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SKT-SP & FLEAT-SP

Installation & Repair Manual

Ref: IM 002/02

SKT-SP & FLEAT-SP

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1.0 Introduction

Roads safety barrier systems are designed to shield vehicles from striking a hazard. Steel guardrail systems are the world's most widely specified safety barrier systems and have significantly contributed to improving the safety of our regions roads.

The strength of a steel guardrail system is primarily developed through a combination of the flexural resistance of the rail and the bending resistance of the supporting posts.

In addition, the use of end terminals is an important characteristic in the function of a steel guardrail system. Terminals are the specially designed end pieces located at the leading and trailing end of the system.

End terminals are designed to anchor the steel guardrail system and introduce the necessary tensile and flexural strength required for safe vehicle containment and re-direction throughout the length-of-need section.

The SKT-SP & FLEAT-SP also provide the additional feature of reducing the severity of an impact near or at the end of the system.

2.0 The SKT-SP

The SKT-SP guardrail end terminal is an energy-absorbing, tangent end terminal, designed to minimise the severity of impacts occurring at the end of the safety barrier system.

Designed for attachment directly to w-beam guardrail, the SKT-SP is one of the world's leading end treatment solutions and is fully compliant to the requirements of NCHRP Report 350.

The tangential design feature allows the SKT-SP to be installed parallel to the roadway reducing the requirement for earthworks and site grading associated with traditional parabolic-flared terminal designs.

The SKT-SP is available in two configurations. The compact 7.62m TL2 terminal is an economical solution where the posted speed is less than or equal to 70km/h. The standard 15.24m TL3 terminal is acceptable for all posted speeds greater than 70km/h.

3.0 The FLEAT-SP

The FLEAT-SP guardrail end terminal is a flared, energy-absorbing end terminal, designed to minimise the severity of impacts occurring at the end of a safety barrier system.

Designed for attachment directly to w-beam guardrail, the FLEAT-SP is one of the world's leading end treatment solutions and is fully compliant to the requirements of NCHRP Report 350.

The FLEAT-SP is available in two configurations. The compact 7.62m TL2 terminal is an economical solution where the posted speed is less than or equal to 70km/h. The standard 11.43m TL3 terminal is acceptable for all posted speeds greater than 70km/h.

The straight flare design feature allows the FLEAT-SP to be installed at a variable offset from 760mm to 1220mm (TL3) or 510mm to 810mm (TL2) to the roadway reducing the potential for head-on impacts.

4.0 Bill of Materials

With the exception of the impact head, all components used for the assembly of the SKT-SP and FLEAT-SP are interchangeable. The SKT-SP and FLEAT-SP are installed using bolted hinged posts at post locations 1 & 2 followed by steel line posts at post locations 3 and beyond.

4.1 SKT-SP Materials

Item Description	Item Quantity		Unit Weight (kg)
	7.62m TL2 Configuration	15.24m TL3 Configuration	
SKT Impact Head	1	1	80
3810mm Slotted Anchor Rail	1	1	43
3810mm Standard W-Beam Rail	1	3	43
150 x 150mm RHS Hinged Post Top – Post 1	1	1	11
Hinged Post Bottom w/ Soil Plate – Post 1	1	1	55
Hinged Post Top – Post 2	1	1	11
Hinged Post Bottom – Post 2	1	1	18
1830mm Steel Line Post	3	6	24
200mm Wide Blocking Piece	3	6	4
2m Anchor Cable with 2 x 1”Nut/ Washer	1	1	7
Anchor Bracket	1	1	6
Bearing Plate	1	1	5
Bearing Plate Retainer Tie	1	1	
Impact Head Cover (optional outside of Victoria)	1	1	
M16 x 220mm Hex. Bolt/Nut/2 Washers	1	1	
M20 x 220mm Hex. Bolt/Nut/2 Washers	1	1	
1/2” x 1 ¼” Anchor Bracket Shoulder Bolt/Nut/2 Washers	8	8	
5/16” x 1” Hex. Bolt/Nut/2 Washers	2	2	
M16 x 255mm Mushroom Post Bolt/Nut	3	6	
M16 x 32mm Mushroom Splice Bolt/Nut	17	33	
Total Weight	**380kg**	**550kg**	

4.2 FLEAT-SP Materials

Item Description	Item Quantity		Unit Weight (kg)
	7.62m TL2 Configuration	11.43m TL3 Configuration	
FLEAT Impact Head	1	1	50
3810mm Slotted Anchor Rail	1	1	43
3810mm Standard W-Beam Rail	1	2	43
150 x 150mm RHS Hinged Post Top – Post 1	1	1	11
Hinged Post Bottom w/ Soil Plate – Post 1	1	1	55
Hinged Post Top – Post 2	1	1	11
Hinged Post Bottom – Post 2	1	1	18
1830mm Steel Line Posts	3	5	24
200mm Wide Blocking Piece	3	5	4
2m Anchor Cable with 2 x 1”Nut/ Washer	1	1	7
Anchor Bracket	1	1	6
Bearing Plate	1	1	5
Bearing Plate Retainer Tie	1	1	
Impact Head Cover (optional outside of Victoria)	1	1	
M16 x 220mm Hex. Bolt/Nut/2 Washers	1	1	
M20 x 220mm Hex. Bolt/Nut/2 Washers	1	1	
1/2” x 1 ¼” Anchor Bracket Shoulder Bolt/Nut/2 Washers	8	8	
5/16” x 1” Hex. Bolt/Nut/2 Washers	2	2	
M16 x 255mm Mushroom Post Bolt/Nut	3	5	
M16 x 32mm Mushroom Splice Bolt/Nut	17	25	
Total Weight	**350kg**	**450kg**	

5.0 Component Identification

Bottom Post 1

Bottom Post 2

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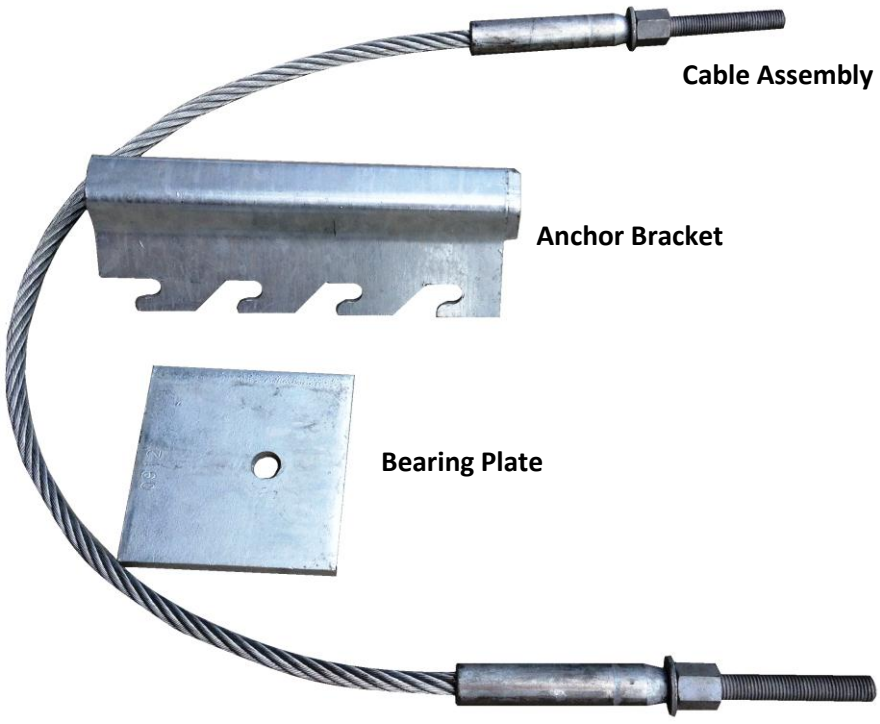
Top Post 1

Top Post 2



Cable Assembly

Anchor Bracket

Bearing Plate

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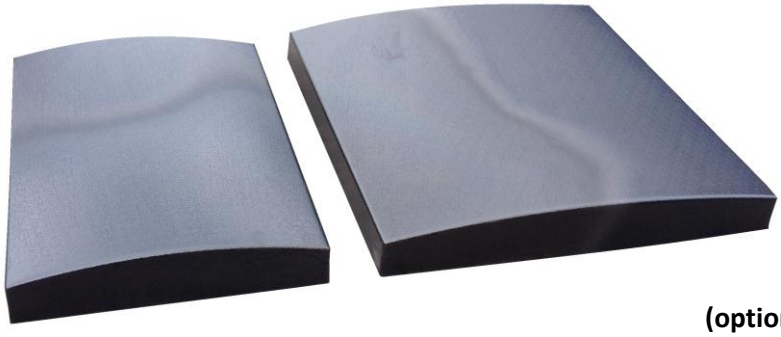
Slotted Anchor Rail

SKT Impact Head

FLEAT Impact Head



Impact Covers
(optional outside of Victoria)

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Steel Line Post

200mm Blocking Piece

Anchor Bracket Shoulder Bolt/Washers/Nut

6.0 Tools Required

Tools required for the installation of the SKT-SP and FLEAT-SP are the same as those used for the installation of standard guardrail. This includes;

- Post driving equipment or auger;
- Hand tamper;
- Impact driver drill with attachments;
- Metal snips;
- String line;
- Tape measure;
- Hammer;
- 12mm diameter pinch bar; and
- Slings or chains.

6.1 Recommended PPE

It is recommended that the following personal protective equipment (PPE) be provided for the safe installation of the SKT-SP and FLEAT-SP;

- Safety footwear;
- Gloves;
- Hearing protection;
- High visibility clothing;
- Sun protection (broad brimmed hat, sunscreen & tinted safety glasses); and
- PPE as required for the use of post driving equipment or auger.

7.0 Site Establishment

7.1 Traffic Control

Prior to the commencement of any work, the site should be evaluated for risks to workers, pedestrians and other road users. The establishment of traffic control should provide safe travel for passing vehicles and/or pedestrians and appropriately protect workers near the roadside.

7.2 Underground Services

The installation of the SKT-SP and FLEAT-SP requires the supporting posts to be embedded into the ground. Prior to the installation of posts an investigation for potential underground hazards is recommended.

7.3 Overhead Obstructions

The site should be evaluated for potential overhead instructions that may present a risk during the installation process. These obstructions typically include power lines, signage or trees.

7.4 Unloading Exclusion Zone

Only appropriate load-rated slings and chains should be used for the safe unloading of product. It is recommended that an exclusion zone be maintained around the unloading process. This provides distance between moving machinery and workers in the event that goods or the machinery move unexpectedly.

Unloading and the storing of the product on a level surface is recommended. Storing product adjacent to the installation area eliminates the requirement for workers to carry items over long distances.

8.0 Installation Sequence

The major steps in the installation of the SKT-SP and FLEAT-SP are as follows;

- Set-out;
- Installing the bolted hinged posts at post locations 1 and 2;
- Installing the steel line posts at post locations 3 and beyond;
- Attachment of the cable anchor bracket using the special shoulder bolts;
- Attachment of the guardrail;
- Attachment of the impact head; and
- Attachment of the cable assembly.

8.1 Set-Out

It is recommended that a string line be used to establish the alignment of the terminal and the post locations. The offsets nominated in this document are measured to the face of rail.

