INGAL CIVIL PRODUCTS

A valmont COMPANY

T-39 Thriebeam

NCHRP 350 Test Level 3 & 4 Compliant Barrier

Product Manual

Release 01/11

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T-39 Thriebeam NCHRP 350 Test Level 3&4 Compliant Barrier

1.0 Introduction

T-39 Thriebeam Barrier is the latest innovation in steel safety barrier systems providing superior design, rapid installation and driver confidence. T-39 has been fully crash tested and evaluated according to specifications for Test Level 3 (TL3) and Test Level 4 (TL4) of the US National Cooperative Highway Research Program Report 350 (NCHRP Report 350) and the anticipated update to NCHRP Report 350.

Traditional 'deemed to comply' C posts have been replaced with specially engineered Steel Yielding Line Posts (SYLP's) in order to prevent vehicle snagging, thus eliminating the requirement for blocking pieces. This, together with rail splices located mid-span between posts, results in reduced working widths, an easier to install system and a fully compliant NCHRP Report 350 safety barrier.

2.0 Standards and Approvals

T-39 has been fully crash tested to comply with the following standards;

- Australian Standard AS/NZS 3845:1999
- National Cooperative Highway Research Program (NCHRP) Report 350

  Test Level 3 (TL3) and Test Level 4 (TL4)

3.0 Barrier Specification

Dimensions:	
T-39 Panel:	4000mm net laying length
SYLP:	1830mm long
Flange Protector:	150mm long w-beam section
Post Bolt:	5/8" x 1.75" slotted countersunk bolt
Splice Bolt:	M16 x 32mm mushroom head, grade 8.8
Barrier Height:	990mm above ground level
Post Height:	813mm above ground level
Post Spacing:	2000mm
System Width:	316mm (median barrier) 233mm (verge barrier)
Finish:	Galvanized to AS/NZS 4680:2006

4.0 Technical Data

4.1 Functional Principles

T-39 contains errant vehicles through the development of lateral forces, which gradually redirect the vehicle toward the roadway. During impact, lateral resistance is developed as the beam deflects laterally. As it deflects and stretches, large tensile forces develop in the beam and redirect the vehicle.

In addition to the tensile forces, the beam, which is supported at regular intervals by the SYLP's, also develops considerable bending resistance, which imparts additional redirective forces to the vehicle.

Structural failure of traditional steel safety barrier systems during impact is occasionally the result of splice connections when it is located near a post. The T-39 system has relocated the splice to the mid-span of the beam in order to reduce splice stresses and reduce the likelihood of rail rupture.

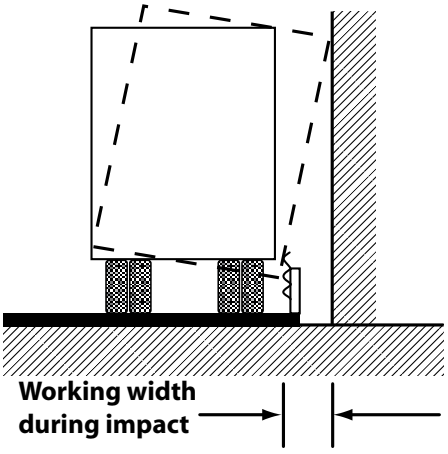


Figure 1: Working Width for TL4 Impact

4.2 Barrier Deflection

The working width is defined as the maximum width measured from the barrier face 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 the impacting vehicle. T-39 deflections and working widths are detailed in Table 1.

