

# Flexfence

Wire Rope Safety Barrier

## *Product Manual*



Release 04/21

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## 1.0 Introduction

The superior design and clean lines of Flexfence Wire Rope Safety Barrier (WRSB) has seen it become the road safety industry's preferred wire rope barrier. Flexfence has gained popularity as a median barrier for the prevention of crossmedian accidents. Cross-median accidents are typically violent collisions with a high probability of multiple serious injuries and death. Thus, the design trend is towards providing positive vehicle containment in wider median applications for which barriers have not historically been warranted.

The straight alignment of the ropes allows for easy installation and tensioning. Post footings are typically concrete with a sleeve to form a recess. Once the anchors and footings are poured, the ropes are cut to length, stainless steel end fittings are machine swaged and the ropes are tensioned.

The Flexfence system has configurations that are compliant with NCHRP-350 Test Level 3 and TL4. With the transition to MASH compliant highway safety products across most Australian jurisdictions, please check with your local road authority for it's current status. In jurisdictions where Flexfence has moved to Legacy status, it has been replaced with MashFlex, our MASH compliant WRSB system. An upgrade kit is available for existing runs of Flexfence to bring them up to a MASH compliant level, refer drawing WR-STD-89.

## 2.0 Configurations

### 2.1 Flexfence TL3

Flexfence TL3 is a 4-rope barrier assessed in accordance with NCHRP Report 350 Test Level 3 (TL3). The TL3 heavy vehicle impact is performed with a 2,000kg pick-up truck travelling at 100km/h and 25°.

In addition, Flexfence TL3 has been evaluated to the requirements of containment classes N2 and H1 as

per the European EN1317-2 specification. This requires impacts with a 10,000kg rigid truck travelling at 70km/h and 15° (H1) and a 1,500kg passenger car travelling at 110km/h and 20° (N2).

### 2.2 Flexfence TL4

Flexfence TL4 is available as a 3-rope or 4-rope barrier and has been assessed in accordance with NCHRP Report 350 Test Level 4 (TL4).

The TL4 configuration requires the addition of a post stiffener plate and top rope hook. All other components are identical to the TL3 configuration. The 3 rope configuration is achieved by removing the 2nd from bottom cable.

The TL4 heavy vehicle impacts are performed with a 2,000kg pick-up truck travelling at 100km/h and 25° and an 8,000kg rigid truck travelling at 80km/h and 15°.

## 3.0 Specification

### Material:

Steel Wire Rope:	Mass – 1.21kg/m Ultimate Tensile Strength – 165.5kN
Sigma Posts:	Material to AS/NZS 1594
Anchor Bracket:	Material to AS/NZS 1594
Swage Fittings:	Stainless Steel, Grade 304
Plastic Parts:	UV Stabilised Polypropylene

### Finish:

Steel Wire Rope:	Galvanised coating
Sigma Posts:	Galvanised to AS/NZS 4680
Anchor Bracket:	Galvanised to AS/NZS 4680

### Dimensions:

Steel Wire Rope:	Right Hand Lay, Ø19mm, 3 strands, 7 wires each (1 x 3.15mm + 6 x 3.0mm)
Sigma Posts:	1230mm long
<b>Cable Heights:</b>	
Top:	720mm
2nd from Top:	640mm
2nd from Bottom:	560mm
Bottom:	480mm



Figure 1: Flexfence TL4 (4 Rope)

## 4.0 Technical Data

### 4.1 Flexfence Performance

Wire rope safety barriers are classified as flexible barriers and consideration must be given to the expected movement of the barrier when impacted.

The design of a WRSB should include an assessment of the mass of the impacting vehicle, its speed and angle of impact. Whilst rigorous crash testing is undertaken to evaluate the performance of roadside barriers, the deflection results obtained during testing should not be considered an exact distance, but rather as a single point within the range of deflections that can be expected.

### 4.2 Working Width

The working width is the maximum width that is required to prevent an impacting vehicle from colliding with an object behind a road safety barrier system. This includes the dynamic deflection and the extra width due to the roll of an impacting vehicle. The roll of a vehicle is an important consideration in shielding a fixed object hazard such as a utility pole or bridge support.

### 4.3 Dynamic Deflection

The dynamic deflection is defined as the largest transverse deflection of a road safety barrier system recorded during an actual crash or during a full-scale impact test.

If the available space between the hazard and the barrier is not adequate, then the barrier can be stiffened in advance of, and alongside the hazard by reducing the post spacing. Other factors that can have an influence on the deflection of the barrier include tension in the wire rope cables, horizontal curvature and installation length.

Flexfence crash test deflection results are listed on the Ingal drawings.

### 4.4 Footing Selection

The post footing provides lateral support to the post during impact ensuring the post yields by bending near ground level. The type and size of footing is dependant upon the surrounding soil type and distance to the embankment rounding point.

Table 1 provides guidelines for the construction of post footings for varying site conditions.

**Table 1: Post Footing Selection Guide**

Centre of Post Footing to Rounding Point	Standard Soil		Weak Soil	
	Dia	Depth	Dia	Depth
Less than 0.5m	300	600	300	750
Greater than 0.5m	300	600	300	600

The minimum concrete compressive strength at 28 days is 25Mpa.

If using the Driven Sleeve footing option, please refer drawing WR-STD-86 and your local Road Controlling Authority acceptance conditions prior to design or installation.

In the event that the soil type cannot be verified, then a post pull-over test can be conducted to validate the structural capacity of the footing.

A pull-over test is conducted by applying a load to the top of the post whilst positioned in the proposed footing design. The footing is required to remain stable until the post yields. Once the post yields, the footing has been subjected to its maximum potential load.

### 4.5 Minimum Length

The recommended minimum length-of need for a Flexfence installation is 40m.

### 4.6 Maximum Length

The recommended maximum run length of a Flexfence installation is 1200m.

### 4.7 Point-of-Need

Flexfence is designed to contain and redirect errant vehicles away from road side hazards. The location along the barrier system that redirection occurs is known as the point-of-need.

The point-of need for both the Flexfence TL3 and TL4 configurations is 12.6m from the anchor point when using the TL3 End Terminal.

## 5.0 End Terminals

End terminals are used to anchor the system and provide a soft gating impact to prevent vehicles from launching or snagging upon impact with Flexfence.

### 5.1 TL3 Terminal

The TL3 Terminal has been crash tested to meet the requirements of NCHRP Report 350 TL3. It can be used on all new installations or retrofitted to existing Flexfence installations.

The TL3 Terminal gradually tapers the cables from full height to an anchor bracket located at ground level.

The TL3 Terminal has demonstrated an ability to provide a soft, gating impact without releasing the cables from the anchor point. This non-release feature allows the system to remain anchored following design impacts.

This important feature contrasts terminals that are designed to release the cables for end-on impacts. Once these terminals release the cables their ability to provide continued containment and redirection for errant vehicles is compromised.

### 5.2 Standard Terminal

The Standard Terminal is designed to provide the necessary tensile support to redirect errant vehicles that impact the wire rope barrier within the length-of-need section.

### 5.3 TL3 Terminal - Workzone Applications

If used in a temporary workzone, the hazard free area is to be 30m from anchor point, with a width of 6m running parallel with the system.





Figure 2: TL3 End Terminal

## 6.0 Installation

The following written instructions should be read in conjunction with Ingal Civil Products' drawings.

A Safe Work Method Statement is available upon request to assist in the safe assembly of Flexfence.

Tooling and equipment is provided by Ingal for the installation of Flexfence. This equipment is known as the Flexfence Tension Unit and Flexfence Swaging Unit. Please contact your nearest Ingal representative for the safe operating instructions for this equipment.

### 6.1 Site Preparation

The approach terrain to the barrier should be level, otherwise a maximum grading of 1V:10H is permitted. Steeper slopes may result in the vehicle impacting the barrier at other than the design height.

### 6.2 Horizontal and Vertical Alignment Criteria

The length and/or horizontal curvature of an installation of wire rope barrier may increase the dynamic deflection of the barrier. In addition, horizontal curves may place more lateral load on the post foundations. To calculate the effect of a curve on the deflection, multiply the deflections as detailed on the system arrangement drawings by the curve correction factor in Table 2, the length column is the total length of the run. These correction factors only apply to convex curves.

The minimum allowable sag vertical curve for wire rope barriers is  $\geq 30\text{m}$ . ( $K = \text{length of VC in metres divided by the change in grade expressed as a percentage}$ ). There is no K value limit for crest curves.

Table 2: Length and Curve Correction Factors

Length (m)	Convex Curve Radius (m)			
	150-299	300-449	450-749	750+
0-100	1.4	1.3	1.1	1.0
101-200	1.6	1.4	1.2	1.1
201-300	1.6	1.5	1.3	1.1
301-500	1.7	1.5	1.3	1.2
501-1000	1.8	1.6	1.4	1.2

## 6.3 End Anchor Site Preparation

The site should be inspected for the presence of underground utilities prior to any excavation. The site should be prepared free of obstructing vegetation and other hazards that may interfere with the installation or operational performance of the system. Some sites may require minor grading if installed beyond the edge of the pavement shoulder.

