SENTRYLINE - M®
WIRE ROPE BARRIER

MASH TL-3 and TL-4

Product and Installation Manual
New Zealand version

Please call CSP®
on 0800 655 200 or visit
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Table of contents

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Introduction

Sentryline – M® Wire Rope Barrier System Overview

Sentryline – M® Wire Rope Barrier System is a high-tension cable barrier designed and tested for full compliance with Manual for Assessing Safety Hardware (MASH 2016) levels TL-3 and TL-4. Sentryline - M® Wire Rope Barrier System has several advantages over other cable barrier systems available on the market:

- Unlike systems with internal slots cut in posts Sentryline – M® Wire Rope Barrier System posts will not trap cables when the posts have been bent during a vehicle impact.
- Compared to other products – both NCHRP350 and MASH compliant – utilising either interwoven or 'stacked' cable arrangements Sentryline – M® Wire Rope Barrier System allows for the cables to be installed in any order to suit the site conditions and installers preferences.
- Similarly, after vehicle collisions, the Sentryline – M® Wire Rope Barrier System cables can be removed and re-attached individually, without the need to disassemble other cables.
- Sentryline – M® Wire Rope Barrier System features non-releasing terminal ends which ensure the cables stay tensioned after a vehicle impact and maintain the redirecting capacity of the system in secondary collisions.
- Unlike other cable barrier systems, the cable attachment system in Sentryline – M® Wire Rope Barrier System does not include plastic parts which could be damaged by bush fires.
- Sentryline – M® Wire Rope Barrier System is the only MASH 2016 compliant cable barrier system with terminal ends which can be supported by either mass concrete blocks or drilled reinforced concrete piles, giving the installers more flexibility.

System Description

Sentryline – M® Wire Rope Barrier is designed and tested to exhibit acceptable structural behaviour, minimise occupant risk and ensure the safe trajectory of an impacting vehicle as set forth in MASH 2016 for longitudinal barriers. It has passed the following vehicle impact tests required to achieve the TL-3 and TL-4 accreditation:

4-10 pass - dynamic deflection 1.8m and working width 2.0m at 3.0m post centres

4-11 pass - dynamic deflections 3.02m and working width 3.02m at 3.0m post centres

4-12 pass - dynamic deflections 2.15m and working width 3.05m (measured at 3.0m above the ground) at 3.0m post centres

3-30 pass

3-31 pass

3-32 pass

3-33 pass - at 5 degree impact angle

3-34 pass

3-35 pass - at 5th transition post (TLP5)

3-37b pass

The TL-3 dynamic deflections and working widths of the system with posts installed at 2.0m centres are:

> TL-3 dynamic deflection 2.14m, TL-3 working width 2.14m

The TL-3 / TL-4 dynamic deflections and working widths of the system with posts installed at 3.0m centres are:

> TL-3 dynamic deflection 3.02m, TL-3 working width 3.02m

> TL-4 dynamic deflection 3.02m, TL-4 working width 3.05m

Sentryline – M® Wire Rope Barrier cables have been positioned and attached to maximise their performance in vehicle impact tests required by MASH 2016:

1st cable attached with aluminium half-tie at 590mm above ground level

2nd cable attached with aluminium half-tie at 700mm above ground level

3rd cable attached with aluminium half-tie at 800mm above ground level

4th cable seated in a vertical slot at 900mm above ground level

Aluminium cable Half Ties have been designed for optimal cable retention and release during a vehicle impact as well as being easy to install and replace. (The tie shape is patent pending).

Sentryline – M® Wire Rope Barrier System is normally installed with non-releasing Terminal Ends featuring a unique post and strut arrangement which enhances the system performance in an end-on vehicle impact scenario. (The trigger post design concept is patent pending).

Limitations and Warnings

Sentryline – M® Wire Rope Barrier System has been rigorously tested and evaluated per the evaluation criteria in the MASH 2016 guidelines for a longitudinal barrier. The impact conditions recommended in MASH 2016 are intended to address typical in-service collisions.

Sentryline – M® Wire Rope Barrier System allows an impacting vehicle to be re-directed in a safe and predictable manner under MASH 2016 impact conditions. It is imperative that the system is installed as per the manufacturers specification.

Vehicle impacts that vary from the MASH 2016 impact conditions described for longitudinal barriers may result in significantly different results than those experienced in testing. Vehicle impact characteristics different than, or in excess of, those described in MASH 2016 testing (weight, speed and angle) may result in system performance that may not meet the MASH 2016 evaluation criteria.

Geotechnical Warning

Sentryline – M® Wire Rope Barrier System line post concrete foundations require sufficient strength from the supporting soil and guidelines contained within this manual on foundation sizes relate specifically to the corresponding soil strength. If it is determined that soil conditions on site do not meet or exceed these requirements, alternative size foundations must be designed by a local geotechnical engineer for use at that location.

Before Installation

Design, selection and placement of the Sentryline – M® Wire Rope Barrier System shall be in accordance with the Road Controlling Authority's guidelines and the details shown in the construction drawings. Installation shall be in accordance with the installation instructions supplied for this product.

NOTE: Concrete foundations will have to be designed by a local geotechnical engineer if soil conditions on site do not meet the required level described in the manual.

Depending on the application, post spacing and conditions on site, installation and assembly of the system should take a three person crew less than four hours to cast the piles, install the posts and place the cables for a 100m section.

Sentryline – M® Wire Rope Barrier System is a highly engineered safety device made up of a relatively small number of parts. Before starting installation ensure that the site personnel are familiar with the specification of the system and the installation procedure described in this manual. Alternative installation methodology may be acceptable, as long as the final assembly is as described in this manual.

Safety statements

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 etc.)
- Installation work areas should be separated from live traffic lanes as described in the Traffic Management Plan.
- 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).
- All installers must be well clear of drilling or excavating machinery operating.
- The cable and reel are extremely heavy so it is recommended that the cable is run out from a single axis spindle. Do not place hands or fingers in or around moving parts.
- Only trained personnel can use the tensioning machine. All installers must be extremely careful they are clear of moving parts when the machine is being operated. Ensure cables are properly anchored at terminal ends before tensioning.

Limited Warranty - New Zealand Only

CSP Pacific (CSP) has tested the impact performance of its barrier systems and crash cushion systems, and other highway safety hardware under controlled conditions, however, CSP does not represent nor warrant that the results of those controlled conditions would necessarily avoid injury to persons or property.

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The forgoing warranty benefits shall not apply to (i) any Products that have been subject to improper storage, accident, misuse or unauthorised alterations, or that have not been installed, operated and maintained in accordance with approved procedures and (ii) any components manufactured by the Buyer.

The customer acknowledges that it has acquired the Goods for the purposes of a business and that the Consumer Guarantees Act 1993 will not apply to the supply of the Goods by CSP Pacific to it.

Design Considerations

Design conditions and limitations outlined in the Road Authority guidelines like M23 Appendix A: Permanent road safety barrier systems by Waka Kotahi NZ Transport Agency override those listed below.

Curves

Horizontal - The minimum allowable curve is 200m radius.

Vertical – Minimum allowable vertical sag radius is 2400m. This maximum does not apply to crests of hills.

Curve Multiplying Factor Table - Multiply the relevant dynamic deflection or working width by the appropriate factor from the table below to calculate the likely deflection of the barrier on a curve.

The multiplying factors in the table apply to convex curves only.

Dynamic deflections or working widths for concave curves can be taken as those determined by the vehicle crash testing for straight length of barrier.

Length	Convex Curve Radius (m)					
	200-400	400-600	600-800	800-1000	1000-1500	1500+
0-100	1.5	1.4	1.3	1.2	1.1	1.0
101-200	1.8	1.6	1.4	1.3	1.2	1.1
201-300	2.0	1.8	1.6	1.4	1.3	1.1
301-400	2.2	2.0	1.8	1.6	1.4	1.2
401-500	2.5	2.2	1.9	1.7	1.5	1.2
500+	2.5	2.2	2.0	1.8	1.5	1.2

Slopes

A maximum slope of 10:1 is preferable. On slopes greater than this, advice should be sought from the Road Controlling Authority guidelines.

Kerbs

As with all road side safety hardware Sentryline – M® Barrier has been designed and tested so the centre of gravity of the impacting vehicle is a constant height in relation to the system. For this reason, it is preferred that kerbs or channels are not in front or behind the barrier as they will result in altering the height of the vehicle at impact. If there is no option but to install near a kerb advice should be followed from the Road Controlling Authority's guidelines.

Undulating ground conditions

Site specific grading may be necessary to ensure that there are no 'humps' or 'hollows' that may significantly alter the impacting vehicles stability or substantially alter the cable heights in relation to the ground.

Ditches

If the slope of the ditch is greater than 10:1 then follow the Road Controlling Authority's guidelines.

System Design

Median and Roadside Applications

The Sentryline – M® Wire Rope Barrier can be impacted from either side of the post with no difference in performance. Therefore, the barrier can be used in both median and roadside situations in either orientation as long as the slot arrangement is consistent.

Barrier Length

Minimum – Is 183m and represents the distance between the upstream and downstream Length of Need of the Sentryline - M® Wire Rope Terminal End at either end.

NOTE: A shorter barrier may not have sufficient length to fully re-direct an errant vehicle as per the performance criteria from crash testing.

Maximum – No theoretical limit if the barrier is essentially straight in both horizontal and vertical alignment and tensioned as required. However, when a barrier is impacted, the ability of the barrier to resist subsequent impacts before repair is not guaranteed. For this reason, Sentryline – M® Barrier is recommended to be limited to a maximum of 1000m between Terminal Ends.

Flare Rate

The maximum flare rate within the shy line offset is 30:1 measured from the tangent.

Terminal End Treatments

The Sentryline – M® Wire Rope Barrier is terminated using the Sentryline - M® Wire Rope Terminal End. For further details consult the Sentryline - M® Wire Rope Terminal End Installation & Product Manual.

Transitions

Transitions from Sentryline – M® Wire Rope Barrier to other types of barriers are possible and details are available on request. Please contact CSP®.

Intermediate Anchors

It is recommended that a Sentryline – M® Wire Rope Barrier is limited to 1000m in length and that intermediate anchor set-ups are utilised when a barrier length greater than 1000m is required.

To create an intermediate anchor, simply overlap one Sentryline – M® Wire Rope Barrier run with the next. A minimum 400mm center distance gap between the barriers is required. The Length of Need (LoN) of each barrier must be as per the Sentryline - M® Wire Rope Terminal End Overlap drawing. (See Appendix on page 51)

Batter Hinge Point

It is recommended that the minimum lateral extent of the soil, outside an envelope of the embedded portion of the test article, be equal to the Dynamic Deflection (Figure A). This is so that the foundations have sufficient support during impact to resist movement and provide sufficient space to prevent vehicles from rolling. The allowable minimum soil between the post and the better hinge point is 1000mm* (Figure B).

NOTE: This is an example only and based on a particular soil type and barrier footing of 300mm diameter by 750mm deep. It may be required that a specific foundation will need to be designed by a local geotechnical engineer. Please refer to RCA guideline TAN #16-18 for Waka Kotahi NZ Transport Agency projects.

*** Accepted by Waka Kotahi NZ Transport Agency and applies to New Zealand only.**

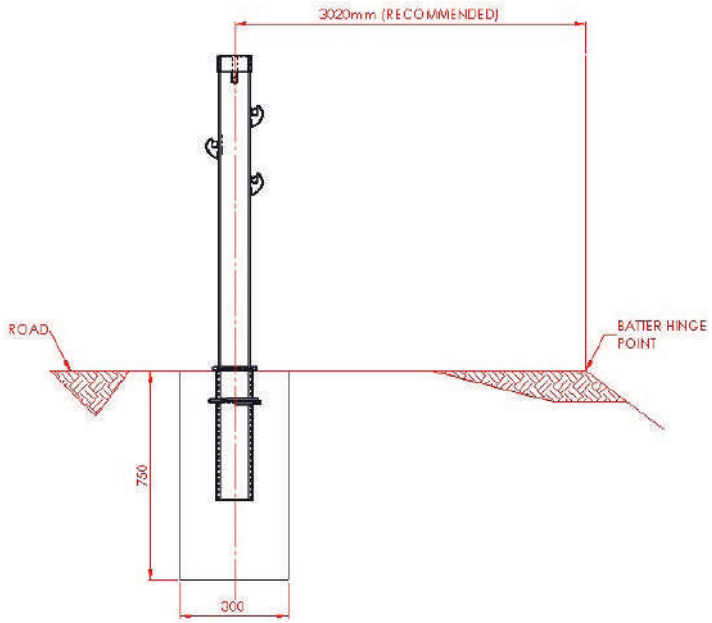


Figure A

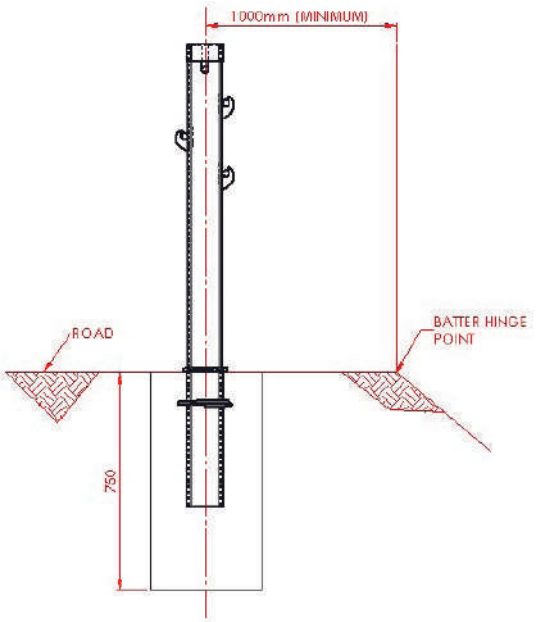


Figure B

Length of Need (LoN)

The Length of Need (LoN) for a Sentryline - M® Wire Rope Barrier connected to a Sentryline - M® Wire Rope Terminal End is at 5th transition post (not counting the trigger and deflection posts) which is 13.5m from the Deflection Post (Shown in Figure C on next page).