Table 1: T-39 Deflections & Working Widths

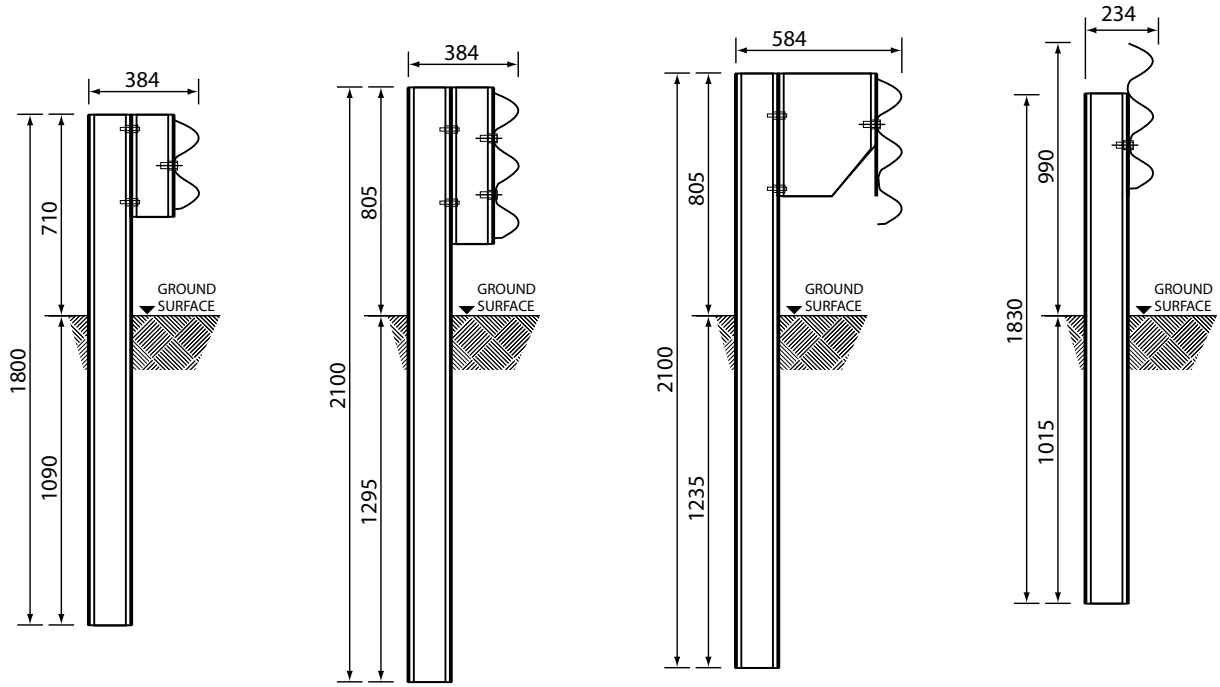
Vehicle Type	Impact Conditions	Barrier Configuration	Evaluation	Dynamic Deflection	Working Width
820kg Small Car	100km/h at 20°	Median Barrier	Crash Test	0.34m	0.88m
2270kg Pick-Up Truck (TL2)	70km/h at 25°	Verge Barrier	Calculation	0.35m	0.35m
2270kg Pick-Up Truck (TL3)	100km/h at 25°	Verge Barrier	Crash Test	0.63m	0.63m
8000kg Single Unit Truck (TL4)	80km/h at 15°	Verge Barrier	Crash Test	0.81m[1]	1.86m

[1] During the TL4 Impact (8000kg Single Unit Truck), the truck box exhibited an estimated roll angle of over 30° and extended more than 1m beyond the deflected rail. This area must be kept free of rigid vertical objects such as overhead/cantilever sign support and bridge piers when specified as a TL4 barrier. Refer to Figure 1.
When specified as a TL3 barrier, the working width is equivalent to the dynamic deflection of the system.

5.0 Application Benefits

The T-39 Thriebeam Barrier offers the following application benefits when compared to existing 'deemed to comply' barrier systems with C posts;

- Fully compliant to NCHRP Report 350 Test Level 3 (TL3) and Test Level 4 (TL4)
- Reduced working widths and site earthworks since posts can be installed 350mm closer to the roadway (as compared to the current TL4 'deemed to comply' system).
- No blocking pieces required provides for a more easily installed and maintained system.
- Successfully crash tested as a verge (single sided) and median (double-sided) barrier.



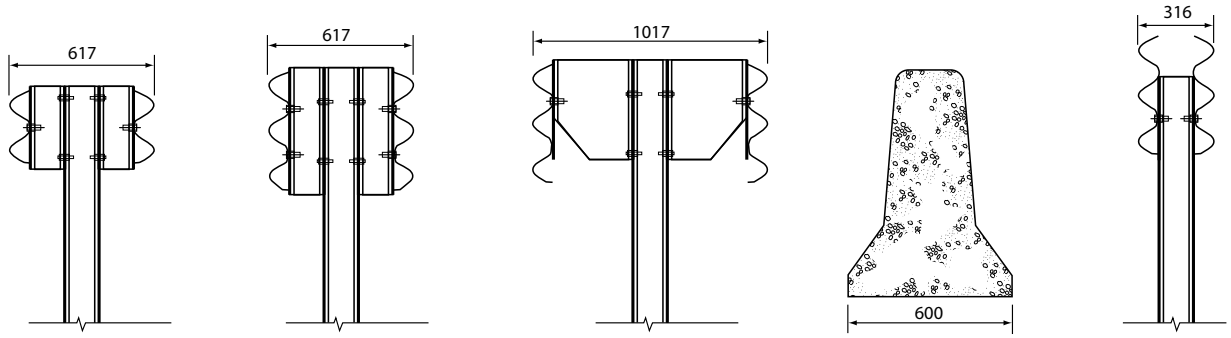
G4 W BEAM*
TL3 'Deemed to Comply'

G9 THRIEBEAM*
TL3 'Deemed to Comply'

G9 THRIEBEAM – Modified*
TL4 'Deemed to Comply'

T-39
TL3 & TL4 Compliant

Figure 2: Barrier Comparisons – Verge Applications (*Denotes with C posts)



G4 W BEAM

G9 THRIEBEAM

G9 THRIEBEAM Modified

CONCRETE

T-39

Figure 3: Barrier Comparisons – Median Applications

6.0 Installation

6.1 Site Preparation

T-39 should be located at least 600mm (measured from back of post) in front of embankments that require shielding. This distance is required to provide proper post support.