When establishing the post locations of the terminal, take care to note the following;

- The first two posts from the end of each terminal have no offset blocking piece;
- The 200mm blocking pieces used within the terminals are wider than the standard w-beam blocking pieces;
- The 1.905m spacing for the posts throughout the terminals is different from the standard w-beam barrier spacing of 2.0m and 2.5m (Victoria).

8.1.1 SKT-SP Set-Out

The SKT-SP is a tangential terminal and no offset is required. However, if space permits the use of a 25:1 or flatter straight flare may be used to reduce the potential for nuisance impacts with the terminal.

When installing a 15.24m SKT-SP (TL3 configuration) the maximum offset is 600mm. When installing a 7.62m SKT-SP (TL2 configuration) the maximum offset is 300mm.

8.1.2 FLEAT-SP Set-Out

The FLEAT-SP is a flared, energy-absorbing end terminal. The flare follows a straight alignment and is achieved by setting back the position of the posts.

When installing an 11.43m FLEAT-SP (TL3 configuration) the straight flare measured at the start of the system is between 760mm and 1220mm. When installing a 7.62m FLEAT-SP (TL2 configuration) the straight flare measured at the start of the system is between 510mm and 810mm.

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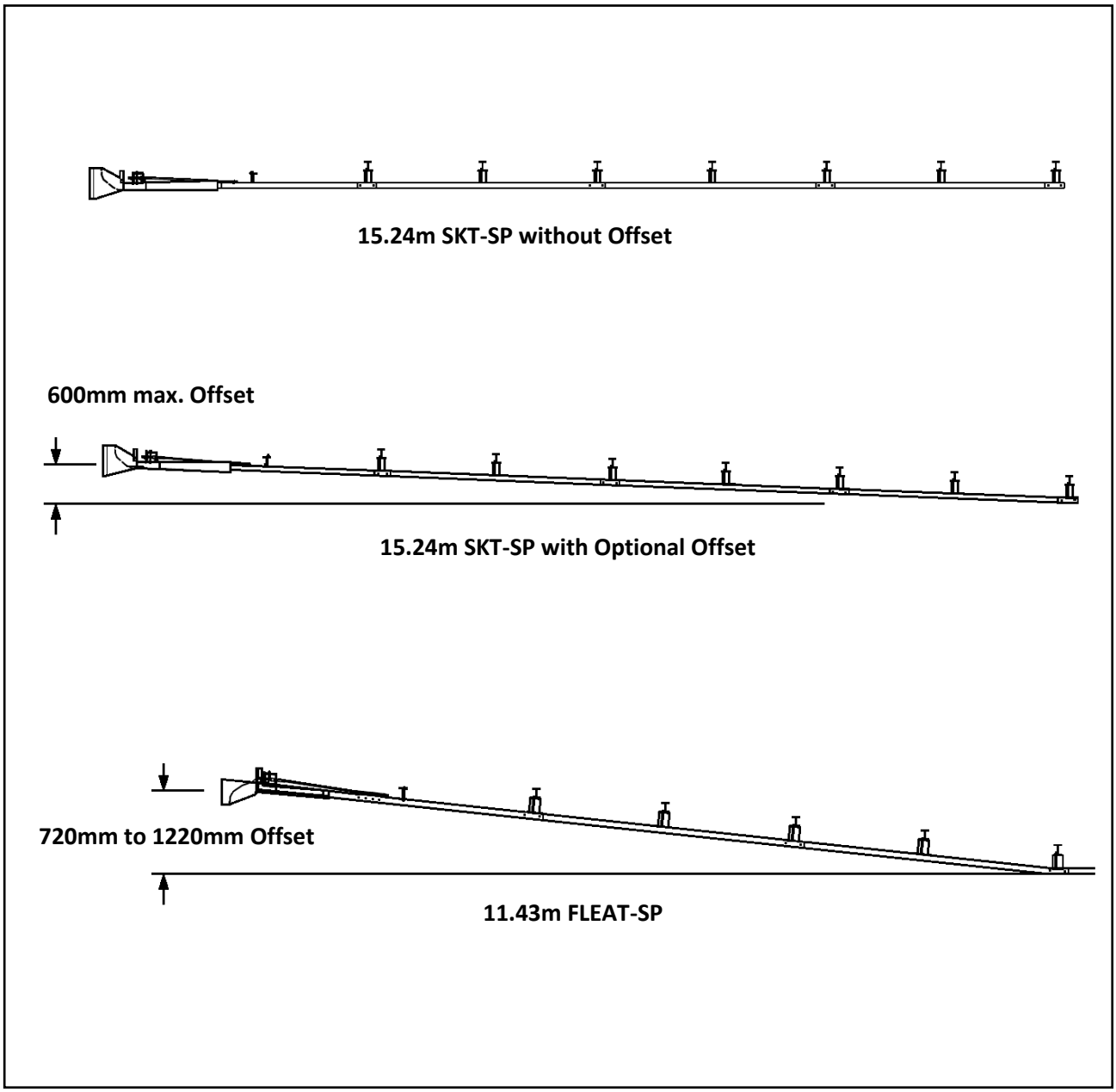

Figure 1: Set-Out Details

8.2 Installation of Bolted Hinged Posts

Potential Hazards: *Use of post driving equipment or auger, contact with underground hazards, excessive noise, hand injury from pinch points and injury from movements and posture.*

Recommended Control Measures: *Observe the safe work instructions as per machinery requirements, ensure the area has been inspected for underground hazards, wear appropriate hearing protection, wear gloves, observe correct techniques when lifting (bend at the knees), and use a team lift when installing bottom post 1.*

Hinged posts are installed at post locations 1 and 2. The hinged post assembly comprises a bottom section and top section that is bolted together. The lower section of the post must be installed prior to the attachment of the upper section.

The bottom of post 1 is aligned so that the soil plate is located on the downstream side of the post i.e. away from the impact head.

The bottom of post 1 may be installed by;

- Driving with an appropriate driving head to the required depth, approximately 1800mm, or
- Auguring a pilot hole approximately 1800mm deep, and driving the post to the required depth with an appropriate driving head, or
- Auguring a hole approximately 1800mm deep, placing the post in the hole and backfilling. The post hole should be large enough (e.g. 300mm diameter) to allow the backfill material to be placed in 150mm lifts and compacted with tamping equipment

Once installed, the bottom post should not protrude more than 100mm above ground level.

The bottom of post 2 is aligned so that the hinge bolt hole is located on the downstream side of the post i.e. away from the impact head.

Post 2 is positioned 1.905m from post 1.

Note: *There is no ground strut used between posts 1 and 2 for the SKT-SP and FLEAT-SP.*

The bottom of post 2 may be installed by;

- Driving with an appropriate driving head to the required depth, approximately 1100mm, or
- Auguring a pilot hole approximately 1100mm deep, and driving the post to the required depth with an appropriate driving head, or
- Auguring a hole approximately 1100mm deep, placing the post in the hole and backfilling. The post hole should be large enough (e.g. 300mm diameter) to allow the backfill material to be placed in 150mm lifts and compacted with tampering equipment.

Once installed, the bottom post should not protrude more than 100mm above ground level.

The top for post 1 is approximately 740mm in length and is fabricated from 150mm x 150mm RHS. The post features rectangular openings cut into the base which facilitate the attachment of the cable assembly.

A M16 x 220mm hex. bolt and (2) washers is used to secure the top and bottom post sections at post location 1.

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The top for post 2 is approximately 770mm in length and is an I-beam cross section. The post features two open slots used to attach the guardrail to the post. The open slots are orientated towards post 1.

A M20 x 220mm hex. bolt, nut and (2) washers is used to secure the top and bottom post sections at post location 2.

There is no torque requirement for these bolts. They should be tightened to a snug position.

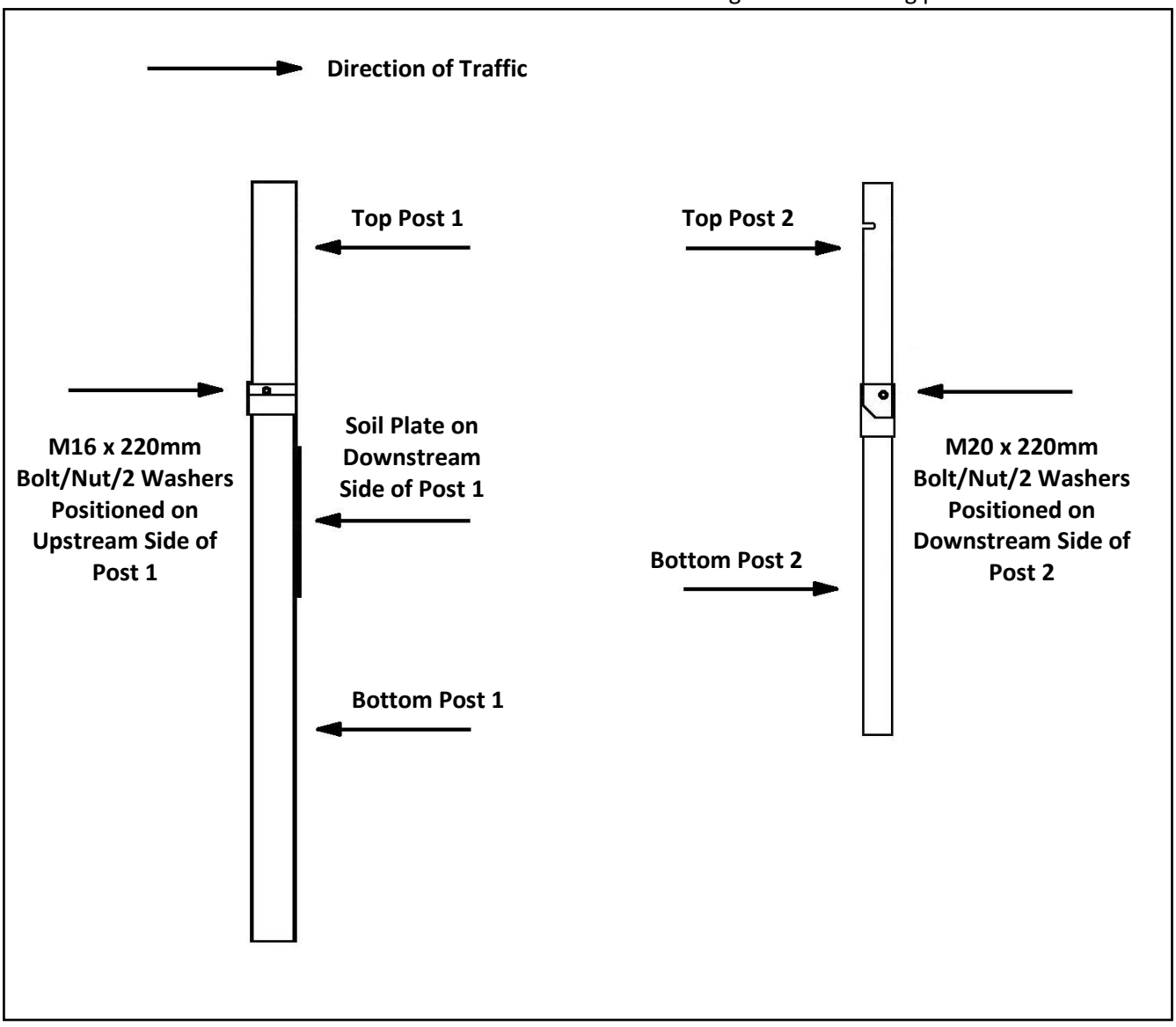

Figure 2: Bolted Hinged Posts Assembly

8.3 Installation of Steel Line Posts

Potential Hazards: *Use of post driving equipment or auger, contact with underground hazards, excessive noise and hand injury from pinch points.*

Recommended Control Measures: *Observe the safe work instructions as per machinery requirements, ensure the area has been inspected for underground hazards, wear appropriate hearing protection and wear gloves.*

The steel line posts are approximately 1830mm in length and are manufactured from an I-beam cross section. They are installed as post locations as follows;

TL2 (7.62m) SKT-SP: Post locations 3 to 5.