Vehicles impacting the end of the terminals will normally continue behind and beyond the barrier and may encounter non-traversable terrain or other roadside hazards. It is recommended that the guidelines as stated in AS/NZS 3845 for the installation of gating safety barrier end terminals be observed.

AS/NZS 3845 requires that a Hazard Free Zone immediately behind the terminal... should be reasonably traversable and free from fixed object hazards. If a clear runout is not possible, this area should be similar in character to adjacent unshielded roadside areas.

## 6.4 Construction of Anchor Blocks

Flexfence is available with a variety of anchor block designs. These include;

1. Default block - Type 3 - WR-STD-64
2. Poor soil conditions - Type 1 - WR-STD-62
3. Spacial limitations - Pier - WR-STD-82

The selection of a suitable design will depend upon soil type, refer anchor drawings for minimum conditions.

Typically, the alignment of the anchor block will follow the same alignment as the length of need section. If site conditions require the anchor block to be offset to the length of need section, a 200m radius can be introduced upstream from the end anchor until the desired offset angle is achieved. The fence can then be tapered at a constant rate to achieve the required offset distance.

The construction sequence is as follows;

1. Excavate the anchor hole in accordance with Ingal drawings.
2. If installing the rectangular anchor block, clip out several grids of the reomesh square to fit over the anchor bracket as shown in Ingal drawing WR-STD-62.



Figure 3: Clipping of Reomesh

3. Attach 3 off M20 x 550mm hook bolts to the base of the anchor bracket using 2 off M20 nuts per hook bolt. One M20 nut is used either side of the anchor bracket to secure each hook bolt.
4. Using formwork, suspend the anchor bracket and reomesh, ensuring the anchor bracket levelling plate is at the same longitudinal grade as the roadway. The position of the anchor bracket is to be in accordance with Ingal drawings.



Figure 4: Placement of Anchor Bracket

5. To prevent flotation or dislodgement during the concrete pour, drive a shortened star picket into the base or side of the excavation and use tie wire to secure the bracket.
6. Pour concrete into the excavation and vibrate. Ensure that the anchor bracket has remained secure.
7. Trowel the surface of the anchor block and shape to provide fall way from the anchor bracket.



Figure 5: Trowelling of the Anchor Block

## 6.5 Construction of Concrete Post Footings

1. Establish post spacing in accordance with expected dynamic deflections and excavate postholes to the dimensions in accordance with Table 1. Note that the height of the footing must be within 20mm of the design reference height.
2. Pour concrete into each hole.
3. Insert the post footing reinforcement ring to a depth providing 50mm of cover.





**Figure 6: Insertion of the Post Reo Ring**

4. Insert the Flexfence post into the plastic HDPE sleeve.
5. Push the Flexfence post and the plastic HDPE sleeve into the wet concrete so that the top of the plastic sleeve is at ground level. The posts are orientated so that the smooth face is towards the traffic face.
6. Trowel the surface of the post footings and shape to provide a slight fall away from the post sleeve. Any doming should not exceed 20mm in height.



**Figure 7: Trowelling of the Post Footing**

## 6.6 Driven Sleeve Post Footings

The Driven Sleeve Footings are driven directly into the ground and should be vertical. The sleeve installation process shall not cause damage to the sleeve, such that it reduces the design life, or introduces sharp edges. Refer drawing WR-STD-86.

Ensure the area has been inspected for underground hazards and services prior to installation.

Sleeves should be driven to a depth appropriate for the finished cable heights, as per drawing WRSTD-60.

## 6.7 Post Assembly Sequence

1. It is recommended that concrete used for the construction of anchor blocks and post footings be cured for a period of 7 days prior to tensioning.
2. Slide the ground covers over each Flexfence post.
3. Starting at the leading or high end of the fence, connect the bottom wire rope to the anchor using a temporary anchor connection and run out the wire

through the post slots to the far anchor and cut the rope to length. When a reel is depleted, attach the end to the next reel by tying the cables together and continue to run out the cable.

4. Insert the plastic spreaders into the post slots.
5. Repeat these procedures with subsequent wire ropes. Ensure the stainless frame is inserted between the top two ropes.
6. When all the ropes have been installed, fit the plastic caps to the posts.



**Figure 8: Driven Sleeve Installation**

## 6.8 Assembly Sequence – Flexfence TL4

The installation of Flexfence TL4 requires the addition of a rope hook be attached through the pre-punched holes in the top of the posts. Refer drawing WR-STD-60.

1. Prior to running out the wire, a reinforcement plate is required in each full height post. If installing a post without the pre-welded plate, a plate is dropped into the post and will come to rest within the post sleeve at the ground level.
2. If installing the TL4 system, ensure the post has the pre-welded stiffening plate (Figure 9). If not, please contact your local Ingal Civil representative.

Note. Ensure steel rope spreaders are used in the first full height post of the Flexfence TL3 Terminal. Refer post (k) on drawing WR-STD-050.



**Figure 9: Pre-welded stiffener plate**



Figure 10: Attachment of Rope Hook

## 6.9 Installation of Tension Bays

Tension bays are located at 300m centres and not more than 150m from either anchor point, drawing WR-STD-59.

For fences less than 600m;

1. Swage the stainless steel end fittings onto all the cables and attach to the anchor bracket. The procedure for swaging is contained in the Flexfence Swaging Unit Safe Operating Procedure Manual. The bottom rope is located nearest to the approaching traffic face. Each end fitting is secured at the anchor with one washer and two nuts. If using the standard terminal, ensure safety check ropes are attached before swaging.

*Note: An inspection hole is drilled into each stainless steel end fitting to ensure the wire rope cables are properly inserted into the end fittings before swaging.*



Figure 11: Anchor Block Fitting Arrangement

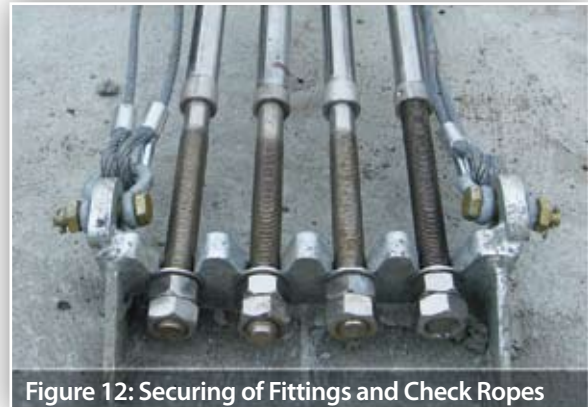


Figure 12: Securing of Fittings and Check Ropes

2. Pull the slack out of the wire ropes toward the other anchor. This can be achieved by hand or by using a sling equipped with a lever claw clamp.



Figure 13: Attachment of Lever Claw Clamp

3. At locations where the wire rope reels have been temporarily joined, swage the end fittings onto the cables and install a tension fitting. End fittings should be positioned so that the end of the fitting is a minimum distance of 50mm from the post.
4. After the slack has been removed from the fence, attach the check ropes (if required), machine swage the end fittings and attach to the trailing or low-end anchor.
5. Identify the tension bay location(s).
6. Mark and cut out an 800mm section from each cable. It may be necessary to attach temporary clamps one post back from the tension bay location prior to cutting in order to prevent the cables from retracting. End fittings should be positioned so that the end of the fitting is a minimum distance of 50mm from the post.





Figure 14: Attachment of Temporary Clamp

7. Swage the end fittings to each cable and attach the tension fittings. The procedure for swaging is contained in the Flexfence Swaging Unit Safe Operating Procedure Manual.
8. Attach the tensioning rig to the bottom cable and tension from the bottom up. The procedure for Tensioning is contained in the Flexfence Tension Unit Safe Operating Procedure Manual. Each rope is tensioned in accordance with Table 4.

#### For fences greater than 600m

1. Attach the safety check ropes (if required) and machine swage the cables at the leading or high-end anchor tand attach to the anchor bracket.
2. Pull the slack out of the wire ropes towards the 1st tension bay location. This can be achieved by hand or by using a sling equipped with a lever claw clamp.
3. At the 1st tension bay location clamp the wire rope cable to a post. Repeat process for each cable, clamping each cable to a different post.
4. Cut the cables on the un-tensioned side of clamps and machine swage fittings. Assemble the tension fittings.
5. Relocate to the 2nd tension bay and repeat the above process. Continue until all the tension bays are completed.

6. Once the slack has been removed from the fence, attach the check ropes (if required), swage the end fittings and attach to the trailing or low-end anchor.
7. Once the cables are attached at the anchor bracket, relocate to the centre tension bay.
8. Attach the tensioning rig and tension in accordance with Table 4 from the bottom up.
9. Relocate from the centre bay outwards repeating the tension process.
10. Once complete, relocate to the centre bay and repeat tensioning in this bay only.