The approach terrain to the barrier must be level. Grading to 1:20 is preferable and 1:10 maximum slope should be present. Steeper slopes can result in the vehicle impacting the barrier at other than the design height.

The distance between T-39 and the hazard should accommodate the expected deflection of the barrier as detailed in Table 1.

Ensure the area has been inspected for underground hazards and that suitable traffic control is in place.

6.2 Recommended PPE

The following Personal Protective Equipment (PPE) is recommended for the installation of T-39;

- Hard hat (if required by the site supervisor)
- Footwear offering a minimum of steel toe caps and adequate ankle support
- Hi visibility vests or clothing
- Ear protection
- Protective gloves
- Eye Protection
- Sun protection (wide brimmed hat, sleeved shirt, sunscreen)

6.3 Installation Sequence

The following written instructions should be read in conjunction with the enclosed Ingal Civil Products Drawings:

DEV-06-04-01	T-39 Verge Application General Arrangement
DEV-06-04-02	T-39 Verge Application Assembly
DEV-06-04-05	T-39 Transition to Type B Guardfence (Victoria)
DEV-06-04-06	T-39 Transition to G4 W Beam

6.3.1 Installation of Posts

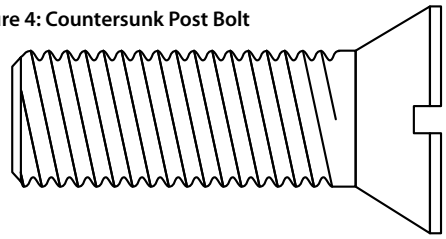
1. Post locations are marked ensuring the hazard to be protected is located outside the expected working width of the barrier.
2. Posts are installed at 2000mm centres. The tolerance on post spacing shall be plus or minus 25mm. The posts are driven directly into the ground and should be vertical. (The post installation process shall not cause damage to the post, such that it reduces the effective operation of the safety barrier or its design life, or introduces sharp tearing edges, nor shall it cause damage to pavement). Alternately, a hole can be augured and the post placed in the hole. The posthole is then backfilled with the material that was excavated. Material should be placed in layers and suitably compacted. The posts should be installed to a depth of 1015mm. The four 21mm diameter holes in the posts should located be at ground level when installation is complete.

   If rock is encountered, posts should be set near the roadside edge of a 530mm to 580mm hole drilled to a depth of 610mm and backfilled with a granular, compressible material so that the post can rotate back at the groundline upon impact. The size and depth of the drilled hole may vary depending upon the depth of soil above the rock. Please refer to Section 6.4 for details.
3. When a lateral force of 1kN is applied in any direction within the top 200mm of a post before the rail is secured, movement of the post at ground level shall not be more than 3mm

6.3.2 Installation of Rails

1. The holes in the rails for attachment to the posts are slotted to allow for tolerances in post spacing. If the post and rails are out of alignment, holes may be drilled into the rail and the rail may be saw cut. Flame cutting is not permitted. Coating repairs are to be carried out using a zinc rich paint or metallic repair product.
2. Rails are attached to the posts using the 5/8" countersunk bolts.

Figure 4: Countersunk Post Bolt



3. The rails are spliced mid-span between posts using M16x32mm mushroom head bolts. Washers are NOT used.
4. W-beam flange protectors are located between the rail and post connection. The flange protector nests in the bottom two corrugations of the beam as the beam bears against the post.
5. It is recommended that posts be installed only a few metres ahead of rail assembly to ensure correct post spacing and alignment. On curves, the rails can be laid on the ground to determine post locations.
6. The tolerance on the height of the barrier is plus or minus 20mm.