TL3 (15.24m) SKT-SP: Post locations 3 to 8.

TL2 (7.62m) FLEAT-SP: Post locations 3 to 5.

TL3 (11.43m) FLEAT-SP: Post locations 3 to 7.

The steel line posts may be installed by;

- Driving with an appropriate driving head to the required depth, approximately 1100mm, or
- Auguring a pilot hole approximately 1100mm deep, and driving the post to the required depth with an appropriate driving head, or
- Auguring a hole approximately 1100mm deep, placing the post in the hole and backfilling. The post hole should be large enough (e.g. 300mm diameter) to allow the backfill material to be placed in 150mm lifts and compacted with tampering equipment.

The steel line posts are spaced at 1905mm centres.

8.4 Attaching the Cable Anchor Bracket

Potential Hazards: *Hand injury from pinch points.*

Recommended Control Measures: *Wear gloves.*

For ease of installation, it is recommended that the cable anchor bracket be secured to the slotted anchor rail prior to securing the rail to the posts. This ensures that the top of post 2 does not interfere with the attachment of the cable anchor bracket.

The anchor rail is identified by the horizontal slots punched into the end of the rail. The anchor rail also has eight 19mm diameter holes to accommodate the cable anchor bracket.

The cable anchor bracket is secured with eight 1/2" x 1 ¼" hex. head anchor bracket shoulder bolt, nut and (2) washers. A single washer is placed on either side of the rail.

Note*: The cable anchor bracket bolts and nuts are specially engineered. No other bolts are to be used at this location. The bolts are manufactured with a unique shoulder.*

The cable anchor bracket is positioned with the welded plate of the bracket towards post location 2. Align the bracket with the holes in the anchor rail and insert the bolts and hand-tighten.

Once all bolts are inserted, ensure the shoulders align with the cable bracket slots. When positioned, slightly tap with a hammer until the shoulders and slots are fully engaged. The bolts can now be fully tightened with a wrench.

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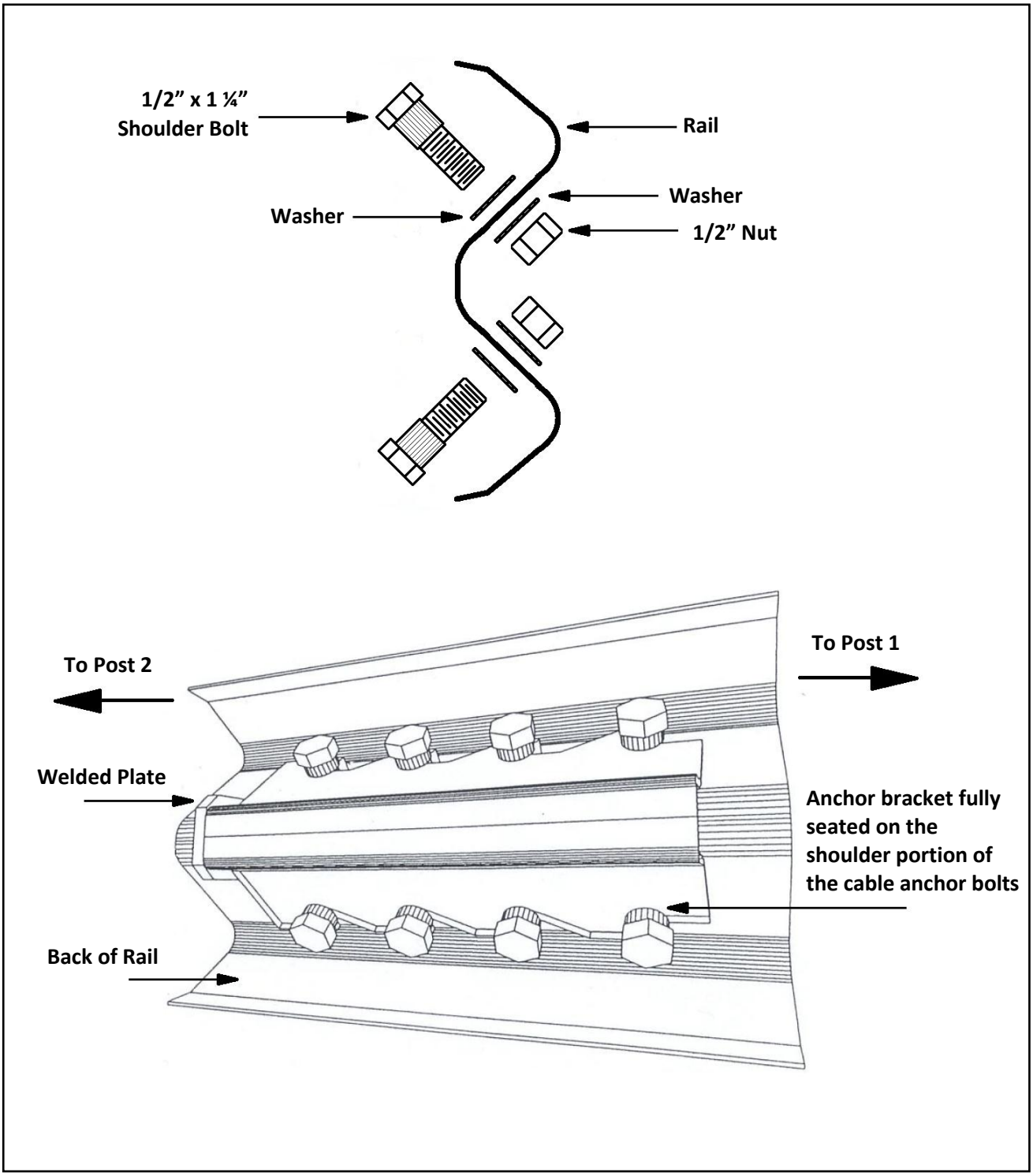

Figure 3: Cable Anchor Bracket Assembly

8.5 Attaching the Rails & Blocking Pieces

Potential Hazards: *Injury from movements and posture, hand injury from pinch points, strain to wrists from tightening bolts and excessive noise from use of impact driver.*

Recommended Control Measures: *Observe correct techniques when lifting rails (bend at the knees), wear gloves, use a pinch bar to align holes, use an impact drill to tighten bolts and wear appropriate hearing protection.*

The anchor rail is positioned at the start of the terminal with the slots towards post 1. The anchor rail is secured to post 2 using a standard M16 x 32mm mushroom head splice bolt & nut.

Note*: The anchor rail is not bolted at post 1 for the assembly of the SKT-SP & FLEAT-SP. The rail is not bolted at post 3 for the FLEAT-SP only.*

Standard 3810mm rails are used throughout the remainder of the terminal. Rails are splice together using eight standard M16 x 32mm mushroom head bolts and nuts. The rail lap is orientated so that the leading edge of the splice is shielded from the nearside approaching traffic.

The use of a pinch bar will assist in aligning the splice holes as the bolts are inserted. The use of a driving pin to elongate the splice holes is NOT permitted.

At the steel line post locations a 200mm wide blocking piece is positioned between the posts and the rail. The rails are then secured with a M16 x 255mm mushroom head bolt and nut with the bolt passing through the rail, blocking piece and post.

There is no torque requirement for these bolts. They should be tightened to a snug position.

The finishing height of the rail is 710mm to 730mm above ground level.

Note*: All rail used within the SKT-SP and FLEAT-SP is straight. No curved rails are permitted. The offset of the FLEAT-SP is achieved by loose bolting at the splice locations and then manually setting the rails back. Once the rails are secured to the post, the splice bolts can be fully tightened.*

8.6 Attaching the Impact Head

Potential Hazards: *Injury from movements and posture and hand injury from pinch points.*

Recommended Control Measures: *Observe correct techniques when lifting the impact head (bend at the knees), use a team lift, wear gloves and use a pinch bar to align impact head.*

Ensure the cable anchor bracket is secured to the anchor rail prior to the attachment of the impact head. Align the impact head over the end of the anchor rail with the protruding tube positioned on the non-traffic side of the system. Slide the impact head forward until the post angle attachments on the impact head are aligned with the holes in post 1.

When correctly installed, the exit slot of the SKT-SP impact head is towards the non-traffic side of the system. The exit slot of the FLEAT-SP impact head is towards the traffic side of the system.

Secure the impact head to post 1 with two sets of 5/16” x 1” hex. bolt, nut and (2) washers.

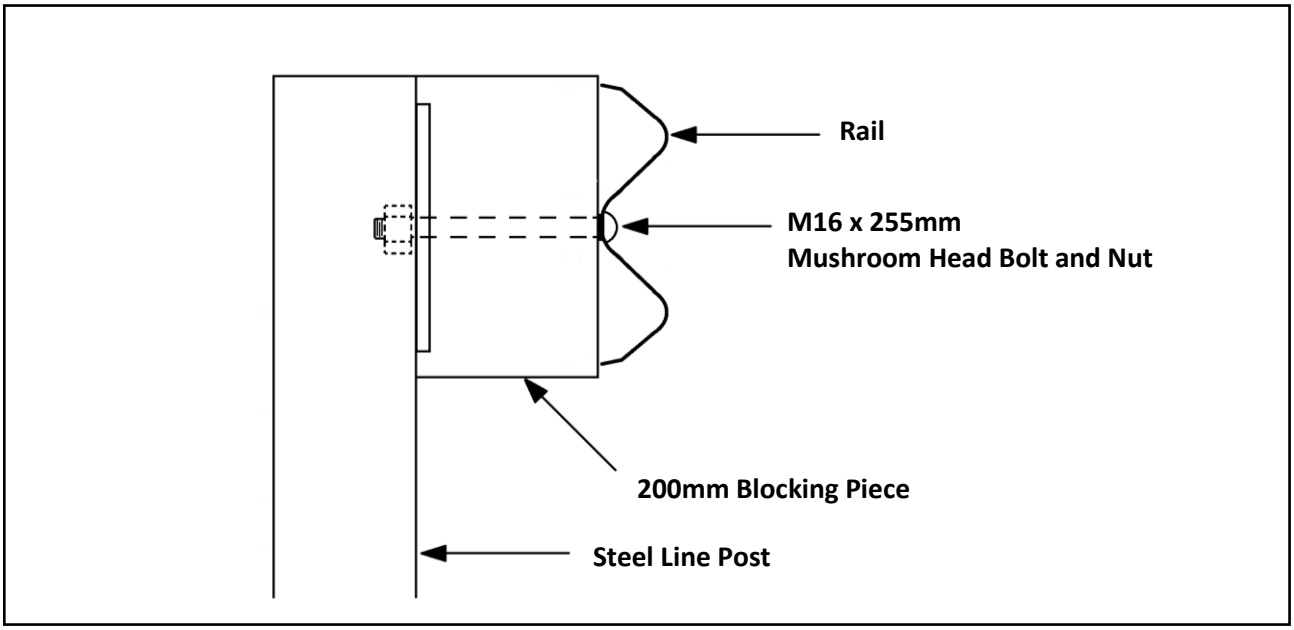

Figure 4: Attachment of Rail to Steel Line Posts (Post Locations 3 and Beyond)