NOTE: As per the LoN design section of the Road Controlling Authority's guidelines, care must be taken when calculating the actual length of the barrier required versus the theoretical length of the LoN. The barrier LoN should be placed at or beyond the design LoN.

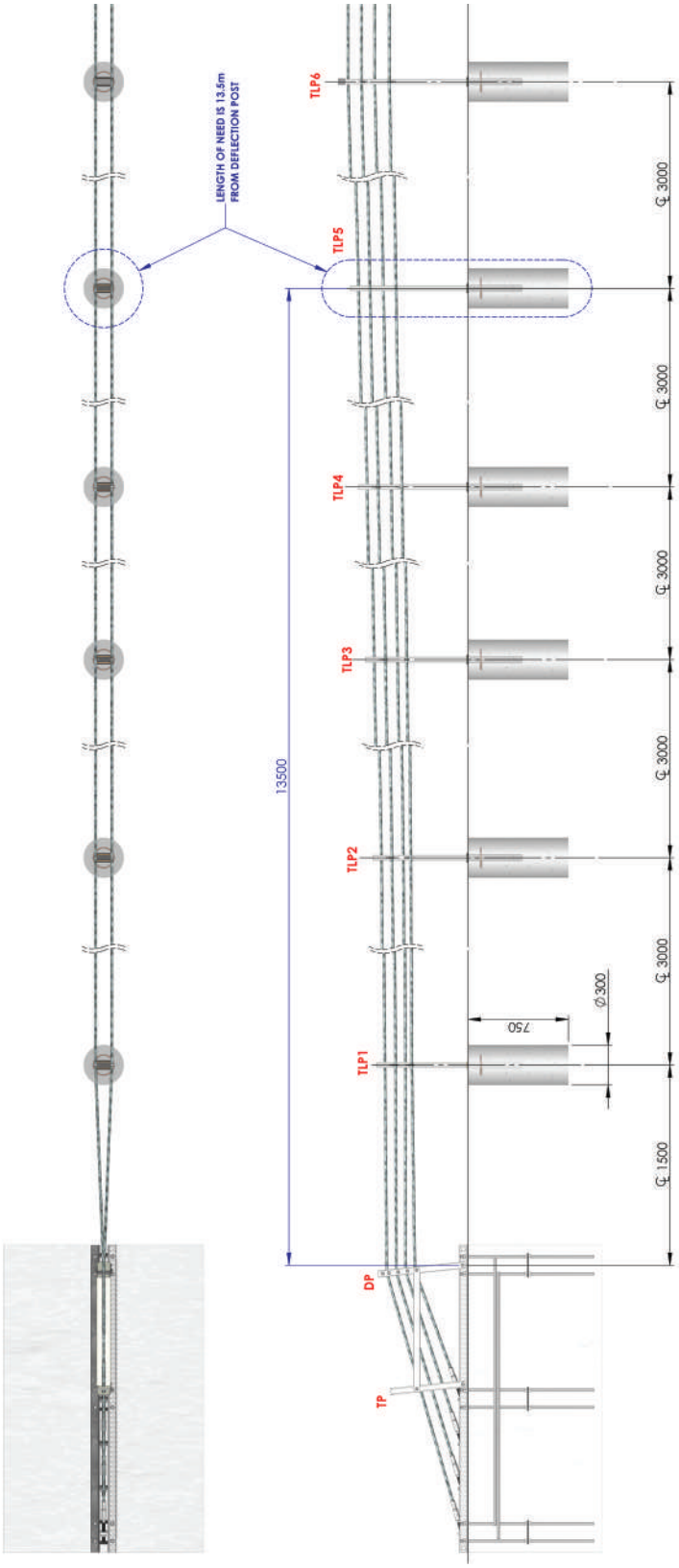

LENGTH OF NEED IS 13.5m FROM DEFLECTION POST
TLP6
TLP5
TLP4
TLP3
TLP2
TLP1
DP
TP
13500
3000
3000
3000
3000
3000
1500
750
Ø300

Figure C

Working Width

The barrier performance described by the measurements from actual crash testing can be useful when assessing a products suitability to perform as required at a given location. MASH 2016 suggests that the working width defined as:

'The distance between the traffic face of test article before the impact and the maximum lateral position of any major part of the system or vehicle after the impact.'

The previous edition of the road hardware testing manual, NCHRP350, used the term dynamic deflection which refers to the lateral deformation of the barrier under vehicle impact.

The working width and dynamic deflections measured during the MASH 2016 vehicle crash testing of the Sentryline – M® Wire Rope Barrier are as follows:

TL-3 Deflection Results

Test 3-11	2270 kg pickup truck, 100 kph at 25 degrees		
	Post Spacing	Dynamic Deflection	Working Width
	2.0m	2.14m	2.14m
Test 3-10	1100 kg sedan, 100 kph at 25 degrees		
	Post Spacing	Dynamic Deflection	Working Width
	3.0m	1.8m	2.0m
Test 3-11	2270 kg pickup truck, 100 kph at 25 degrees		
	Post Spacing	Dynamic Deflection	Working Width
	3.0m	3.02m	3.02m

TL-4 Deflection Results

Test 4-12	10,000 kg truck, 90 kph at 15 degrees		
	Post Spacing	Dynamic Deflection	Working Width
	3.0m	2.15m	3.05m

Taking the extreme values from all relevant tests, the MASH 2016 working widths of the Sentryline – M® Wire Rope Barrier are:

TL-3 working width 3.02m

TL-4 working width 3.05m

Extrapolation of Results:

Due to the complex nature of the dynamic interaction of the vehicle with the barrier during crash testing there is no reliable correlation between the post spacing and working width of the system. In general terms reduced post centres will reduce the working width but the only measurements which can be assumed to represent the likely performance of the barrier and those taken during the vehicle crash tests.

Line Post Foundations

For the line post foundation pile to provide the required support to the post during vehicle impact, and have sufficient strength to resist movement, it relies on the design of the concrete foundation and the surrounding soil conditions on site. Soil conditions have different characteristics that will affect the strength of the concrete foundations.

IF SOIL CONDITIONS ON SITE DO NOT MEET OR EXCEED THE REQUIRED STRENGTH DETAILED IN THIS MANUAL, SITE SPECIFIC FOUNDATIONS MUST BE DESIGNED BY A LOCAL GEOTECHNICAL ENGINEER

If an alternative post foundation is required then the following processes must be followed:

- Geotechnical testing conducted to determine existing soil conditions.
- The intermediate posts in the Sentryline – M® Wire Rope Barrier, and associated foundations, should be designed to resist an applied shear load of 9kN when impacted at a height of 700 mm from the ground level (the location of the second cable) at an angle of 90 degrees to the barrier.
- Non-standard post foundations must be tested in accordance with the standard load test. This testing is detailed in the post foundation on-site testing procedure in this manual or contact CSP®.

NOTE: Auguring for foundations is the preferred default method. For further information contact CSP®.

The standard concrete post foundation is 300mm diameter by 750mm deep. This is used when the soil conditions on site meet AASHTO standard specifications M 147: grading A or B.

The post socket and rebar ring must be cast into concrete foundation piles with the following dimensions. The augured holes for this option are 300mm diameter by 750mm deep and filled with 25MPa concrete. (Theoretical volume 0.053m³).

Driven Steel Socket Option

Sentryline – M® Driven Sockets can be used as an alternative to the typical concrete post footing where a steel sleeve is driven inground (See Appendix on page 54).

NOTE: A site-specific project approval must be granted by Waka Kotahi NZ Transport Agency National Office or the local Road Controlling Authority to use the Driven steel socket option. For further information contact CSP®.

Bolt Down Line Post Option

Bolt Down Sentryline – M® post option can be used on concrete ground beam where services or ground conditions do not allow the use of standard concrete post footings. Installation to be undertaken in accordance with drawing FX759-1. (See Appendix on page 55).

NOTE: A site-specific project approval must be granted by Waka Kotahi NZ Transport Agency National Office or the local Road Controlling Authority to use the Bolt down line post option. For further information contact CSP®.

Tension Bays

For installations less than 300m long, one tension bay located near the middle of the Sentryline – M® Wire Rope Barrier installation is sufficient. For installations greater than 300m, multiple tension bays will be required. The first tension bay is to be located 150m in from each terminal end and any other tension bays are at a maximum spacing of 350m from each other or as often as necessary to correctly tension the system. When positioning the strong back brackets, care must be taken to cut the cables mid-span between the posts so that they are offset to each other.

NOTE: Do not place two strong backs within 30m of each other when on the same cable.

Tension

It is important that the tension of the Sentryline – M® Wire Rope Barrier installation correlates to the actual air temperature at the time of installation as per the following table:

Air Temp C°	0-3	4-9	10-14	15-20
Tension kN	32-30.5	30.5-28.5	28.5-26.5	26.5-25
Air Temp C°	21-26	27-32	32-37	38-43
Tension kN	25-23.2	23.2-21.5	21.5-19.5	19.5

DO NOT TENSION A BARRIER FOR AT LEAST 7 DAYS AFTER THE FOUNDATIONS HAVE BEEN CAST.

NOTE: As with all cable barrier systems it is recommended that two weeks after the barrier is tensioned for the first time, it should be re-tensioned to remove 'construction creep'.

The tension values can vary from what was measured and logged at time of installation. This can be due to the ambient air temperature, natural settling and redistribution of the cable tension, vehicle impacts length and curvature and/or construction creep.

It is recommended that the tension on the cables is checked after all barrier impacts and at least annually as part of a maintenance program. A tension meter can be used to check the tension, refer to page 38.

If the tension is different from the values listed in above table the installation should be re-tensioned following the procedures in this manual.

Special Circumstances

Trapped Vehicles

If a vehicle is entrapped in the cables it may be causing greater tension than would otherwise be present. Follow the instructions below before cutting cables.

DO NOT CUT CABLES THAT ARE UNDER TENSION

De-tensioning Cables (With a Tension Machine)

Best practice is to release the tension fully from each cable using the tension machine at the tension bays. (Process outlined on page 38 of this manual).

De-tensioning Cables (Without a Tension Machine)

If a tension machine is not available, it is possible to release the tension at a tension bay using a ring spanner to unwind the nuts from the swage fittings within the strong back bracket.

NOTE: When using either method a tension bay on either side of the trapped vehicle must be de-tensioned. If there is not a tension bay on either side of the trapped vehicle, de-tension all the cables at the tension bay available first. Then move the trapped vehicle in the direction of the terminal end until the remaining tension in the cables is removed sufficiently.

Only then, once the cable barrier is fully de-tensioned on each side of the vehicle, can the cables be cut using appropriate cutting equipment and the vehicle removed. Re-instate the barrier as per the installation instructions contained in this manual.

Emergency Access

Sentryline – M® Wire Rope Barrier can easily be lowered to the ground by removing an adequate length of cable housed in the ties/slots. After the posts are removed from the sockets in this area, a ‘gate’ is formed and vehicles can pass to the other side of the barrier. There is no need to de-tension the system and no machinery or lifting devices are required to perform this task.

To decommission:

> Remove the plastic caps from 20-40 posts (amount will vary due to conditions on site).

> By hand, lift the cables out of the ties/slots at each post in the intended ‘gate’ area. When removed from a sufficient number of ties/slots the cables will lower to the ground and create a ‘gate’ in the system where vehicles can ride safely over the barrier cables.

> Remove and store the posts from the sockets in the ‘gate’ area so the vehicles have unrestricted access to the other side.

