessary to remove these sections, inspect for damaged bolts and reassemble with the joint closed. If on reassembly the joint is not closed back up, then it could be difficult to join the barrier sections together again due to the extra length.

Identify for future assessment/rectification any damaged sections by placing a piece of coloured insulation tape or coloured cable tie around the outer pin of the male QuickLink between the two plates that hold the pin. If possible, cable tie on a label with the description of the damage, where and when it occurred. If during loading or installation of the BG 800™ the installer finds a damaged section they are unsure of using, do not use it until it has been inspected and certified acceptable to use by a competent person.

12.0 Photo Examples



Standard Install



Bridge Install



LDS Install



T-Top Transition Section



MDS Install



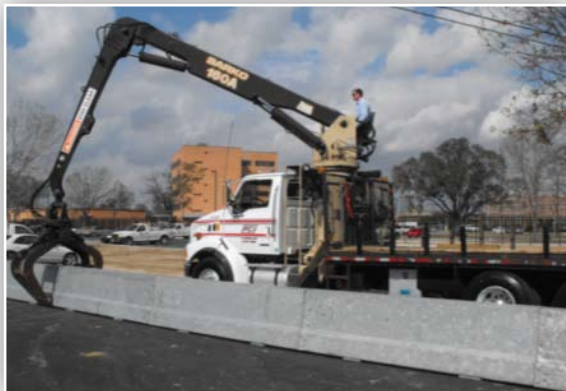
Variable Length Barrier



Barrier Trailer



Full Height End Section



Lifting Grab



External Anchor Shoe



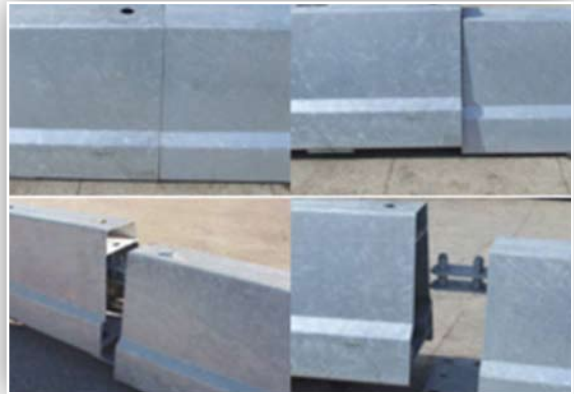
Lifting Cradle



Intermediate Anchor



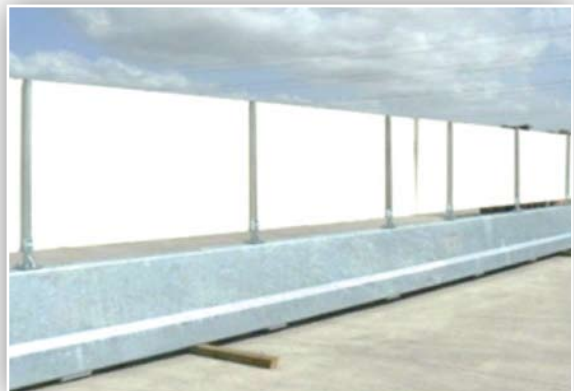
Security Nut Installation



Joining BG800



Gate Post & Hinge Joint



Anti-Gawk Screen



Security Fence



Typical Impact Damage

13.0 Frequently Asked Questions

1) What type of equipment is required to install BG 800™?

Suitable lifting equipment such as a hiab crane with hook lifting chains, marking and drilling equipment (e.g. Hilti or compressed air rock drill), various sockets and spanners up to 36mm, 6mm Allen key. Please refer to the tools and equipment section.

2) What ground conditions are required to install BG 800™?

Various ground conditions can be accommodated as long as the anchoring method chosen is suitable. Contact Ingal Civil Products for further assistance.

3) What can BG 800™ attach to?

There are connections to concrete, thrie beam and various crash cushions. Contact Ingal Civil Products for further assistance.

4) Does BG 800™ require anchoring?

BG 800™ is an anchored system and must always be anchored as a minimum at the 8 anchor points in the terminal sections at the start/end of every run of barrier.

Intermediate anchoring may also be required with the frequency dependent on the system used (Standard every 60m, MDS every 6m, LDS every 12m).

5) On average, how long does it take to install BG 800™?

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 fifteen 12m standard sections can be completed in under 20 minutes.

6) What testing has BG 800™ been approved to?

BG 800™ has been extensively tested to both European and American standards. Please see the testing section for further details.

7) Can BG 800™ be installed in any temperature/humidity environment?

BG 800™ can be installed in the majority of environments, in some environments enhanced components may be required – e.g. gate wheels. Contact Ingal Civil Products for further assistance.