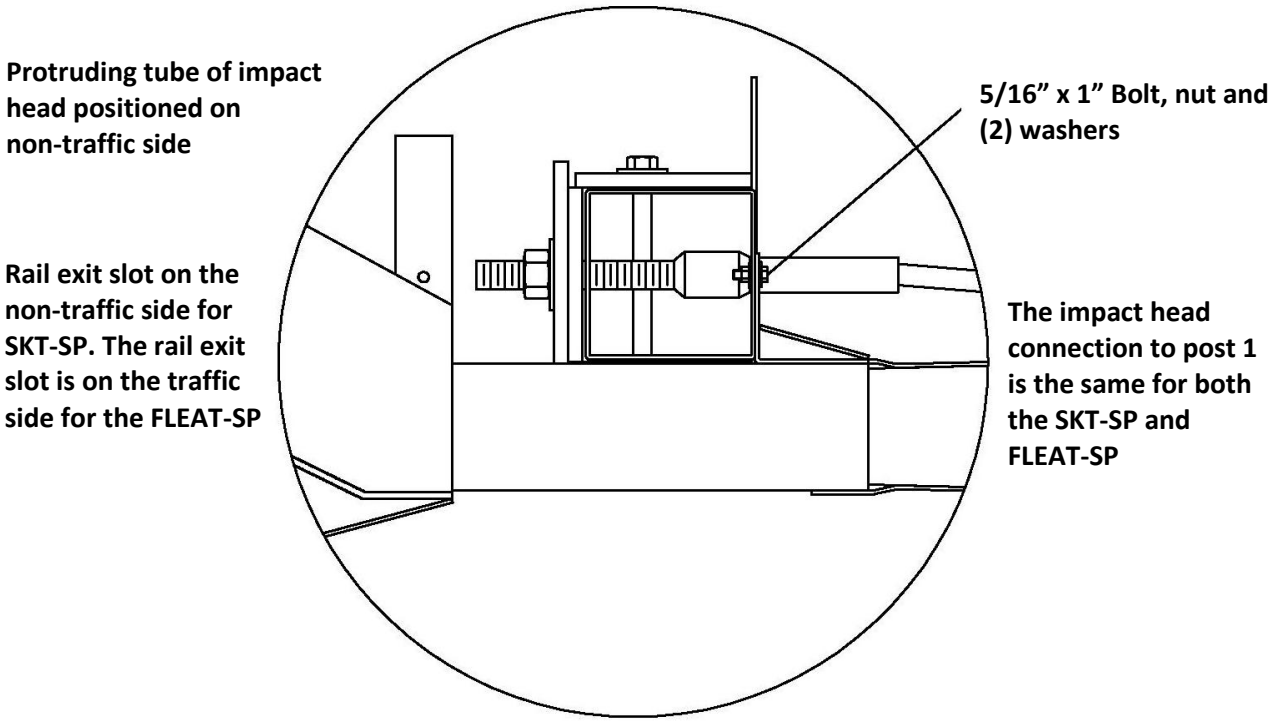

Figure 5: Securing of Impact Head (SKT-SP Impact Head Shown)

8.7 Installing the Cable Assembly

Potential Hazards: *Hand injury from pinch points.*

Recommended Control Measures: *Wear gloves.*

The cable assembly is integral to the anchorage of the terminal, contributing to the tensile and flexural strength of the system.

Place the cable assembly through the cable anchor bracket and through the slots at the base of post 1. Secure the cable assembly to the anchor bracket with a 1" hex nut and washer.

Place the bearing plate at the base of post 1 with the 125mm dimension up and the 75mm down. Secure the cable assembly to the bearing plate with a 1" hex nut and washer.

To prevent rotation of the bearing plate, secure with a cable tie positioned around the post.

While tightening the cable, use a hammer to tap the cable anchor bracket from the downstream end to ensure that it is securely interlocked with the shoulder bolts. Restrain the cable at the end being tightened with vice grips to avoid twisting the cable.

Upon completion of installation, the cable should be taut.

Note*: The SKT-SP impact head has a longer impact head than the FLEAT-SP. Therefore the SKT-SP cable assembly is fed through the feeder chute.*

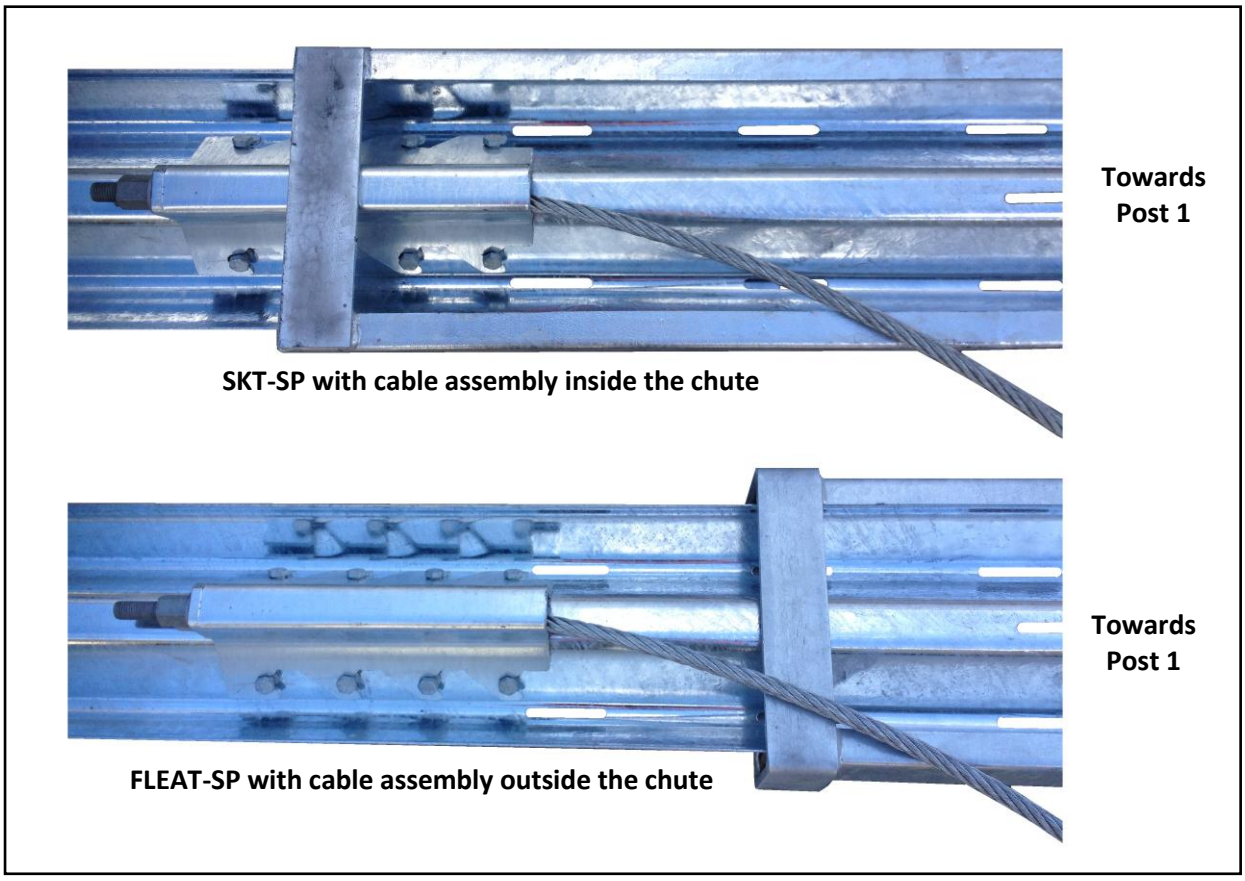

Figure 6: Cable Assembly Orientation

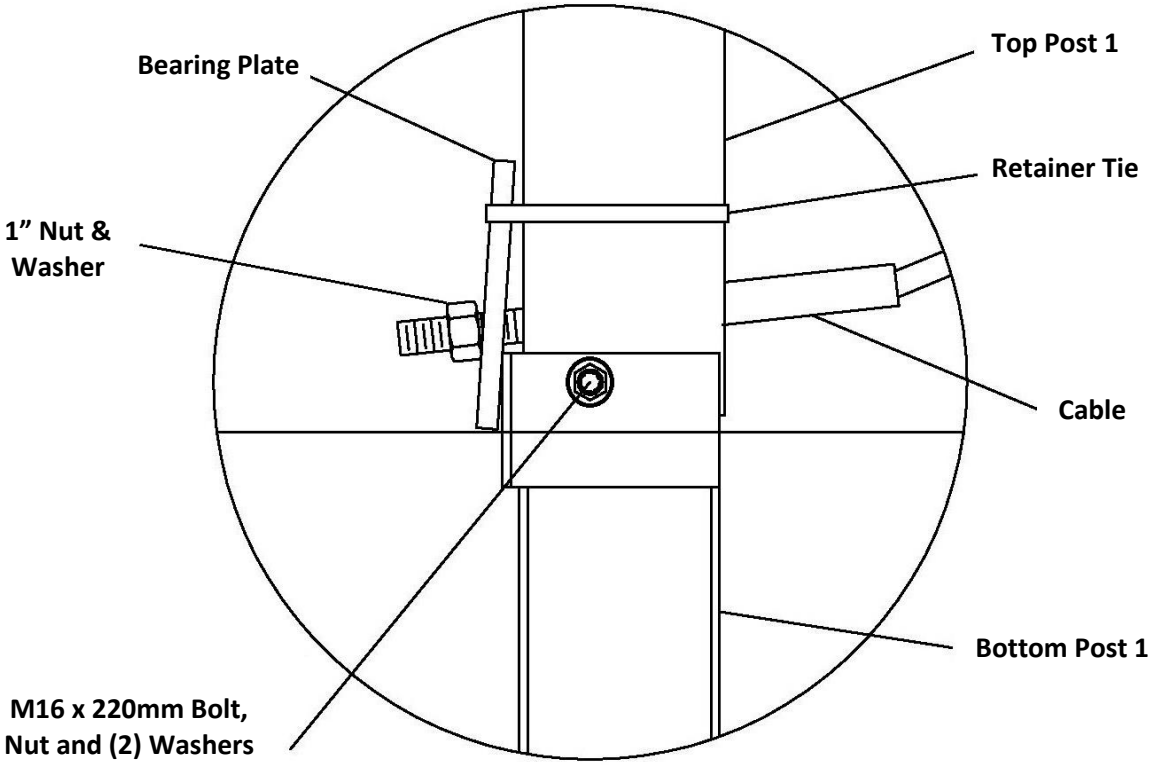

Figure 7: Bearing Plate Connection to Cable Assembly

8.8 Delineation

It is recommended that the face of the impact head be delineated as per state regulatory requirements.