To reinstate:

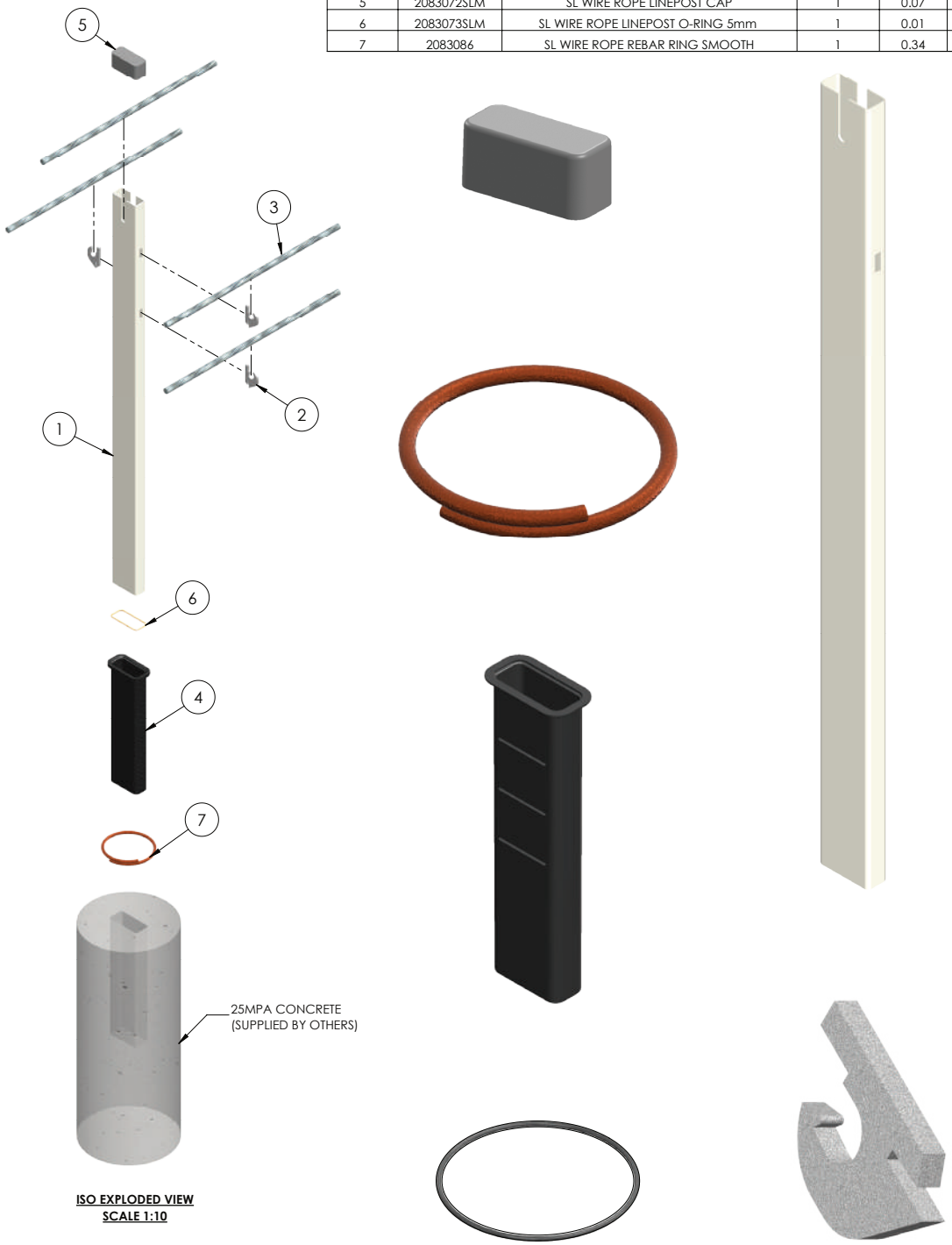
> Place the posts back into the sockets making sure that the tie orientation matches.

> Lift each cable and place back to their respective ties/slots. If the tie hooks have been damaged by cable removal insert new ties. Push the caps firmly back into place

NOTE: If the cables are to be removed from the location, the system will need to be de-tensioned.

Parts Identification

ITEM NO.	PART NO.	DESCRIPTION	QTY.	WEIGHT EA.	DWG NO.
1	2083131SLM	SL WIRE ROPE LINEPOST 1370mm WHITE - 3 SLOTS	1	7	FX747-1
2	2110162SLM	SL WIRE ROPE HALF TIE 8mm ALUMINIUM	3	0.04	FX747-2
3	2200036SLM	SL WIRE ROPE 19mm DIA.	AS REQUIRED		
4	2083070SLM	SL WIRE ROPE POST SOCKET	1	0.37	FX747-4
5	2083072SLM	SL WIRE ROPE LINEPOST CAP	1	0.07	FX747-3
6	2083073SLM	SL WIRE ROPE LINEPOST O-RING 5mm	1	0.01	FX747-5
7	2083086	SL WIRE ROPE REBAR RING SMOOTH	1	0.34	



ISO EXPLODED VIEW
SCALE 1:10

Bill of Materials

In addition to components shown on the previous page, the following additional components are required:

> 4 x the total length of the barrier of 19mm cable.

NOTE: It pays to be conservative with these lengths.

> 4 x Strong Backs for each tension bay.

NOTE: There may be more than one tension bay per barrier run depending on the length or design of the barrier.

> 8 x Swage Fittings c/w M24 Nuts for each tension bay.

> 4 x Swage Fittings c/w M24 Nuts for each Sentryline - M® Wire Rope Terminal End (These are included in Sentryline - M® Terminal Kits).

NOTE: There may be more than one tension bay per barrier run depending on the length or design of the barrier.

> 0.053m^3 of concrete is required for each post if the standard 300mm diameter x 750mm deep foundation pile is used.

NOTE: From the foundation details shown in this manual or calculated by 'other' are theoretical. Allowance must be made that the holes may be larger than this due to the act of drilling and removing spoil on site.

Installation Preparation

Getting Started

Sentryline – M® Wire Rope Barrier is designed so that the TL-3 and TL-4 systems have the same post. For all installations, whether median or edge of road locations, start from the last post of the Terminal End.

Preparation

Before installing a Sentryline – M® Wire Rope Barrier, ensure that all components required for the system are on site and have been identified. The Sentryline – M® Wire Rope Barrier is a highly engineered safety device made up of relatively small number of parts. Before starting installation ensure that one is familiar with the makeup of the system. Refer to the Parts Identification and Bill of Materials section in this manual for more information.

Ensure that the area where the Sentryline – M® Wire Rope Barrier is to be installed, is flat enough so that the ground conditions will not significantly alter the height of the vehicle in relation to the height of the barrier's cables. Minor site grading may be required.

Soil Conditions

The Sentryline – M® Wire Rope Barrier line post foundation piles and concrete block footing have been designed to have sufficient strength to remain intact after multiple vehicle impacts. Also, they must be able to support the terminal end frame which houses and anchors four cables under tension on horizontal curves up to 200m radius. Therefore, it is extremely important that the soil conditions on site have the adequate bearing capacity to support the Sentryline – M® Wire Rope Barrier foundations.

Refer to the Line Post Foundations in the System Design section in this manual for more information.

It is recommended that soil tests are carried out at the location the Sentryline – M® Wire Rope Barrier is to be installed.

IF SOIL CONDITIONS ON SITE DO NOT MEET OR EXCEED THE REQUIRED STRENGTH DETAILED IN THIS MANUAL, SITE SPECIFIC FOUNDATIONS MUST BE DESIGNED BY A LOCAL GEOTECHNICAL ENGINEER.

Tools Required

The tools required to install the Sentryline – M® Wire Rope Barrier are:

- Drilling or excavating machinery suitable for foundation design.
- Concrete trowel or float, string line, measuring tape and marker pen.
- Machinery capable of lifting the cable reel and a single axle spindle.
- Cut off saw (generator).
- Tensioning Machine.
- CSP® Swaging Unit.

Installation Instructions

Step 1 – Site Preparation

It is preferred that the Sentryline – M® Wire Rope Barrier is installed on flat, level ground with sufficient distance behind the foundation piles as described in the Batter Hinge Point section. The Sentryline – M® Wire Rope Barrier starts at post #11 (where post #1 is the 'trigger' post of the Terminal End) with post spacing as described in the construction drawings.

NOTE: The Sentryline – M® Wire Rope Barrier is a continuation of the Sentryline - M® Wire Rope Terminal End should be installed in a tangent position. The maximum flare rate allowed is 30:1 measured from the tangent.

BEFORE DRILLING OR EXCAVATION ALWAYS ENSURE THAT THE AREA IS CLEAR OF UNDERGROUND SERVICES

Step 2 – Foundation Construction

Excavate or drill the area that the Sentryline – M® Wire Rope Barrier posts are to be located as per the foundation option required. (Shown in Figure A and B).

All technical information on post foundations and guidance on site specific foundations design, is located in the System Design section in this manual under Foundation Options.

DO NOT PROCEED PAST THIS POINT IF THE TYPE OF FOUNDATION REQUIRED HAS NOT BEEN ESTABLISHED

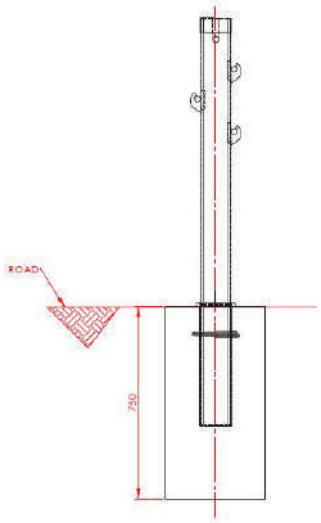


Figure A

Figure B

Step 3 - Construction of a foundation pile

COMPLETE ALL OF STEP 3 BEFORE MOVING TO NEXT FOOTING

Fill the hole to no closer than 100mm from the top with concrete (25MPa), place the rebar ring in the centre. (Shown in Figure D).

Fill the remainder of the hole with concrete immediately. (Shown in Figure E).

Figure D

Figure E

Immediately push the socket ('flat' side perpendicular to direction of barrier) into the centre of the footing until the top edge is flush with the concrete. (Shown in Figure F).

Using string lines and levels will aid in correct positioning of the rebar ring and socket.

A 20mm 'crown' or 'dome' should be formed on the top surface of the foundation pile to encourage water dissipation away from the top of the post and socket.

NOTE: To prevent the possibility of a socket 'floating' use a stiff mix of concrete or place a post in the socket to ensure the final position will remain as intended. (Shown in Figure G).

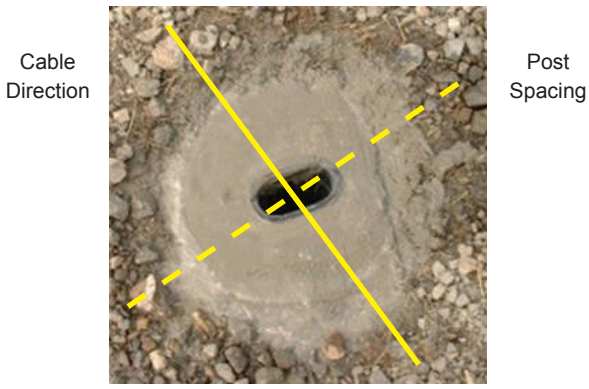


Figure F

Figure G

At this stage extreme care must be taken to ensure that the sockets will be at the correct height. This guarantees that when the barrier cable are installed, the cable heights will be within the construction tolerances of +/-25mm.

NOTE: Diagrams showing cable heights can be found in the Appendix of this manual.

Step 4 - Installing the Posts

Push the rubber 'O' ring onto the bottom of the post approximately 400mm. (Shown in Figure H).

This will prevent debris from building up in the socket which can make removal difficult.

Slide a post into the socket once the concrete has set and adjust the 'O' ring so that it fills the gap between the post and post socket. (Shown in Figure I).

Figure H

Figure I

Ensure that the posts are aligned so that the orientation of the three slots located on the side of the post are consistent.

Step 5 - Installing the Cable Ties

Install the ties supporting the bottom three cables into pockets cut in the side of post. The recommended tie installation methodology is as follows:

1. Hold tie by the hook between an index finger and thumb.
2. Insert the top of the tie into slot cut in post.
3. Push the tie into the slot on an angle as far as it will go (the tie will not fall inside the post).
4. Allow the tie to fall into place by pulling it down gently.

Refer to Figure J for Tie installation instructions.

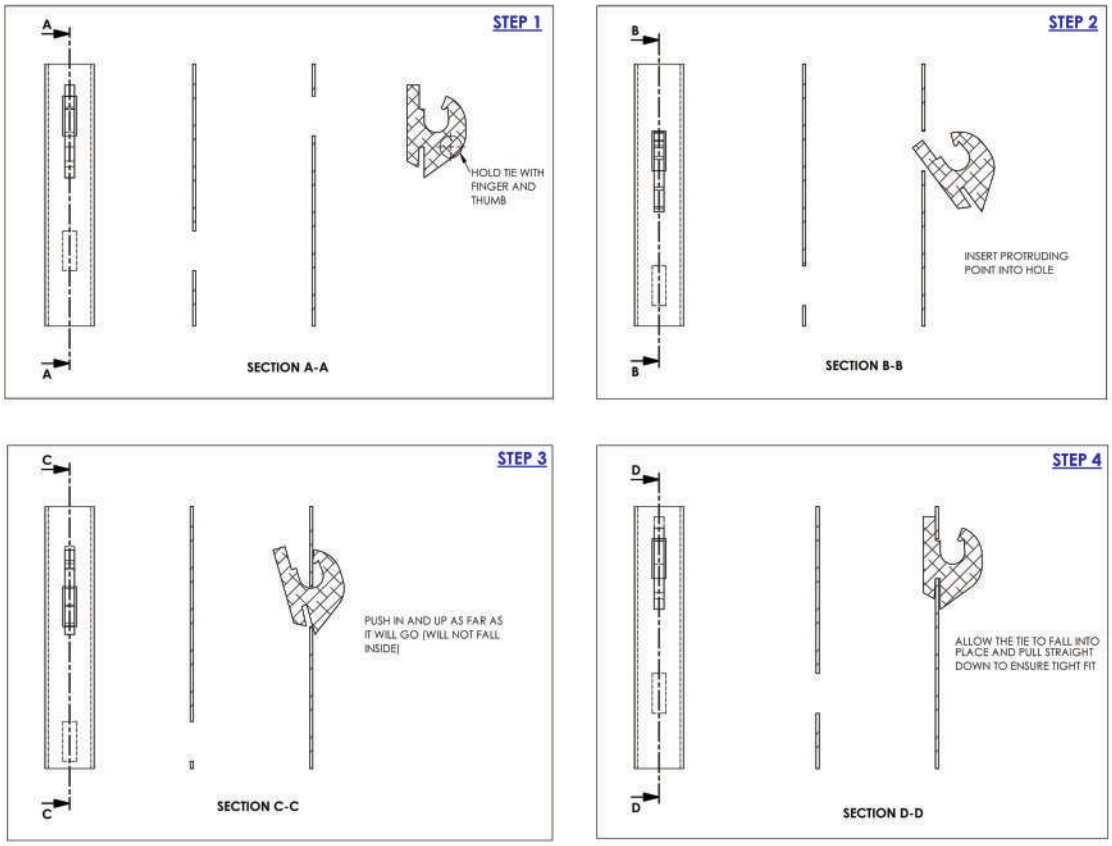


Figure J

Step 6 – Installing the cables

Using a truck or trailer fitted with a cable reel frame, run the cables out to the desired length with cables on either side of the posts. (Shown in Figures K & L).