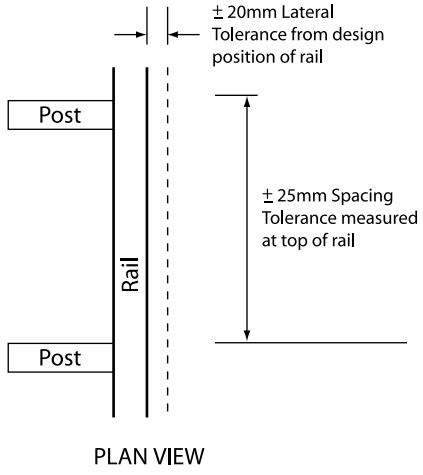


Figure 5: Post Tolerances Plan View

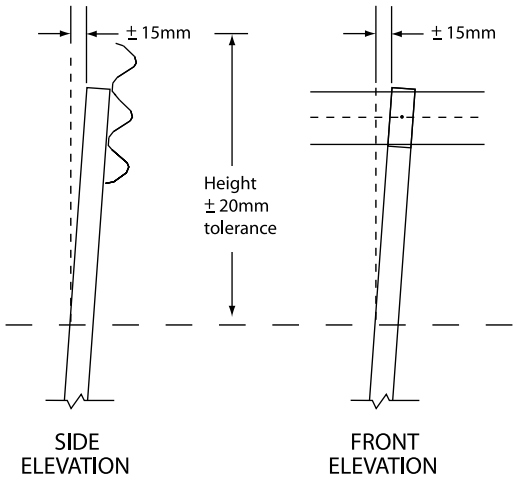


Figure 6: Post Tolerances - Side & Front View

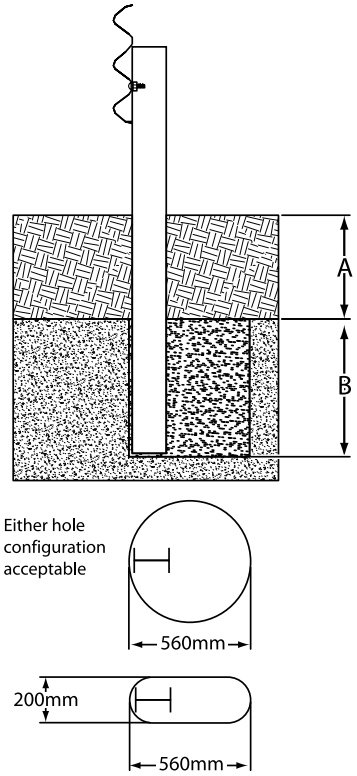
Table 2: T-39 Installation Checklist		
To ensure the correct installation of T-39, you must have answered yes for each question.		
Is the hazard to be shielded located outside the expected dynamic deflection of T-39	☐ Yes	☐ No
Have the posts been positioned at 2000mm spacings	☐ Yes	☐ No
Are the posts installed at the correct height of 815mm	☐ Yes	☐ No
Have the posts been installed within the allowable tolerances;	☐ Yes	☐ No
• Post spacing ± 25mm		
• Post height ± 20mm		
Has the rail been spliced observing the correct rail lap	☐ Yes	☐ No
Are the rail laps located mid-span between posts	☐ Yes	☐ No
Are the flange protectors installed behind the rail at each post location	☐ Yes	☐ No
Are the rails attached to the posts using the countersunk head bolt	☐ Yes	☐ No
Are the rails spliced with M16x32mm mushroom head bolts	☐ Yes	☐ No
Are all the bolts snug tight	☐ Yes	☐ No
Is the T-39 suitably transitioned and anchored with approved terminals	☐ Yes	☐ No

6.4 Posts in Rock and in Mowing Strips

A guardrail post is designed to absorb some crash energy through post rotation in the soil prior to post failure. Restraining guardrail posts by setting them in narrow holes drilled into solid rock, by setting them in concrete, or by placing a mowing strip around the posts can lead to early post failure, placing more load on the rail element itself and possibly leading to rail rupture and subsequent penetration by an impacting vehicle.

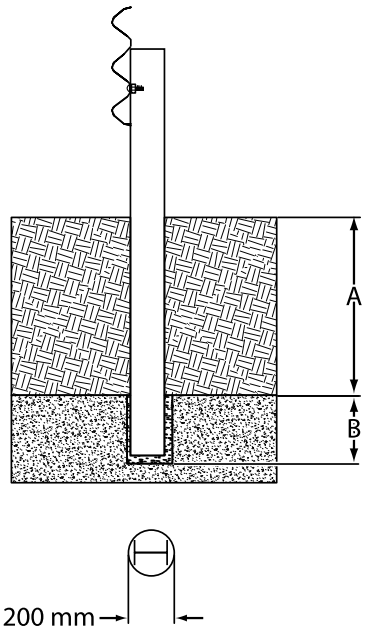
Posts in solid rock should be set near the roadside edge of a 560mm hole drilled 610mm deep and backfilled with a compressible material so that the post can rotate approximately 380mm at the ground line upon impact. For locations where solid rock is below the surface the size and depth of the drilled hole will vary as shown, depending on the depth of soil above the solid rock.

When mowing strips are required, a minimum 'leave-out' area in the strip that will allow a minimum 180mm of post deflection at the ground line is recommended. This area is then backfilled with a low strength (less than 0.85Mpa) concrete mix.



