



MIXED WOOD AND STEEL GUARDRAIL

T 40 4M S2

Patented

TECHNICAL SPECIFICATIONS

ITALY



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MIXED WOOD AND STEEL GUARDRAIL MODEL « T40 4M S2»

1 - SPECIFICATIONS AND SYSTEM DESCRIPTION

This guardrail system addresses a number of issues such as :

- combination of both normal (N2) and higher (H2) containment levels,
- aesthetically pleasing appearance,
- energy absorption properties of wood,
- composite nature of the wood-steel design allows full development of the strengths natural to both materials while minimizing the inherent weaknesses of wood and of steel,
- ease of installation by the use of standard material,

Brief description :

- guardrail system supported by 2m long steel posts IPE 140 with wood cladding at 2 meters spacing – Figure 5 ,
- steel spacer blocks - Figure 10 ,
- 2 meters long steel-backed wooden rails, model T 40, built with 2 superposed diameter 22 cm half round logs - Figures 6 & 7,
- steel fishplates TL 600 joining guardrails at post locations - Figure 8
- 4 butt straps TL 20 reinforcing the TL 600 fishplates –Figure 8 ,
- steel intermediate fishplates TI 600- Figure 9 ,
- fastener hardware with TRCC 16-110 and 16-120 connecting wooden rails with embedded U channels.

Crash Worthiness

The mixed wood and steel guardrail T40 4MS2 has been tested at LIER (French Laboratory of “Essais Inrets Equipements de la Route”).

Said crash tests have been conducted in accordance with European Standard EN 1317, parts 1 and 2 . The crash tests , successfully performed (TB 11, TB 32 and TB 51), met both containment levels H2 and N2 of the Standard.

	Vehicle Weigth	Speed	Impact angle
TB 11	900 kg	100 km/h	20°
TB 32	1500 kg	110 km/h	20°
TB 51	13000 kg	70 km/h	20°

2 – GUARDRAIL SYSTEM ANALYSIS

The mixed wood and steel guardrail achieve its performance service due to the “breakaway” design of the post-to-spacer and rail connections detail. During impact, as the vehicle “rides” down the rail, the steel posts bend and the rails are desolidarized from the posts thanks to the bolts, breaking out the fishplates TL 600 and TI 600 oblong holes. The system “breakaway” feature allows the rail to form a pocket which captures, guides and direct the vehicle back toward the highway.

3 – INSTALLATION DESIGN CRITERIA

3.1 – DESIGN DISTANCE FROM RAIL FACE TO “FIXED-DEADLY-OBJECT”

3.1.1. T 40 at containment level H 2

According to the working width of the system, a distance of 1.20 m ($W 4 \subseteq 1.30m$) is necessary to the functioning of the system (space between the front of the device and the front face of the obstacle).

3.1.2. T 40 at containment level N 2

According to the working with of the system, a distance of 1.00 m ($W 3 \subseteq 1.00m$) is necessary to the functioning of the system (space between the front of the device and the front face of the obstacle)

3.2 – DESIGN DISTANCE FOR DROP-OFF or significant change in Shoulder elevation behind Rail Face

3.2.1. T 40 at containment level H 2

The distance between rail face and the drop-off has to be equal to 0.80 m.

3.2.2. T 40 at containment level N 2

The distance between rail face and drop-off has to be equal to 0.60m

3.3 - MINIMAL LENGTH for Full Guardrail System Strength Development

The minimal length resiuired is 60 m, end terminals not included, in order to assure correct anchorage of the system. For shorter lengths, it is recommended to use 2 m rails with posts every 2 m.

3.4 – SPECIFIC TOPOGRAPHIC CONSIDERATIONS

- CURVATURES

Fishplates TL 600 oblongs holes allow to cover a 6° angle between 2 rails devices in the horizontal or vertical plan. Therefore, it is possible to follow easily highway horizontal or vertical curvature.

For lower radius curves, it is recommended to use 2 m rails.

- STANDARD SYSTEM END TREATMENTS

The system is terminated with standard 8 m units buried in the

ground and bolted to the steel posts according to the assembly showed in figure 13.

- CONNECTIONS TO EXISTING ROAD STRUCTURES

There are no specific difficulties and connections require individual design treatments, eventually based on the manufacturer's recommendations or local regulations.