8) What maintenance does the BG 800™ require?

BG 800™ is a low maintenance barrier system that requires minimal maintenance. See the maintenance section of this manual for further details on permanent and temporary applications

9) What is the expected lifespan of BG 800™?

BG 800™ has an expected lifespan of over 25 years. This is dependent on maintenance regime and site specific environment.

10) What is the smallest run of barrier and the largest available?

The minimum recommended installed length of BG 800™ is 18m between inner anchor shoes; i.e. for an installation with no approved crash cushion connected to the end terminal; the minimum total system length including terminals and anchors is 30m.

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?

BG 800™ Minimum Deflections System (MDS) might be the best option for this application. With the additional T-top sections and anchors every 6m deflection is minimal, 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 BG 800™ on a bridge deck, is this possible?

BG 800™ 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 and possibly a variable length BG 800™ section for the bridge expansion joint.

Please contact Ingal Civil Products for project specific design assistance.

14.0 Foundation Pavement & Anchor Details

Australia & New Zealand Approval Pavement Category						
System Type						
Standard 60 metre anchoring	Type 1 Concrete	Type 2 Deep lift asphaltic concrete	Type 3 Asphaltic concrete over granular pavement	Type 4 Flush seal over granular pavement	Type 5 Unsealed compacted formation	Type 6 Natural surface
	<ul style="list-style-type: none"> Flat & Flag top pins M24 250mm threaded bar with resin M24 460mm threaded bar with resin 1" Kelkin Leftie 18.25" (464mm) with Keligrout 1" Kelkin Leftie 14.25" (362mm) with Keligrout M24 Mechanical Anchor 	<ul style="list-style-type: none"> Flat & Flag top pins M24 460mm threaded bar with resin 1" Kelkin Leftie 18.25" (464mm) with Keligrout 	<ul style="list-style-type: none"> Flat & Flag top pins M24 460mm threaded bar with resin 	<ul style="list-style-type: none"> Driven pile anchor 	<ul style="list-style-type: none"> Driven pile anchor 	Not permitted - see note.
	<ul style="list-style-type: none"> M24 250mm threaded bar with resin M24 460mm threaded bar with resin 1" Kelkin Leftie 18.25" (464mm) with Keligrout 1" Kelkin Leftie 14.25" (362mm) with Keligrout M24 Mechanical Anchor 	<ul style="list-style-type: none"> M24 460mm threaded bar with resin 1" Kelkin Leftie 18.25" (464mm) with Keligrout 	<ul style="list-style-type: none"> M24 460mm threaded bar with resin 	<ul style="list-style-type: none"> Not permitted 	<ul style="list-style-type: none"> Not permitted 	Not permitted - see note.
LDS 12 metre anchoring	<ul style="list-style-type: none"> M24 250mm threaded bar with resin M24 460mm threaded bar with resin 1" Kelkin Leftie 18.25" (464mm) with Keligrout 1" Kelkin Leftie 14.25" (362mm) with Keligrout M24 Mechanical Anchor 	<ul style="list-style-type: none"> M24 460mm threaded bar with resin 1" Kelkin Leftie 18.25" (464mm) with Keligrout 	<ul style="list-style-type: none"> M24 460mm threaded bar with resin 	<ul style="list-style-type: none"> Not permitted 	<ul style="list-style-type: none"> Not permitted 	Not permitted - see note.
	<ul style="list-style-type: none"> M24 250mm threaded bar with resin M24 460mm threaded bar with resin 1" Kelkin Leftie 18.25" (464mm) with Keligrout 1" Kelkin Leftie 14.25" (362mm) with Keligrout M24 Mechanical Anchor 	<ul style="list-style-type: none"> M24 460mm threaded bar with resin 1" Kelkin Leftie 18.25" (464mm) with Keligrout 	<ul style="list-style-type: none"> M24 460mm threaded bar with resin 	<ul style="list-style-type: none"> Not permitted 	<ul style="list-style-type: none"> Not permitted 	Not permitted - see note.
MDS 6 metre anchoring	<ul style="list-style-type: none"> M24 250mm threaded bar with resin M24 460mm threaded bar with resin 1" Kelkin Leftie 18.25" (464mm) with Keligrout 1" Kelkin Leftie 14.25" (362mm) with Keligrout M24 Mechanical Anchor 	<ul style="list-style-type: none"> M24 460mm threaded bar with resin 1" Kelkin Leftie 18.25" (464mm) with Keligrout 	<ul style="list-style-type: none"> M24 460mm threaded bar with resin 	<ul style="list-style-type: none"> Not permitted 	<ul style="list-style-type: none"> Not permitted 	Not permitted - see note.