Note:
For overlying soil depths (A) ranging from 0 to 460mm, the depth of the required drilling (B) is equal to 610mm

Figure 7: Post in Solid Rock – Case 1



Note: For overlying soil depths (A) ranging from 460mm to the embedment depth of the post, depth of required drilling (B) is equal to either 305mm or the desired embedment depth minus the depth of the soil, whichever is less.

Figure 8: Post in Solid Rock – Case 2

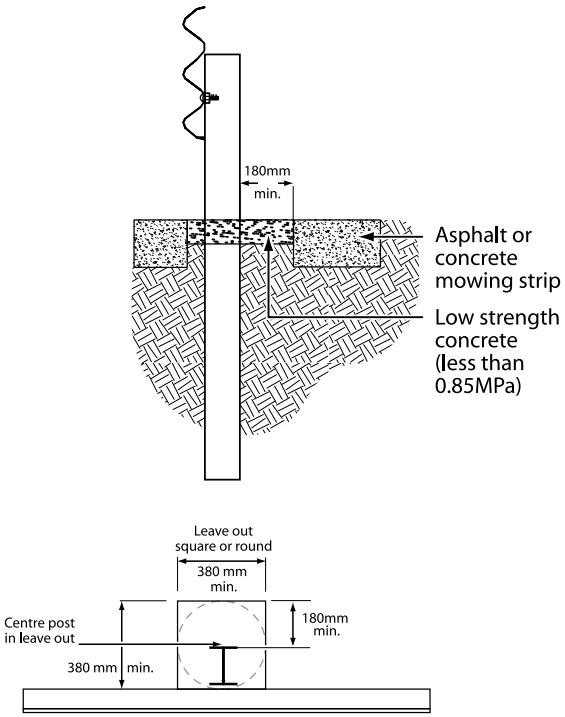
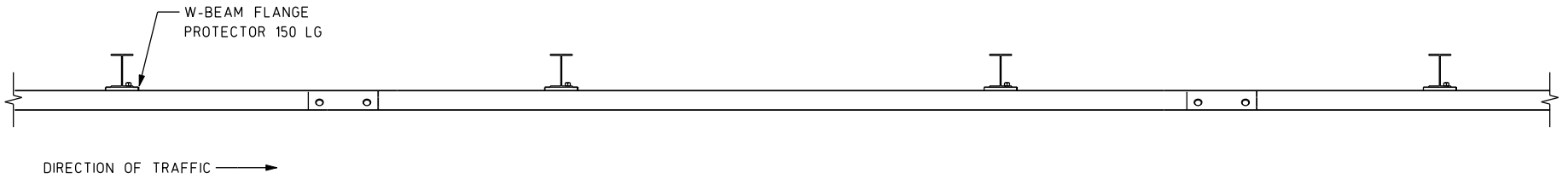
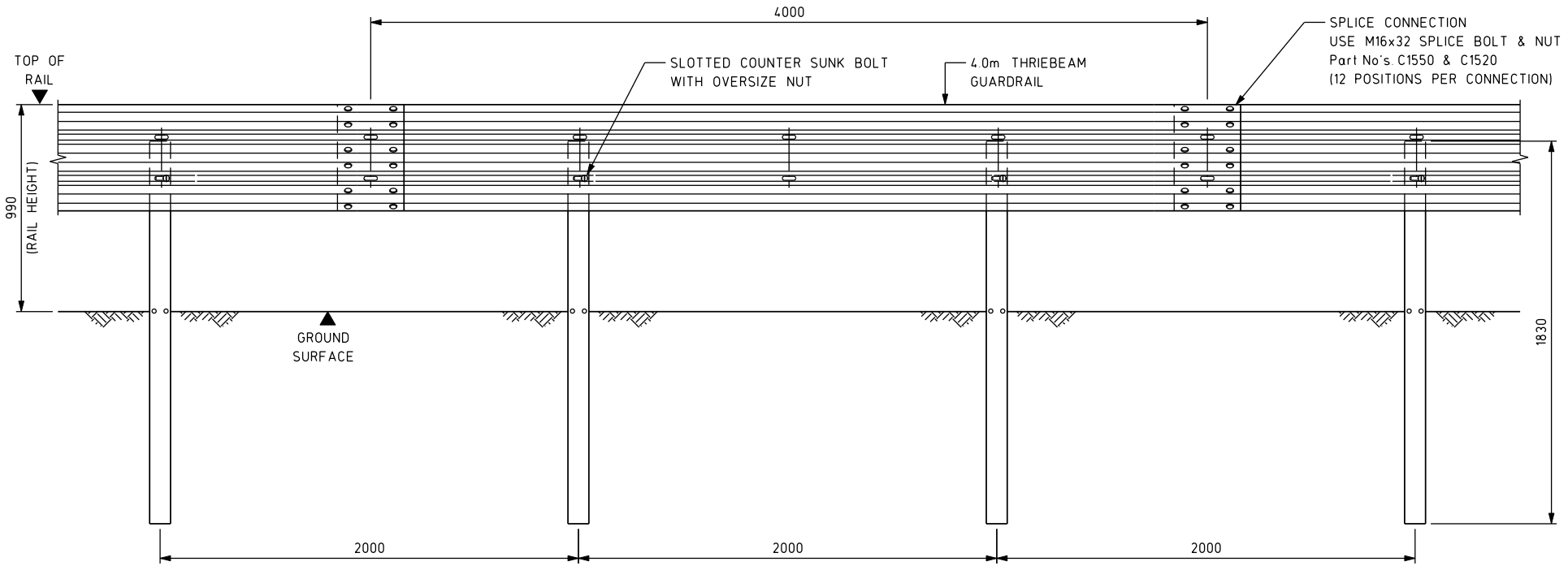