- END TREATMENTS TO WALL, PARAPET OR BRIDGE ABUTMENT

No specific design connections details are offered. End Treatments attachments can be designed and provided on a case by case basis.

4 - GUARDRAIL ASSEMBLY SPECIFICATIONS

4.1 – STEEL POSTS

The standard post is 2 m in length. Soil conditions should allow for the post to develop sufficient strength.

4.2 – RAIL SERVICE HEIGHT

The center-line of the rail face should be 85 cm (+ 0. - 5 cm) above the average elevation of the road shoulder in a 50 cm wide band in front of the said rail.

At no time should the center-line of the rail face be less than 65 cm above the average elevation of the road shoulder in front of the rail section in question.

4.3 – INSTALLATION CONSIDERATIONS

The posts IPE 140 with wooden cladding have to be driven into the ground at a 2m spacing such that center-line of the rail shall be no more than 85 cm. The steel spacer T 40 is placed on the IPE support post with an hexagonal head bolt TH 16 - 160.

The fishplates TL 600 and TI 600 are alternatively attached to the spacers T 40 with 2 hexagonal head bolts TH 16-40. Fishplates oblong holes allow a 30 cm horizontal adjustment on both sides of the IPE post.

Rails sections are joined while fitting the 8 bolt heads diam.16 mm with fishplate TL 600 . 4 butt-straps TL 20 reinforce this connecting system (fig .2) The intermediate fishplate TI 600 is attached on rail components with 4 round head TRCC bolt 16-120.

Connection hardware and fasteners are kept "loose" until multiple sections of rail are in place allowing for final adjustment of rail configuration. After final rail adjustment, all hardware should be tightened.

5 – GUARDRAIL SYSTEMS COMPONENTS

5.1 - LISTING AND DESCRIPTION OF MAJOR COMPONENTS

- STEEL POST IPE 140 x 73 x 4.7 x 6.9 mm, length 2 m- Figure 5

- STEEL SPACER BLOCK TE 40 – Figure 10

- GUARD RAIL TYPE TE 40/4MS2, TE 40/2M. The rails as per Figure 6

are built with 2 superposed diameter 22cm half round logs , both backed with a steel channel, factory bolted into place with 2 bolt sets at each rail section end as per Figure 7.

- FISHPLATE TL 600 described in Figure 8 is a press-broken steel 270 x 10 x 600 mm in length with 12 vertical and 2 horizontal oblong holes.
- FISHPLATE TL 20 (butt-straps) is a structural steel 60 x 4 x 200 mm. in length. Figure 8.
- INTERMEDIATE FISHPLATE TI 600 is a press-broken steel 270 x 10 x 600 mm in length with 4 vertical and 2 horizontal oblong holes. Figure 9
- FISHPLATE for END TERMINAL TE 41 is a structural steel 260 x 10 x 410 mm in length with 6 vertical and 1 horizontal oblong holes . Figure 12.
- STEEL SPACER BLOCK for END TERMINAL TEF 40, to be buried into the ground and bolted to the C 125 steel post. Figure 11
- BURIED POST for END TERMINAL, C 125 x 50 x 25 x 5 x 2000 mm in length
- FASTENER HARDWARE : bolts 16 X 160 TH with hexagonal heads + washers, 16 x 40 TH with hexagonal heads + plates 45 x 45 mm (or washers 16 x 50 x 5 mm), square nuts M 16 .

5.2 - MATERIALS

THE WOOD

Species of wood for use as guard rails and spacer block shall be Scots Pine, Douglas Pine, Larch, Spruce or Epicea Krast (Black Spruce or Laricio). Excluded is Pinus Pinaster , a resin bearing pine because of its weak impact resilience.

Technical qualities :

The minimum qualities required are the following :

- growth ring shall be 10 mm wide, measured on five sequential rings at one end of wood component,
- maximum diameter of knots measured perpendicular to the generating line should not exceed 7 cm in the running parts, 3 cm in the last 35 cm to the end of the wood component,
- wood components shall not have evidence of fungi or insect decay,
- moisture content after treatment and drying shall not exceed 20%.

Mechanical properties :

- for the rail components , minimum Modulus of Elasticity E shall be 7580 Mpa and minimum Allowable Bending Stress Fb shall be 4.65 Mpa,
- for spacers, minimum Modulus of Elasticity shall be 6985 Mpa and Modulus of Rupture MOR shall be 48,925 or greater.