Notes: Alternative anchor options may be used that replicate the strength/characteristics of tested anchors. Alternative anchor options will require a local site specific risk assessment. There may be the need for a geotechnical report as to ground suitability for the type of pinning required. If conflict arises with details listed within this manual, then the conditions in state approval documents take precedence.

15.0 Anti-Gawk Screen Foundation Pavement & Anchor Details

Australia & New Zealand Approval Pavement Category						
	Type 1 Concrete	Type 2 Deep lift asphaltic concrete	Type 3 Asphaltic concrete over granular pavement	Type 4 Flush seal over granular pavement	Type 5 Unsealed compacted formation	Type 6 Natural surface
System Type						
Standard with Ingal Civil Screen Up to 36m anchoring	<ul style="list-style-type: none">• M24 250mm threaded bar with resin• M24 460mm threaded bar with resin• 1" Kelkin Leftie 18.25" (464mm) with Keligrout• 1" Kelkin Leftie 14.25" (362mm) with Keligrout• M24 Mechanical Anchor. AUS ONLY.	Anchor spacing at 36m; <ul style="list-style-type: none">• 1" Kelkin Leftie 20.13" (511mm) with Keligrout. AUS ONLY. Anchor spacing at 24m; <ul style="list-style-type: none">• M24 460mm threaded bar with resin. AUS ONLY.• 1" Kelkin Leftie 18.25" (464mm) with Keligrout	Anchor spacing at 24m; <ul style="list-style-type: none">• M24 460mm threaded bar with resin. AUS ONLY. Anchor spacing at 36m & bow tie anchor; <ul style="list-style-type: none">• M24 460mm threaded bar with resin. AUS ONLY.	Not permitted - see note.	Not permitted - see note.	Not permitted - see note.
LDS with Ingal Civil Screen 12 metre anchoring	<ul style="list-style-type: none">• M24 250mm threaded bar with resin• M24 460mm threaded bar with resin• 1" Kelkin Leftie 18.25" (464mm) with Keligrout• 1" Kelkin Leftie 14.25" (362mm) with Keligrout• M24 Mechanical Anchor	<ul style="list-style-type: none">• M24 460mm threaded bar with resin• 1" Kelkin Leftie 18.25" (464mm) with Keligrout	<ul style="list-style-type: none">• M24 460mm threaded bar with resin	Not permitted - see note.	Not permitted - see note.	Not permitted - see note.
MDS with Ingal Civil Screen 6 metre anchoring	<ul style="list-style-type: none">• M24 250mm threaded bar with resin• M24 460mm threaded bar with resin• 1" Kelkin Leftie 18.25" (464mm) with Keligrout• 1" Kelkin Leftie 14.25" (362mm) with Keligrout• M24 Mechanical Anchor	<ul style="list-style-type: none">• M24 460mm threaded bar with resin• 1" Kelkin Leftie 18.25" (464mm) with Keligrout	<ul style="list-style-type: none">• M24 460mm threaded bar with resin	Not permitted - see note.	Not permitted - see note.	Not permitted - see note.

Notes: Alternative anchor options may be used that replicate the strength/characteristics of tested anchors. Alternative anchor options will require a local site specific risk assessment. There may be the need for a geotechnical report as to ground suitability for the type of pinning required. If conflict arises with details listed within this manual, then the conditions in state approval documents take precedence. Refer to drawing BG-70-38 for wind loading requirements.

16.0 Risk Assessments

Whereas these Risk Assessments outline the basic hazards and risks involved with installing BG 800™, you must provide your own detailed Risk Assessment which will encompass your particular working environment and may require site specific information. Risk assessments, safe system of work method statements & appropriate traffic management must be in place before starting BG 800™ installations.

16.1 Unloading and Loading Units

Hazard	Precautions to minimise the risk	Actions
Injury to head	Use of PPE (hard hats) Competent crane operator/banksman Operative to be vigilant	Instruction Training Training
Injury to hands	Use of PPE (gloves) Use of correct tools Competent crane operator/banksman Operative to be vigilant	Instruction Training Training Training
Injury to feet	Use of PPE (safety boots) Competent crane operator/banksman Operative to be vigilant	Instruction Training Training
Load slipping from crane	Use certified approved slings Competent slinger	Inspection Training
Load swinging into other vehicles	Use correct tag ropes Establishment of correct safety zones	Training Training
Units becoming dislodged while unsecured	Competent crane operator Competent slinger	Training Training
Units falling from delivery vehicle	Follow correct sequence for unloading/loading Operatives to stay clear of side of vehicle while unloading/loading Competent crane operator	Training Training Training
Slinger falling from vehicle or load	Safe access and egress to vehicle and load Operative to be vigilant	Instruction Training
Injury from manoeuvring delivery vehicle	Competent banksman Competent driver Operatives to be vigilant	Training Training Training
Injury from traffic	Correct traffic management procedures Operatives to be vigilant	Training Training
Electrocution from or damage to overhead power lines or cables	Site inspection prior to installation	Training