Figure 9: Post in Mowing Strips



DIRECTION OF TRAFFIC →

PLAN VIEW



ELEVATION

The T-39 Thriebeam Barrier has been approved by the US Federal Highway Administration as conforming to NCHRP Report 350 Test level 3 (TL3) and Test level 4 (TL4). This report has been adopted as the basis of testing for AS/NZS 3845:1999 "Road Safety Barrier Systems".

ISSUE	Description	Chkd	Date
1	INITIAL ISSUE	A.J.P	29/9/06

INGAL Civil Products

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PROJECT THRIEBEAM BARRIER SYSTEM
T-39 VERGE APPLICATION

TITLE GENERAL ARRANGEMENT

DATE	29/9/06
DRAWN	A PURDON
DESIGNED	TRINITY IND.
CHECKED	T.C.
MATERIAL	AS SHOWN
FINISH	AS SPECIFIED
SCALE	1:20 AT A3

INGAL CIVIL PRODUCTS DRAWING No.
DEV-06-04-01
ISSUE No.
1

CAD FILE - DEV0604010GN 29/9/06

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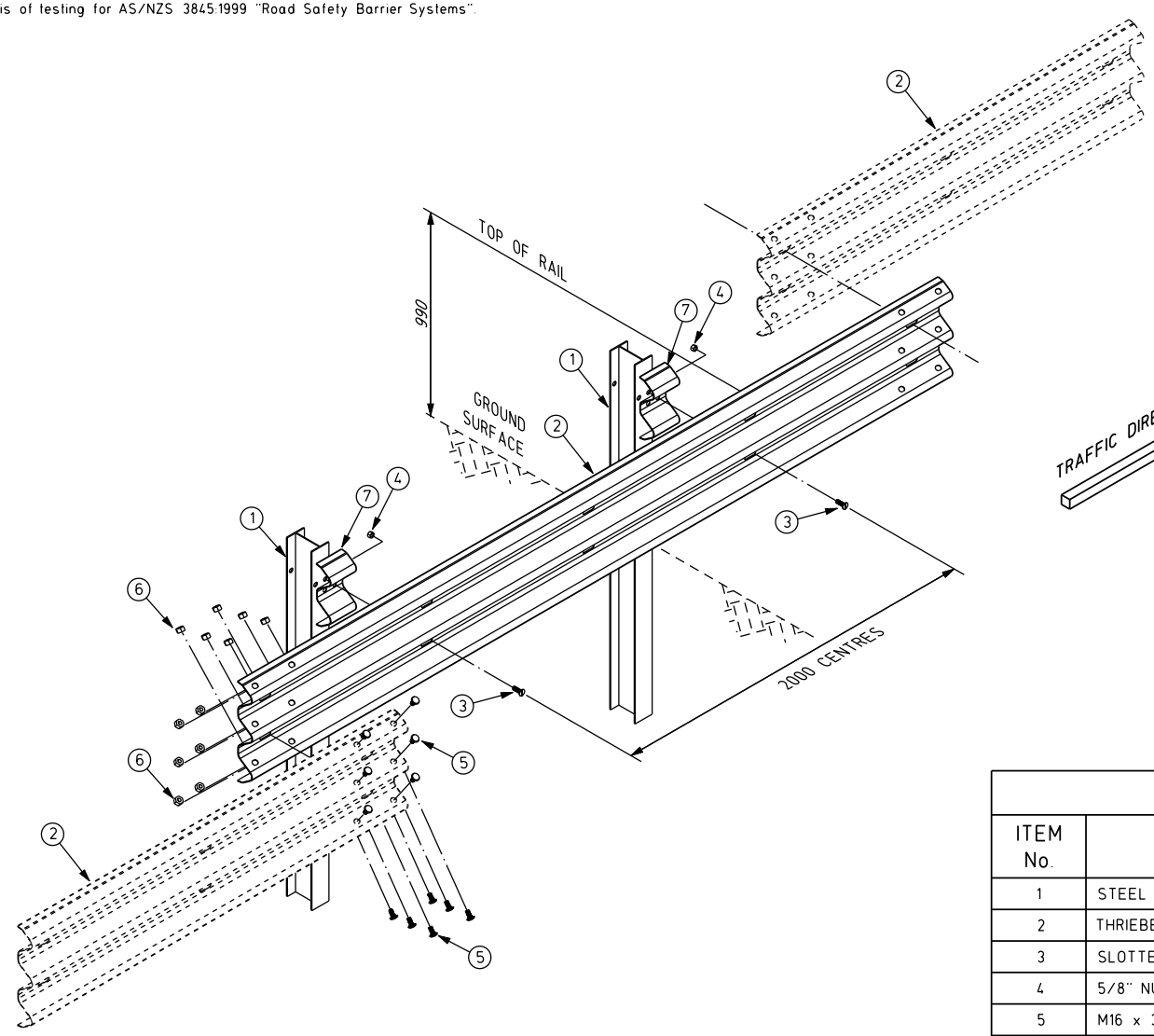