Preserving treatment :

Wood components rails and wooden cladding shall have a preserving treatment corresponding to classes 3 or 4 of European norm EN 335 for biological contamination with preservation products defined by the European norm EN 599.

THE METAL

- **All the metal parts, except the fasteners**, are steel. All steel components shall be fit for hot –dip galvanizing (EN ISO 1461) and its mechanical characteristics are at least equal to the steel quality S 235 JR, as defined in the European norm EN 10025.

- **The steel posts are IPE 140**

- **The metal for fasteners** is defined as follows :

- the screw bolts shall be of quality 5.6,

- the screw nuts shall be of quality 5,

The quality class is defined by French norm NF E 27 005.

- **Protection against the corrosion**

All steel components (included fasteners) should be protected against corrosion by hot –dip galvanization according as per standard specification EN ISO 1461.

5.3 - DIMENSIONS AND TOLERANCES

All the sizes and tolerances of the drawings are in millimetres, even when not specified.

For wood components (measured at 20% of humidity)

- diameter 22 cm (-0, +0.5 cm)

- length of the wood 399 cm (+or -0.5 cm)

- rectitude : admitted tolerance is of 1% of the maximum length

- gap or space between rail sections at the joints shall be 1 cm.

For steel components

- holes (+ or -0.5 mm)

- center to center distances (+ or -2 mm)

- length of steel reinforcing components (+ or -5 mm)

5.4 – MANUFACTURER IDENTIFICATION MARKING

Each rail section shall be marked by a letter stamp to read « T1 », and the year of manufacture.

5.5 -COMPONENTS NOMENCLATURE

DESIGNATION	CODE	CHARACTERISTICS
Steel Post	IPE 140	Support IPE 140 x 73 x 4.7 x 6.9 mm Length = 2000 mm
Steel spacer block	T40	Spacer Diam.18 cm drilled and embedable
2 Model T 22 guard rails	T40/4MS2*	Diameter 22 cm, length 4000 mm - 1 U channel 90 x 30 x 5 mm length 3920 mm - 4 bolts welded to the U channel - 1 pressure treated half round log, length 3980 mm drilled with 2 holes * factory-assembled
2 Model T 22 guard rails	T40/2M*	Diameter 22 cm, length 2000 mm - 1 U channel 90 x 30 x 5 mm length 1920 mm - 4 bolts welded to the U channel - 1 pressure treated half round log, length 1980 mm drilled with 2 holes * factory-assembled
Fishplate	TL 600	Press- brokeed steel 270x10 mm, length 600 mm with 14 oblong holes
Reinforcing fishplate (butt-strap)	TL 20	Structural steel 60x4 mm, length 200 m
Intermediate fishplate	TI 600	Press-brokeed steel 270x10 mm , length 600 mm with 6 oblong holes
Fishplate for buried end terminal	TE 41	Strucural steel 260 x 10 mm, length 410 mm with 7 oblong holes
Steel spacer block for buried end terminal	TEF 40	Spacer 245 x 125 x 197 mm
Bolts	TRCC M16x120 M16x110 TH M16 x 160 M16 X 40	Round head bolts and square nuts Hexagonal head bolts and square nuts
Nuts	M 16	
Steel post for buried terminal	C 125	Standard Support C 125 x 50 x 25 x 5 mm Length = 2000 mm