One or more of the cables may be run out at the same time depending on the installer's equipment.

Insert the bottom three cables into ties by first placing them at the top of the tie and then pushing down through the throat of the hooks (see Figure M). Cable may have to be rotated slightly to ensure it slots into tie. The top cable is installed by seating it in the central slot (see Figure N).

Figure K

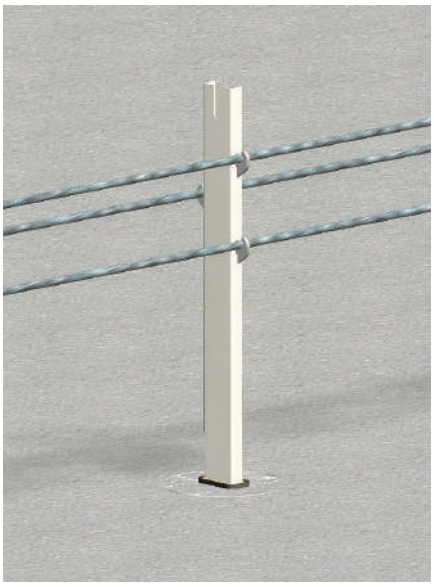


Figure M

Figure L

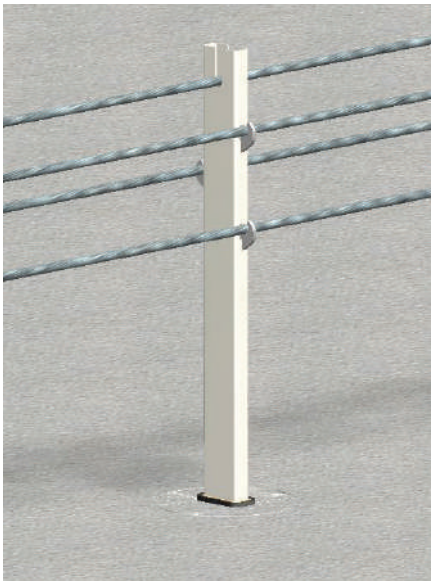
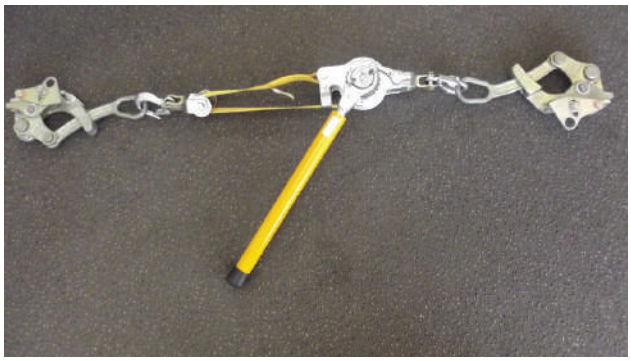


Figure N

Removing the slack from the cables

It may be necessary to pull out the slack progressively out of the cable before tensioning the system. This should be done gradually starting at one Sentryline - M® Wire Rope Terminal End and working towards the other Terminal End. The slack will be easier to remove by using 3 Tonne rated rope grips with a strop rated 3.0 Tonne.



Method

Run the cable completely the full length of the installation from one Terminal End to the other Terminal End. At the end of each cable the strop is hooked to the anchor and as much slack is taken out before fitting the end swage fitting at this Terminal End.

The tension bays are then marked at the correct spacing. The rope grips are placed either side of the tension bay and strop is used to take out any slack. At the same time at the tension bay location cut out a 800mm section of rope and fit the tension bay. Repeat this process on each rope and at each tension bay along the installation finishing at the other Terminal End.

NOTE: Place a piece of folded steel over the strop webbing to protect it from being accidentally cut while cutting the cable to fit the tension bays.

Step 7 – Placing the Post Caps

Slide the cap down the inside of the post and push down until cap is ‘hard home’ onto the top of the post. (Shown in Figure O).

If using a mallet or similar, make sure that the cap is not damaged in any way.

See Figure P for Line Posts installation.

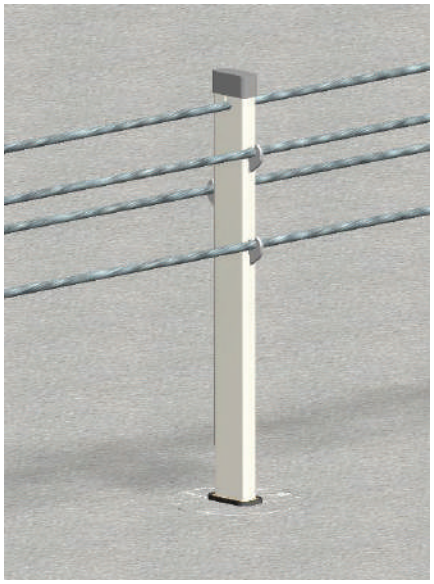


Figure O

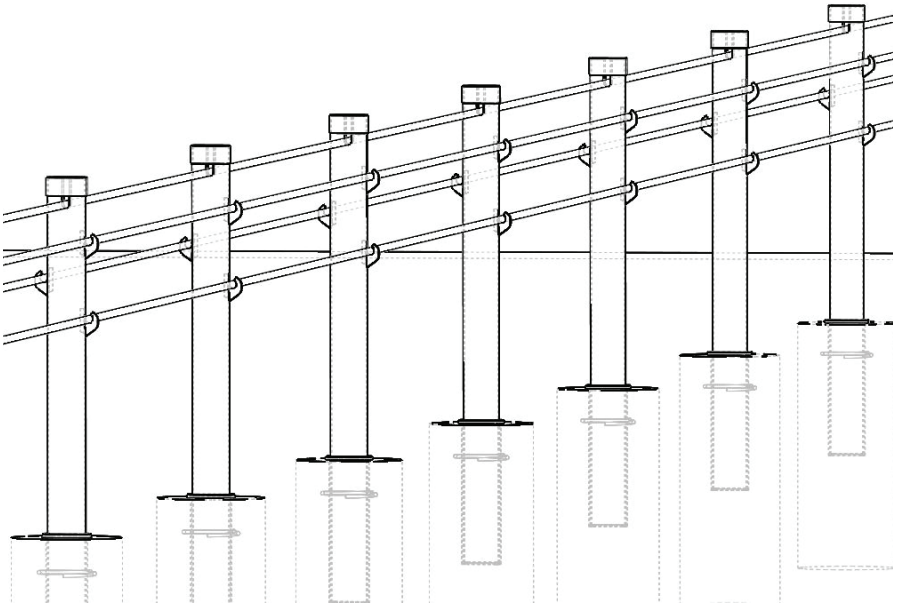


Figure P

Step 8 - Connecting to the Cable Barrier Terminal End

Connect the cables to the Terminal End as per the manufacturer's instructions.

The Sentryline - M® Wire Rope Terminal End is the recommended terminal end for Sentryline – M® Wire Rope Barrier. (Shown in Figure Q).

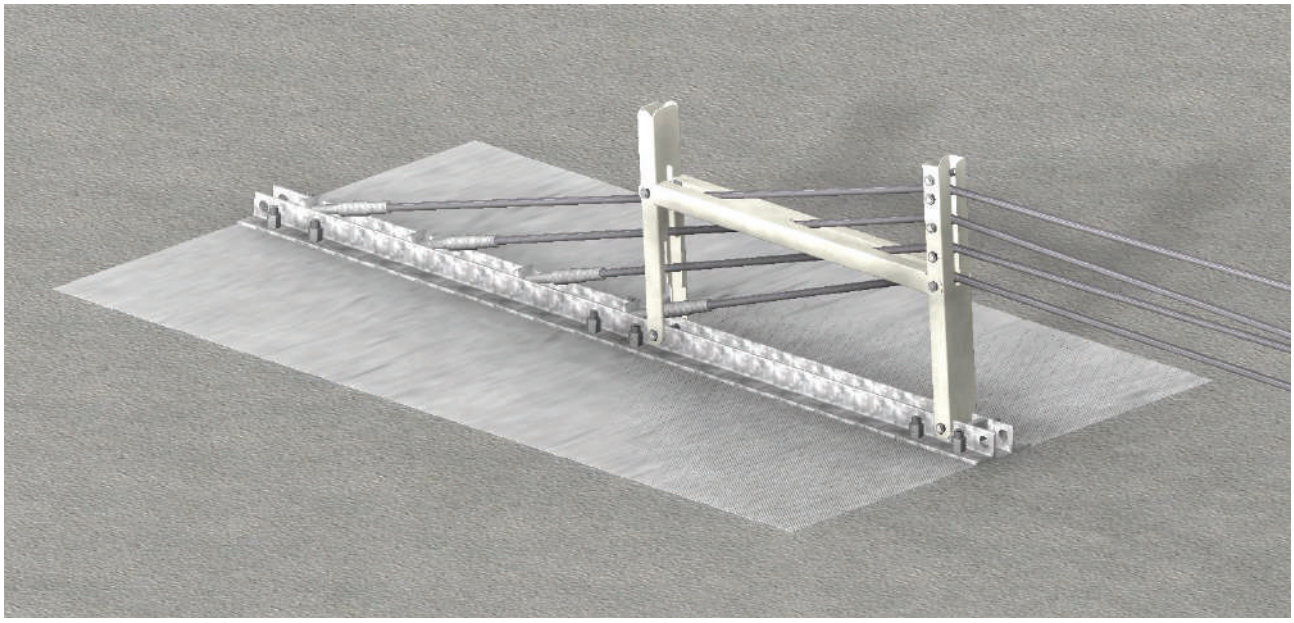


Figure Q

Connecting the Machine Swage Fittings

Personal Protection

Before operating the swaging and tensioning equipment read all instructions and follow the safe operating procedures. While operating this equipment it is recommended that the following personal protective equipment be worn:

- Long sleeve shirt and trousers or overalls.
- High visibility vest or high visibility component included in clothing.
- Gloves.
- Safety glasses/ face shield or other appropriate eye protection.
- Steel capped protective footwear.

To avoid personal injury keep hands and feet away from moving components during operation. Always keep your body to the side of the swaging operation, and ensure guards are in place during operation. Be sure there is adequate ventilation when the generator is in use.

Running the generator will cause the engine and exhaust to become hot. Keep body parts clear until components have cooled.

Ensure that the equipment is in proper working order and the guards are all in place; cycle the equipment at least once without a swage fitting in the dies before commencing the job.

Read all instructions, warnings and cautions carefully. Follow all safety precautions to avoid personal injury or property damage during system operation.

CSP® cannot be held responsible for damage or injury resulting from unsafe product use or incorrect product and/or system operation. Contact CSP® when in doubt regarding safety precautions and operations.

Equipment Operation

The CSP® swaging unit is designed for the swaging of CSP® supplied swage fittings, keep free of kinks and keep away from fire. All other use is prohibited. Avoid kinking or twisting the hoses and avoid contact with fire.

Site Safety

Identify the area where work is to be completed and clear area of debris so there are no trip hazards or other obstructions which may prevent the work being conducted in a safe manner and ensure suitable traffic control is in place.

Select a safe area where the swaging and tensioning unit will sit during the duration of the process. Make sure the area complies with the site safe working conditions.

Observe weather conditions and operate the equipment out of the rain, or cover if using in the rain to protect the equipment. Keep the swaging area clean and clear of debris.

Inspections

Hose Inspections

Before operating the swaging unit, check that all hose connections are tight with the proper tools. If loose, tighten using proper tools. Do not over tighten. Connections need only be tightened securely and leak free.

The hydraulic hoses are fitted with protective sheathing to prevent escaping hydraulic fluid from causing injury. Do not operate the swaging tool if the sheathing is damaged or missing.

Hydraulic Fluid Level

Check the fluid level in the hydraulic reservoir through the oil level gauge. The power supply is to be disconnected when adding fluid to the reservoir. Only use approved Enerpac hydraulic fluid to fill the reservoir.