Note: Upon completion, the tension bays shall not be more than 90% (40mm gap) of their full extent so as to allow for further adjustment. There should also be a min 40mm exposed thread beyond each nut.

Table 3: Construction Tolerances

Description	Recommended Tolerance
Rope Height	-10mm /+30 mm
Post Spacing	± 30mm
Post Footing Dimensions	- 10mm
Anchor Block Dimensions	- 20mm
Cable Tension	- 1kN / +2kN

Table 4: Tension Unit Pressure Requirements

Ambient Temperature °C	TL3 System (Bar)	TL4 System (Bar)
-5	(24kN) 263	(36kN) 386
0	(23kN) 247	(34kN) 363
5	(21kN) 231	(32kN) 340
10	(20kN) 215	(29kN) 316
15	(18kN) 200	(27kN) 293
20	(17kN) 184	(25kN) 270
25	(16kN) 168	(23kN) 247
30	(14kN) 152	(21kN) 224
35	(13kN) 137	(19kN) 201
40	(11kN) 121	(17kN) 177

#### 6.10 Clean-up and Waste Materials

Recycle, reuse or dispose of all surplus material, rubbish and other debris in accordance with the requirements of the local state based environmental protection specification.



Figure 15: Tension Bay



## 7.0 Flexfence Maintenance

Flexfence is a low maintenance roadside safety barrier. Except for repairs due to impacts, there is virtually no maintenance required for the system. It is recommended that regular drive-by inspections be performed to ensure the following;

1. Post caps have not dislodged. Delineation stickers are attached to the post caps and a loss of numerous caps could result in poor delineation.
2. Debris has not accumulated around the system. A clear zone, free of hazards should exist immediately behind the fence to accommodate for the expected dynamic deflection.
3. Safety check ropes should be secured to the anchor - Standard Terminal only. Refer WR-STD-55.
4. Ropes have not dislodged from the posts as a result of minor impacts.

### 7.1 Cable Tension

Flexfence is supplied with pre-stretched wire rope. The pre-stretching process removes the constructional stretch in the wires as they 'bed-down'. Wire rope is essentially an elastic member and will not require retensioning after most impacts. For fences subjected to regular vehicle impacts or large seasonal temperature variations, it may be necessary to evaluate the rope tension annually. This can be undertaken using the Flexfence Tension Unit.

### 7.2 Bush Fire Damage <sup>1</sup>

The performance of galvanized coatings when subjected to bushfire depends on a number of factors, such as flame duration, intensity and the characteristics of the galvanized coating and the technology with which it is applied.

Typical bushfire conditions may expose steel structures to air temperature of 800°C for periods of up to 120 seconds, however zinc coatings are generally reflective and will not absorb heat at the same rate as an uncoated steel surface. Depending on the section thickness of the steel, the actual steel surface temperatures may not exceed 350°C.

Typically, the bushfire flame duration and intensity are not high enough to compromise the structural strength of the steel. The hot dip galvanized coating will thus remain largely unaffected through a bushfire event. If the bushfire causes damage to the galvanized surface, then the item(s) shall be replaced.

### 7.3 Damage Assessment

In the event of a vehicle impact, damage to the barrier is to be assessed in accordance with Table 5. In the event that the ropes are to be cut, they are NOT to be cut under tension.

A Safe Work Method Statement is available upon request to assist in the safe repair of Flexfence.

<sup>1</sup> Information based upon testing conducted on behalf of BlueScope Steel by the CSIRO Manufacturing and Infrastructure Technology Bushfire CRC in 2005.

**Table 5: Damage Assessment**

Type of Defect	Description of the Defect	Action to be Taken
Galvanizing damage on Posts.	The sum total of the damaged or uncoated areas does not exceed 10cm <sup>2</sup> (0.5% of the total surface area). The sum total of the damaged or uncoated areas exceeds 10cm <sup>2</sup> (0.5% of the total surface area).	An organic zinc rich epoxy paint is to be applied to the repair areas in two coats. The post is to be replaced.
Galvanizing Damage on Wire Rope Cable	The wire rope is nicked or gouged to less than 10% depth. The wire rope is nicked or gouged greater than 10% depth.	An organic zinc rich epoxy paint is to be applied to the repair areas in two coats. The wire rope section is to be replaced.
Mechanical Damage on Wire Rope Cable (Refer drawing WR-STD-59 on page 14)	Any rope length containing more than 1 broken wire. Any rope where the diameter is reduced by more than 10% by abrasion. Any rope which has been crushed or flattened by more than 10% of its nominal diameter.	The rope section is to be replaced. The rope section is to be replaced The rope section is to be replaced.
Mechanical damage on Posts.	The post is distorted.	The post is to be replaced.
Damaged End Fitting	There is damage to the thread of the fitting, however tension can be maintained in the wire rope system without relying on the fitting.  There is damage to the thread of the fitting and tension cannot be maintained in the wire rope system without relying on the fitting. The fitting is cracked. The body of the fitting is distorted.	There is no requirement for immediate replacement. The location of the fitting should be noted and scheduled for replacement during routine maintenance.  The fitting is to be replaced.  The fitting is to be replaced. The fitting is to be replaced.
Damaged Tension Fitting	The fitting is cracked. The body of the fitting is distorted.	The fitting is to be replaced. The fitting is to be replaced.

## Flexfence Tensioning Report And Checklist

Customer:

Project:

Fence ID:

Fence Length:

Ambient Temperature:

Tensioning Force:

Checked By:

Signed:

Date

### End Anchors

Is the anchor block dimensions in accordance with Ingal drawings	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Has the anchor bracket been installed with the levelling plate at the same longitudinal grade as the roadway	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have safety check ropes been attached to the cables (drawing WR-STD-55 only)	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have the safety check ropes been attached to the anchor bracket (drawing WR-STD-55 only)	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Has each end fitting been secured with one washer and two nuts	<input type="checkbox"/> Yes	<input type="checkbox"/> No

### Post Fittings

Have the posts been installed at the correct spacing	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have the posts been installed with the correct orientation towards approaching traffic	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have ground covers been attached to the posts	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have plastic spacers been inserted between each cable	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Has the stainless frame been inserted between the top and second from top cable	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have post caps been attached to the posts	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Has delineation been attached to the post caps	<input type="checkbox"/> Yes	<input type="checkbox"/> No

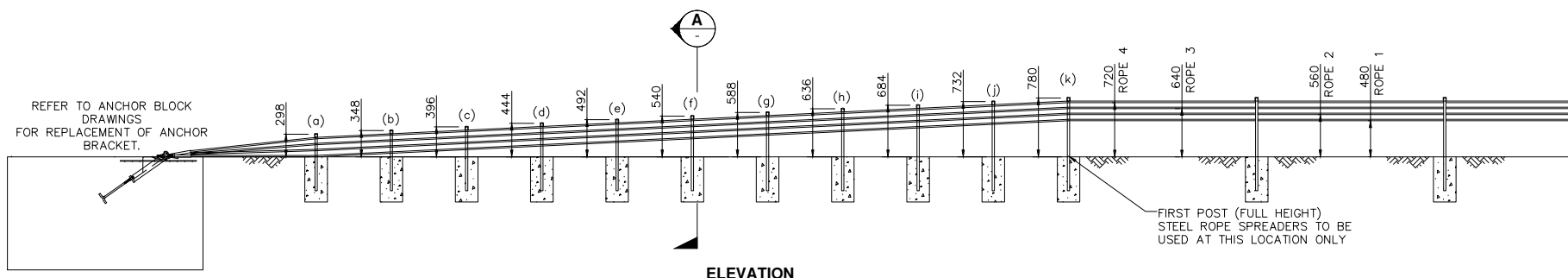
### Post Fittings – TL4 System Only

Have rope hooks been attached to each post along the length of need section	<input type="checkbox"/> Yes	<input type="checkbox"/> No
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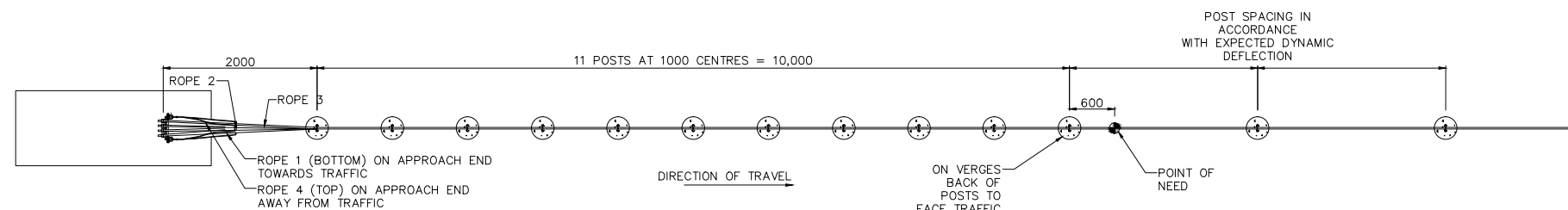
### Tension Bays