FIGURE 1 : VIEW OF STANDARD ELEVATION

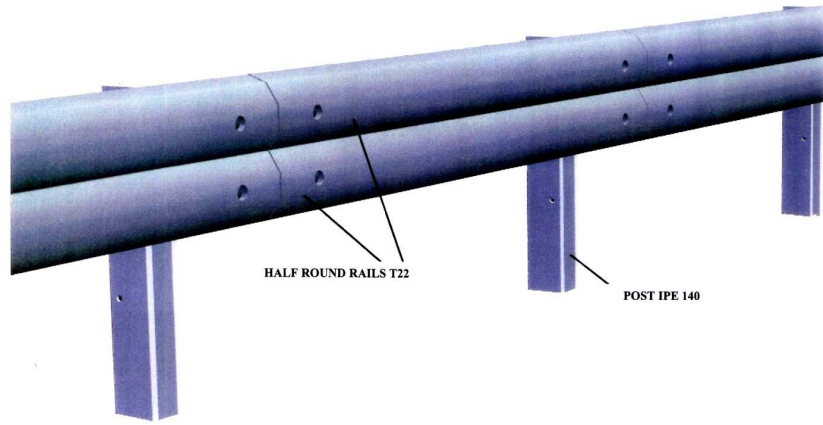


FIGURE 2 : VIEW OF MAIN CONNECTION

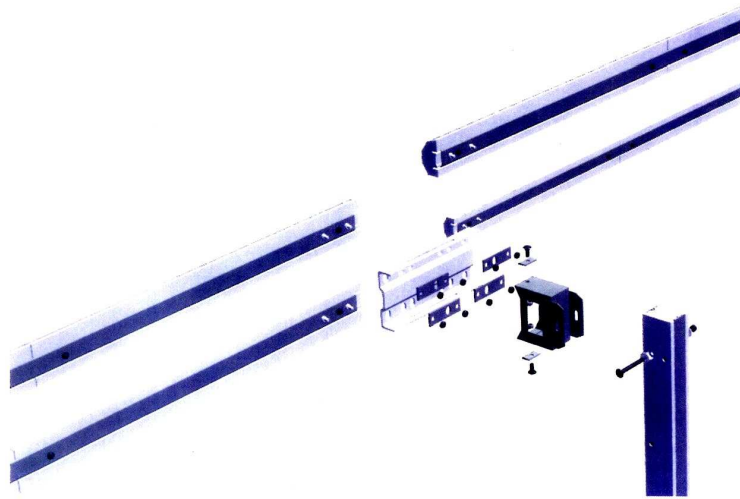


FIGURE 3 : VIEW OF INTERMEDIATE CONNECTION

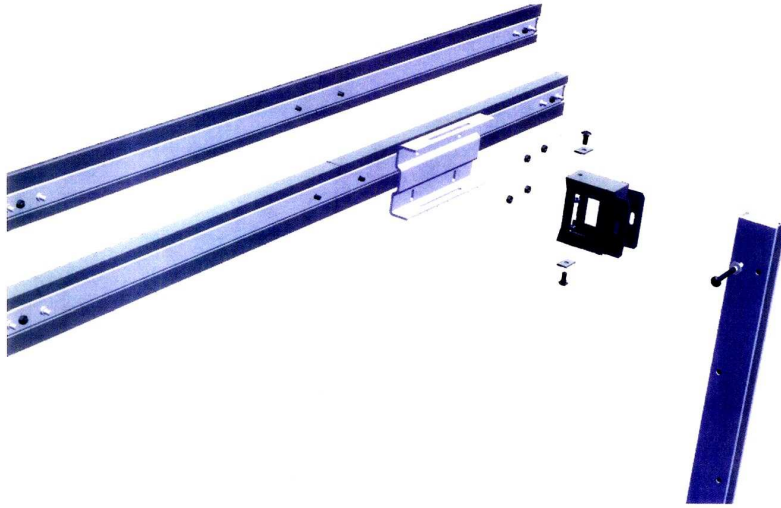