Bleeding Air from the System

Air can accumulate in the hydraulic system during the initial set-up or after prolonged use, causing the cylinder to respond slowly or in an unstable manner. To remove the air;

1. Loosen a fitting that is situated higher than the rest of the fittings in the system.
2. Run the pump until the oil is flowing freely.
3. Tighten the fitting.

Generator Fuel Level

The Honda engine is designed to run on unleaded fuel. Check the fuel level before starting the generator. If refuelling is required, refuel when the engine is not running. Do not over fill, and wipe away any spilled fuel. Avoid getting water or dirt in the fuel tank. Ensure fuel is stored in an approved container.

Generator Oil Level

Oil is a major factor affecting performance and service life. Check the engine oil level with the engine stopped and in a level position. Use Honda 10W-30 or equivalent.

1. Remove the oil filler cap/dipstick and wipe it clean.
2. Insert the oil filler cap/dipstick into the oil filler neck, but do not screw it in, then remove it to check the oil level.
3. If the oil level is near or below the lower limit mark on the dipstick, fill to the upper limit mark. Do not overfill.
4. Reinstall the oil filler cap/dipstick.

Generator Operation

A generator is used as the power source to the hydraulic pump.

To operate the generator:

1. Turn the fuel valve ON and turn the key to the on position.
2. Move the throttle lever to the MAX position
3. Using the pull cord, pull the cord and start the engine.
4. Move the throttle lever away from the MAX position, about 2/3 of the way toward the MIN position.
5. Turn pendant switch to the swaging position, far right as indicated.
6. Position the throttle lever for the desired engine speed.

To stop the generator in an emergency, simply push the emergency stop button (red button).

When transporting the generator, ensure the fuel lever valve is switched OFF. If left ON, fuel may gather in the engine crankcase and dilute the engine oil.

This will reduce the lubrication properties of the oil and can cause severe engine damage.

Swaging Unit Operation

Attachment of the End Fitting

Only end fittings supplied by CSP® are to be used.

1. Identify the location where the end fitting is to be attached to the wire rope.
2. Cut the wire rope at the required location. This can be achieved by using a wire cutter or a disk grinder. If using a disk grinder the following is to be observed;

   · The operator is to be fitted with a full face shield and PPE as noted under Personal Protection at the beginning of this section.

   · The wire rope is to be appropriately clamped or secured. The wire rope should NOT be held by hand when cutting.

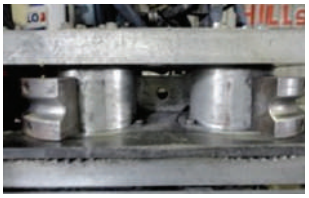
   · Care is to be taken not to contact the wire rope downstream of the cutting location.
3. When the wire rope is cut to its correct length, remove any burrs with a file and ensure the rope is correctly twisted.
4. Insert the wire rope into the end fitting. Making sure the wire rope is driven hard into the back of the terminal.

Swaging the End Fitting

1. Turn the generator on in accordance with instructions on page 33.
2. Remove the nut from the end fitting.
3. Feed the end fitting through the roller die area so that the threaded section of the end fitting passes through the cross bar.
4. Reattach the end-fitting nut so that the thread of the end fitting is flush with the back of the nut. Refer above.
5. Gripping the end fitting, pull back to ensure a tight connection with the cross.
6. Close the roller heads against the end fitting so they rest on this and insert the safety key to begin the swaging operation.
7. Operate the hydraulic ram by pressing the button on the pendant control.
8. Pressure around the end fitting will increase as the hydraulic ram moves and the roller dies rotate. The end fitting will pull through the roller dies.
9. Once the swage is complete, rotate the roller dies to the front of the swaging unit.
10. Remove the end fitting from the cross bar by releasing the nut.
11. Return the nut to the end fitting.

To stop the hydraulic pump in an emergency press the emergency stop buttons located on the unit. Under normal conditions turn the main switch on the control box to the OFF position.

Completed process - Swaged wire.







Troubleshooting

Repairs must be performed in a dirt-free environment by qualified personnel, familiar with this equipment.

Problem	Cause	Solution
Generator will not start	1. Fuel valve OFF 2. Choke OPEN 3. Engine switch OFF 4. Out of fuel 5. Spark plug faulty 6. Flooded engine 7. Fuel filter restricted 8. Carburettor malfunction 9. Ignition malfunction	1. Move lever to ON position 2. Move lever to CLOSED position unless warm 3. Turn switch to ON position 4. Refuel 5. Replace spark plug 6. Dry and reinstall spark plug. Start engine with throttle lever in MAX position 7. Repair by authorised service dealer 8. Repair by authorised service dealer 9. Repair by authorised service dealer
Generator lacks power	1. Filter element(s) restricted 2. Wrong fuel 3. Fuel filter restricted 4. Carburettor malfunction 5. Ignition malfunction	1. Clean or replace filter element(s) 2. Drain fuel tank and carburettor and refuel 3. Repair by authorised service dealer 4. Repair by authorised service dealer 5. Repair by authorised service dealer
Pump does not operate	1. Main isolator switch OFF 2. Unit is not plugged in 3. Emergency stop button has not been reset 4. Swaging guard open	1. Switch main isolator ON 2. Plug unit in 3. Reset emergency stop buttons and press reset button on the control box 4. Close the swaging guard
Pump is not delivering oil or delivers only enough oil to advance hydraulic ram partially or erratically	1. Low fluid level in reservoir 2. Air trapped in system 3. Loose coupler 4. Contaminated oil 5. Relief valve or low pressure valve out of adjustment	1. Check fluid level and refill if necessary 2. Remove air from system 3. Check all couplers 4. Repair by authorised service dealer 5. Repair by authorised service dealer
Swaging dies do not turn	1. Low fluid level 2. Directional Valve Spool is sticking 3. Oil leakage through hose or fitting 4. Selector Switch is in wrong position 5. Valve spool is sticking	1. Check fluid level and refill if necessary 2. Repair by authorised service provider 3. Tighten fittings or replace hoses and refill tank with hydraulic oil 4. Move selector switch on pendant to swage position 5. Repair by authorised service provider
Tensioning Unit does not extend or contract	1. Selector switch on pendant in wrong position 2. Low hydraulic fluid level 3. Oil leakage coming from hose or fitting 4. Blocked hose, fitting or valve 5. Valve spool is sticking	1. Move selector switch on pendant to the tensioning position. 2. Check fluid level and refill if necessary 3. Tighten fittings or replace hoses and refill tank with hydraulic oil 4. Repair by authorised service provider 5. Repair by authorised service provider

Step 9 – Tensioning the Barrier

Tensioning the barrier is achieved by pulling the swage fittings attached to the ends of the cable together using a hydraulic machine or a 3.0 tonne rated cable hoist. The swage fittings can then be secured to the strong back bracket which will hold the tensioned cables together when the machine is released.

ENSURE FULL TENSION MACHINE TRAINING, INCLUDING SAFE USE, HAS BEEN COMPLETED BEFORE OPERATING A TENSION MACHINE.

Tension Machine and associated training is available from CSP®.

Place swage fittings and strong back bracket into the tension machine ensuring that the cable is held by the safety catches. Once all personnel's hands are clear activate the machine so that it extends and pulls the swage fittings together. (Shown in Figure V).

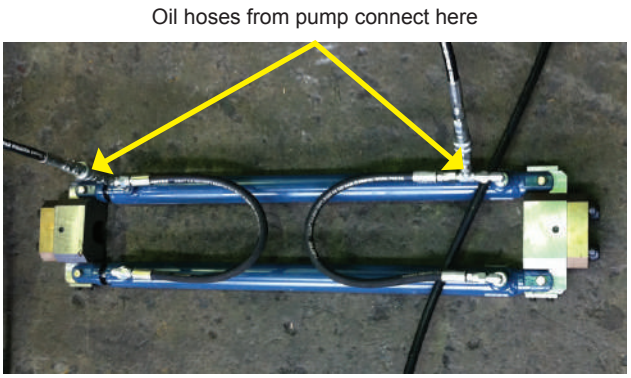
NOTE: The tension machine may be pre-set to stop at tension; therefore it may be necessary to adjust the settings on the machine. Refer to Tension in the System Design section in this manual or contact CSP® for more information.

Operation of the Tensioning Machine Unit

Locate the tensioning unit within about five metres of the tension turnbuckle.

Attach the air hoses from the pump to the tensioning unit.

Run nuts along the threaded section of the swage fittings inside the strong back bracket using a ring spanner until secure. (Shown in Figure W).



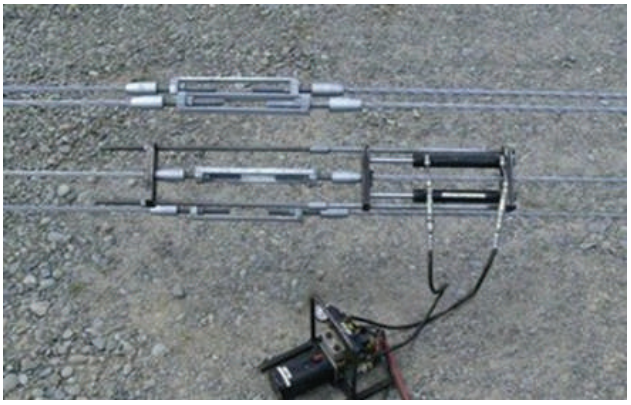


Figure V

Figure W

Activate the tension machine so it contracts and the machine can be lifted from the cable. Repeat Step 10 until all the cables are tensioned.

KEEP HANDS AND FINGERS CLEAR OF MOVING COMPONENTS.

De-Tensioning the Barrier

The barrier can be de-tensioned simply reversing the above procedures as outlined below.

Place tension machine on the cable ensuring that safety catches are in place. Extend the machine slightly which will release the tension on the nuts against the strong back bracket. Using a ring spanner remove the nuts from the swage fitting thread. Contract the machine so the tension is released from the cable and remove the tension machine.

Tension Meter

A tension meter can be used to check the tension of all new and existing installations. (Shown in figure X). The tension meter is attached to the rope to check the correct tension has been achieved. The final tension will be determined by the air temperature at the time of tensioning. (Refer to page 38).

Figure X

Step 10 – Delineation

Delineation may be required as per the Road Controlling Authority guidelines.

Median installations of Sentryline-M® Wire Rope Barrier must include a yellow reflectorised marking on the top of the post or post cap at 15m intervals along its length.

Shoulder installations of Sentryline-M® Wire Rope Barrier must include a white reflectorised marking on the top of the post or post caps at 15m intervals along its length.

For further details including type, location and placement contact the Road Controlling Authority.

Post Foundation On-Site Testing Procedure

Objective

To enable the Sentryline – M® wire rope safety barrier to perform as designed when impacted by an errant vehicle the post needs to be able to yield with limited movement of the surrounding ground. The Sentryline – M® post is installed into a concrete or steel driven socket. The socket has two main functions:

1. Strengthen the ground surrounding the Sentryline – M® Wire Rope Barrier post to help avoid dynamic movement.
2. Enable repair of the Sentryline – M® Wire Rope Barrier after an impact without having to repair the ground.

To determine if a constructed Sentryline – M® Wire Rope Barrier foundation or driven socket is suitable for use a non-destructive test is completed. When a post is impacted by an errant vehicle the loads are applied at a dynamic loading rate. The dynamic strength of soil is typically shown to be higher than the static strength. To avoid the need to undertake the testing of the sockets at dynamic loading rates, this testing procedures uses a reduced load (less than the failure load of the post) and applies the loading at a static loading rate.

Equipment

The following equipment will be needed to complete the testing.

- Sentryline – M® Barrier Post
- 1000 kg rated lifting sling (or larger)
- 1000 kg rated D-Shackle (or larger)
- 1000 kg rated lever hoist (or larger)
- Rigid anchor point (load rated)
- String line and packets
- Stake or peg
- Calibrated Loadcell (1000 kg min)
- Calibrated tape measure or rule

Methodology for concrete foundation socket

a. Ensure that the concrete has cured for at least 7 days and that the concrete strength is a minimum of 25MPa prior to conducting the load test. Place a post into the plastic socket of the concrete foundation.

b. Attach a Lifting sling, or equivalent, to the post. Attach a D shackle and calibrated electronic load cell to the lifting sling. The shackle and sling must be structural load rated for a capacity in excess of 1000 kg.

c. Attach a lever hoist with a rated capacity of 1000 kg or more to the other end of the loadcell and secure it to a rigid mounting point. Suitable anchor points would include a rated attachment point on a parked vehicle or excavator.

d. Ensure the mounted height at the attachment point of the sling to the post and to the rigid mounting point are approximately 700 mm (±5 mm).

e. Install a datum point in front of the concrete sockets by driving a peg into the soil approximately 100 mm in-front of the front edge of the concrete. Care should be taken to ensure the peg is vertical.

f. Place a mark on the concrete on the top surface of the concrete socket and using a calibrated metal rule obtain a horizontal distance measurement from the mark on the concrete to the leading edge of the peg. Record the measurement to the nearest 1 mm. If the edge of the peg shows any roughness, mark the location on the edge where the measurement was completed.

g. Ensure the loadcell is reading zero load and then using the lever hoist slowly increase the load up to a minimum load value of 920kg (-0, +10).

h. Whilst the system is loaded, repeat the measurement of the horizontal measurement (step f). Care must be taken to use the same measurement points when repeating the measurements. Record the measurement to the nearest 1 mm.

i. A series of photographs should be taken on each loaded post. The photographs should clearly show the load application, the post being loaded and the value of the applied load. Ideally, photographs should also be completed of the horizontal measures (pre and post loading).