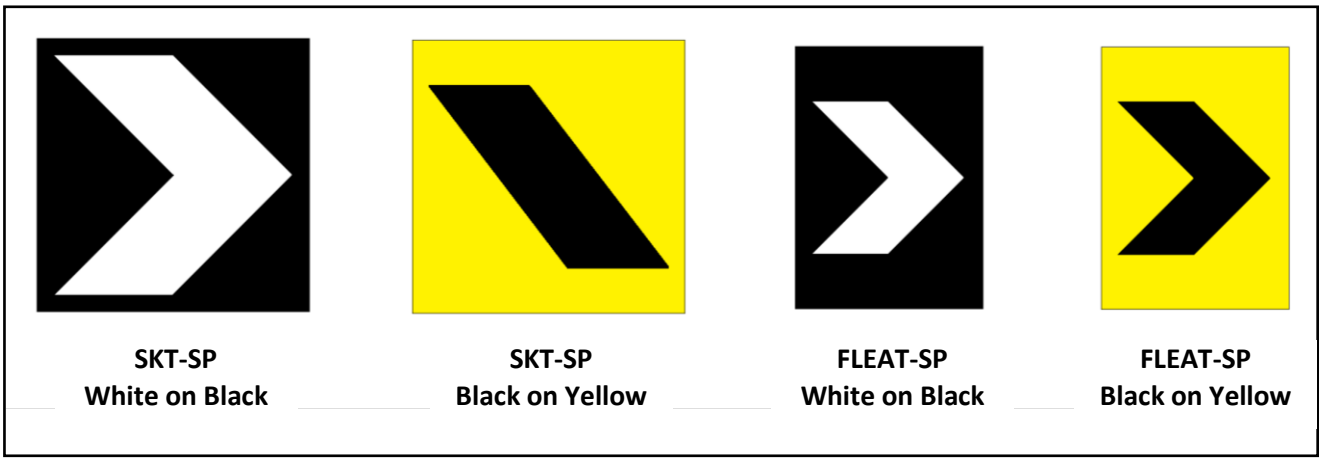

Figure 8: Delineation Options

8.9 Installation of Impact Head Covers

The installation of impact head covers is a requirement on the Victorian classified road network. Installations outside of Victoria may also require covers if the terminal is installed on roads with high motorcycle use. This will be at the discretion of the project manager.

The covers slide over the impact head and are secured at the sides using galvanised self-drilling metal screws. The delineation is attached to the face of the cover.

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SKT-SP

Installation Checklist

Customer: _____

Location: _____

Terminal Type: _____

Checked By: _____

Signed: _____

Date: _____

❑	The 1st rail is the anchor rail containing horizontal slots.
❑	The rails throughout the terminal are straight and not curved.
❑	The height measured to the top of the rails is 710mm to 730mm as per road authority requirements.
❑	The rail is not secured to post 1.
❑	The rail is secured to post 2 with a M16 x 32mm mushroom head bolt & nut.
❑	The rails are spliced with eight (8) M16 x 32mm mushroom head bolt & nuts.
❑	The rail lap is orientated so that the leading edge of the splice is shielded from approaching traffic.
❑	Hinged post 1 is bolted on the upstream side of the post with a M16 x 220mm bolt, nut and (2) wshrs.
❑	Hinged post 2 is bolted on the downstream side of the post with a M20 x 220mm bolt, nut and (2) washers.
❑	The posts are spaced at 1905mm centres.
❑	200mm blocking pieces are attached to the steel line posts.
❑	The rail is secured to the steel line posts with a M16 x 255mm mushroom head bolt & nut.
❑	The guide chute of the impact head is parallel to the top of rail.
❑	The protruding tube on the impact head is positioned on the non-traffic side of the system.
❑	The impact head is secured to post 1 with two 5/16” x 1” hex. bolt, nut and (2) washers.
❑	The bearing plate at post 1 is correctly aligned with the 125mm dimension up and the 75mm down.
❑	The cable anchor bracket is properly secured to the anchor rail using the special shoulder bolts.
❑	The cable assembly is taut and a retainer is fitted to the bearing plate.
❑	All bolts are tightened.
❑	The fill material around the posts is suitably compacted.
❑	Any minor damage to the galvanised finish is repaired using two coats of an organic zinc rich pain.
❑	A cover is attached to the impact head (if required).
❑	Delineation is attached to the impact head.

FLEAT-SP

Installation Checklist

Customer: _____

Location: _____

Terminal Type: _____

Checked By: _____

Signed: _____

Date: _____

❑	The 1st rail is the anchor rail containing horizontal slots.
❑	The rails throughout the terminal are straight and not curved.
❑	The height measured to the top of the rails is 710mm to 730mm as per road authority requirements.
❑	The FLEAT-SP is installed on a straight flare of between 760mm and 1220mm (TL3 configuration) or 510mm and 810mm (TL2 configuration).
❑	The rail is not secured to post 1 or post 3.
❑	The rail is secured to post 2 with a M16 x 32mm mushroom head bolt & nut.
❑	The rails are spliced with eight (8) M16 x 32mm mushroom head bolt & nuts.
❑	The rail lap is orientated so that the leading edge of the splice is shielded from approaching traffic.
❑	Hinged post 1 is bolted on the upstream side of the post with a M16 x 220mm bolt, nut and (2) wshrs.
❑	Hinged post 2 is bolted on the downstream side of the post with a M20 x 220mm bolt, nut and (2) wshr
❑	The posts are spaced at 1905mm centres.
❑	200mm blocking pieces are attached to the steel line posts.
❑	The blocking pieces are secured to the steel line posts with a M16 x 255mm mushroom head bolt & nut.
❑	The guide chute of the impact head is parallel to the top of rail.
❑	The protruding tube on the impact head is positioned on the non-traffic side of the system.
❑	The impact head is secured to post 1 with two 5/16” x 1” hex. bolt, nut and (2) washers.
❑	The bearing plate at post 1 is correctly aligned with the 125mm dimension up and the 75mm down.
❑	The cable anchor bracket is properly secured to the anchor rail using the special shoulder bolts.
❑	The cable assembly is taut and a retainer tie is fitted to the bearing plate.
❑	All bolts are tightened.
❑	The fill material around the posts is suitably compacted.
❑	Any minor damage to the galvanised finish is repaired using two coats of an organic zinc rich pain.
❑	A cover is attached to the impact head (if required).
❑	Delineation is attached to the impact head.

9.0 Maintenance

The SKT-SP and FLEAT-SP are low maintenance terminals. Except for repairs due to impacts, it is recommend that an annual inspection be undertaken to assess the following;

- The impact head is appropriately delineated;
- Debris has not accumulated around the terminal which may impede the function of the terminal;
- Vegetation around the terminal is appropriately maintained;
- Nuisance impacts have not gone undetected; and
- The anchor assembly is taut and the bearing plate is correctly aligned.

9.1 Bushfire Damage

The SKT-SP and FLEAT-SP are predominantly constructed from hot dip galvanised steel components. The performance of hot dip galvanised components when subjected to a fire depends upon numerous factors such as flame duration, flame intensity and the characteristics of the galvanised finish.

Bushfires can produce high temperatures, however exposure of roadside structures to maximum flame intensity is generally for a short duration as the fire front moves forward. The combination of the reflectivity of the galvanised surface and the heat sink provided by the mass of the steel to which the hot dip galvanising is applied has shown galvanised steel to provide excellent performance during bushfires.

However, if it is observed that a bushfire has caused damage to the galvanised coating it is recommended that these item(s) be replaced. If an item adjacent to a blocking piece is being replaced i.e. post or rail, it is recommended that the blocking piece is also replaced.

10.0 Repair

In the event of a vehicle impact, damage to the terminal is to be assessed in accordance with Table 1. Typically, impacts with a SKT-SP or FLEAT-SP will require replacement of damaged sections of rail and posts. The bearing plate, nuts, washers, cable anchor bracket and the special cable anchor bracket shoulder bolts are rarely damaged.

Additional tools required for repair include;

- Acetylene torch to cut away damaged rail;
- Heavy duty chain to remove the impact head;
- Sledge hammer; and
- Post extractor.

Similar to the installation sequence, it is recommended that the guidelines contained in Section 7.0 be observed in the establishment of traffic control and an unloading exclusion zone in addition to investigation for underground services and overhead obstructions.

SKT-SP & FLEAT-SP
Installation & Repair Manual

Table 1: Damage Assessment Guidelines

Type of Damage	Description of the Damage	Remedial Action
Damage to the galvanised coating on the posts.	The sum total of the damaged area does not exceed 45cm^2 (0.5% of the total surface area) and no individual damaged area exceeds 40cm^2.	An organic zinc rich paint is to be applied to the repair area in two coats.
	The sum total of the damaged area exceeds 45cm^2 (0.5% of the total surface area) or an individual damaged area exceeds 40cm^2.	The post is to be replaced.
Damage to the galvanised coating on the rails.	The sum total of the damaged area does not exceed 200cm^2 (0.5% of the total surface area) and no individual damaged area exceeds 40cm^2.	An organic zinc rich paint is to be applied to the repair area in two coats.
	The sum total of the damaged area exceeds 200cm^2 (0.5% of the total surface area) or an individual damaged area exceeds 40cm^2.	The rail is to be replaced.
Damage to the blocking pieces.	The blocking piece is cracked or chipped.	The blocking piece is to be replaced.
Damage to the posts.	The posts are bent or the welds have cracked.	The posts are to be replaced.
Damage to the impact head.	The impact head has superficial damage. Its ability to function is not compromised.	The impact head may be reused. If uncertain, replace the impact head.
	The impact head is distorted and its ability to function is compromised.	The impact head is to be replaced.
Damage to the rails.	The rail is dented, twisted or flattened.	The rail is to be replaced.
	There are nicks in any part of the rail.	
	The slots in the rail are distorted.	
Damage to bolts.	The body of the bolt is distorted.	The bolt is to be replaced.
	The thread of the bolt is damaged.	
Disturbance of material around the posts.	The material around a post is loose.	The material is to be suitably compacted.

10.1 Removal of the Impact Head

Potential Hazards: *Injury from movements and posture, hand injury from pinch points, hand injury from damaged edges and injury from sudden movement as the impact head is released.*

Recommended Control Measures: *Observe correct techniques when lifting the impact head (bend at the knees), wear gloves and maintain an appropriate exclusion zone around the impact head until removed from the rail.*

A head-on impact with the SKT-SP or FLEAT-SP will cause the impact head to travel over the rails. The rails are sequentially kinked as it moves through the impact head.

The kinked rail on the SKT-SP exits the impact head on the non-traffic side, whilst the kinked rail on the FLEAT-SP exits the rail on the traffic side.

Using an acetylene torch, cut away the damaged rail near the exit shute of the impact head. In most instances, the impact head can now be removed by hand.

If the impact head is unable to be removed, attach a heavy duty chain through the opening behind the impact plate. Secure the other end of the chain to equipment capable of pulling the impact head from the rails. Ensure the downstream rail is still bolted to the supporting posts prior to applying the load.

10.2 Removal of Damaged Posts

Potential Hazards: *Hand injury from pinch points, hand injury from damaged edges and injury from sudden movement as the posts are released.*

Recommended Control Measures: *Wear gloves and maintain an appropriate exclusion zone around the post until removed.*

Posts 1 and 2 are hinged and will typically yield at ground level. It is unlikely that the bottom sections of posts 1 and 2 will be required to be replaced.

Damaged steel line posts should be removed using an appropriate post extractor. Once the damage post is removed, the ground material should be suitably compacted before a replacement post is installed.

10.3 Removal of Damaged Rails

Potential Hazards: *hand injury from pinch points, hand injury from damaged edges, injury from sudden movement as rails are released and excessive noise from use of impact drill.*

Recommended Control Measures: *Wear gloves and wear appropriate hearing protection.*

Using an impact drill, remove the splice bolts at the rail connection. Rails that have twisted or bent during impact may need to be cut into manageable sections using an acetylene torch.