Have tension bays been installed at not more than 150m from the end anchors	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have tension Bays been installed at not more than 300m apart	<input type="checkbox"/> Yes	<input type="checkbox"/> No



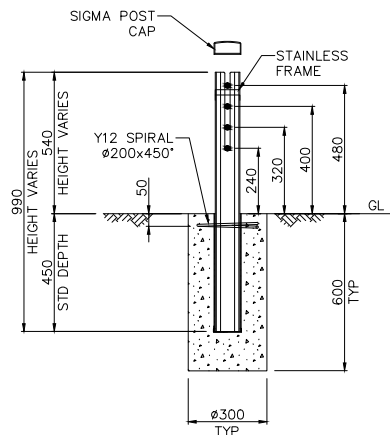
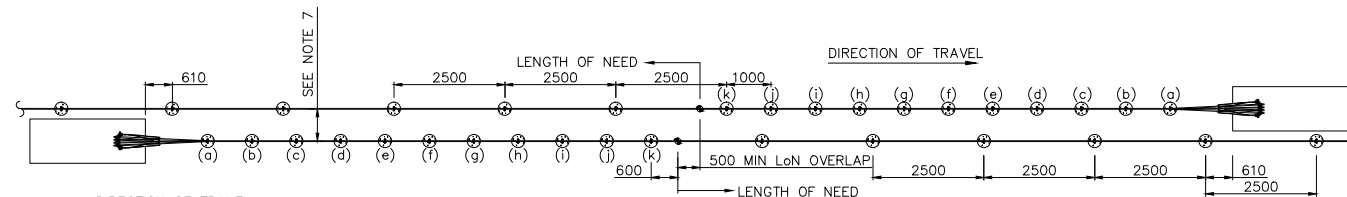


ELEVATION



PLAN

ITEM No.	POST LENGTH
a	748
b	798
c	846
d	894
e	942
f	990
g	1038
h	1086
i	1134
j	1182
k	1230

SECTION A  
NTSINTERMEDIATE ANCHOR GENERAL ARRANGEMENT  
(DIMENSIONS INDICATIVE OF 2.5m BARRIER POST SPACING)

## NOTES:

1. DIMENSIONS SHOWN ARE IN mm UNLESS OTHERWISE STATED.
2. THE FLEXFENCE TL3 TERMINAL HAS BEEN APPROVED BY THE US FEDERAL HIGHWAY ADMINISTRATION AS CONFORMING TO NCHRP REPORT 350 TEST LEVEL 3 (TL3) IN A 3 ROPE AND A 4 ROPE CONFIGURATION.
3. THE USE OF A 3 ROPE CONFIGURATION REQUIRES THE OMITANCE OF THE SECOND FROM BOTTOM CABLE.
4. ICP DISTRIBUTE THIS WRSB SYSTEM UNDER THE PRODUCT NAME SAFENCE IN NEW ZEALAND. REFER NZTA APPROVAL LETTER FOR APPROVED CONFIGURATION.
5. LENGTH OF NEED OVERLAP FOR INTERMEDIATE ANCHOR TO BE 500mm FOR A FLEXFENCE INSTALLATION WITH A POST SPACING OF 2.5m, CONTACT YOUR ICP REPRESENTATIVE FOR OVERLAP WHEN USING A DIFFERENT POST SPACING.
6. SAFETY CHECK ROPES NO LONGER REQUIRED ON THIS TERMINAL.
7. DISTANCE BETWEEN TERMINALS MUST BE GREATER THAN OR EQUAL TO ITS DYNAMIC DEFLECTION.

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	TITLE	INGAL CIVIL PRODUCTS REFERENCE No.
10	16/01/17	NOTE 7 ADDED	MC	LG	LG			AUSTEC	02/11/2011	FLEXFENCE	TL3 END TERMINAL	
9	13/12/16	CHECK ROPE REMOVAL	MC	LG	LG			TC	02/11/2011	WIRE ROPE SAFETY BARRIER		
8	29/01/16	INTERMEDIATE ANCHOR - NOTE ADDITION	LG					TC	02/11/2011			
7	01/08/14	STEEL ROPE SPREADERS ADDED	LG	LRB	LG							
6	15/04/13	INTERMEDIATE ANCHOR DETAIL ADDED	LG	LRB	LG							
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	TITLE	INGAL CIVIL PRODUCTS REFERENCE No.
SCALE	NTS											
SIZE	A1											



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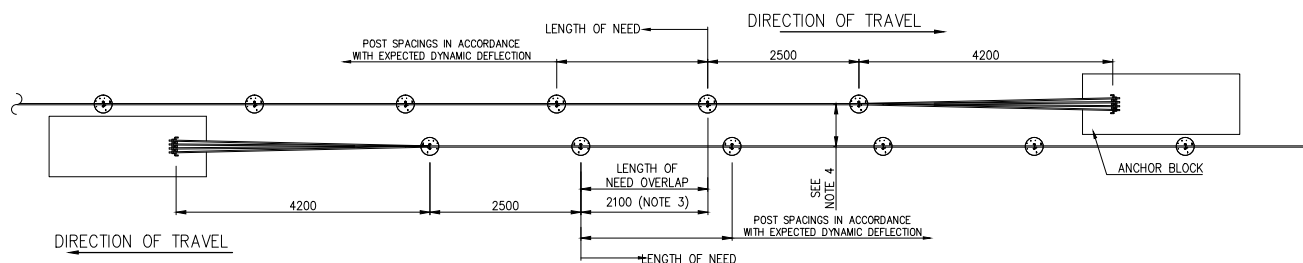
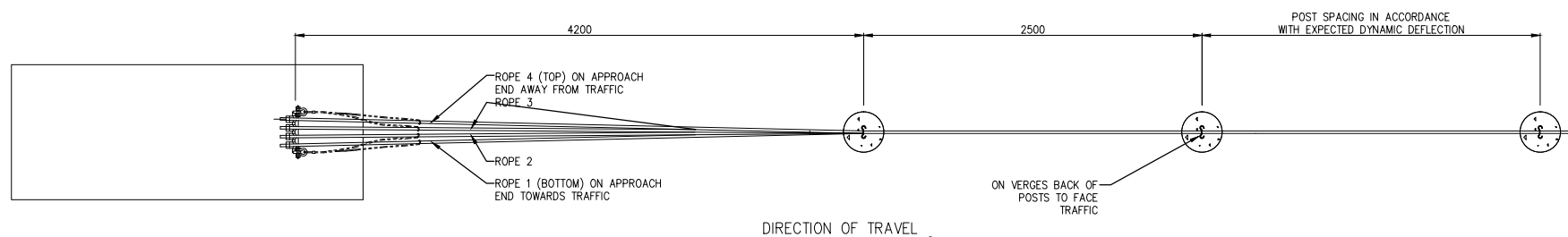
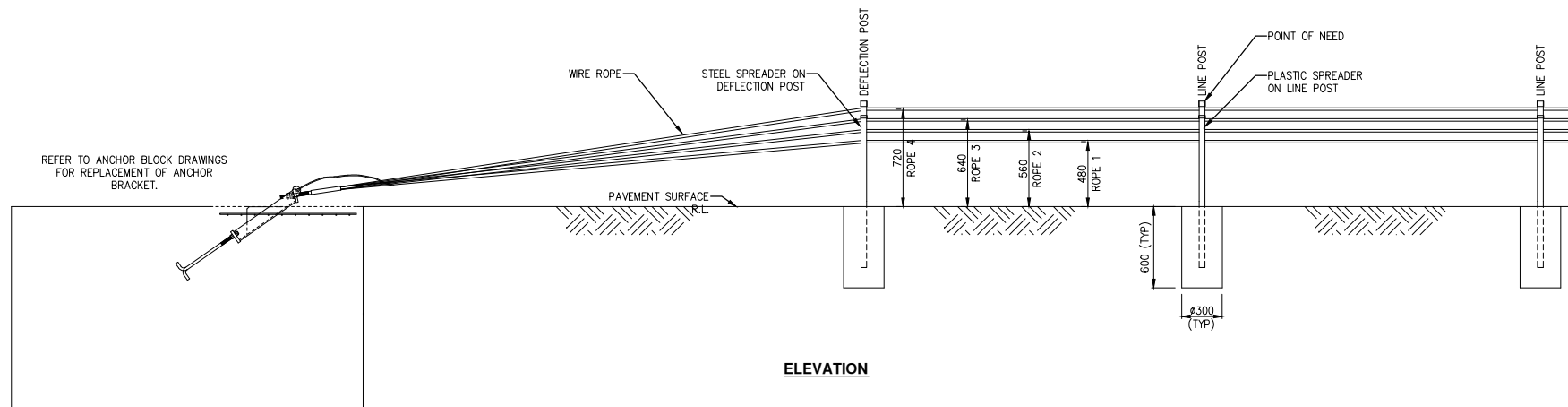
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CIVIL PRODUCTS

PROJECT  
FLEXFENCE  
WIRE ROPE SAFETY BARRIER

TITLE  
TL3 END TERMINAL

INGAL CIVIL PRODUCTS  
REFERENCE No.  
DRAWING No.  
WR-STD-050

REV. 10



Use of this terminal is limited to locations where geometric constraints limit use of TL3 Terminal. Please contact your local ICP representative for further advice prior to design or installation. Approval may be required from road controlling authority.