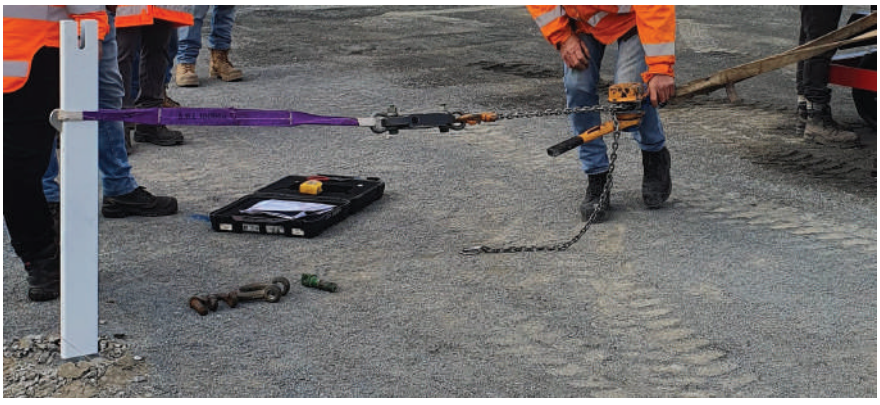


Figure 1.0 Set up prior to testing

Results

Calculate the change in horizontal measurement from the two readings.

> If the change in horizontal distance is less than 6mm the socket is considered to have sufficient static capacity.

> If the change in horizontal distance is greater than 6mm the socket is considered suspect and additional investigations should be undertaken or advice obtained from a qualified geotechnical engineer.

Methodology for Steel Driven Socket

1. Once the post has been placed in the steel socket, repeat steps b to d as outlined on page 41.
2. Install a datum point in front of the driven sockets by driving a peg into the soil approximately 100mm in-front of the front edge of the socket. Care should be taken to ensure the peg is vertical.
3. Obtain a horizontal distance measurement from the edge of the driven socket to the leading edge of the peg using a calibrated metal rule. Record the measurement to the nearest 1mm. If the edge of the peg shows any roughness, mark the location on the edge where the measurement was completed.
4. Repeat steps g to i as outlined on page 41.

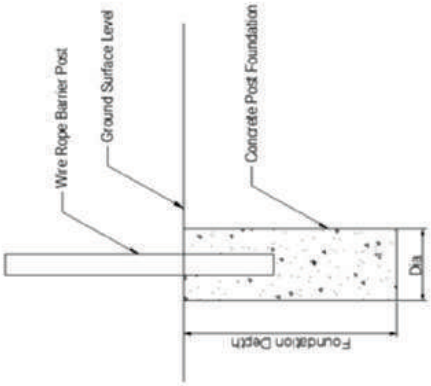
The steel driven socket is considered to have sufficient static capacity if the change in horizontal distance is less than 6mm.

Testing Frequency

A sample of not less than 3% (minimum testing of one post in every 100m) of each installed length of WRSB shall be tested in accordance with the instructions outlined on pages 41 and 42, unless varied by project engineer or installer.

Load Testing Report: Wire Rope Safety Barrier – Post Foundation

Rev 1 - 2013



Post Foundation Sizes:

Depth/s: _____ mm

Foundation Dia's: _____ mm

Concrete Strength: _____ MPa

Installation Company: _____

Date: _____

Company Contact: _____

Project Number: _____

Road Name: _____

Road Location: _____

Product: _____

Installation Length: _____

General Soil Classification: _____

# of Tests Conducted: _____

Test Passes/Failed: _____

Comments: _____

_____

Installation Company Representative:

Name: Signature:

Client/Authority Representative:

Name: Signature:

Maintenance and Repair - Standard Concrete Linepost Socket

Maintenance

Sentryline – M® Wire Rope Barrier is a relatively maintenance-free high tension cable barrier. However as the tension can vary from what was installed it is recommended that the tension of the cables is checked after all barrier impacts and at least annually as part of a maintenance program. For more information refer to page 16.

Repair after a typical impact

Recommended tool

> Crow bar

Replacement parts required for an average impact

> Posts

> Cable ties

> Caps

Appropriate safety gear must be used at all times.

Remove all damaged caps.

Remove and replace all damaged posts and cable ties with new ones.

NOTE: Ensure that the 'slots' on the side of the posts match the configuration of the rest of the intact barrier posts.

Place the cables back into the appropriate ties/ slots. Put new caps onto the posts.

NOTE: The caps need to be pushed 'hard home'.

Non-Standard Impacts

If for whatever reason a cable is damaged (any one strand or more are severed) then that cable must be replaced. Refer to Installation Instructions section in this manual for more information.

NOTE: Do not place two strong backs within 30m of each other when on the same cable.

If the impact was at or near an end anchor, tension will need to be checked and the cables may need to be re-attached to the Sentryline - M® Wire Rope Terminal End. Refer to Installation Instructions section in this manual and the Sentryline - M® Wire Rope Terminal End manual for more information.

Foundations which are constructed correctly should not move or be damaged in anyway. If the soil at the repair site has been disturbed and/or dislodged it must be reinstated to similar or a better condition as existed before the impact.

System Disposal

All components used on the Sentryline - M® Wire Rope Barrier System are fully recyclable. We encourage end of life and impact damaged components be safely disposed of by recycling. For further information contact CSP®.

Maintenance and Repair - Driven Socket

Maintenance

All maintenance requirements for the standard concrete socket system as outlined on Page 44 apply to Sentryline-M® Wire Rope Driven Socket System.

Driven sockets should generally not move or be damaged in anyway after an impact. To access whether a driven socket requires replacement after an impact or not, CSP® recommends the following guidelines:

Figure A
PASS

Figure B
MARGINAL

Figure C
FAIL

If PASS - Existing Driven socket can be used

If MARGINAL - On site engineering review and sign off required

If FAIL - Driven Socket is to be replaced with a new one.

Repair after a typical impact

Recommended tool

- Crow bar
- Steel plate gripper
- Post rammer

Replacement parts required for an average impact

- Posts
- Cable ties
- Caps
- Driven sockets

Appropriate safety gear must be used at all times.

Remove all damaged caps, posts and Half ties.

Remove all damaged driven sockets using a steel plate gripper (OPTIONAL).

Replace all damaged driven sockets, posts and half ties with new ones.

NOTE: Ensure that the 'slots' on the side of the posts match the configuration of the rest of the intact barrier posts.

Place the cables back into the appropriate ties/ slots. Put new caps onto the posts.

NOTE: The caps need to be pushed 'hard home'.

If the soil at the repair site has been disturbed and/or dislodged it must be reinstated to similar or a better condition as existed before the impact.

Installation Checklist - Standard Concrete Socket

Item	Y	N
Site soil conditions checked and appropriate post foundation installed to suit as per procedures in Waka Kotahi NZ Transport Agency Technical Advice Note #16-18.		
Ground is level and the top of the pile is flush.		
The plastic socket is cast in correctly and a rebar ring is positioned **100mm down from the top**.		
If installed near a steep slope, **there is sufficient** supporting soil outside the line of the posts in relation to the foundation size.		
Posts are spaced as per the **Construction Drawings**.		
Posts are installed with **slot orientation consistent** for the entire length of the barrier.		
Satisfactory **on-site post foundation testing** is conducted to establish the foundation's resistance to the prescribed load.		
Top cable is positioned in the **top slot** while the bottom 3 cables sit in the Half Ties.		
An 'o' ring seal is positioned on all posts at the **top of the socket.**		
All posts have a plastic cap inserted in the top.		
Cable heights, 590mm, 700mm, 800mm and 900mm. (± 25mm).		
Each of the 4 cables has been **tensioned correctly.**		

Job Number:			
Location:			
Client/Asset Owner:			
Principal Contractor:			
Installer:			
Installed by:		Date	
Inspected by:		Date	

Contact CSP® for more information on this or other road safety products.

Installation Checklist - Driven Socket

Item	Y	N
Site soil conditions for the full depth of the socket are equal or better than AASHTO standard soil.		
Ground is level and the top of the socket is flush.		
If installed near a steep slope, **there is sufficient** supporting soil outside the line of the Driven Sockets.		
Posts are spaced as per the **Construction Drawings**.		
Posts are installed with **slot orientation consistent** for the entire length of the barrier.		
Satisfactory **on-site post foundation testing** is conducted to establish the socket's resistance to the prescribed load.		
Top cable is positioned in the **top slot** while the bottom 3 cables sit in the Half Ties.		
All posts have a plastic cap inserted in the top.		
Cable heights, 590mm, 700mm, 800mm and 900mm. (± 25mm).		
Each of the 4 cables has been **tensioned correctly.**		

**For Waka Kotahi projects, all lengths of WRSB installed using driven sockets must be clearly noted on the project as-built records and recorded in the Road Controlling Authority's asset management system to ensure future maintenance contractors are aware of the differing foundation type.*

Job Number:			
Location:			
Client/Asset Owner:			
Principal Contractor:			
Installer:			
Installed by:		Date	
Inspected by:		Date	

Frequently Asked Questions

1. **What type of equipment is required to install the Sentryline – M® Wire Rope Barrier?**

   Standard tools required include a wrench, measuring tape, string line and trowel. Machinery suitable for drilling or excavating the line post foundation holes. A cable reel device to dispense the cable and lifting equipment to lift the cable reels. A cut off saw (cutting wheel) is required to cut the cables and a tension machine to tension the system.

2. **How much concrete is required to install the footings on an Sentryline – M® Wire Rope Barrier and what strength does it need to be?**

   The volume will vary depending on the type of foundation being used. The standard post foundation contained in this manual and the corresponding theoretical volume is 300mm diameter x 750mm deep 0.053m³. (Due to the drilling and removing spoil the actual amount may be larger than this). The concrete used must be 25Mpa.
   Note: Other foundation sizes and types might be required due to on site soil conditions. Concrete volume requirements will vary accordingly.

3. **Is there a curing period for the concrete before the cable barrier can be tensioned?**

   Yes, it is recommended that the system is not tensioned until at least 7 days after all concrete piles have been poured.

4. **Does your company provide spare parts? What is the lead-time for supply?**

   It is important to fix a damaged cable barrier as soon a possible because it most probably won't perform as required when damaged. For this reason it is recommended that spares are held by maintenance contractors. (The concrete piles are very unlikely to be damaged).

5. **On average, how long does it take to install a Sentryline - M® Wire Rope Barrier?**

   Depending on the application and circumstances at the site, installation and assembly of the system should take a three person crew less than 4 hours to cast the piles, install the posts and place the cables for a 100m section. (Assuming posts are at 3m spacing and have a 300mm x 750mm pile foundation).

6. **What about vandalism, can the Sentryline - M® Wire Rope Terminal End be easily damaged?**

   No, once the system has been tensioned it is an extremely rigid system and tampering without the use of heavy duty tools or machinery is very unlikely to damage or affect the performance of the system.

7. **How easily can the Terminal End and Sentryline – M® Wire Rope Barrier be restored after impact?**

   Sentryline – M® Wire Rope Barrier is a simple cable barrier to fix and including the Terminal End, the system is easily repaired after impact. Damaged line posts can be removed using a crow bar and

new ones positioned in the sockets before the cables and caps are repositioned. It is recommended that the cable tension is checked after impact. If the system has been de-tensioned due to damage to the 'trigger' post, a hydraulic tension machine and trained personnel will be required to re-tension the system after the 'trigger' post is replaced. The foundation piles and ground strut should not be damaged in anyway.

8. What maintenance does the Sentryline – M® Wire Rope Barrier require?

Sentryline – M® Wire Rope Barrier is relatively maintenance free barrier as the cables used are pre-stretched. It is however recommended that the cable barrier is checked two weeks after initial tension, at least annually as part of a maintenance program and after impacts. Refer to the Maintenance section in this Sentryline – M® Wire Rope Barrier Product Manual for recommendations on maintenance.

9. Will the plastic caps require frequent replacement due to weather deterioration of the product?

The plastic caps are made from UV stabilised plastic and are extremely resistant to deterioration from the weather.