10.4 Procedure Immediately After an Impact

In some circumstances, an assessment of the damaged terminal is undertaken to evaluate the extent of damage and determine replacement parts required. There is often a time lag before the terminal is appropriately repaired.

In these circumstances, consideration for a temporary repair is recommended. This is achieved as follows;

- Remove any damaged rail and the impact head from the roadway;
- Using an acetylene torch, cut away the damaged rail near the exit chute of the impact head.
- Remove the damaged impact head by hand. If this is not possible, attach a heavy duty chain through the opening behind the impact plate. Secure the other end of the chain to equipment capable of pulling the impact head from the rails. Ensure the downstream rail is still bolted to the supporting posts prior to applying the load.
- Locate the first upright post downstream of any damaged rail and cut off the rail approximately 225mm in front of the post. If the post is at a splice location, the rail can be removed by unbolting the splice connection.
- Re-install the impact head over the rail and secure to the post through the top and bottom angle attachments.
- If the impact head is damaged and unable to be reinstated over the rail, turn down and bury the end rail as far away from the traffic as possible.
- Erect appropriate warning signs adjacent to and in advance of the damaged terminal.

The procedures are temporary only and should only be implemented until a full repair is undertaken. It is always recommended that damage to guardrail end terminals be prioritised and undertaken as soon as possible.

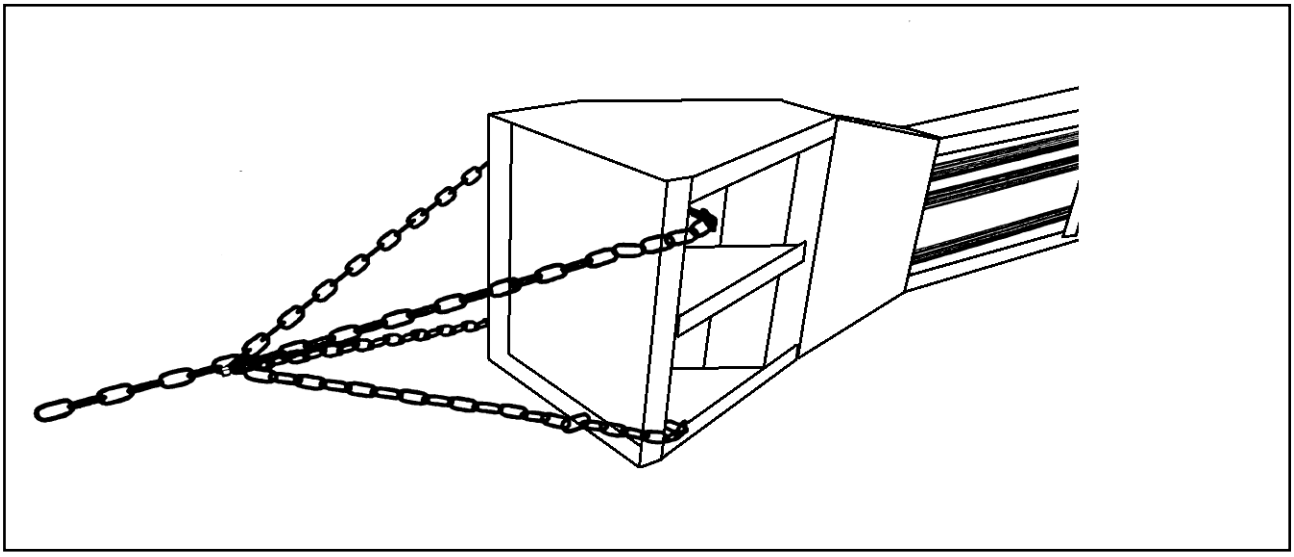
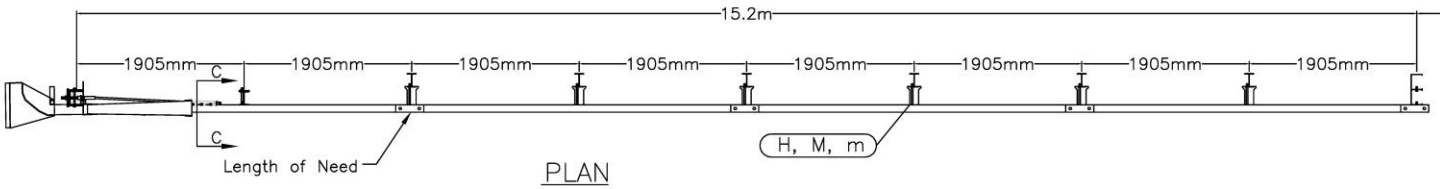


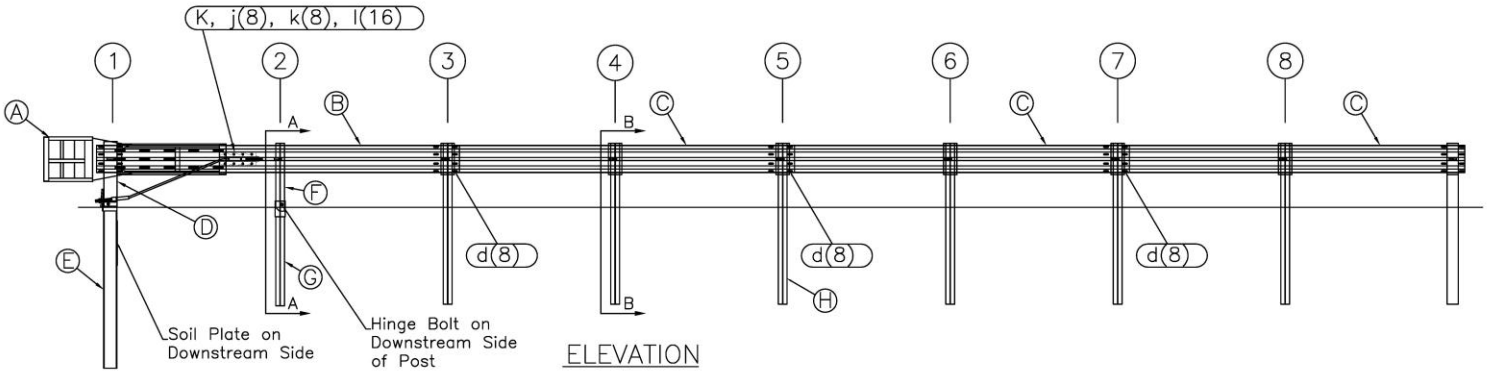
Figure 9: Attachment of Chains for Removal of Impact Head

STANDARD POSTS &
GUARDRAIL SECTIONS

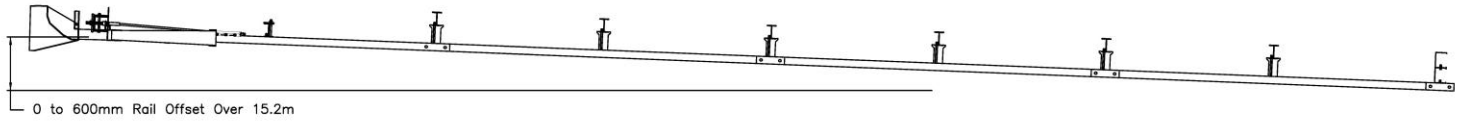


PLAN

TRAFFIC



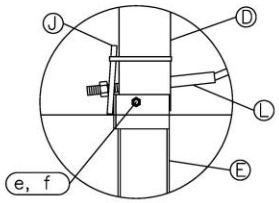
ELEVATION



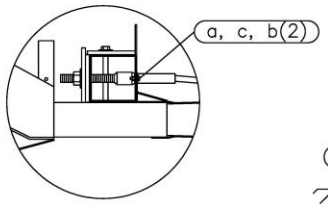
OPTIONAL FLARED INSTALLATION
25:1 maximum flare rate

ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	SKT IMPACT HEAD	GE-EF-MX-3333-AG
B	1	SLOTTED ANCHOR RAIL	GE-WB-SR-3810-BG
C	3	W-BEAM GUARDRAIL 3810	GR-WB-SR-3810-AG
D	1	TOP POST 1	GE-PG-IS-0650-BG
E	1	BOTTOM POST 1	GE-PG-IS-1900-BG
F	1	TOP POST 2	GE-PG-IS-0700-AG
G	1	BOTTOM POST 2	GE-PG-IS-1100-AG
H	6	STEEL LINE POST	GE-PG-IS-1830-CG
J	1	BEARING PLATE	GE-EF-MX-0011-AG
K	1	ANCHOR CABLE BRACKET	GE-EF-MX-0015-AG
L	1	CABLE ASSEMBLY	GE-EF-MX-2000-AG
M	6	COMPOSITE BLOCK	GE-BL-SS-0310-AS
		HARDWARE	
a	2	5/16" x 1" HEX BOLT	GE-FS-56-0001-HG
b	4	5/16" WASHER	GE-FS-56-0000-AG
c	2	5/16" NUT	GE-FS-56-0000-HG
d	25	M16 x 32mm SPLICE BOLT/NUT	GR-FS-16-0016-MG
e	1	M16 x 220mm BOLT/NUT/WASHER	GE-FS-16-0220-HG
f	1	M16 WASHER	GE-FS-16-0000-CG
g	1	M20 x 220mm BOLT/NUT/WASHER	GE-FS-20-0220-HG
h	1	M20 WASHER	GE-FS-20-0000-BG
j	8	1/2" x 1 ¼" ANCHOR BRACKET SHOULDER BOLT	GE-FS-12-0114-HG
k	8	1/2" ANCHOR BRACKET NUT	GE-FS-12-0000-HG
l	16	1/2" ANCHOR BRACKET WASHER	GE-FS-12-0000-AG
m	6	M16 x 255mm POST BOLT/NUT	GE-FS-16-0255-NG

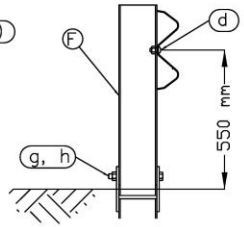
NOTES:
1. THE LOWER SECTIONS OF POSTS 1 & 2 SHALL NOT PROTRUDE MORE THAN 100mm ABOVE GROUND.
2. THE CABLE ASSEMBLY MUST BE TAUT.