16.2 Connection of Units

Hazard	Precautions to Minimise the Risk	Actions
Injury to head	Use of PPE (hard hats)	Instruction
Injury to feet	Use of PPE (steel toe capped safety boots)	Instruction
Injury to hands or fingers	Use of PPE (wear gloves)	Instruction
	Carry out all operations under the control of a competent banksman and plant operator	Training
	Adhere to correct and approved working methods	Instruction
	Use correct tools	Instruction
Injury from collision with passing traffic	Correctly installed traffic management	Inspection Training

16.3 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 BG 800™ unless such a safety zone is provided. It is suggested that a working area of not less than 0.5 metres will be required between the BG 800™ and the safety zone.

16.4 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 (ear defenders)	Training
Dust inhalation	Use of PPE (dusk 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

16.5 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 banksman and crane operator only	Training & Instruction
Death or injury as a result of manoeuvring truck	All truck movements under control of competent banksman	Training
Injury from collision with passing traffic	Correctly installed traffic management	Training

17.0 Installation Checklist

BG800™ Installation Checklist

Customer:

Project:

Barrier Run Information: Location:

Barrier ID:

Number of Runs:

Overall Length:

Installed By:

Checked By:

Signed:

Date

Is the site suitable for BG800?

☐ Yes ☐ No

Are the pavement conditions suitable?

☐ Yes ☐ No

Are the anchors selected suitable for the pavement condition?

☐ Yes ☐ No

Are all the components available?

☐ Yes ☐ No

Do the anchor shoes have the lynch pin installed?

☐ Yes ☐ No

Are the start and end sections installed correctly with all 8 anchors installed?

☐ Yes ☐ No

Are all the QuickLink security nuts installed?

☐ Yes ☐ No

Has any intermediate anchoring been used? If so, note the spacing here _____

☐ Yes ☐ No

Has T-Top been installed correctly for MDS?

☐ Yes ☐ No

Check there are no snagging points (more than 10mm)

☐ Yes ☐ No

Delineators installed?

☐ Yes ☐ No

Anti-gawk Screen installed correctly and checked?

☐ Yes ☐ No

Note any variations or comments:

18.0 Permanent Applications

When BG 800™ is installed in permanent applications the following conditions apply;

- ABSORB 350 Crash Cushion is not to be used as this is for temporary use only.
- Flat & Flag top pins are not to be used as these are for temporary use only. M24 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.

19.0 Approvals

Association	Approval Web Link
Austrorads	http://www.austrorads.com.au/road-construction/barrier-assessment

Country	State	Road Authority	Approval Web Link
Austrorads	New South Wales	Road & Maritime Services	http://www.rms.nsw.gov.au/businessindustry/partners-suppliers/approved-productsmaterials/safety-barriers/index.html
	South Australia	Department of Planning, Transport and Infrastructure	http://www.dpti.sa.gov.au/standards/raod_safety_barriers
	Victoria	Vic Roads	https://www.vicroads.vic.gov.au/business-andindustry/technical-publications/technicalpublications-a-to-z
	Queensland	Department of Transport and Main Roads	https://www.tmr.qld.gov.au/businessindustry/Business-with-us/Approved-products-and-suppliers/Traffic-engineering-and-road-safetyapproved-products.aspx
	Western Australia	Main Roads	https://www.mainroads.wa.gov.au/BUILDINGROADS/STANDARDSTECHNICAL/ROADANDTRAFFICENGINEERING/ROADSIDEITEMS/Pages/List_of_Approved_Road_Safety_Barrier_Systems.aspx#TOCh41
New Zealand	N/A	New Zealand Transport Agency	https://www.nzta.govt.nz/resources/road-safetybarrier-systems/

Drawings to be included?



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CIVIL PRODUCTS
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For more information

contact us on the web

www.ingalcivil.com.au

Head Office: Sydney

57-65 Airds Road, Minto, NSW 2566

Ph: +61 2 9827 3333

Fax: +61 2 9827 3300

Free call (within Australia):

1800 803 795

Email: sales@ingalcivil.com.au

Our Locations:

- Adelaide • Brisbane
- Melbourne • Newcastle
- Perth • Sydney • Wagga
- Auckland • Christchurch