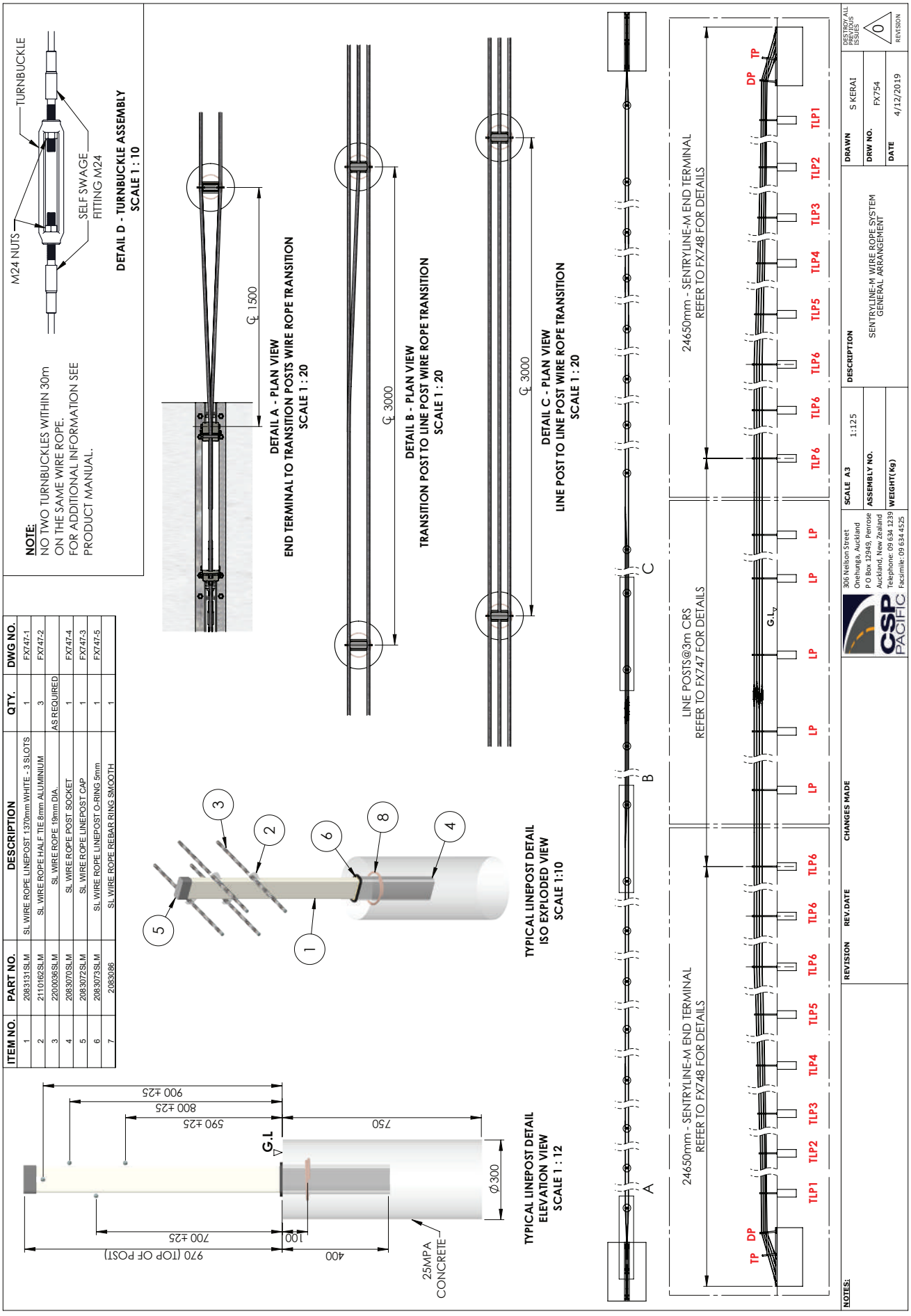
10. What is the Deflection rating of the Sentryline – M® Wire Rope Barrier?

Deflection is from actual crash testing and the figure published is from the MASH 2016 TL-3 test involving a 2270kg pickup truck at a 25 degree angle and at 100kph (3-11). The Sentryline – M® Wire Rope Barrier at 3.0m post spacing has a Dynamic Deflection of 3.02m and Working Width of 3.02m.

APPENDIX

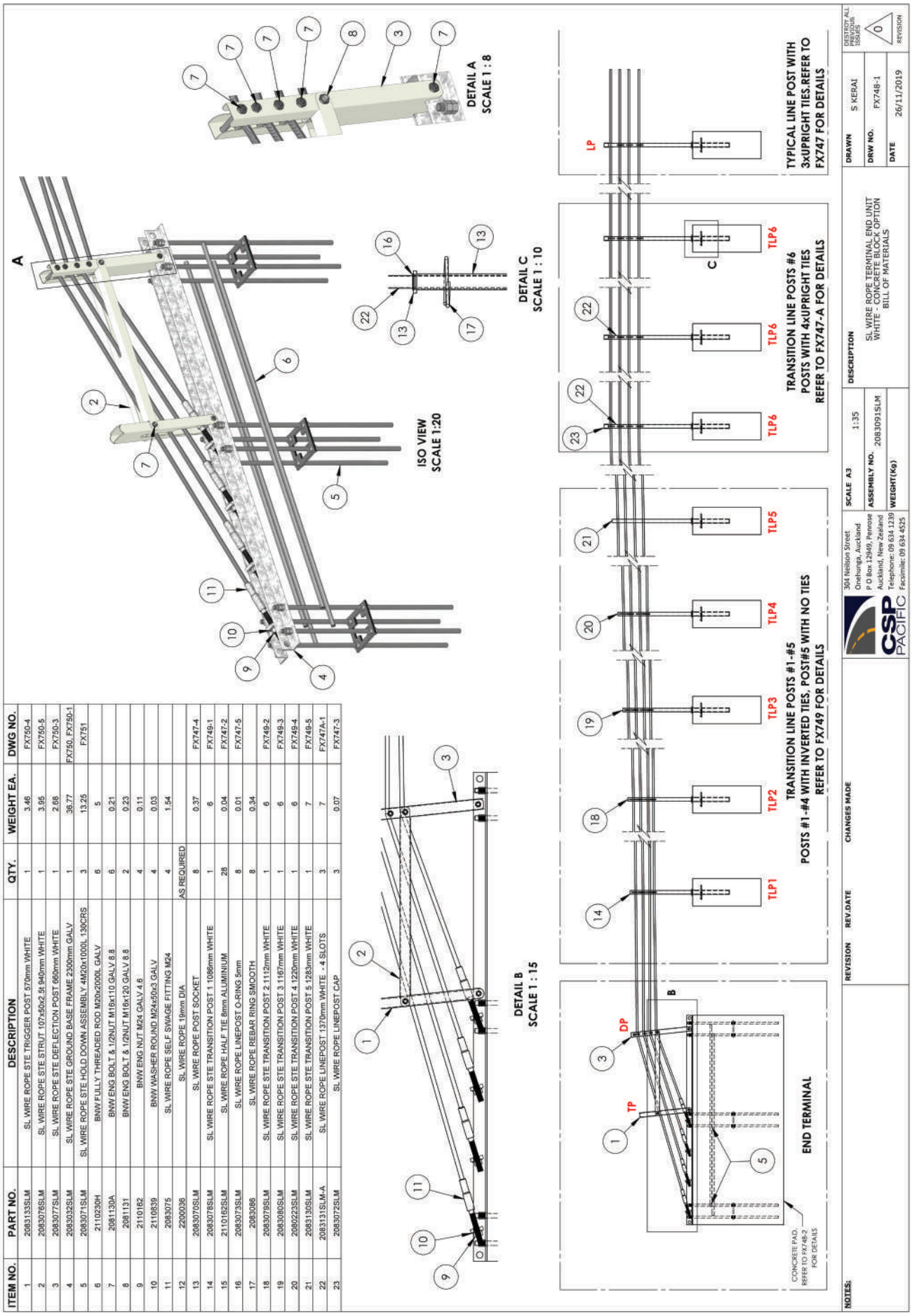
Technical Drawings

Sentryline-M® Wire Rope Terminal End and Sentryline-M® Wire Rope Barrier General Arrangement

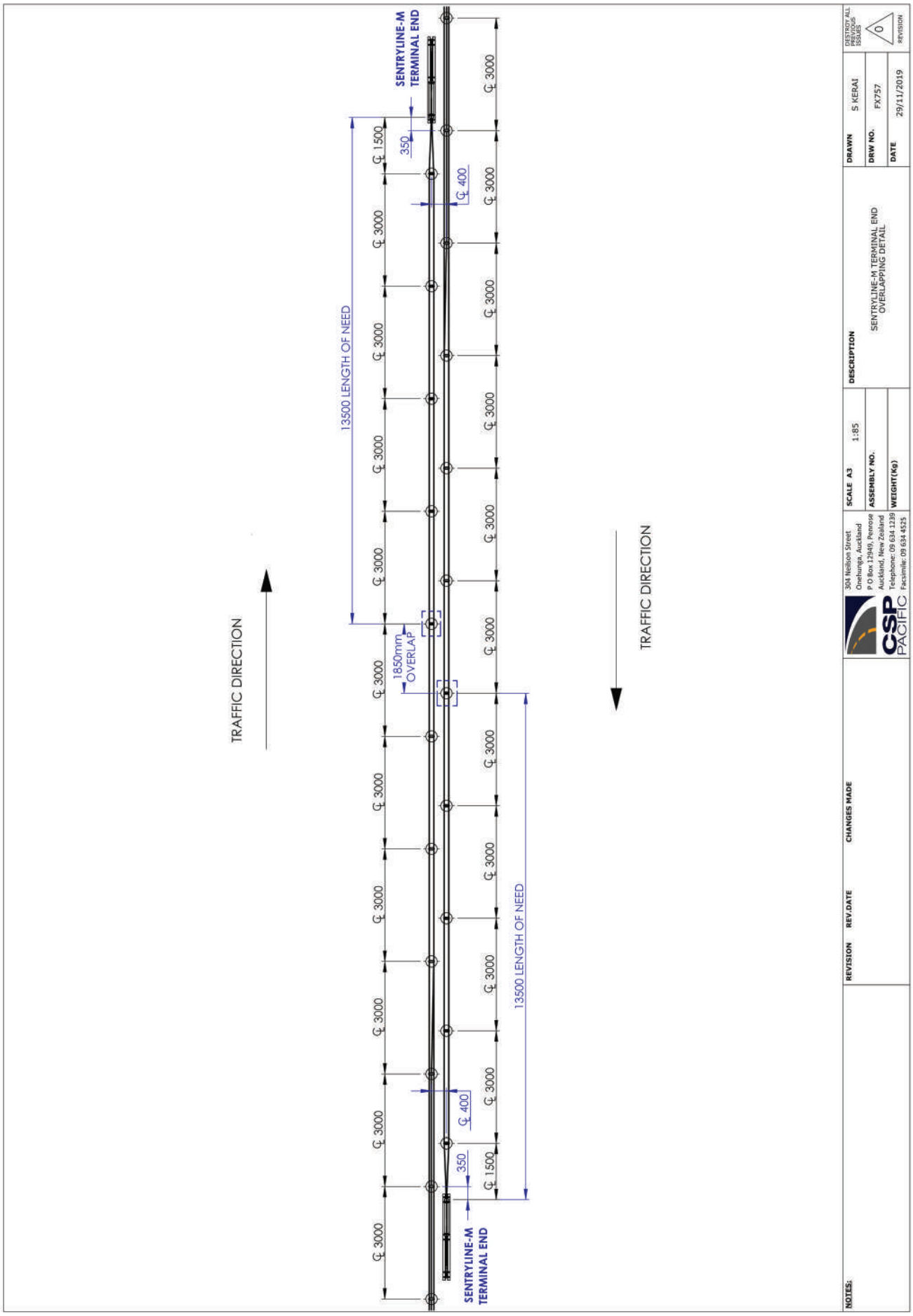


ITEM NO.	PART NO.	DESCRIPTION	QTY.	DWG NO.
1	2083131SLM	SL WIRE ROPE LINEPOST 1370mm WHITE - 3 SLOTS	1	FX747-1
2	2110162SLM	SL WIRE ROPE HALF TIE 8mm ALUMINIUM	3	FX747-2
3	2200036SLM	SL WIRE ROPE 19mm DIA.	AS REQUIRED	
4	2083070SLM	SL WIRE ROPE POST SOCKET	1	FX747-4
5	2083072SLM	SL WIRE ROPE LINEPOST CAP	1	FX747-3
6	2083073SLM	SL WIRE ROPE LINEPOST O-RING 5mm	1	FX747-5
7	2083086	SL WIRE ROPE REBAR RING SMOOTH	1	

Sentryline-M® Wire Rope Terminal End General Arrangement



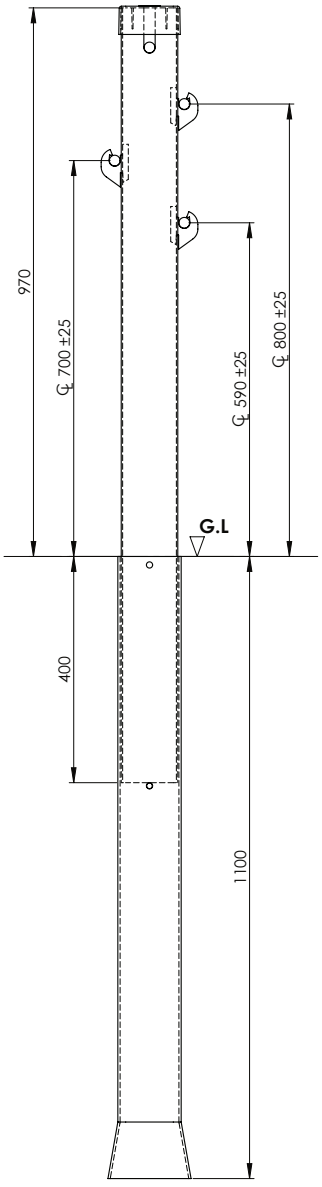
Sentryline-M® Wire Rope Terminal End Overlapping Detail