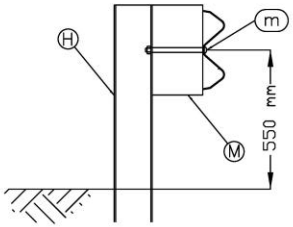
Post #1 Connection Detail



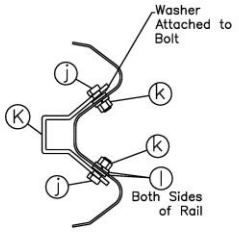
Impact Head Connection Detail



SECTION A–A
Post #2



SECTION B–B
Posts #3 thru #8



SECTION C–C
Anchor Bracket

REVISIONS					
REV	DATE	DESCRIPTION	DRAWN	APPRD.	
E	26.04.13	REVISED AND REISSUED FOR REVIEW	DB	TC	
D	23.04.13	REVISED AND ISSUED FOR REVIEW	DB	TC	
C	07.03.13	INITIAL ISSUE	DB	TC	
B	04.03.13	ISSUED FOR APPROVAL	DB	TC	
A	01.03.13	ISSUED FOR REVIEW	DB	TC	

REVISIONS					
REV	DATE	DESCRIPTION	DRAWN	APPRD.	
G	03.09.14	REISSUED FOR APPROVAL	DB	TC	
F	21.05.13	ISSUED FOR APPROVAL	DB	TC	

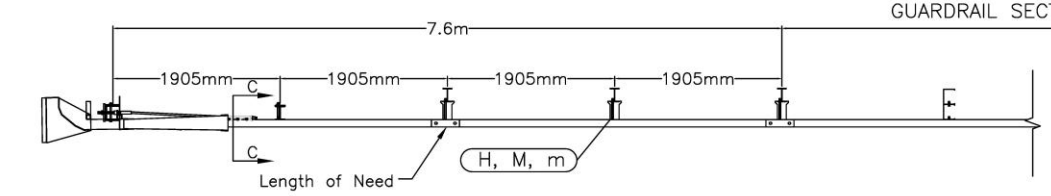
SAFE DIRECTION

DRAWING DESCRIPTION: NCHRP-350 TL3 SKT-SP TERMINAL

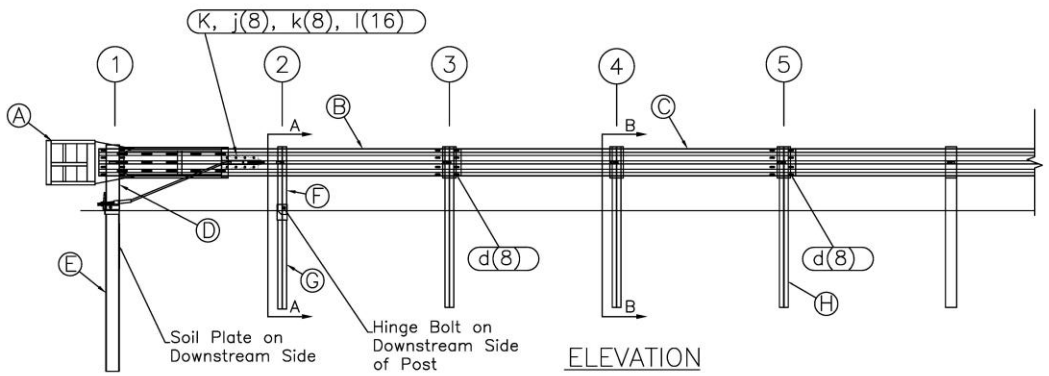
DRAWING REFERENCE: K-SKT SP TL3

DRAWN BY	AUSTEC DRAFTING	DIMENSIONS	mm
CHECKED	H. WALLACE	SCALE	NTS
APPROVED	T. COLQUHOUN		

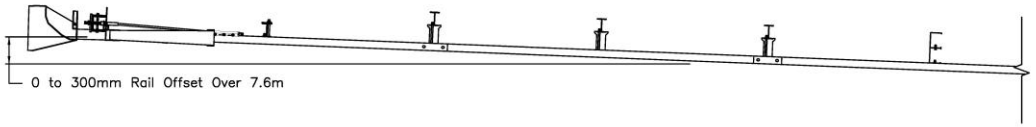
STANDARD POSTS & GUARDRAIL SECTIONS



PLAN



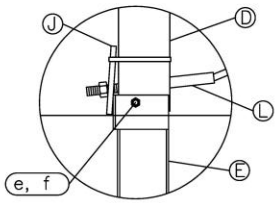
ELEVATION



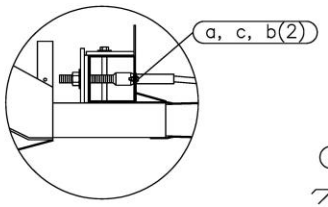
OPTIONAL FLARED INSTALLATION
25:1 maximum flare rate

ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	SKT IMPACT HEAD	GE-EF-MX-3333-AG
B	1	SLOTTED ANCHOR RAIL	GE-WB-SR-3810-BG
C	1	W-BEAM GUARDRAIL 3810	GR-WB-SR-3810-AG
D	1	TOP POST 1	GE-PG-IS-0650-BG
E	1	BOTTOM POST 1	GE-PG-IS-1900-BG
F	1	TOP POST 2	GE-PG-IS-0700-AG
G	1	BOTTOM POST 2	GE-PG-IS-1100-AG
H	3	STEEL LINE POST	GE-PG-IS-1830-CG
J	1	BEARING PLATE	GE-EF-MX-0011-AG
K	1	ANCHOR CABLE BRACKET	GE-EF-MX-0015-AG
L	1	CABLE ASSEMBLY	GE-EF-MX-2000-AG
M	3	COMPOSITE BLOCK	GE-BL-SS-0310-AS
HARDWARE			
a	2	5/16" x 1" HEX BOLT	GE-FS-56-0001-HG
b	4	5/16" WASHER	GE-FS-56-0000-AG
c	2	5/16" NUT	GE-FS-56-0000-HG
d	17	M16 x 32mm SPLICE BOLT/NUT	GR-FS-16-0016-MG
e	1	M16 x 220mm BOLT/NUT/WASHER	GE-FS-16-0220-HG
f	1	M16 WASHER	GE-FS-16-0000-CG
g	1	M20 x 220mm BOLT/NUT/WASHER	GE-FS-20-0220-HG
h	1	M20 WASHER	GE-FS-20-0000-BG
j	8	1/2" x 1 ¼" ANCHOR BRACKET SHOULDER BOLT	GE-FS-12-0114-HG
k	8	1/2" ANCHOR BRACKET NUT	GE-FS-12-0000-HG
l	16	1/2" ANCHOR BRACKET WASHER	GE-FS-12-0000-AG
m	3	M16 x 255mm POST BOLT/NUT	GE-FS-16-0255-NG

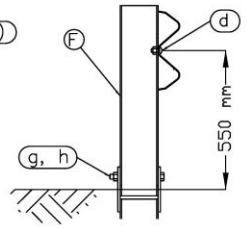
NOTES:
1. THE LOWER SECTIONS OF POSTS 1 & 2 SHALL NOT PROTRUDE MORE THAN 100mm ABOVE GROUND.
2. THE CABLE ASSEMBLY MUST BE TAUT.



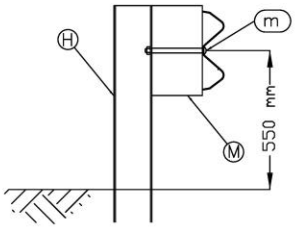
Post #1 Connection Detail



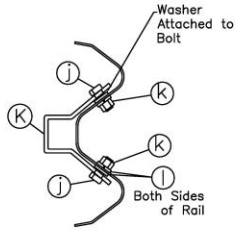
Impact Head Connection Detail



SECTION A–A
Post #2



SECTION B–B
Posts #3 thru #5



SECTION C–C
Anchor Bracket

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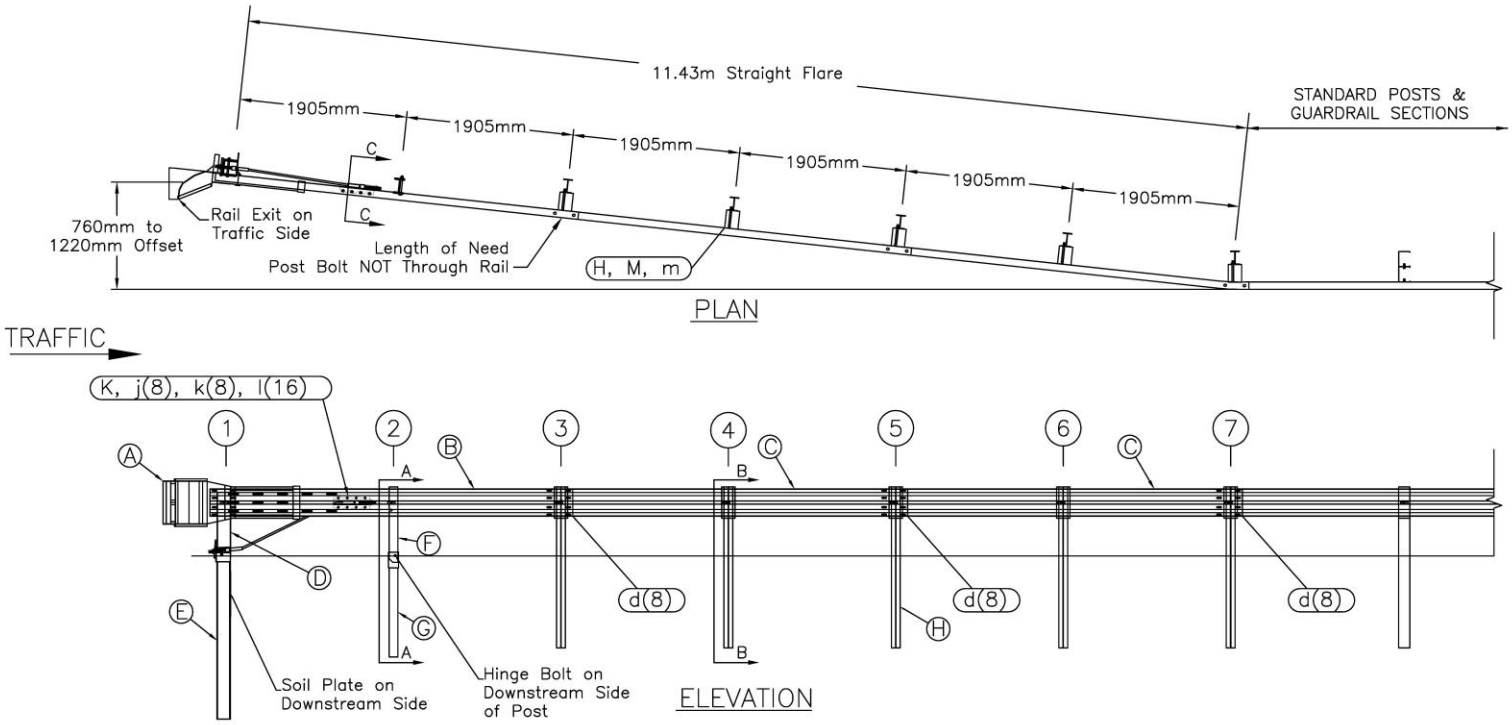
D	23.04.13	REVISED AND ISSUED FOR REVIEW	DB	TC							
C	07.03.13	INITIAL ISSUE	DB	TC							
B	06.03.13	ISSUED FOR APPROVAL	DB	TC		G	03.09.14	REISSUED FOR APPROVAL	DB	TC
A	01.03.13	ISSUED FOR REVIEW	DB	TC		F	21.05.13	ISSUED FOR APPROVAL	DB	TC
REV	DATE	DESCRIPTION	DRAWN	APPRD.		REV	DATE	DESCRIPTION	DRAWN	APPRD.