FIGURE 4 : STANDARD INSTALLATION

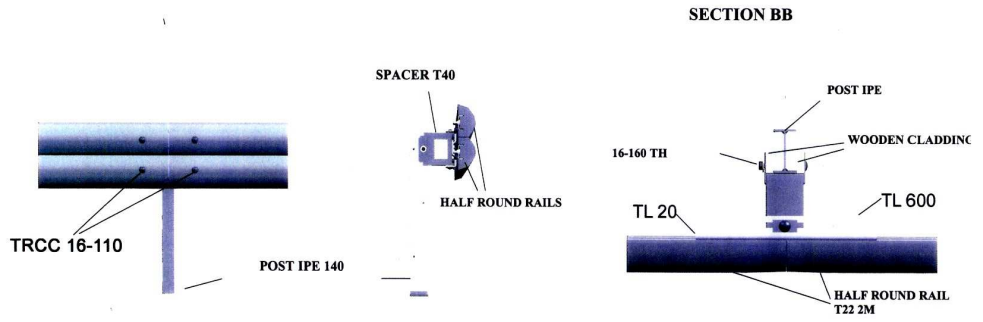


FIGURE 5 : POST IPE 140

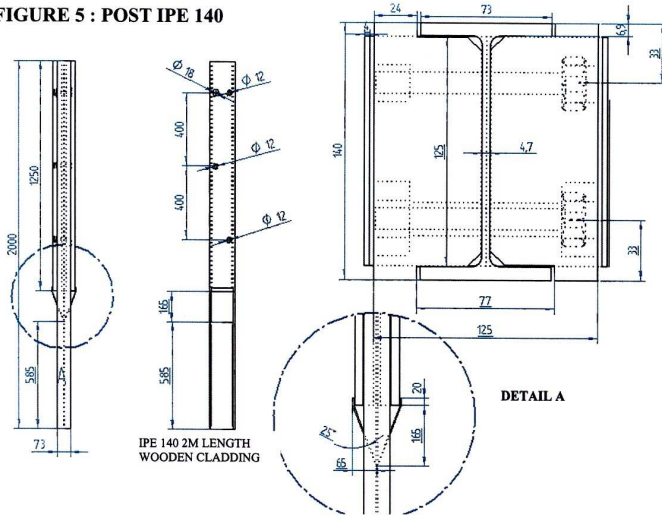
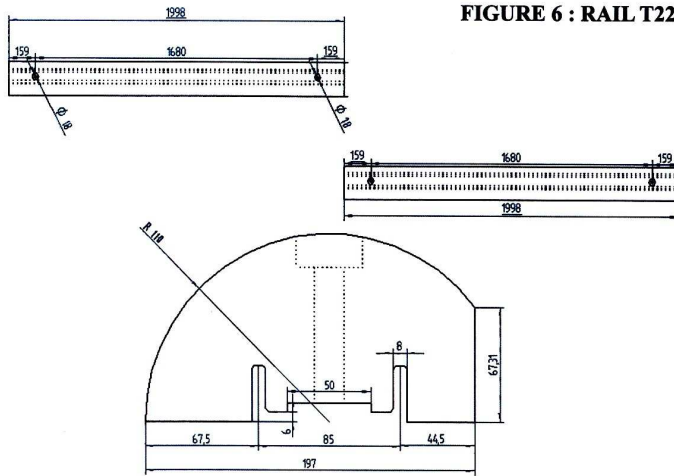
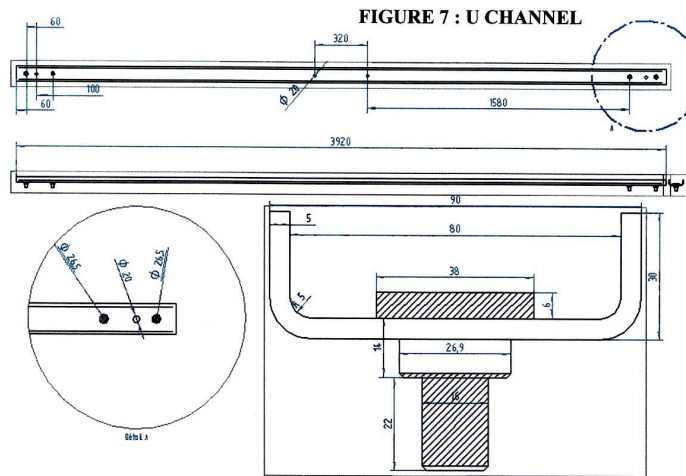