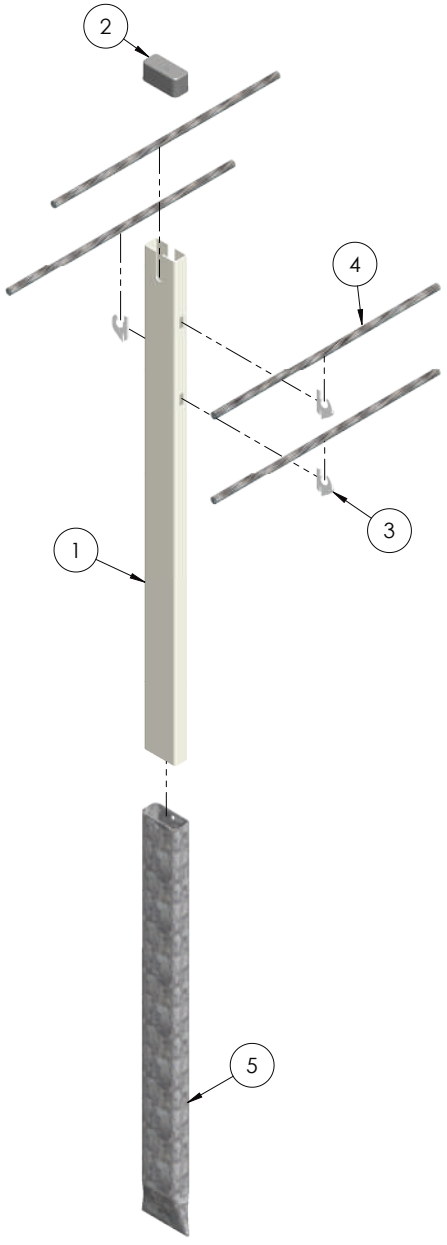
Sentryline-M® Driven Socket Option

REVISION	REV.DATE	CHANGES MADE

ITEM NO.	PART NO.	DESCRIPTION	QTY.	WEIGHT EA.	DWG NO.
1	2083131SLM	SL WIRE ROPE LINEPOST 1370mm WHITE - 3 SLOTS	1	7	FX747-1
2	2083072SLM	SL WIRE ROPE LINEPOST CAP	1	0.05	FX747-3
3	2110162SLM	SL WIRE ROPE HALF TIE 8mm ALUMINIUM	3	0.04	FX747-2
4	2200036SLM	SL WIRE ROPE 19mm DIA.	4		
5	2200100SLM	SL WIRE ROPE DRIVEN SOCKET 112x52x4 1100L GALV	1	10.10	FX758-1



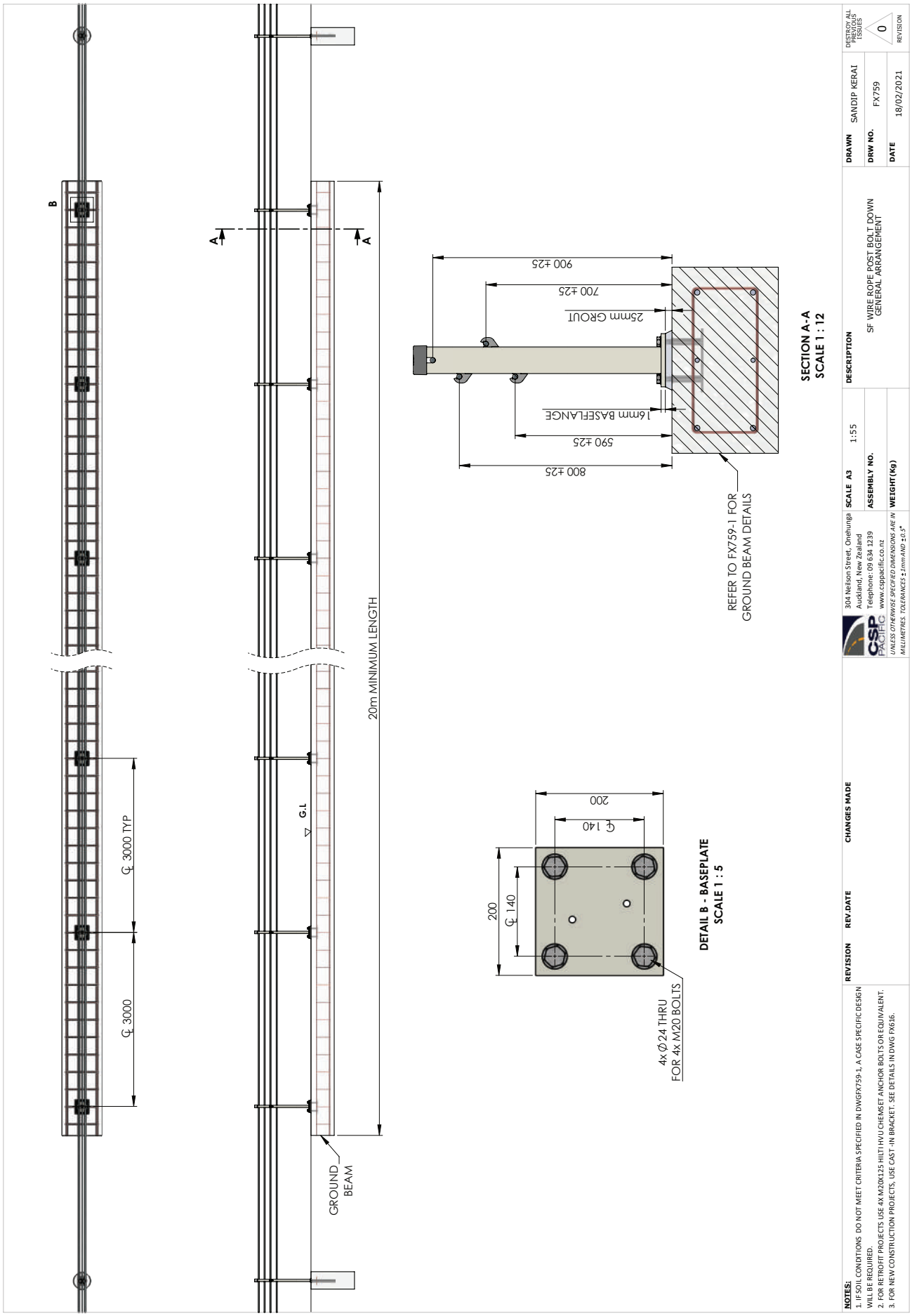
ELEVATION VIEW
SCALE 1:8



ISO EXPLODED VIEW
SCALE 1:10

NOTES:					
	306 Neilson Street, Onehunga, Auckland P O Box 12949, Penrose, Auckland, New Zealand Telephone: 09 634 1239 Facsimile: 09 634 4525	SCALE A3 1:5 ASSEMBLY NO. 2200100SLM WEIGHT(Kg)	DESCRIPTION SF WIRE ROPE POST DRIVEN ASSY WHITE - 3 SLOTS	DRAWN S KERAI DATE 7/07/2020 DRW NO. FX758	DESTROY ALL PREVIOUS ISSUES 0 REVISION

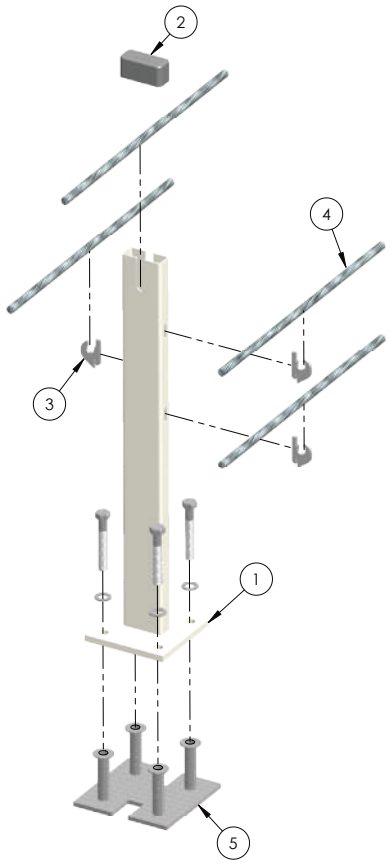
Sentryline-M® M Bolt Down Post Option



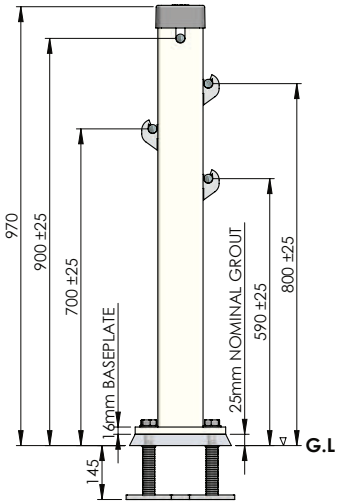
Sentryline-M® M Bolt Down Post Option

REVISION	REV.DATE	CHANGES MADE
1	17/02/20	GROUND BEAM DETAILS NOW ADDED.

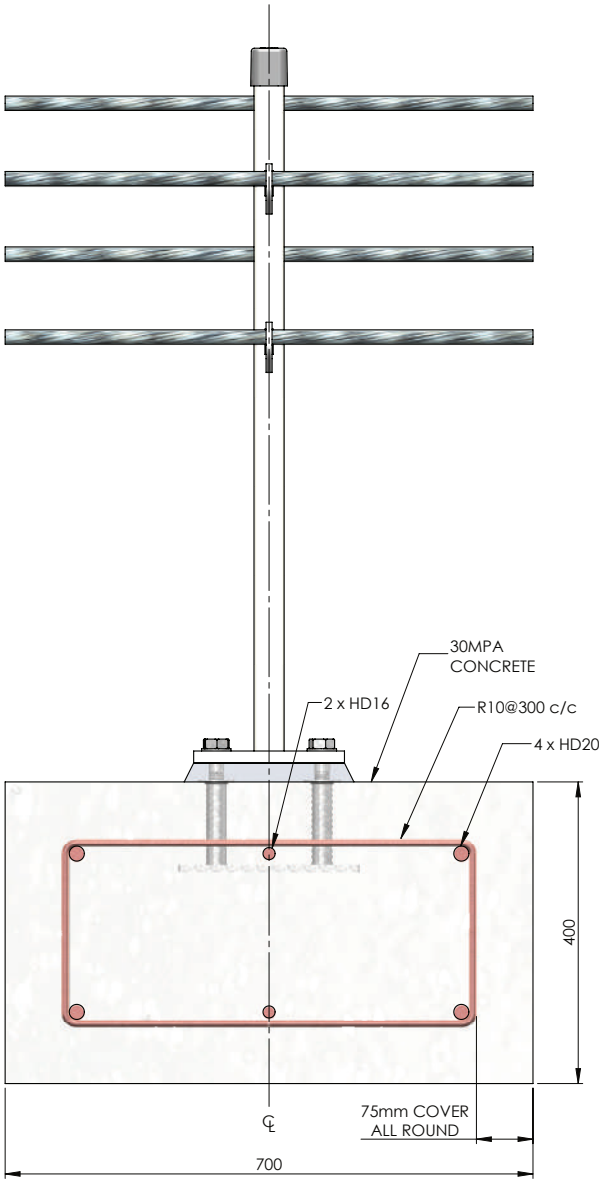
ITEM NO.	PART NO.	DESCRIPTION	QTY.	WEIGHT EA. (KG)	DWG No.
1	2083100SLM	SF WIRE ROPE LINEPOST 945mm BASEPLATE WHITE	1	9.40	FX759-2
2	2083072SLM	SL WIRE ROPE LINEPOST CAP	1	0.05	FX747-3
3	2110162SLM	SL WIRE ROPE HALF TIE 8mm ALUMINIUM	3	0.04	FX747-2
4	2200036SLM	SL WIRE ROPE 19mm DIA.	AS REQUIRED		
5	2080071D	AF CIB WITH PLATE & BOLT KIT	1	6.64	FX759-5



ISO EXPLODED VIEW
SCALE 1:6



ELEVATION VIEW
FOUNDATION DETAILS NOT SHOWN
SCALE 1:6



END VIEW
FOUNDATION & REINFORCING DETAILS
SCALE 1:6

NOTES:
1. THIS GROUND BEAM HAS BEEN DESIGNED FOR COHESIVE SOILS, WITH AN UNDRAINED SOIL COHESION OF 50 KPA TO REPRESENT THE LOWER BOUND OF ACCEPTABLE SOIL CAPACITY.IF SOIL CONDITIONS DO NOT MEET CRITERIA SPECIFIED, A CASE SPECIFIC DESIGN WILL BE REQUIRED.
2. FOR RETROFIT PROJECTS USE 4 X M20 STUDS INSTALLED TO A DEPTH OF 150mm WITH HILTI HIT-HY 200-R EPOXY. FOR NEW CONSTRUCTION PROJECTS, USE CAST-IN BRACKET. SEE DETAILS IN DWG FX616-2.

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETRES. TOLERANCES ±1mm AND ±0.5°

SCALE A3	1:6
ASSEMBLY NO.	2083096SLM
WEIGHT(Kg)	
DESCRIPTION	SF WIRE ROPE POST STD BOLT DOWN ASSY WHITE - 3 SLOTS
DRAWN	SANDIP KERAI
DRW NO.	FX759-1
DATE	18/02/2021

DESTROY ALL PREVIOUS ISSUES
1
REVISION