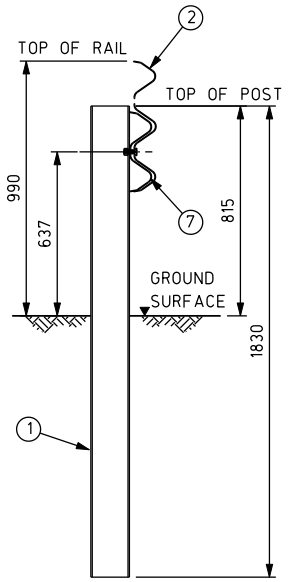

BILL OF MATERIALS		
ITEM No.	DESCRIPTION	QTY
1	STEEL YIELDING LINE POST - 1830 LONG	2
2	THRIEBEAM BARRIER, 4.0m N.L.L. & 1000mm SLOT SPACINGS	1
3	SLOTTED COUNTER SUNK BOLT 5/8" x 1 3/4" LONG	2
4	5/8" NUT	2
5	M16 x 32LG SPLICE BOLT - MUSHROOM HEAD	12
6	M16 OVERSIZE NUT	12
7	FLANGE PROTECTOR	2

ISSUE	Description	Chkd	Date
1	INITIAL ISSUE	A.J.P.	29/9/06

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PROJECT THRIEBEAM BARRIER SYSTEM
T-39 VERGE APPLICATION ASSEMBLY

TITLE GENERAL ARRANGEMENT

DATE	29/9/06
DRAWN	A PURDON
DESIGNED	TRINITY IND.
CHECKED	T.C.
MATERIAL	AS SHOWN
FINISH	AS SPECIFIED
SCALE	NTS

INGAL CIVIL PRODUCTS DRAWING No.
DEV-06-04-02
ISSUE No.
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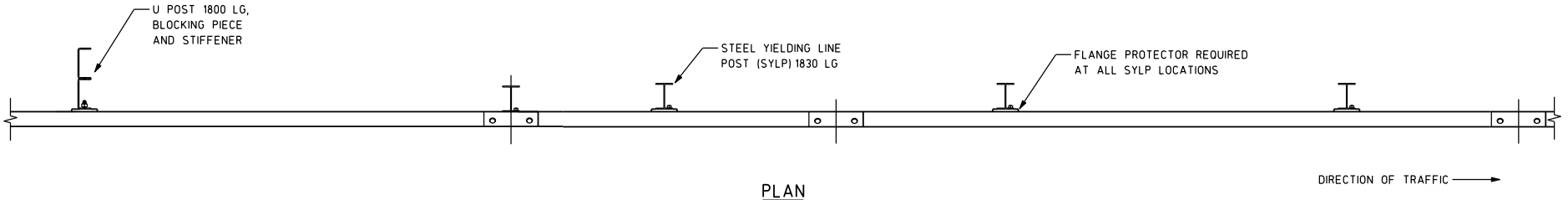
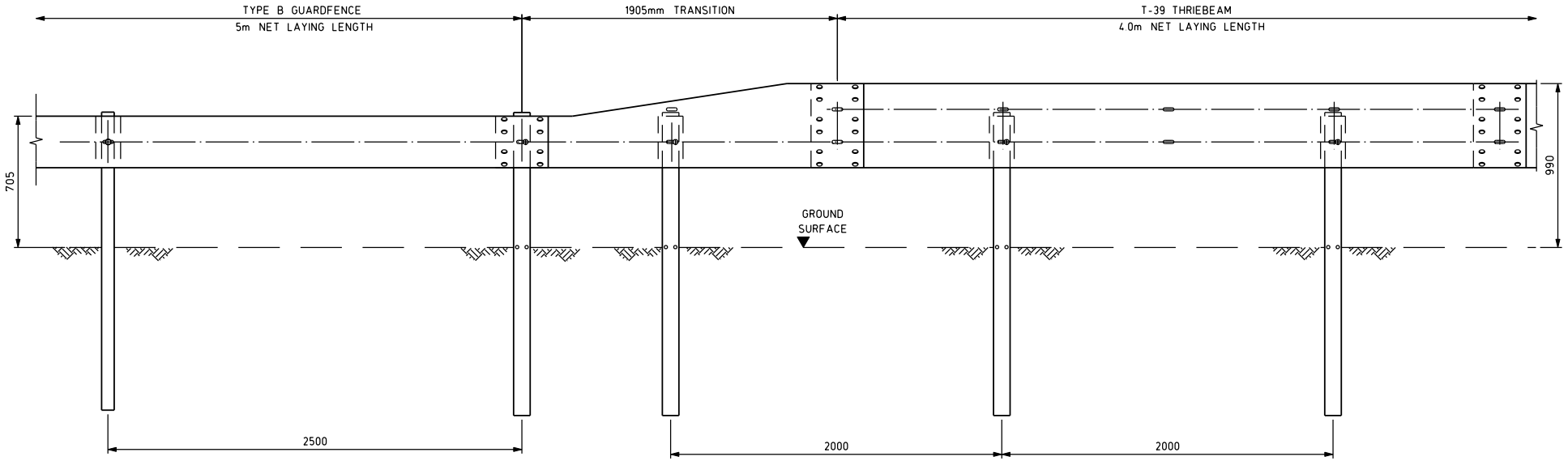
CAD FILE - DEV060402DGN 29/9/06