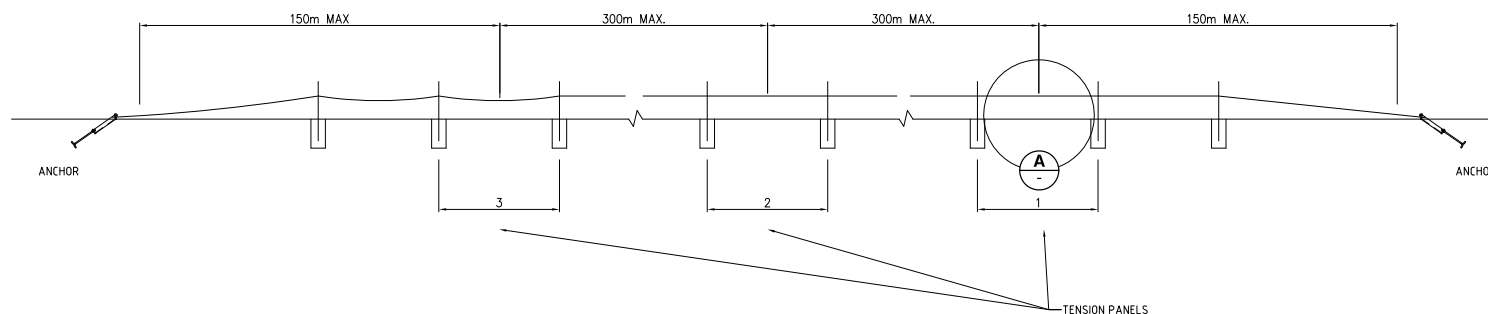
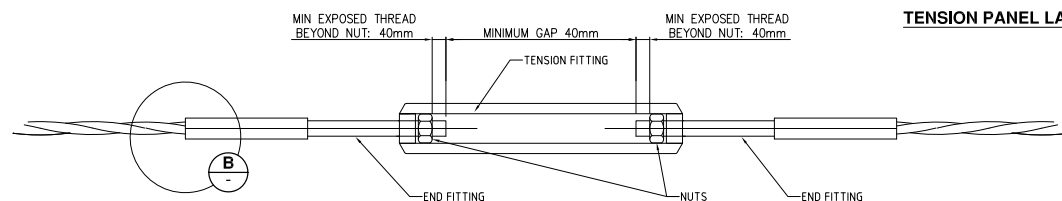
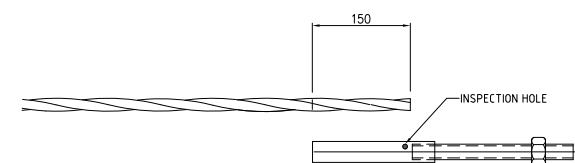
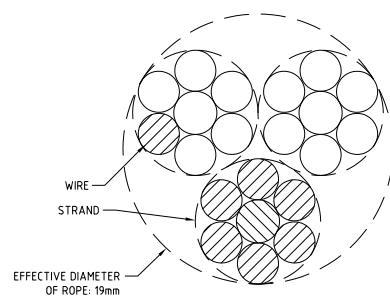
#### NOTES:

- DIMENSIONS SHOWN ARE IN mm UNLESS OTHERWISE STATED.
- ICP DISTRIBUTE THIS WRSB SYSTEM UNDER THE PRODUCT NAME SAFENCE IN NEW ZEALAND. REFER NZTA APPROVAL LETTER FOR APPROVED CONFIGURATION.
- LENGTH OF NEED OVERLAP FOR INTERMEDIATE ANCHOR TO BE 2100mm FOR A FLEXFENCE INSTALLATION WITH A POST SPACING OF 2.5m. CONTACT YOUR ICP REPRESENTATIVE FOR OVERLAP WHEN USING A DIFFERENT POST SPACING.
- DISTANCE BETWEEN TERMINALS MUST BE GREATER THAN OR EQUAL TO ITS DYNAMIC DEFLECTION.


REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	TITLE	INGAL CIVIL PRODUCTS PART No.																																																																																																																					
8	16-01-17	NOTE 4 ADDED	MC	LG	LG																																																																																																																												
7	08-04-13	INTERMEDIATE CROSS-OVER ANCHOR DETAIL ADDED	LG	LRB	LG																																																																																																																												
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<table border="1"> <tr> <td>REV</td><td>DATE</td><td>DESCRIPTION</td><td>DRAWN</td><td>CHECKED</td><td>APPROVED</td><td>DRAWING NUMBER</td><td>REFERENCE DRAWINGS</td><td>NAME</td><td>DATE</td><td>PROJECT</td><td>TITLE</td><td>INGAL CIVIL PRODUCTS PART No.</td></tr> <tr> <td>8</td><td>16-01-17</td><td>NOTE 4 ADDED</td><td>MC</td><td>LG</td><td>LG</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>7</td><td>08-04-13</td><td>INTERMEDIATE CROSS-OVER ANCHOR DETAIL ADDED</td><td>LG</td><td>LRB</td><td>LG</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>6</td><td>08/02/13</td><td>SAFENCE NOTE ADDED</td><td>LG</td><td>SE</td><td>LRB</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>5</td><td>02/11/11</td><td>TITLE BLOCK UPDATED</td><td>DJB</td><td>TC</td><td>TC</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>4</td><td>08/02/10</td><td>DETAILS UPDATED</td><td>MS</td><td>TC</td><td>TC</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>3</td><td>24/04/03</td><td>TITLE AMENDED</td><td>XX</td><td>TC</td><td>TC</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>2</td><td>09/02/01</td><td>NOTES AND TITLE AMENDED</td><td>AJP</td><td>TC</td><td>TC</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>1</td><td>26/06/00</td><td>INITIAL ISSUE</td><td>AJP</td><td>TC</td><td>TC</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>													REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	TITLE	INGAL CIVIL PRODUCTS PART No.	8	16-01-17	NOTE 4 ADDED	MC	LG	LG								7	08-04-13	INTERMEDIATE CROSS-OVER ANCHOR DETAIL ADDED	LG	LRB	LG								6	08/02/13	SAFENCE NOTE ADDED	LG	SE	LRB								5	02/11/11	TITLE BLOCK UPDATED	DJB	TC	TC								4	08/02/10	DETAILS UPDATED	MS	TC	TC								3	24/04/03	TITLE AMENDED	XX	TC	TC								2	09/02/01	NOTES AND TITLE AMENDED	AJP	TC	TC								1	26/06/00	INITIAL ISSUE	AJP	TC	TC							
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<b>STANDARD END TERMINAL 4-ROPE CONFIGURATION</b>												WR-STD-55																																																																																																																					
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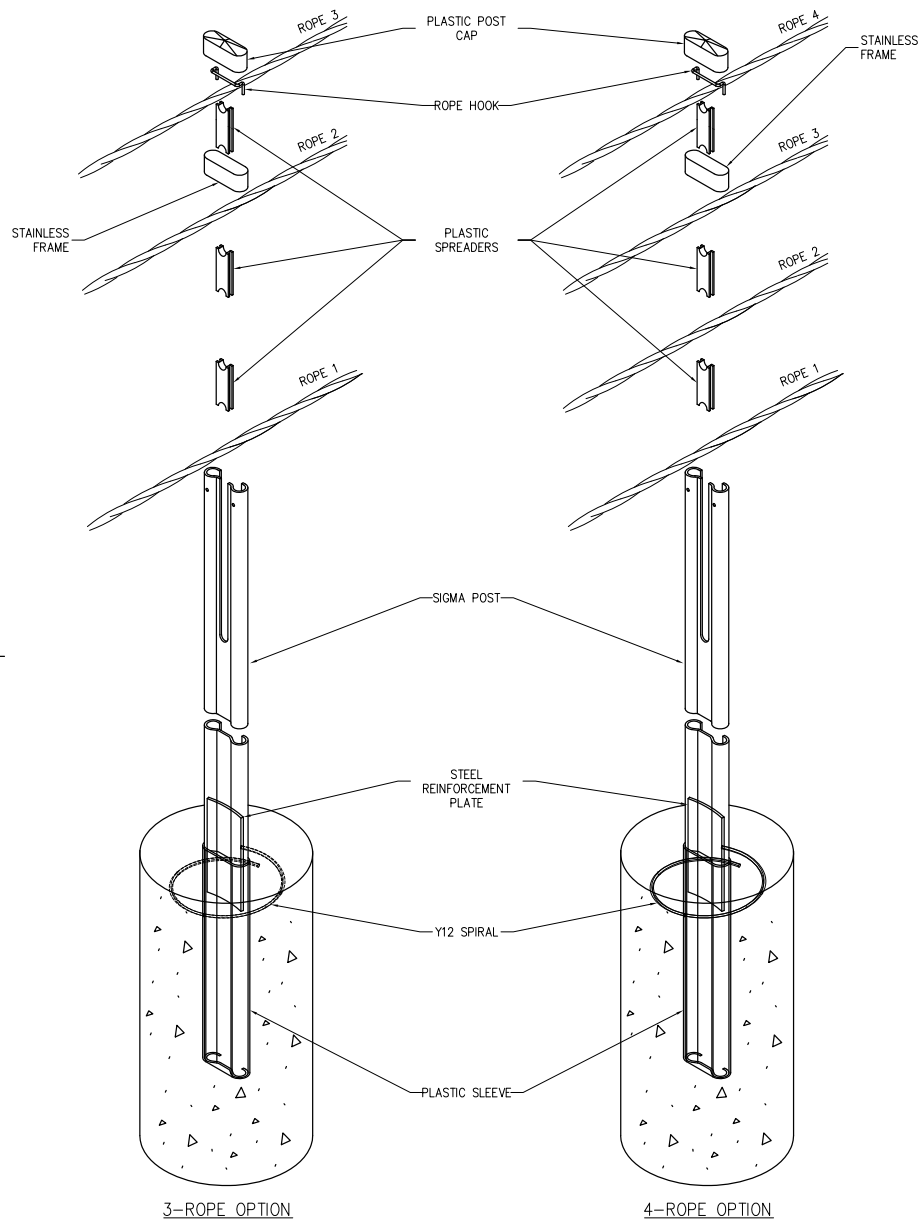
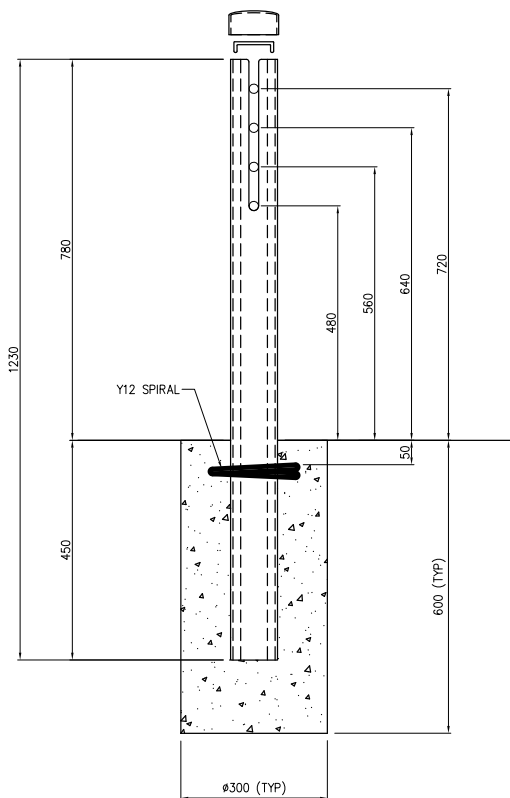
**TENSION PANEL LAYOUT****DETAIL A**  
NTS**DETAIL B**  
NTS**CROSS-SECTION OF ROPE**  
7 WIRES PER STRAND  
3 STRANDS PER ROPE**NOTES:**