SAFE DIRECTION

DRAWING DESCRIPTION: NCHRP-350 TL2 SKT-SP TERMINAL

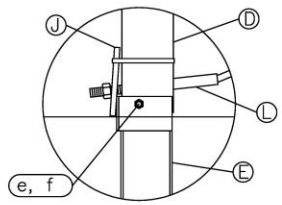
DRAWING REFERENCE: K-SKT SP TL2

DRAWN BY	AUSTEC DRAFTING	DIMENSIONS	mm
CHECKED	H. WALLACE	SCALE	NTS
APPROVED	T. COLQUHOUN		

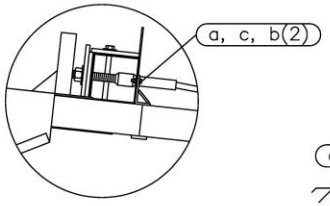


ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	FLEAT IMPACT HEAD	GE-EF-MX-4444-AG
B	1	SLOTTED ANCHOR RAIL	GE-WB-SR-3810-BG
C	2	W-BEAM GUARDRAIL 3810	GR-WB-SR-3810-AG
D	1	TOP POST 1	GE-PG-IS-0650-BG
E	1	BOTTOM POST 1	GE-PG-IS-1900-BG
F	1	TOP POST 2	GE-PG-IS-0700-AG
G	1	BOTTOM POST 2	GE-PG-IS-1100-AG
H	5	STEEL LINE POST	GE-PG-IS-1830-CG
J	1	BEARING PLATE	GE-EF-MX-0011-AG
K	1	ANCHOR CABLE BRACKET	GE-EF-MX-0015-AG
L	1	CABLE ASSEMBLY	GE-EF-MX-2000-AG
M	5	COMPOSITE BLOCK	GE-BL-SS-0310-AS
		HARDWARE	
a	2	5/16" x 1" HEX BOLT	GE-FS-56-0001-HG
b	4	5/16" WASHER	GE-FS-56-0000-AG
c	2	5/16" NUT	GE-FS-56-0000-HG
d	25	M16 x 32mm SPLICE BOLT/NUT	GR-FS-16-0016-MG
e	1	M16 x 220mm BOLT/NUT/WASHER	GE-FS-16-0220-HG
f	1	M16 WASHER	GE-FS-16-0000-CG
g	1	M20 x 220mm BOLT/NUT/WASHER	GE-FS-20-0220-HG
h	1	M20 WASHER	GE-FS-20-0000-BG
j	8	1/2" x 1 ¼" ANCHOR BRACKET SHOULDER BOLT	GE-FS-12-0114-HG
k	8	1/2" ANCHOR BRACKET NUT	GE-FS-12-0000-HG
l	16	1/2" ANCHOR BRACKET WASHER	GE-FS-12-0000-AG
m	5	M16 x 255mm POST BOLT/NUT	GE-FS-16-0255-NG

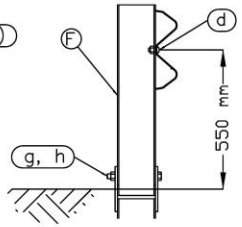
NOTES:
1. THE LOWER SECTIONS OF POSTS 1 & 2 SHALL NOT PROTRUDE MORE THAN 100mm ABOVE GROUND.
2. THE CABLE ASSEMBLY MUST BE TAUT.



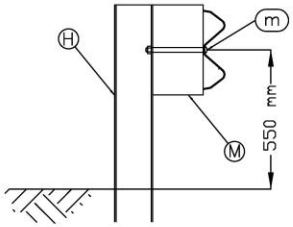
Post #1 Connection Detail



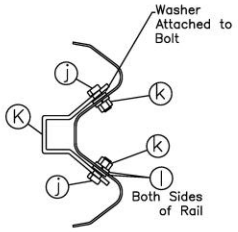
Impact Head Connection Detail



SECTION A–A
Post #2



SECTION B–B
Posts #3 thru #7



SECTION C–C
Anchor Bracket

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	D	21.05.13	ISSUED FOR APPROVAL	DB	TC
	C	23.04.13	REVISED AND ISSUED FOR REVIEW	DB	TC
	B	12.03.13	INITIAL ISSUE	DB	TC
	A	11.03.13	ISSUED FOR REVIEW	DB	TC

REVISIONS	REV	DATE	DESCRIPTION	DRAWN	APPRD.

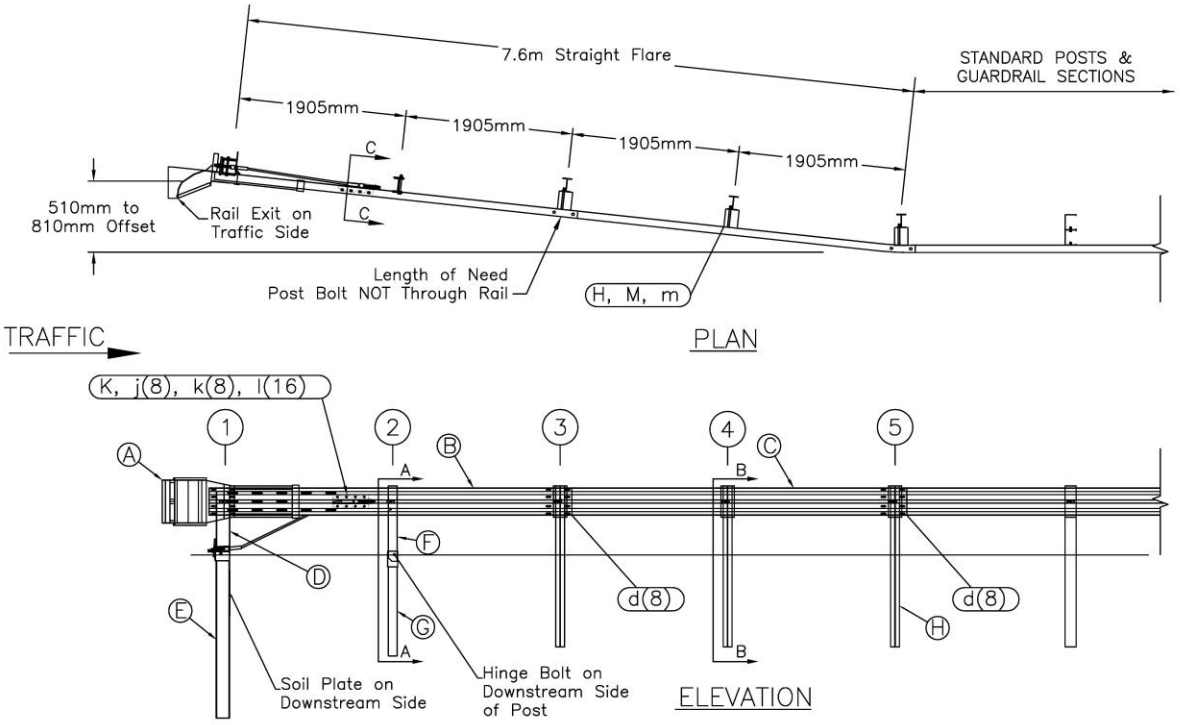
SAFE DIRECTION

DRAWING DESCRIPTION: NCHRP-350 TL3 FLEAT-SP TERMINAL

DRAWING REFERENCE: K-FLEAT SP TL3

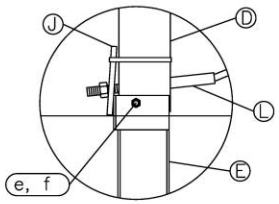
DRAWN BY	AUSTEC DRAFTING	DIMENSIONS	mm
CHECKED	H. WALLACE	SCALE	NTS
APPROVED	T. COLQUHOUN		

ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	FLEAT IMPACT HEAD	GE-EF-MX-4444-AG
B	1	SLOTTED ANCHOR RAIL	GE-WB-SR-3810-BG
C	1	W-BEAM GUARDRAIL 3810	GR-WB-SR-3810-AG
D	1	TOP POST 1	GE-PG-IS-0650-BG
E	1	BOTTOM POST 1	GE-PG-IS-1900-BG
F	1	TOP POST 2	GE-PG-IS-0700-AG
G	1	BOTTOM POST 2	GE-PG-IS-1100-AG
H	3	STEEL LINE POST	GE-PG-IS-1830-CG
J	1	BEARING PLATE	GE-EF-MX-0011-AG
K	1	ANCHOR CABLE BRACKET	GE-EF-MX-0015-AG
L	1	CABLE ASSEMBLY	GE-EF-MX-2000-AG
M	3	COMPOSITE BLOCK	GE-BL-SS-0310-AS
HARDWARE			
a	2	5/16" x 1" HEX BOLT	GE-FS-56-0001-HG
b	4	5/16" WASHER	GE-FS-56-0000-AG
c	2	5/16" NUT	GE-FS-56-0000-HG
d	17	M16 x 32mm SPLICE BOLT/NUT	GR-FS-16-0016-MG
e	1	M16 x 220mm BOLT/NUT/WASHER	GE-FS-16-0220-HG
f	1	M16 WASHER	GE-FS-16-0000-CG
g	1	M20 x 220mm BOLT/NUT/WASHER	GE-FS-20-0220-HG
h	1	M20 WASHER	GE-FS-20-0000-BG
j	8	1/2" x 1 ¼" ANCHOR BRACKET SHOULDER BOLT	GE-FS-12-0114-HG
k	8	1/2" ANCHOR BRACKET NUT	GE-FS-12-0000-HG
l	16	1/2" ANCHOR BRACKET WASHER	GE-FS-12-0000-AG
m	3	M16 x 255mm POST BOLT/NUT	GE-FS-16-0255-NG

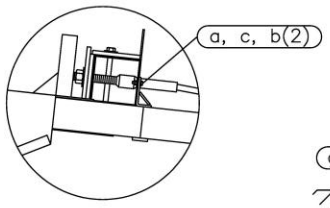


NOTES:

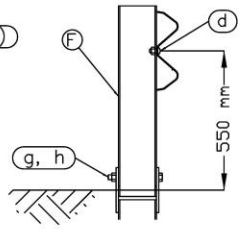
1. THE LOWER SECTIONS OF POSTS 1 & 2 SHALL NOT PROTRUDE MORE THAN 100mm ABOVE GROUND.
2. THE CABLE ASSEMBLY MUST BE TAUT.



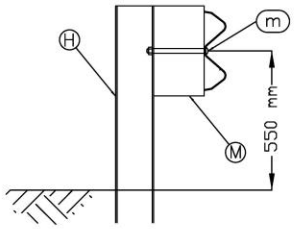
Post #1 Connection Detail



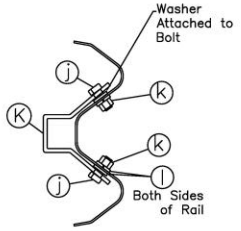
Impact Head Connection Detail



SECTION A–A
Post #2



SECTION B–B
Posts #3 thru #5



SECTION C–C
Anchor Bracket

REVISIONS	REV	DATE	DESCRIPTION	DRAWN	APPRD.
	E	03.09.14	REISSUED FOR APPROVAL	DB	TC
	D	21.05.13	ISSUED FOR APPROVAL	DB	TC
	C	23.04.13	REVISED AND ISSUED FOR REVIEW	DB	TC
	B	14.03.13	INITIAL ISSUE	DB	TC
	A	12.03.13	ISSUED FOR REVIEW	DB	TC

REVISIONS	REV	DATE	DESCRIPTION	DRAWN	APPRD.

SAFE DIRECTION

DRAWING DESCRIPTION: NCHRP-350 TL2 FLEAT-SP TERMINAL

DRAWING REFERENCE: K-FLEAT SP TL2

DRAWN BY	AUSTEC DRAFTING	DIMENSIONS	mm
CHECKED	H. WALLACE	SCALE	NTS
APPROVED	T. COLQUHOUN		

SKT-SP & FLEAT-SP

Installation & Repair Manual

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