PLAN



ELEVATION

ISSUE	Description	Chkd	Date
2	TYPE B FENCE HEIGHT MODIFIED	A.J.P	04/04/07
1	INITIAL ISSUE	A.J.P	29/9/06

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PROJECT THRIEBEAM BARRIER SYSTEM
T-39 TRANSITION TO TYPE B GUARDFENCE

TITLE GENERAL ARRANGEMENT

DATE	29/9/06
DRAWN	A PURDON
DESIGNED	TRINITY IND.
CHECKED	T.C.
MATERIAL	AS SHOWN
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SCALE	1:25 AT A3

INGAL CIVIL PRODUCTS DRAWING No.
DEV-06-04-05
ISSUE No.
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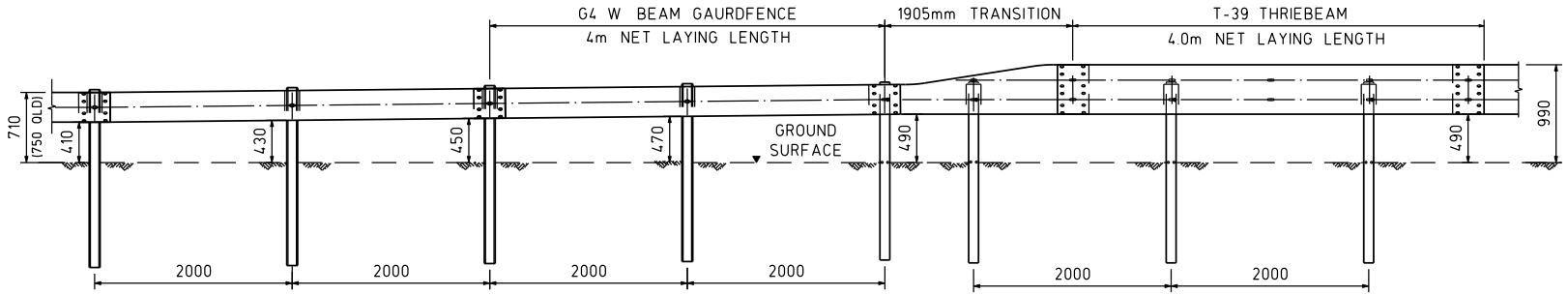
CAD FILE - DEV060405.DGN 04/04/07

PLAN



ELEVATION

ISSUE	Description	Chkd	Date
2	TRANSITION LENGTH MODIFIED	A.J.P	09/10/07
1	INITIAL ISSUE	A.J.P	29/9/06

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PROJECT THRIEBEAM BARRIER SYSTEM
T-39 TRANSITION TO G4 W BEAM

TITLE GENERAL ARRANGEMENT

DATE	29/9/06
DRAWN	A.PURDON
DESIGNED	TRINITY IND.
CHECKED	T.C.
MATERIAL	AS SHOWN
FINISH	AS SPECIFIED
SCALE	1:50 AT A3

INGAL CIVIL PRODUCTS DRAWING No.
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ISSUE No.
2

CAD FILE - DEV060406.DGN 09/10/07

For more information

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