1. ALL MEASUREMENTS ARE IN mm UNLESS STATED OTHERWISE.

REVISIONS						REFERENCES						INGAL CIVIL PRODUCTS 57-65 AIRDS ROAD MINTO, N.S.W. AUSTRALIA 2566 PH. +61 2 9827 3333 FAX +61 2 9827 3300 www.ingalcivil.com.au	PROJECT FLEXFENCE WIRE ROPE SAFETY BARRIER	INGAL CIVIL PRODUCTS REFERENCE No.
	6	09-08-2018	DBMS ADDED TO DETAIL A	VB	LG		LG	DRAWN	AUSTEC	2/11/2011				
	5	22-09-2017	ROPE SECTION ADDED	MC	LG		LG	CHECKED	TC	2/11/2011				
	4	08/02/13	NOTES ADDED	LG	SE		LRB	APPROVED	TC	2/11/2011				
	3	02/11/11	TITLE BLOCK UPDATED	DJB	TC		TC	SCALE	NTS					
	2	25/02/10	TITLE BLOCK UPDATED	MS	TC		TC	SIZE	A1					
	1	13/07/06	INITIAL ISSUE	AJP	TC		TC							
	REV	DATE	DESCRIPTION	DRAWN	CHECKED		APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS					

										NAME		DATE		INGAL CIVIL PRODUCTS 57-65 AIRDS ROAD MINTO, N.S.W. AUSTRALIA 2566 PH. +61 2 9827 3333 FAX +61 2 9827 3300 www.ingalcivil.com.au	PROJECT FLEXFENCE WIRE ROPE SAFETY BARRIER	INGAL CIVIL PRODUCTS REFERENCE No.	
										DRAWN	AUSTEC	2/11/2011					
										CHECKED	TC	2/11/2011					
										APPROVED	TC	2/11/2011					
										SCALE	NTS						
										SIZE	A1				DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS	TITLE TENSION PANEL ARRANGEMENT	DRAWING No. WR-STD-59
										NAME		DATE			DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS	TITLE TENSION PANEL ARRANGEMENT	DRAWING No. WR-STD-59
										DRAWN	AUSTEC	2/11/2011					
										CHECKED	TC	2/11/2011					
										APPROVED	TC	2/11/2011					
										SCALE	NTS						
										SIZE	A1						





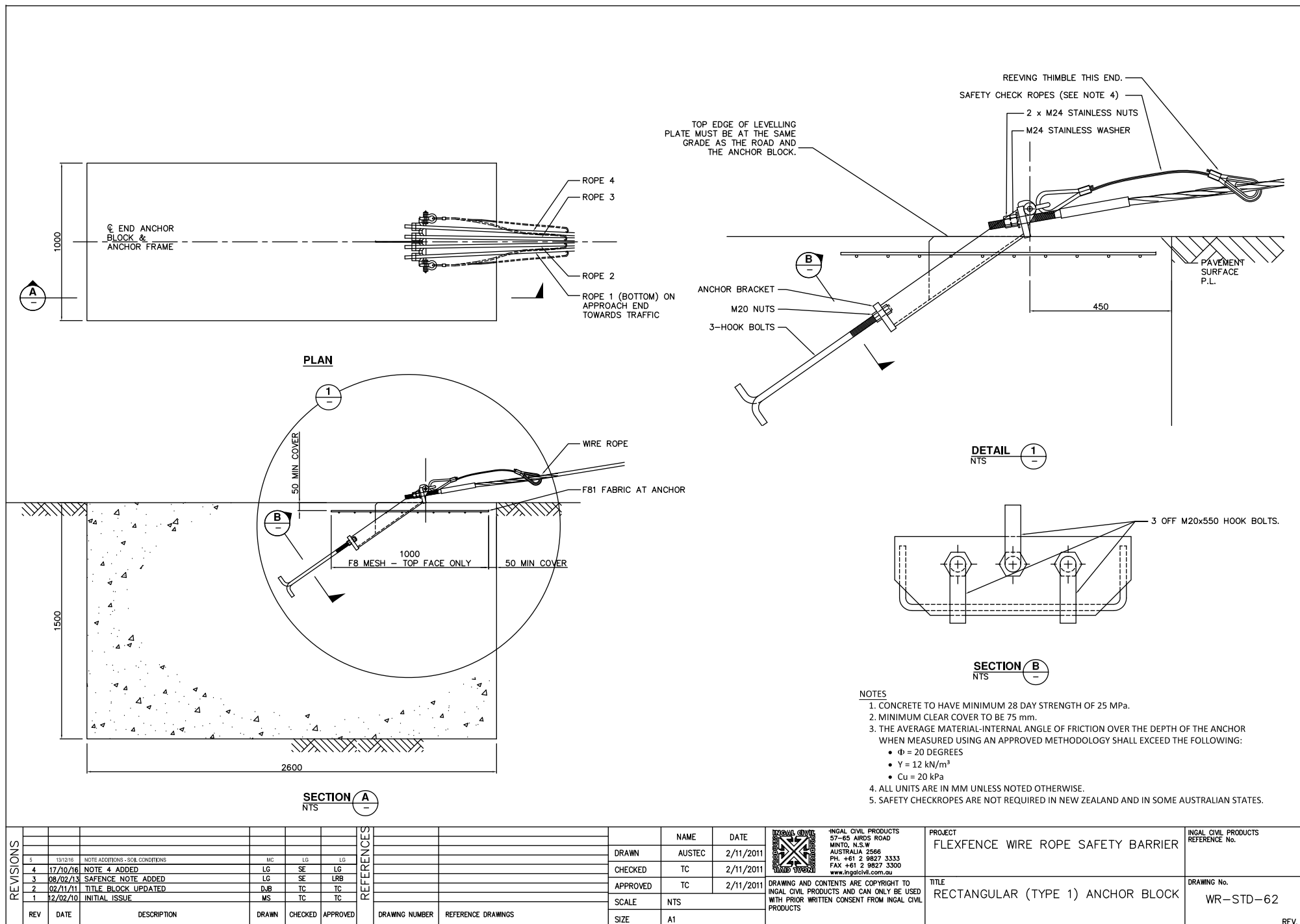
#### NOTES:

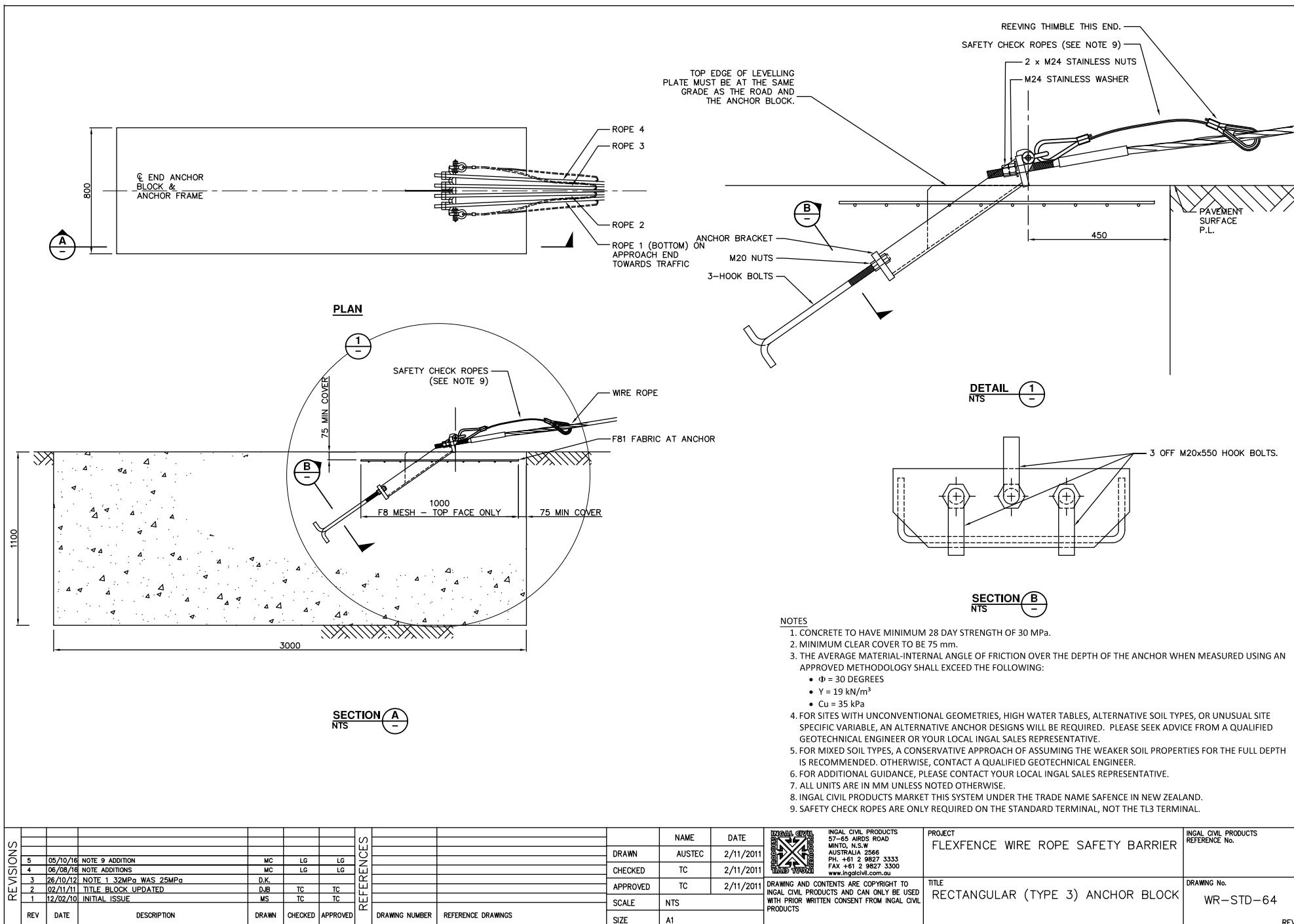
- THE IMPACT CONDITIONS ARE DESCRIBED AS FOLLOWS:
  - TL3 REFERS TO NCHRP REPORT 350 TEST LEVEL 3. THIS IS AN IMPACT WITH A 2,000KG PICK-UP TRUCK TRAVELING AT 100KM/H AND 25 DEGREES.
  - TL4 REFERS TO NCHRP REPORT 350 TEST LEVEL 4. THIS IS AN IMPACT WITH AN 8,000KG RIGID TRUCK TRAVELING AT 80KM/H AND 15 DEGREES. FLEXFENCE TL4 HAS BEEN APPROVED BY THE US FEDERAL HIGHWAY ADMINISTRATION AS A 3 ROPE OR 4 ROPE BARRIER.
- THE DYNAMIC DEFLECTION VALUES SHOULD NOT BE CONSIDERED AN EXACT DISTANCE, BUT RATHER AS A SINGLE POINT WITHIN THE RANGE OF DEFLECTIONS THAT CAN BE EXPECTED.
- STATE ROAD AUTHORITY SPECIFICATIONS SHOULD BE REFERENCED TO OBTAIN APPROVED POST SPACINGS AND RELEVANT MULTIPLYING FACTORS FOR INSTALLATIONS ON CURVES AND/OR VARIATIONS IN BARRIER LENGTHS (IF REQUIRED).
- SIZES OF CONCRETE POST FOOTINGS ARE DEPENDANT UPON LOCAL GROUND CONDITIONS. REFER TO FLEXFENCE PRODUCT MANUAL FOR FOOTING SIZE OPTIONS.
- DIMENSIONS SHOWN ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED
- ICP DISTRIBUTE THIS WRSB SYSTEM UNDER THE PRODUCT NAME SAFENCE IN NEW ZEALAND. REFER NZTA APPROVAL LETTER FOR APPROVED CONFIGURATION.

POST SPACING (M)	DYNAMIC DEFLECTION (M)	
	TL3*	TL4*
2.0	1.3	1.1
2.5	1.4	1.2
3.0	1.6	1.3

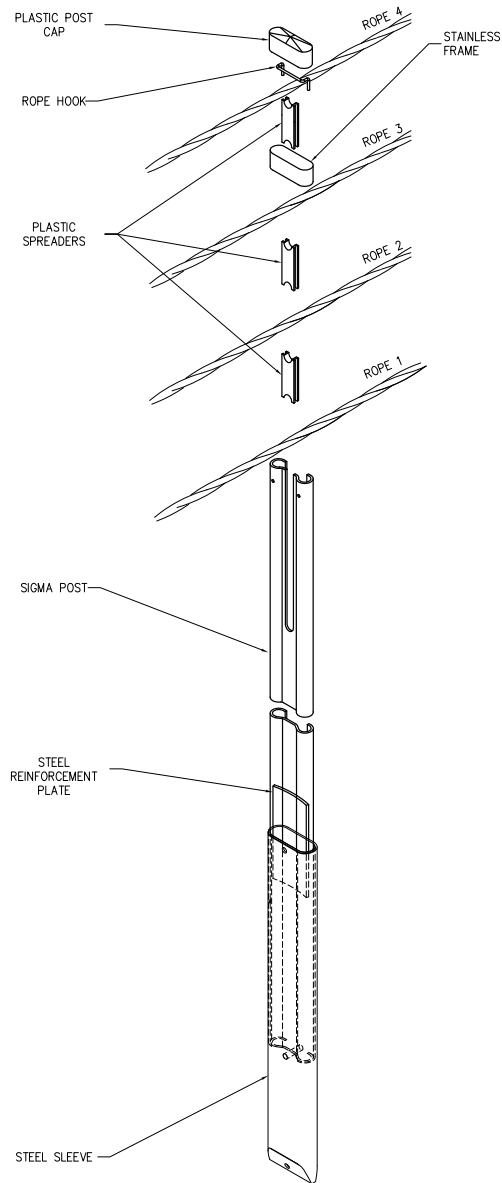
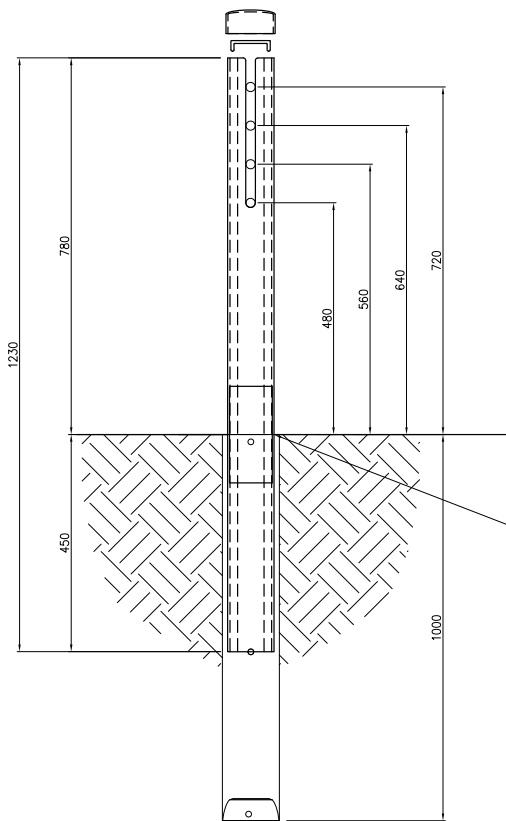
\* CABLE TENSION SET TO 25KN