FIGURE 6 : RAIL T22 2M





**FIGURE 8 : FISHPLATE TL 600
FISHPLATE TL20**

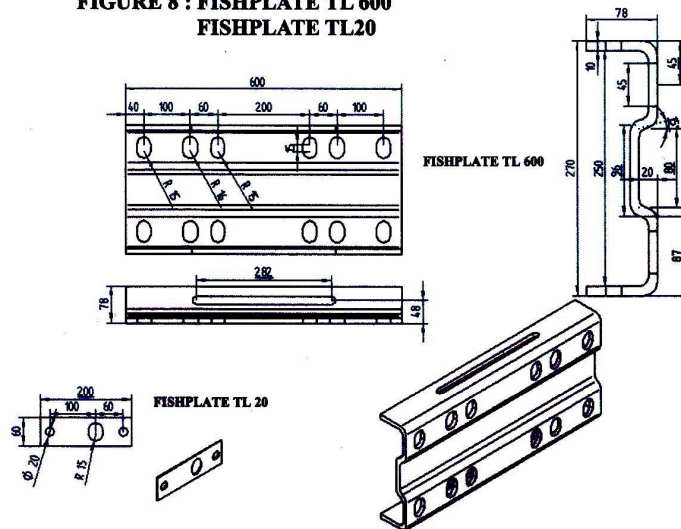


FIGURE 9 : INTERMEDIATE FISHPLATE TI600

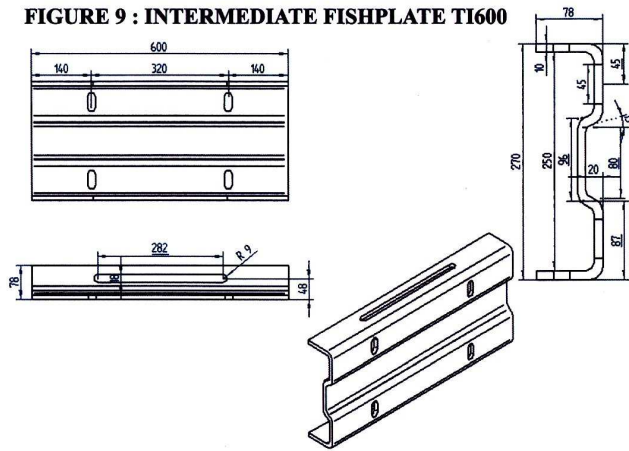


FIGURE 10 : SPACER TE40

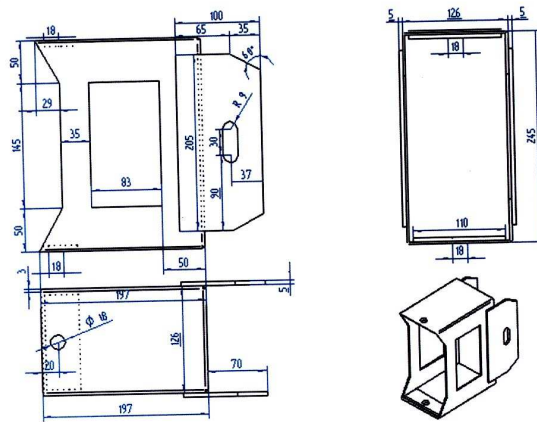


FIGURE 11 : SPACER FOR END TERMINAL

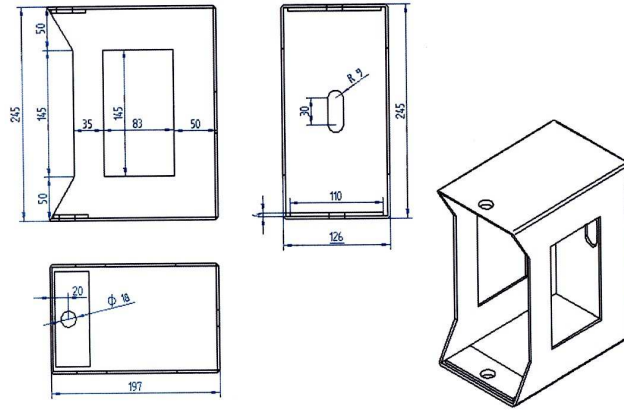
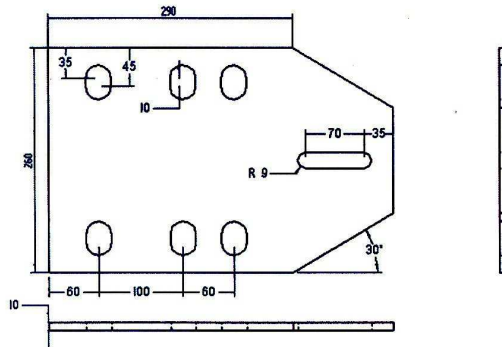


FIGURE 12 : FISHPLATE TE 41



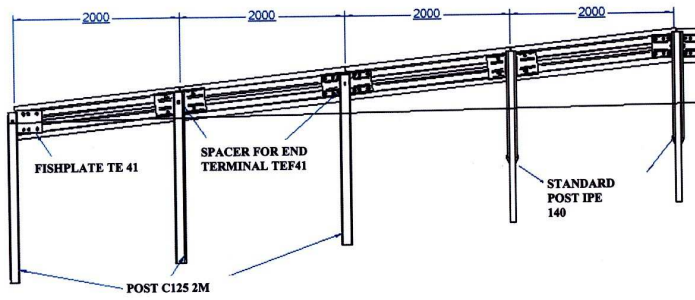


FIGURE 13 : END TERMINAL