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	TITLE	DRAWING No.
7	08/02/13	SAFENCE NOTE ADDED & DEFLECTION UPDATED	LG	SE	LRB							
6	02/11/11	TITLE BLOCK UPDATED	DJB	TC	TC							
5	04/05/10	NOTES AMENDED	MS	TC	TC							
4	06/02/10	NOTES AMENDED	MS	TC	TC							
3	28/07/09	TITLE AMENDED	MS	TC	TC							
2	24/04/07	TITLE AMENDED	AJP	TC	TC							
1	09/02/07	NOTES AND TITLE AMENDED	AJP	TC	TC							
0	06/07/06	INITIAL ISSUE	AJP	TC	TC							
<div> <div> <p>INGAL CIVIL PRODUCTS 57-65 ARDS ROAD MINTO, N.S.W AUSTRALIA 2566 PH: +61 2 9827 3333 FAX: +61 2 9827 3300 www.ingalcivil.com.au</p> </div> <div> <p>DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS</p> </div> </div>												
									SCALE	NTS		
									SIZE	A1		
FLEXFENCE WIRE ROPE SAFETY BARRIER											TL4 POST ARRANGEMENT	WR-STD-60
												REV. 7





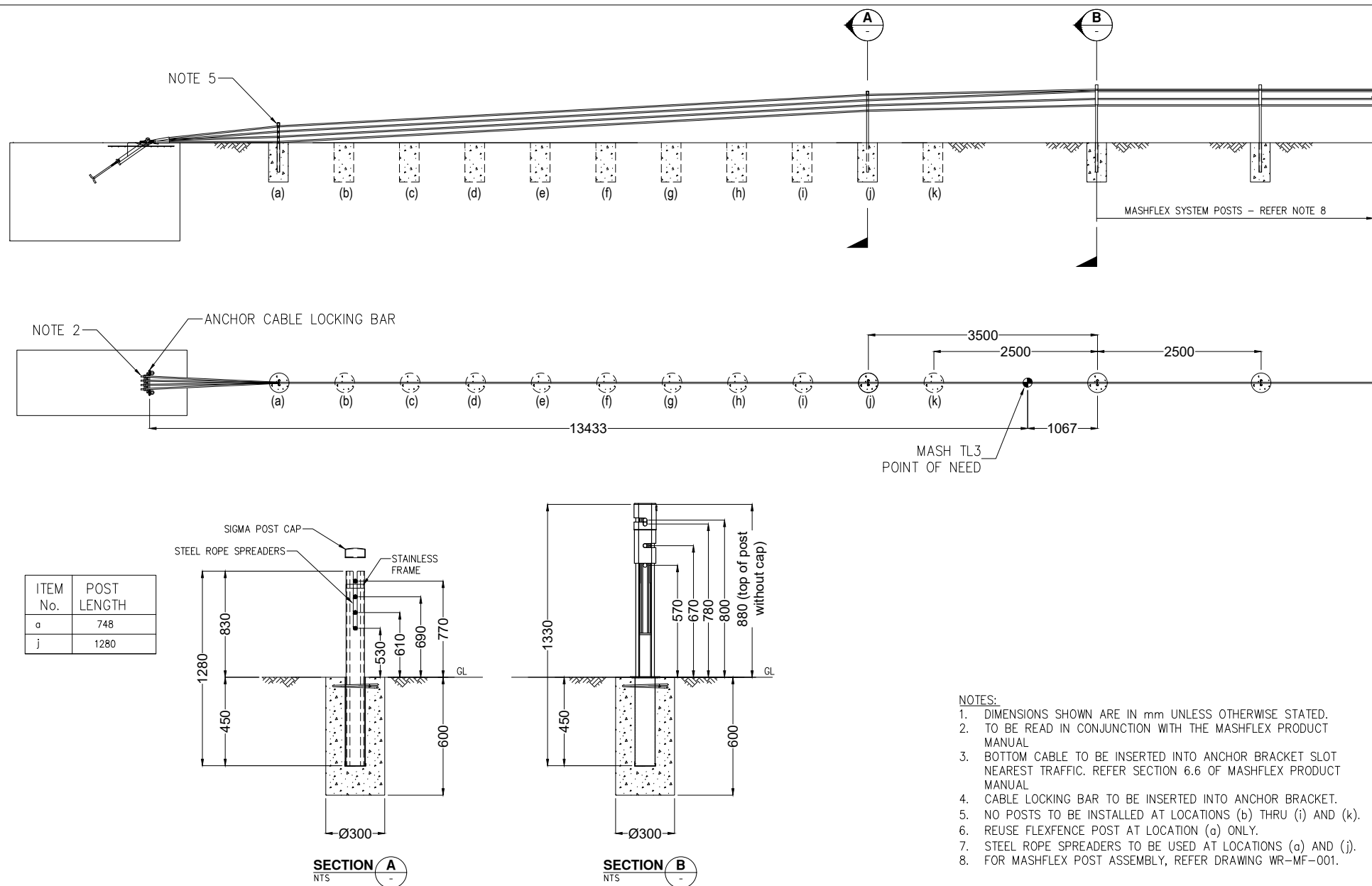




#### NOTES:

- THE IMPACT CONDITIONS ARE DESCRIBED AS FOLLOWS:  
a) TL3 REFERS TO NCHRP REPORT 350 TEST LEVEL 3. THIS IS AN IMPACT WITH A 2,000KG PICK-UP TRUCK TRAVELING AT 100KM/H AND 25°.  
b) TL4 REFERS TO NCHRP REPORT 350 TEST LEVEL 4. THIS IS AN IMPACT WITH AN 8,000KG RIGID TRUCK TRAVELING AT 80KM/H AND 15°. FLEXFENCE TL4 HAS BEEN APPROVED BY THE US FEDERAL HIGHWAY ADMINISTRATION AS A 3 ROPE OR 4 ROPE BARRIER.
- THE DYNAMIC DEFLECTION VALUES SHOULD NOT BE CONSIDERED AN EXACT DISTANCE, BUT RATHER AS A SINGLE POINT WITHIN THE RANGE OF DEFLECTIONS THAT CAN BE EXPECTED.
- STATE ROAD AUTHORITY SPECIFICATIONS SHOULD BE REFERENCED TO OBTAIN APPROVED POST SPACINGS AND RELEVANT MULTIPLYING FACTORS FOR INSTALLATIONS ON CURVES AND/OR VARIATIONS IN BARRIER LENGTHS (IF REQUIRED).
- DIMENSIONS SHOWN ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED
- ICP DISTRIBUTE THIS WRSB SYSTEM UNDER THE PRODUCT NAME SAFENCE IN NEW ZEALAND. REFER NZTA APPROVAL LETTER FOR APPROVED CONFIGURATION.
- CABLE TENSION 25kN @ 20°C AMBIENT AIR TEMP.
- SOIL TO MEET OR EXCEED THE REQUIREMENTS FOR AASHTO STANDARD SOIL OR RMS-R44 VERGE MATERIAL (Min CBR 15%, PLASTICITY INDEX:  $\geq 6$  AND  $\leq 12$ ).

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	INGAL CIVIL PRODUCTS 57-65 ARDS ROAD MINTO, N.S.W AUSTRALIA 2566 PH. +61 2 9827 3333 FAX +61 2 9827 3300 www.ingalcivil.com.au	PROJECT FLEXFENCE WIRE ROPE SAFETY BARRIER	INGAL CIVIL PRODUCTS REFERENCE No.
3	15-05-2017	NOTE ADDITIONS	MC	LG	LG			DRAWN	MC	12-12-2015		
2	14-03-2017	NOTE ADDITIONS		LG				CHECKED	LG	12-12-2015		
1	22-08-2016	SLEEVE EXTENDED TO 1000mm		LG				APPROVED				
								SCALE	NTS		TITLE TL4 POST DRIVEN SLEEVE ARRANGEMENT	DRAWING No. WR-STD-86
								SIZE	A1			REV. 3



REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	TITLE	INGAL CIVIL PRODUCTS PART No.	DRAWING No.	Rev
0		ORIGINAL ISSUE										N/A	WR-STD-89	0

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*For more information*

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Email: [sales@ingalcivil.com.au](mailto:sales@ingalcivil.com.au)

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